BEFORE THE NATIONAL GREEN TRIBUNAL (SZ), SITTING AT CHENNAI

Appeal No. 14/2020

BETWEEN:
Yelahanka Puttenahalli Lake
and Bird Conservation Trust (Regd) **... APPELLANT**

AND

Ministry of Environment & Forest and
Ors **.... RESPONDENT**

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Place: Chennai

Date: 19/10/2020

AJAY J. NANDALIKE
KAR 1580/2007
Advocate for the Respondent No.4

BEFORE THE NATIONAL GREEN TRIBUNAL (SZ), SITTING AT CHENNAI

Appeal No. 14/2020

BETWEEN:
Yelahanka Puttenahalli Lake
and Bird Conservation Trust (Regd) ...**APPELLANT**

AND

Ministry of Environment & Forest and Ors .....**RESPONDENTS**

COUNTER STATEMENT TO THEAPPEAL FILED UNDER SECTION 18(1) READ WITH SECTIONS 15(1) AND 16(h) OF THE NATIONAL GREEN TRIBUNAL ACT, 2010

I, Mr. D.R. Kabade, S/o R.Y Kabade, aged 50 years, working as Assistant General Manager (Law), Office of the Head (Legal Services) and authorised signatory of Karnataka Power Corporation Limited, having office at Shakthi Bhavan, Race Course Road, Bangalore- 560 001, do swear and state on oath as under:

1. I am the Assistant General Manager (Law) of the Respondent No.4 in the abovementioned Appeal and as such I am fully conversant with the facts and circumstances of the present case based on my personal knowledge and official records available with me and hence I am competent to affirm the present Counter Affidavit and I am authorized to represent the Respondent No.4.

2. I state that save and except those which are matter of record and are specifically admitted in the present Counter Affidavit, all the

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

statements, averments and submissions made in the instant Appeal are categorically denied. It is further submitted that no statements, allegations and submissions should be deemed to have been admitted unless specifically admitted to herein. The reference to 'KPCL' in the present appeal and this Counter Statement may be read as reference to Respondent No.4.

3. I state that the instant Appeal is not maintainable either in law or on facts and is liable to be dismissed at the threshold for the following reasons.

4. I submit that the Appeal has been filed with an application for condonation of delay which is being heard along with the main appeal. I submit that the present objections are being filed without prejudice to the contention of the Respondent No.4 that the present appeal is barred by limitation.

PRELIMINARY OBJECTIONS:

<u>The Appeal is collusive and mala-fide:</u>

5. One Heritage Estate Apartment Owners Association ('Apartment Association') had filed OA 57 of 2017 before this Hon'ble Tribunal alleging the same facts and pressing for identical reliefs as sought by this Appellant. Before this Hon'ble Tribunal, when the Apartment Association realized that the relief for cancellation of the Environmental Clearance was barred by time, the Apartment Association did not actively press the said OA. It is likely that the

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

Apartment Association did not press the OA as no interim stay was granted.

6. At the same time, this Appellant approached the Hon'ble High Court principally alleging that the Project of the Respondent No.4 affects the Puttenahalli Lake and that the Clearance is in violation of law. The petition without annexures is produced at Annexure A-13 (pp.229 to 246). A perusal of the said document would indicate that the facts alleged, grounds urged and relief sought therein are substantially different from what is sought before this Hon'ble Court.

7. The Appellant failed to allege various facts before the Hon'ble High Court including that the Apartment Association had approached the Hon'ble NGT seeking substantially the same reliefs as sought by the Appellant in WP 25189/2018 and had failed to obtain interim relief before the NGT. It is submitted that it is for this reason that the Appellant approached the Hon'ble High Court seeking relief even inspite of knowing that a similar petition in the NGT was pending. In any event, this fact was disclosed by a memo filed by the Respondent No.4 which the Appellant has chosen not to produce before this Hon'ble Tribunal.

8. The relief sought before the Hon'ble High Court was innocuously worded to the effect that MoEFCC must consider the representation of the Appellant for cancellation of the EC. Even before completion of pleadings by all the Respondents, the High Court dismissed the Writ

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

Petition stating that appropriate forum to agitate the matter was this Hon'ble Tribunal. However, at the urging of the Appellant, the Hon'ble High Court dismissed the argument that there was a jurisdictional error in the grant of the EC.

9. It has now come to light that the Appellant did not disclose to the Hon'ble High Court that the MoEFCC had in fact considered the representation of the Appellant and passed suitable orders. The document has now been produced before this Hon'ble Tribunal as Annexure A8. Therefore, it became evident that the Appellant was only trying to obtain a liberty from the Hon'ble High Court to overcome the statutory bar of limitation.

10. By gross misrepresentation of facts and by suppression of documents, the Appellant managed to persuade the Hon'ble Supreme Court to issue notice to the Respondents. At this juncture, this Hon'ble Tribunal had posted OA 57 of 2017 for final hearing. In order to prevent this Hon'ble Tribunal from hearing the matter on merits, the Apartment Association impleaded themselves before Hon'ble Supreme Court and requested this Hon'ble Tribunal to adjourn the matter. This was a concerted strategy on part of both the Apartment Association and the Appellant to prevent an order on merits which would dissuade the Hon'ble Supreme Court from entertaining the matter.

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BENGALURU
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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

11. After the Hon'ble Supreme Court dismissed the SLP and permitted the Appellant to approach this Hon'ble Tribunal to agitate the facts alleged, grounds urged and relief sought before the High Court before this Hon'ble Tribunal, the Appellant did a volte-face and sought to file the present Appeal making totally different arguments than what was urged before the Hon'ble High Court. This was replicated by the Apartment Association also by filing an amendment application to urge the same grounds.

12. From the above facts, it becomes evident that the Appellant and the Heritage Apartment Owners Association are hand in glove and the entire proceedings before the Hon'ble High Court, before the Hon'ble Supreme Court and this Hon'ble Court is a subterfuge and only an attempt to overcome the statutory bar under Section 14 (3) and 16 of the National Green Tribunal Act, 2010. The Appellant is only a name lender who is acting entirely at the behest of the Apartment Association. In view of this fact and the pendency of OA 57 of 2017, the present appeal may be dismissed on the ground that Appellant's case is substantially covered by the OA 57 of 2017.

Appeal filed in violation of the order of the Hon'ble Supreme Court

13. It is submitted that the Special Leave Petition bearing No. 10555/2019 was filed against the impugned order dated 08/03/2019 passed by the Hon'ble High Court of Karnataka in WP 25189/2018. The prayers sought in the Writ Petition were as under:

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Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

a) Direct the 1st Respondent to consider the representation submitted by the Appellant and initiate necessary action against the 4th Respondent towards the cancellation of the illegal and void environmental clearance bearing SEIAA 20 IND 2014 dated 01.09.2015 issued by the 2nd Respondent herein

b) Direct the 1st and 3rd Respondent to ensure that all steps are taken and necessary financial allocations are made towards preservation of the Puttenahalli Bird Reserve so as to ensure its restoration to its original pristine state.

c) Pass any other orders in the interest of justice and equity.

14. The Appellant has now approached this Hon'ble Tribunal by way of Appeal No.14/2020 seeking the following reliefs:

a) Declare the Environment Clearance vide SEIAA 20 IND 2014 dated 01.09.2015 granted by the Karnataka State Environment Impact Assesment Authority (Respondent No.2) (**"EC"**), to the Karnataka Power Corporation Ltd. (Respondent No.4 herein) as null and void and contrary to the provisions of Environmental Impact Assessment Notification, 2006, and hence cancel the same;

b) Direct the Karnataka Power Corporation Ltd. (Respondent No.4 herein) not to put up the Gas-based Combined Cycle Power Plant at the present site in the vicinity of the Puttenahalli Bird Conservation Reserve and thereby restore the damage done by Puttenahalli-Yelahanka Lakes by illegal encroachment on the lake areas, and

c) Issue an order directing the Respondent No.4 for restitution of environment and to ensure protection of bio-diversity of the

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Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

Puttenahalli and Yelahanka Lakes and to ensure protection of aquatic life, flora and fauna, and

d) Grant such other relief/reliefs that the Hon'ble Tribunal deems fit in the facts and circumstances of the case, in the interests of justice.

15. The Hon'ble Supreme Court has permitted the Appellants to approach this Hon'ble Tribunal in respect of the facts alleged, grounds raised and reliefs sought before the Hon'ble High Court in WP 25189/2018. As the Appellant has raised totally different facts, grounds and reliefs before this Hon'ble Tribunal contrary to the direction of the Hon'ble Supreme Court, the Appeal cannot be entertained as the same would be in violation of the Hon'ble Supreme Court's directions.

16. It is submitted that the relief sought in the writ petition was for consideration of the representation by MoEFCC. It is evident from a reading of Annexure A8 that the same was considered and granted. Therefore, as on the date of the passing of the order by the Hon'ble High Court, the writ petition was rendered infructuous. The appropriate course of action would have been to disclose the same to the Hon'ble High Court. The Appellant sought to press for an order without allowing the MoEFCC to bring out their stand and this information.

17. The Appellant followed the same strategy before the Hon'ble Supreme Court by not allowing pleadings to be completed and did not disclose the existence of the Annexure A8. If the same had been disclosed to

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BENGALURU
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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

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the Hon'ble Supreme Court, the Supreme Court would not have interfered in the matter. Hence, the Appellant has consistently acted in a mala-fide manner.

Reliefs Barred by Limitation:

18. The Appeal has been filed by the Appellant under Section 18 of the National Green Tribunal Act, 2010. The relief sought for by the Appellant viz. seeking a declaration that the Environmental Clearance vide SEIAA 20 IND 2014 dated 01/09/2015 granted by the Respondent No.2 to the Respondent No.4 is null and void, and for a direction to the Respondent No.4 not to put up the Gas based Combined Cycle Power Plant at the present site, is hopelessly barred by time and this Hon'ble Tribunal cannot entertain the same on account of the statutory bar under Section 14 (3) and Section 16 (h) of the National Green Tribunal Act, 2010 ('**NGT Act**').

19. The Appellant is seeking to contend that the statutory bar under Section 14 (3) of the National Green Tribunal Act has been bypassed by the liberty granted by the Hon'ble Supreme Court. It is submitted that a statutory provision cannot be overcome by manner of any liberty or direction.

20. It is pertinent to mention that in the present case, the Appellants were in fact aware of the EC in the year 2016 and chose to approach the Hon'ble High Court only in 2018. This fact was not disclosed before

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

the Hon'ble Supreme Court. Hence, even if one were to exclude the time spent in litigation on the strength of the liberty granted by the Hon'ble Supreme Court, the present appeal would be still barred by time.

21. The answering Respondent had filed M.A No. 1527 of 2020 before the Hon'ble Supreme Court seeking a clarification of the Order dated 10/06/2020. The M.A has been disposed of with the following observation: "*However, all contentions of the parties are left open to be decided by the National Green Tribunal*". A copy of the Order of the Hon'ble Supreme Court in M.A. No.1527/2020 dated 09/09/2020 is already produced as ***Annexure R3***along with the Statement of Objections to the Application for condonation of delay

22. The necessary implication of the same is that all contentions including that of limitation is left open to be decided by this Hon'ble Tribunal. Therefore, the Supreme Court has clearly held that the delay is not deemed to be condoned. Hence, the present appeal is not maintainable in law or fact.

Misrepresentation by the Appellant

23. The Appellant has represented that Puttenahalli Lake was declared a Bird Sanctuary before the Environmental Clearance was given, which is false because although the State Government had commenced the process of declaration of Puttenahalli Lake as a Bird Sanctuary, the declaration would come into effect only on the date on

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

which it was published in the Official Gazette, which occurred on 10/09/2015. Consequently, only from 10/09/2015, Puttenahalli Lake was declared as a Bird Sanctuary and until the said date, SEIAA was empowered to grant EC. With regard to this it must be noted that the Respondent No.4 filed its application for Environmental Clearance on 20/12/2014 and received the same on 01/09/2015. In the interim it has conducted extensive studies and has considered all aspects of the area surrounding the project. The Gazette Notification notifying Puttenahalli Lake as a Bird Sanctuary was issued only on 10/09/2015 after the EC had been granted to the Respondent No.4. Therefore, the action of SEIAA in granting EC is not without jurisdiction.

24. It is a settled law that the Notification or enactment is deemed to come into effect on the date of its Notification in the Official Gazette. This Hon'ble Court in *Municipal Corporation of Greater Mumbai vs Anil Shantaram Khoje (2016)15 SCC 726,B.K.Srinivasan and Others vs State of Karnataka and Ors. (1987) 1SCC 658* has reiterated this position of Law.

25. Therefore, the Notification will only apply with prospective effect from the date of its publication in the gazette. It is not even the case of the Appellant that it applies with retrospective effect.

BRIEF FACTS OF THE CASE

26. Before traversing specific allegations in the Appeal, the Respondent No. 4 prays the leave of this Hon'ble Tribunal to state the true and

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Karnataka Power Corporation Ltd.
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correct facts which are critical for the adjudication of the above Appeal:

27. Karnataka Power Corporation Limited, Respondent No.4 herein, is a State of Karnataka Undertaking which is involved in generating electrical power in the State of Karnataka. Respondent No.4 has a total installed capacity of about 8824 MW consisting of Hydro-Electric Stations, Thermal Power Plants (Coal based), Windmills and Solar PV Plants. The Respondent No.4 has 34 dams and 24 power stations across the State of Karnataka with power production capabilities ranging from 0.35 MW to 800 MW and having power station capacity up to 1720 MW.

28. It is submitted that the State of Karnataka is in constant need of more power due to rapid industrialization, rural electrification and large scale use of electricity for irrigation purposes. The liberalization of country's economic policy has further accelerated the industrial growth in the state resulting in a steep increase in demand for power. In the urban areas of the State, especially in Bangalore, a steady and significant growth in the demand from commercial and residential segments has been recorded during the recent years. Hence, there is a pressing need to explore all possibilities of capacity addition to cater to the state's requirement. The Respondent No.4 is committed to improving the supply of power by regularly resorting to capacity additions to the grid to meet the higher electricity consumption in the state.

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Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
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Palace Road, Bengaluru - 560 001.

29. It is submitted that Respondent No.4 has presently set up a 370 MW capacity Combined Cycle Power Plant using Natural Gas at Yelahanka***("Power Plant").*** Respondent No.4 previously operated a diesel power plant on the Project land between 1993 and 2013. Respondent No.4 has now dismantled certain structures of the earlier diesel power plant to set up the Natural Gas fired Combined Cycle Power Plant in order to increase capacity and efficiency in the production of electricity and to use a more environmentally friendly fuel for production using the existing infrastructure.

30. For the purpose of setting up the 1x370 MW capacity Power Plant using Natural Gas, Respondent No.4 approached the Government of Karnataka. The Government of Karnataka accorded its approval for the project and the same was communicated by way of its Order dated 28/07/2014. A copy of the Order dated 28/07/2014 is produced herewith as ***Annexure R 4.***

31. As per Schedule 1(d), of the Environmental Impact Assessment Notification, 2006 No.1533 dated 14th September 2006, thermal power plants having a capacity of less than 500 MW were classified as Category B1 projects requiring Environmental Clearance ("EC") from the State Level Environment Impact Assessment Authority ("SEIAA"), Respondent No. 2 herein. In accordance with Clause 6 of the Environmental Impact Assessment notification, 2006, the Respondent No.4, on 20/12/2014, submitted a letter to the Respondent

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
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(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

No.2 along with Form No.1, a Pre-Feasibility Report ("PFR") and processing fees, requesting for the grant of an Environmental Clearance for the Project. A copy of the letter, Form 1 and the pre-feasibility report submitted by the Respondent No.4 are produced herewith as ***Annexure R5.***

32. Based on this application, the State Expert Appraisal Committee ("SEAC") of Respondent No.2 held meetings on the 13/01/2015 and 14/01/2015, to consider the project. The SEAC subsequently issued the Terms of Reference ("TOR") on 19/01/2015 based on which the Environmental Impact Assessment Report ("EIA Report") was to be prepared. A copy of the letter issued by the SEAC bearing No. SEIAA 20 IND 2014 dated 19/01/2015 stating the Terms of Reference is produced herewith as ***Annexure R6.***

33. While issuing the Terms of Reference, the SEAC stated that the project was exempted from having to conduct a public consultation in accordance with Para 7(III) (i) (b) of the Environment Impact Assessment notification, as the project was located within a notified industrial area.

34. Subsequently, a detailed study was conducted as per the TOR issued by the SEAC and an Environmental Impact Assessment Report ***("EIA Report")*** was prepared by a consultant accredited by the Ministry of Environment and Forests who carried out Environment Impact Assessment studies over a period of 3 months. The EIA Report, along

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RAMESH KUMAR
BENGALURU
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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
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with a completed questionnaire, a detailed project report ***("DPR")*** and a covering letter was thereafter submitted to the SEAC on 23/07/2015. A copy of the EIA Report submitted by Respondent No.3 to the SEAC is produced herewith as ***Annexure 7*** and a copy of the DPR submitted to the SEAC is produced herewith as ***Annexure R 8.***

35. It is submitted that the SEAC held an appraisal meeting on 05/08/2015. At the meeting, further queries were raised by the SEAC, which were answered by Respondent No.4 vide letters dated 10/08/2015 and 25/08/2015. Copies of the letters answering the queries of the SEAC dated 10/08/2015 and 25/08/2015 are produced herewith as ***Annexure R 9.***

36. It is submitted that after due consideration, Respondent No.2 accorded the environmental clearance to the above project on 01/09/2015. As per the directions of Respondent No.2, in general condition No-11 of the EC letter, the same was advertised in national and local newspapers within seven days from the date of issue of clearance i.e., on 06/09/2015 and 08/09/2015. The Environmental Clearance given by the Respondent No.2 is produced herewith as ***Annexure R 10.*** Copies of the advertisements in the local and national newspapers are produced herewith as ***Annexure R 11.*** The construction of the Power Plant has since been widely publicized including the function inaugurating construction works at the Plant site. This function was attended by the Hon'ble Chief Minister and the Hon'ble Minister for Power and the event was broadcast on various TV Channels and

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
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covered in all media. The general public are eagerly expecting the commissioning of this Power Plant to be the panacea of the power woes of Bangalore.

37. As per procedure and as per the directions of the Respondent No.2, the answering Respondent sent a letter along with supporting documents including the EC to the Karnataka State Pollution Control Board ("KSPCB") , requesting for the issuance of the Consent for Establishment ("CFE") for the above project. After careful consideration of the request of Respondent No.4, the KSPCB issued the CFE for the project to Respondent No.4 on 02/11/2015. A copy of the CFE received from the KSPCB is produced herewith as ***Annexure R 12.***

38. The Respondent No.4 has also obtained the required No-Objection Certificates for the project from various departments of the State. The No- Objection Certificates (NOC) issued by the Department of Fisheries dated 30/05/2015; Airport Authority dated 05/05/2015; Health and Family Welfare department dated 28/10/2015 and Ministry of Defence dated 13/01/2016 are produced collectively herewith as ***Annexure R 13(colly).*** The Letter of Award was issued to the EPC contractor Bharat Heavy Engineering Limited ('BHEL') on 03/11/2015 after obtaining all the statutory clearances required for the project. A copy of the Letter of Award issued to BHEL is produced herewith as ***Annexure R 14.***

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39. It is submitted that presently all civil works at site have been completed and the Plant is presently in the process of being commissioned. The Plant is likely to be commissioned byDecember 2020. Photographs of the Plant and Project Site are produced herewith as ***Annexure R 15.***

40. Water required for the project is to be supplied from by the Bangalore Water Supply and Sewarage Board ("BWSSB") from a tertiary treated sewage water treatment plant at Jakkur. The BWSSB has already completed the erection of the water treatment plant at Jakkur and has supplied 30,000 cubic meters of tertiary treated water to the power plant for commissioning activities. The BWSSB has also completed the pipe laying works of 4.6 km from the water treatment plant at Jakkur to the Power Plant.Further, the Government of Karnataka has accorded the approval and authorized the Respondent No.4 to enter into a common agreement with GAIL India Limited for transportation and supply of Natural Gas to the Power Plant. GAIL India Limited has completed all Pipe line laying and gas station establishment works for supply of gas to the Power Plant and has supplied natural gas of approximately 1059MMBTU for commissioning activities.Furthermore, a 220 KV substation established by the Karnataka Power Transmission Corporation Limited in the Power Plant premises has been charged, and works for erection of towers for the purpose of power evacuation from Power Plant is already complete.

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Karnataka Power Corporation Ltd.
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41. Respondent No.4 submits that the estimated cost of the project was Rs. 2022.52 crores of which Rs. 1518.90 Crores has already been spent so far.

42. The residents of Bengaluru and the industrial areas of Bengaluru which are beleaguered and suffering due to chronic shortage of power during the summer months will be able to breathe easy with the commissioning of this Power Plant. Bengaluru consumes more than 40% of the power generated in the State of Karnataka. Currently, power generated in far off places is being transmitted to Bengaluru which results in transmission losses as well as deprivation of power to other parts of Karnataka. The Power Plant will reduce the transmission losses substantially and increase the total installed capacity of the State. This will enable Respondent No.4 to cater to the domestic and industrial needs of the state and particularly to the peak load demand of the rapidly developing city of Bangalore. It is further submitted that the Power Plant is extremely essential for the stabilisation of the State Power Grid of Karnataka. Respondent No.4 is presently using renewable sources of energy such as solar and wind etc. for the generation of power. However, as these sources are undependable/ not consistent there is a requirement to have a dependable source of power which can be ramped up to balance the grid when these sources are disrupted and there is a variation of load. The Power Plant would therefore greatly improve the flexibility of the Power Grid by providing electricity to tide over any shortfall that may arise due to temporary non-availability of renewable sources of energy. Further,

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
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Gas turbines have a special feature of fast start ups by which the unit is synchronized in a short time. Therefore, the Power Plant is extremely important for the generation of power within the State of Karnataka as it will be the primary source of power to the city of Bengaluru.

43. On 11/06/2018, the Appellant approached the Hon'ble High Court of Karnataka in Writ Petition No. 25189/2018 (GM-RES/PIL) on the following grounds:

a) Direct the 1st Respondent to consider the representation submitted by the Petitioner and initiate necessary action against the 4th Respondent towards the cancellation of the illegal and void environmental clearance bearing SEIAA 20 IND 2014 dated 01.09.2015 issued by the 2nd Respondent herein

b) Direct the 1st and 3rd Respondent to ensure that all steps are taken and necessary financial allocations are made towards preservation of the Puttenahalli Bird Reserve so as to ensure its restoration to its original pristine state.

c) Pass any other orders in the interest of justice and equity.

44. The matter was taken up on the insistence of the Appellant without the pleading being complete, however, the Respondent No.2 (SEIAA) had filed its Objections to the said Writ Petition and the answering Respondent hadfiled a Memo along with supporting documents seeking a direction to the Appellant herein to approach the National Green Tribunal, being the correct forum for the adjudication of the

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RAMESH KUMAR
BENGALURU
Reg. No 12313
GOVT. OF INDIA

KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
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said issues and as an Application bearing OA No. 57/2017 filed by the Apartment Association seeking substantially the same reliefs was already pending before the Hon'ble NGT.

45. The High Court upon considering the Memo filed by the Respondent No.4, by way of its Order dated 08/03/2019 rightly held that the Appellant had a remedy of approaching the National Green Tribunal for the redressal of its grievances. The Hon'ble High Court upon considering the Objections filed by the Respondent No. 2 herein and the submissions made by its Counsel and that of the Appellant also held that the Environmental Clearance granted was not in violation of any law and accordingly dismissed the Writ Petition filed by the Appellant.

46. Further, even after the Hon'ble High Court had held that the proper forum for the adjudication of the dispute is the Hon'ble National Green Tribunal, the Appellant chose to prefer an appeal to the Hon'ble Supreme Court by way of SLP bearing No. 10555/2019 instead of approaching this Hon'ble Tribunal. When the matter was pending before the Hon'ble Apex Court, the Apartment Association filed an application to be impleaded as Petitioners in SLP No.10555/2019. The Hon'ble Supreme Court allowed the Apartment Association to be joined as intervenors but not as Petitioners in the said SLP. The answering Respondent filed its Counter Statement to the SLP.

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RAMESH KUMAR
BENGALURU
Reg No 12313
GOVT. OF INDIA

KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
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(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

47. The matter was then taken up by the Hon'ble Supreme Court on 10/06/2020 and the same was disposed with the following order:

"The Petitioners filed a writ petition no. 25189/2018 before the High Court of Karnataka at Bangalore challenging the order granting environmental clearance dated 1.9.2015 by State Level Environmental Impact Assessment Authority in favour of Respondent No.4. The High Court has rightly held that the said order is appealable to the National Green tribunal. While holding so, the Division Bench has observed that there is no violation of any law in granting environmental clearance, without considering the rival contentions of the parties.

Having heard learned counsel for the parties, we are of the view that it is just and proper for the parties to approach the National Green Tribunal for appropriate relief. The observation of the High Court on merits of the case is hereby set aside.

If the proceedings are initiated before the National Green Tribunal within a period of four weeks from today, the National Green Tribunal is requested to dispose of the same on merits."

48. The Appellant has then approached this Hon'ble Tribunal by way of the instant Appeal.

Para-wise Traversal

49. **Re Para I,II and III** -. It is submitted that there has arisen no situation which has raised substantial questions relating to the

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Asst. General Manager (Law)
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environment as referred to in Section 14 of the NGT Act as claimed by the Appellant, which requires to be adjudicated by this Hon'ble Tribunal. It is false to state that any damage has been caused the environment by the activities of the Respondents and that the same requires restitution of the environment. It is false to state that Environment Clearance dated 01/09/2015 has been granted to the Respondent No.4 dehors the applicable notifications and statutory provisions as contemplated under Section 16 of the NGT Act. Further, the email address submitted by the Appellant for service of notice to the answering Respondent is incorrect. The Respondent No.4 may be served through its Counsel, Pragati Law Chambers, 5A Bharat Apartments, 44 /1 Fairfield layout, Race Course Road, Bangalore 560 001 and at the email addresses Ajay@pragatilaw.in and Tanya@pragatilaw.in.

50. **Re Para IV (1)**:All averments to the extent that they pertain to documents on record do not require to be traversed.

51. **Re Para IV (2):**It is submitted that the Puttenahalli Lake adjoins a notified industrial area having several industries including a Rail wheel factory, the Federal Mogul factory and the Power Plant of the Respondent No.4 and the said Lake is surrounded by apartments complexes and residences. A CDP map of the area is produced herewith as ***Annexure R 16.***All averments in this paragraph are denied as false, save and except those which are matter of record.

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Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
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Palace Road, Bengaluru - 560 001.

52. **Re Para IV(3)-** It is not true to state that the Puttenahalli Lake was declared and notified as a Bird Conservation Reserve on 29/04/2015. It is submitted that the Government of Karnataka had decided to declare the Puttenahalli Lake as a Bird Conservation Reserve on 29/04/2015 and the same was notified in the Official Gazette on 10/09/2015. It is submitted that the Appellant has deliberately not produced the complete Gazette Notification showing the date of the publication of the Gazette. A complete copy of the Gazette Notification is produced herewith as ***Annexure R17.***

53. **Re Para IV(4)-**It is true that the Karnataka State Environmental Impact Assessment Authority, the Respondent No.2 herein, has granted the Environmental Clearance to the Respondent No.4 on 01/09/2015 for the establishment of a Gas based Combined Cycle Power Plant in various survey numbers of Puttenahalli village as well as of Kenchenahalli village, Yelahanka, Bangalore district, Karnataka. It is false to state that the establishment and functioning of the Power Plant would wreck havoc and completely destroyed the pristine conditions of Yelahanka and Puttenahalli Lakes and the surrounding areas.

54. **Re Para IV(5)-**It is submitted that the Office Memorandum dated 02/08/2014 will not be applicable to the Environmental Clearance granted to the Respondent No.4, because on the date on which the Respondent No.4 applied for the said Environmental Clearance and even on the date the same was granted to the Respondent No.4 i.e.

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RAMESH KUMAR
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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
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01/09/2015, there was no 'protected area' within a 10 km radius of the power plant site. The Puttenahalli Lake Bird Conservation reserve came to be notified as a Bird Conservation Reserve only on 10/09/2015after the Environmental Clearance was granted to the Respondent No.4.

55. **Re Para IV(6)-**The said paragraph requires no traversal.

56. **Re Para IV(7)-**It is submitted that as per the Environmental Impact Assessment Notification, 2006 issued by the Respondent No.1, the Gas based Combined Cycle Power Plant of the Respondent No.4, having a generation capacity of 350 MW (being less that 500 MW) would fall under Category 1(d) of the Schedule to the EIA Notification, 2006. As the Power Plant fell under Category 1(d), the same was correctly classified as a "Category B" Project and therefore the said project fell within the jurisdiction of the State Level Environment Impact Assessment Authority(SEIAA) for the purpose of granting clearances. It is submitted that on the date on which the Respondent No.4 applied to the SEIAA for the Environmental Clearance, the Puttenahalli Lake had not been notified as a Bird Conservation Reserve. It is false to state that the Power Plant is surrounded by this Puutenahalli- Yelahanka Lake which was notified as a Bird Conservation Reserve. It is only the Puttenahalli Lake which has been notified as a Bird Conservation Reserve under the provision of Section 36-A of the Wildlife Protection Amendment Act, 2006. As on the date of issuance of the Environmental Clearance

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i.e.01/09/2015, however, the Puttenahalli Lake had not been notified as a Bird Conservation Reserve. The Puttenahalli Lake was notified as a Bird Conservation Reserve only on 10/09/2015 after the Environmental Clearance had already been granted to the Respondent No.4. Therefore, it is false to state that there was any extraordinary situation, even as on the date of the issuance of the EC to the Respondent No.4, which attracted the General Conditions of EIA Notification 2006. It is also false to state that SEIAA would hence lose its jurisdiction to deal with the proposal and that the proposal could only have been dealt with and cleared at the Central Level by the Respondent No.1.

57. **Re Para IV(8)-**As stated above, the Puttenahalli Lake was notified as a Bird Conservation Reserve only after the date on which the Environmental Clearance was issued to the Respondent No.4. Therefore, the project of the Respondent No. 4 was rightly categorised as a 'Category B' project under the EIA notification. As on the date on which the Environmental Clearance was issued. As on the date on which the EC was issued, there was no 'protected area' within 10 kilometres distance from the project site .Therefore, the project was not categorised as 'Category A' project and did not come under the jurisdiction of the MOEFCC. Hence, it is false to state that the Environmental Clearance issued by the SEIAA has been issued without jurisdiction and is non-*est* in the eyes of law. The Appellant is deliberately attempting to mislead this Hon'ble Tribunal.

KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
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58. **Re Para IV(9)-**It is once again reiterated that, as the Puttenahalli Lake came to be notified as a "Bird Conservation Reserve" only after the date of the issuance of the Environmental Clearance to Respondent No.4, the General Conditions to the EIA Notification, 2006 would not apply to the project of the Respondent No.4.Therefore, the same was rightly categorised as a 'Category B' project over which the SEIAA had the jurisdiction to appraise and issue environmental clearances. It is false to state that the General Conditions to the EIA Notification,2006 would apply to the Project and that it would become 'Category A' project and that the MOEFCC alone would have the jurisdiction to issue the Environmental Clearance. It is submitted that there will be no adverse impact of the Power Plant of the Respondent No.4 over the flora and fauna diversity in the surrounding area. There has been no destruction of the habitat of protected species as a result of the proposed activity. All other averments in this paragraph are denied as false.

59. **Re Para IV(10)-**It is submitted that the Respondent No. 4 has rightly approached the Karnataka State Environmental Impact Assessment Authority (SEIAA), the Respondent No.2 herein, for the grant of the Environmental Clearance for the Power Plant. It is false to state that the SEIAA had, without consideration that it did not have jurisdiction to consider the application and without any application of mind issued the Environmental Clearance on 01/09/2015. It is false to state that Environmental Clearance to the Gas based Combined Cycle Power Plant project by the SEIAA is illegal as per the guideline mentioned in

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
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the EIA Notification, 2006. It is false to state that the Environmental Clearance dated 01/09/2015 is void ab initio and is a nullity with no validity in law. It is also false to state that the Respondent No.4 has no right to continue with the construction of the Gas based Combined Cycle Power Plant. All other averments in this paragraph are denied is false.

60. **Re Para IV(11)-**It is submitted that, the fact that the MOEFCC had in fact, acted upon the representation dated 03/07/2018 given by the Appellant, had not been brought to the notice of the Hon'ble High Court or before the Hon'ble Supreme Court. By supressing this information, the Appellant sought a direction from the Hon'ble High Court and the Hon'ble Supreme Court to the MOEFCC to the consider the representations made by it. A copy of the report given by the MOEFCC was not given to the answering Respondent and there for it had no knowledge of the same before it was produced by the Appellant before this Hon'ble Court. The report submitted by the MOEFCC clearly states that the storm water drain which was flowing between the Puttenahalli and Yelahanka lakes was carrying sewage from the Puttenahalli Lake downstream to the Yelahanka Lake. The said sewage had spilled over and was flooding the surrounding areas including the site of the Respondent No.4.It is submitted that, on request of the BBMP, in order to reduce the sewage spillage, the Respondent No.4 got constructed a box drain, to ease the flow of water from one lake to another and to prevent the spillage of sewage in the area. A copy of the minutes of the meeting between the

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Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

Respondent No.4 and the BBMP officials are produced herewith as ***Annexure R18.***It is not true to state that the Yelahanka Lake wet land is not getting the required water supply to sustain the wetland ecosystems.

61. The report of the MOEFCC also states that the area appears to have undergone "*extensive change in land use pattern in recent times(including the laying of road alongside of the Yelahanka Lake) that might have brought about an alteration in the supply of required quantity of water into the wetland. Factors like soil type, management history, climate and soil landscape process has possibly played a considerable role as well in debilitating the eco system.*"The Appellant has chosen to ignore these findings.

62. It is also submitted that the report of the MOEFCC mentions that untreated sewage was being received into the lakes from the surrounding areas. It is submitted that the apartments and residential areas around the lake have been releasing their sewage into the lakes and throwing their garbage around the Lake area. Photographs showing the release of untreated sewage and disposal of garbage into the Puttenahalli Lake by the surrounding residences and apartment complexes are produced herewith as ***AnnexureR19.***Most apartments in the area have not installed Sewage Treatment Plants (STPs), which is required under law. It is pertinent to mention that in the proposal for the declaration of the Puttenahalli Lake as a Bird Conservation Reserve, put forward by the Deputy Conservator of Forests, Bangalore

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Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
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Urban Division Bangalore (submitted by the Appellant as Annexure A2 to this Appeal), it is clearly mentioned that sewage from the nearby housing complexes, mainly Ramanashree California Resorts and Prestige Monte Carlo apartments are flowing into the tank in the North East corner via a drain found along the road. Further another small drain was bringing in sewage from the BMTC bus depot site. It also states that a sewage pipeline also empties sewage from the Yelahanka New Town Housing Board Colony and the Attur layout areas into the Lake. The proposal also notes the existence of a small dysfunctional STP at the Lake. This clearly shows that sewage has been flowing into the Puttenahalli Lake from the surrounding residential areas.The impact of this sewage discharge into the lake is far more adverse than any possible impact of the Respondent's project.

63. On the contrary, the Respondent No.4 has not been letting out any effluents into either of the two lakes .i.e. the Puttenahalli Lake or the Yelahanka Lake. In any case, the Puttenahalli Lake is located upstream of the Power plant of the Respondent No.4 so there could possibly be no discharge of effluents into it from the Power Plant. The Respondent No.4 is strictly abiding by the conditions of the Environmental Clearance, issued to it by the Respondent No.2 and the Zero Liquid Discharge Condition in the Consent for Establishment issued by the KSPCB. As per the latter, the Respondent No.4 is presently putting into place a Zero Liquid Discharge Plant and no effluents whatsoever will be released into either Lakes. All other

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RAMESH KUMAR
BENGALURU
Regd. No. 12113
GOVT. OF INDIA

KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

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averments are denied as false and the Appellant is put to strict proof of the same .There is no violation of any order of this Hon'ble Tribunal. A Buffer zone of more than 50 mts is maintained from the Power Plant.

64. **Re Para IV(12)-**It is false to state that there will be heat, air, noise and light pollution from the Gas based Combined Cycle Power Plant which will have a direct bearing on the birds in the protected area. It is false to state that changes in air temperature due to stack emissions will result in affecting the migratory pattern of the birds themselves and that there would be deposition of pollutants on the water body and that this issue requires specific consideration. The EIA report is a comprehensive document and has considered the impact on the environment and wildlife in the surrounding areas due to the establishment of the Power Plant. All other averments in the paragraph are denied as false.

65. **Re Para IV(13)-**The averments made herein so far as they relate to a matter on record are admitted. It is submitted that the SEIAA vide its letter dated 19/01/2015 had exempted the project from having to conduct a public consultation as per Section 7(III) (i) (b) of the EIA Notification. The SEIAA subsequently accorded the environmental clearance to the above project on 01/09/2015 and the same was advertised on 6th and 8th Sept 2015 as per the directions of SEIAA, vide General Conditions No-11 of the EC letter. The Ministry of Environment and Forests thereafter issued an Office Memorandum

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RAMESH KUMAR
BENGALURU
GOVT. OF INDIA

KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

No..J-11013/36/2014-IA-1 dated 04/04/2016 stating that large scale projects even thermal projects in Industrial areas would not be exempt from holding Public Consultations. It is submitted that the Office Memorandum dated 04/04/2016 was issued the year after the EC was obtained and the EC was published by the Respondent No.4 in the local newspapers. It is further submitted that a bare reading of the EIA notification along with the Office Memorandum clearly shows that the Office Memorandum issued is in the nature of an amendment to the EIA notification,2006 making an exception previously available to certain industries unavailable thereon and is clearly in the nature of an amendment to the same. Therefore, the Office Memorandum would only apply prospectively and not retrospectively to projects which have already received Environmental Clearances pursuant to the exemption under the EIA Notification,2006. It is false to state that the Environment Clearance dated 01/09/2015 has been granted in violation of the EIA Notification,2006.

66. **Re Para IV(14 and 15)-** The averments made herein so far as they relate to a matters on record do not require to be traversed. It is false to state that there is a danger in the construction of the Gas based Combined Cycle Power Plant to the Puttenahalli lake or the surrounding areas and the Appellant is put to strict proof of the same. From the report made by the MOEFCC, produced by the Appellant, it appears that the representation of the Appellant had in fact subsequently been considered. A site visit had been conducted by the

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Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
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Palace Road, Bengaluru - 560 001.

MOEFCC on 05/09/2018, where members of the Appellant Trust were present and a report was submitted on 03/10/2018.

67. **Re Para IV(16,17 and 18)-**It is false to state that the establishment of the Gas based Power Plant within the close vicinity of the Puttenahalli Lake would result in the destruction of the Lake eco-system. It is also false state that the Environmental Clearance dated 01/09/2015 is *void ab initio* and is a nullity since it has been issued without taking into consideration the fact of the 'protected area'. It is submitted that the Puttenahalli Lake was notified as a Bird Conservation Reserve only after the issuance of the Environmental Clearance to the Respondent No. 4. It is not true to suggest that the Gas based Combined Cycle Power Plant would cause grave and irreparable harm and injury to the environment and to the lives of the people residing in the vicinity. The averment that the Environmental Clearance granted to the Respondent No.4 is illegal and void is denied as false. There was no requirement for any steps to be taken by authorities pursuant to the representations made by the Appellant as the same was made on false and baseless grounds. It is also not true to say that the Respondent No.1 did not respond to the Appellant. The documents produced by the Appellant at Annexure A-8 to the present Appeal is evidence of the fact that the MoEF had considered the earlier representations of the Appellant and had conducted a detailed study and given several recommendations. The Appellant was aware of the same as the earlier correspondence dated 30/07/2018 directing that a factual report be submitted by the Principle Chief Conservator of Forests, MoEFCC, was sent to the

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RAMESH KUMAR
BENGALURU
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GOVT. OF INDIA

KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

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Appellant as well. Thereafter, a study was conducted and a report dated 03/10/2018 was submitted to the Respondent No.1. This report has been produced before this Hon'ble Tribunal for the first time in July 2020 and hence the answering Respondent was not aware of the same before the filing of this Appeal.

68. The contents of these paragraphs to the extent that they describe the proceedings before the Hon'ble High Court of Karnataka require no traversal. However, the Appellant has conveniently chosen to remain silent about the fact that a Memo had been filed by the Respondent No.4 before the Hon'ble High Court stating that in light of Section 14, Section 15 and Section 16 (h) of the National Green Tribunal Act, 2010 which provides that the National Green Tribunal has jurisdiction to adjudicate matters relating to disputes regarding the Environmental Clearance granted and restitution of the environment, the Appellant may be directed to approach the National Green Tribunal and implead themselves in an application bearing No. 57/2017 that was already pending before the National Green Tribunal seeking restitution of the environment and the protection of the Puttenahalli Lake.

69. **Re Para IV(19 and 20)-**It is false to state that High Court of Karnataka had erred in not properly appreciating the case of the Appellant. The High Court upon considering the Memo filed by the Respondent No.4, had rightly held that the Appellant had a remedy of filing an appeal before the National Green Tribunal to challenge the Environmental Clearance granted to the Respondent No.4. The

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(Drugs Control Department Premises)
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Hon'ble High Court upon considering the Objections filed by the Respondent No. 2 herein and the submissions made by its counsel and that of the Appellant, had correctly held that the Environmental Clearance granted was not in violation of any law and had accordingly dismissed the Writ Petition filed by the Appellant. It is pertinent to bring notice to the fact that the Appellant admits that it had not sought to challenge the EC before the Hon'ble High Court and that its prayer had been to direct the Respondent No.1 to consider and respond to the representations dated 25/01/2018 and 08/03/2018 made by the Appellant. Therefore, the Appellant is for the first time raising a challenge to the EC in the instant appeal before the Tribunal. Further even after the Hon'ble High Court had held that the proper forum for the adjudication of the dispute is the Hon'ble National Green Tribunal, the Appellant chose to pursue an appeal to the Hon'ble Supreme Court instead of approaching the Hon'ble Tribunal. It is submitted that the reason the Appellant chose to approach the Hon'ble Supreme Court was because it knew that any challenge to the EC made before the Hon'ble National Green Tribunal would be barred by limitation. All averments to the extent that they pertain to matters on record, do not require to be traversed.

70. **Re Para IV (21 to 24):** The averments in the paragraph under reply to the extent to which they pertain to the recorded proceedings before the Supreme Court and documents on record, do not require to be traversed. However, the Supreme Court had not granted leave to the Appellant to challenge the EC. The Order of the Hon'ble Supreme

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Court stating that if the Appellant initiated 'appropriate proceedings' before the Hon'ble National Green Tribunal; the matter had to be taken up by the Tribunal and decided on merits, has been deliberately misinterpreted by the Appellant to make it seem that the Hon'ble Supreme Court had directed that the NGT to entertain the Appeal filed by the Appellant no matter the nature of the reliefs sought and that the delay should be deemed to be condoned. The order of the Hon'ble Supreme Court has clearly been misconstrued in order to serve the interests of the Appellant.

71. The answering Respondent had filed M.A No. 1527 of 2020 before the Hon'ble Supreme Court seeking a clarification of the Order dated 10/06/2020. The M.A has been disposed of with the following observation: "*However, all contentions of the parties are left open to be decided by the National Green Tribunal*". The necessary implication of the same is that all contentions including that of limitation is left open to be decided by this Hon'ble Tribunal. Therefore, the Supreme Court has clearly held that the delay is not deemed to be condoned.

72. **Re Para IV(25)-**It is false to state that the Respondent No. 4 had prior knowledge about the Puttenahalli Lake being declared as a Bird Conservation Reserve. The averment that the establishment of a Gas based Combined Cycle Power Plant within the close vicinity of the Lake would result in the destruction of the Lake eco-system is false and baseless. It is also false to state that the Environmental Clearance

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RAMESH KUMAR
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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

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dated 01/09/2015 is void abinitio and is nullity since it has been issued without taking into consideration the fact of the protected area. It is false to state that Respondent No.4 has concealed the prior knowledge it had about the intention of the Government of Karnataka in declaring the area as a Bird Conservation Reserve. It is false to state that the establishment of a Gas based Combined Cycle Power Plant would cause grave and irreparable damage to the environment and the life of the people residing in the vicinity.

73. **Re Para IV(26)-**It is false to state that Respondent No.4 has deliberately concealed and/orhas submitted false and misleading information to the SEIAA and thereby illegally obtained the present Environmental Clearance. The averment that the RespondentNo.4 has deliberately given false and misleading information in the Application for Environmental Clearance prescribed in Form No.1 submitted by it on 20/12/2014 is untrue. The RespondentNo.4 project is a 'Category B' project and does not attract the general conditions of the EIA Notification, 2006. It is submitted that on the date on which the said application form was submitted to the SEIAA on 20/12/2014, the Puttenahalli Lake had not been notified as a Bird Conservation Reserve. The Respondent No.4 has obtained all required permissions and clearances required for the Project. The Respondent No.4 has not utilised any forest land for the construction of its power plant. All other averments in this paragraph are denied as false and the Appellant is put to strict proof of the same.

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RAMESH KUMAR
BENGALURU
Reg. No 12313
GOVT. OF INDIA

KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
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74. **Re Para IV(27)-**It is submitted that EIA report has dealt with all aspects in the terms of reference issued by the State Level Expert Appraisal Committee(SEAC) in its letter dated 01/09/2015.As on the date of the issuance of the TOR or the submission of the EIA report, there were no notified ecologically sensitive areas falling within a 10 kilometres radius of the project boundary. As stated previously the Puttenahalli Bird Conservation Reserve was notified as such, only after the Environmental Clearance had been granted to the RespondentNo.4 on 10/09/2015. The averments in the paragraph under reply to the extent to which they pertain to documents on record, do not require to be traversed.

75. **Re Para IV(28)-**It is false to state that Respondent No.4 had prepared the EIA report in contravention of the Terms of Reference and has deliberately provided misleading and false information. It is submitted that there were no notified protected areas within the study area of the EIA report on the date on which it was submitted. There have been no contradictions in the statements made by the Responded No.4. The averments in the paragraph under reply to the extent to which they pertain to documents on record, do not require to be traversed. All other averments in the paragraph are denied as false.

76. **Re Para IV(29)-**It is false to state that the data and information given in the Questionnaire for appraisal dated 23/07/2015 by the Respondent No.4 regarding the existence of National Parks/Wildlife Sanctuary is false and misleading. It is reiterated that the Puttenahalli Bird

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
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(Drugs Control Department Premises)
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Conservation Reserve came to be notified as such only on 10/09/2015 after the Environmental Clearance was granted to the Respondent No.4. Therefore, on the date on which the questionnaire was submitted there was no notified National Park, Wildlife sanctuary etc. falling within7 kms of the periphery of the project.

77. **Re Para IV(30)-** The averments in the paragraph under reply to the extent to which they pertain to documents on record, do not require to be traversed. There has been no deliberate concealment and/or submission of false or misleading information or data by the Respondent No.4.

78. **Re Para IV(31)-** It is submitted that there has been no deliberate concealment or suppression of false information and data material to the screening, scoping and appraisal by the answering Respondent. The answering Respondent has no knowledge of any representations made exclusively on this regard to the Respondent No.1 by the Appellant. It is false to state that there has been any alleged suppression of facts and submissions of false facts by the Respondent No.4. It is false to state that by suppressing or concealing the presence of the Puttenhalli Lake Bird Conservation Reserve, the project proponent had suppressed data which was material to the appraisal of the project. It is also false to state that there was any concealment and submission of misleading data leading to the violation of any provisions of the EIA Notification,2006 which would lead to the cancellation of the EC by the MOEF. Further there has been no illegal

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enrichment or fraud played by the answering Respondent in securing the clearance order. There has also been no neglect or lack of seriousness on the part of the Respondent No.4 in the process of obtaining the EC. All efforts were made in earnest by the Respondent No.4. All other averments in this paragraph are denied as false.

79. **Re Para IV(32)-**It is false to state that there will be Heat, Air, Noise and Light pollution from the subject Gas based Combined Cycle Power Plant which will have a direct bearing on the birds in the area. It is submitted that the EIA Report was drawn up after due consideration of all aspects as required by the TOR issued by the Respondent No.2. The EIA Report documents the study of the flora, fauna, aquatic ecology and water quality of Puttenahalli Lake. The EC was granted to Respondent No.4 after consideration of this report on 01/09/2015. All other averments in this paragraph are denied as false.

80. **Re Para IV(33)-**It is submitted that the Respondent No.4 has undertaken several steps to ensure that the lake eco-system is preserved. In order to do so, the Respondent No.4 through its consultant, has studied the lake eco-system extensively while drawing up the EIA Report. Further the Respondent will be abiding by the stringent conditions imposed by the Environmental Clearance and the Consent for Establishment issued by the Karnataka State Pollution Control Board, as per which it has ensure that there is Zero Liquid Discharge from the Plant. The answering Respondent has followed all requirements and conditions and has obtained the Environmental

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Karnataka Power Corporation Ltd.
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Clearance as per procedure prescribed under law. The Power Plant will not pose a threat to the Lakes. The very purpose of the re-categorization of industries by the CPCB was to list non-polluting or "White industries" who would not have to obtain an Environmental Clearance, and that they would be encouraged and given more help in obtaining finance from lending institutions. The new categorization studied the pollution potential of industries to ensure that industries are established in a manner consistent with environmental objectives. It is submitted that the Natural Gas based Power Plant of the Respondent No.4 is more environmentally friendly than the Diesel powered Gas Plant operated previously on the same site The Respondent No.4 has obtained an EC after intense studies of the plant and its surroundings by the consultants. Further, the Respondent No.4 has taken all steps to ensure that the environment around the Plant site would be protected including following a no-discharge condition whereby it would not release any effluents into the lakes. It has also taken up various steps to minimize any air and sound pollution of the environment. The Power plant will not pose a threat to the eco-system of the lakes. All other averments in this paragraph are denied as false.

81. **Re Para IV(34)-**It is submitted that the area in which the Power Plant was set up was a notified industrial area. Prior to the establishment of the Gas based Combined Cycle Power Plant using Natural Gas, there was a Diesel power plant at the site. The latter was shut down and a more ecologically friendly Natural gas based power plant has now been set up in its place. The Diesel based Power("DG Plant") Plant

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KABADE. D.R.
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Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
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was set up as early as 1993. It is submitted that at the time when the DG Plant was established, there was very little development in the area and the area was purely industrial. The area where the DG Plant was located was initially completely isolated and the city grew over the years and due to lack of residential spaces within the vicinity of the city, lands in industrial areas were sought to be utilized for the same. Thereafter, as the city of Bangalore expanded more residences were set up around the industrial area. The Puttenahalli Lake is currently fed by rainwater and from effluent discharges from the surrounding apartments. The same came to be notified as Bird Conservation Reserve only as recently as 10/09/2015. Notwithstanding the above, the Respondent No.4 has followed all prescribed rules in obtaining the EC and the same would not come into the teeth of the Guidelines as the industrial site was pre-existing and was not being set up in the vicinity of the Puttenahalli Lake. In fact, the Respondent No.4 has adopted a more environmentally friendly approach by switching from Diesel to Natural Gas. Further, it is reiterated that no effluents will be discharged from the Power Plant into the Lakes as the Respondent is following a strict Zero Liquid discharge condition imposed by the KSPCB in the Consent for Establishment. In any case, the Puttenahalli lake lies upstream of the Power Plant and no effluents could possibly be drained into it. All other averments in this paragraph are denied as false.

82. **Re Para IV(35)-**It is false to state that the Project was set up without considering the hydrology of the region and affects the rajakaluves

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connecting the Yelahanka and Puttenahalli Lakes and wetlands in the region. It is also false to state that the watershed area of the water bodies in question are being affected prejudicially and that the constructions are contrary to the established law in regard to permissible constructions in the vicinity of water bodies and rajakaluves.It is submitted that all aspects including the hydrology of the area have been taken into account while granting the EC and Consent for Establishment and the Appellant is questioning the same without any scientific basis or study. It is submitted that an Expert Body has studied the environmental impact in a responsible and scientific manner and the same cannot be consigned to trash based on mere false assertions on part of the Appellant which are unsubstantiated and without scientific merit.

83. **Re Para IV(36)-**It is false to state that the Power Plant is being established in an area where no pollution control measures are possible. The answering Respondent has already stated that it would be reusing any waste water generated and that the same would not be released into the lake. Therefore the waste water generated in the Power Plant will be used within the Plant itself. The water used for the project would be the tertiary treated sewage water supplied by the BWSSB of approximately 600 m3/hr with a Total Dissolved solids *("TDS")* of 800 which will be mainly used as a coolant. Out of 600m3/hr of water supplied, only 50 m3/hr water supplied will be treated by a two stage Reverse Osmosis *("RO")* process and used for various other processes within the Power Plant premises. The effluent

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from RO plant around 18-20m3/hr will be treated in mobile RO system till the commissioning of ZLD system. As per the Karnataka State Pollution Control Board *("KSPCB"),* Consent for Establishment letter dated 02/11/2015, and the EC issued by the Respondent No.2, Respondent No.4 will adhere to EC conditions, i.e the treated effluents conforming to the prescribed standards shall be recirculated and reused. The Respondent No.4 is also establishing an Ozonisation plant for water treatment instead of chlorination treatment in the Power Plant at an additional cost of Rs.8 crores to pre-empt any environmental hazards that may be caused by chlorine leakage. It is submitted that there will be no detriment caused directly or indirectly to the Lakes on account of the project of the Respondent No.4. The Respondent is also setting up a Zero Liquid Discharge Plant within its premises to comply with the conditions imposed by the KSPCB in the Consent for Establishment. The Letter of Award issued for setting up of the ZLD Plant is produced herewith as ***Annexure R20.***

84. The Respondent No.4 has also been undertaking various other pollution mitigating methods. The Storm water drain adjacent to the site drain has been reconstructed and the area which has become available after the completion of drain is being used for planting trees. The Respondent No.4 is making all efforts to ensure that the ecological balance of the lake is maintained and is taking steps for developing the greenery around the lake. It is submitted that 33 percent of the total area of the Power Plant site will be reserved for tree plantation. The Respondent No.4 has already taken steps towards

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plantation of trees in the area of about 9 hectares inside the plant premises in a phased manner. About 1000 saplings have been planted in the first phase and the planting of more saplings have been contemplated in the next phase in the vacant areas of the plant. A copy of the tender issued for the planting of 1000 trees in the project area in Phase 1 has been produced herewith as ***Annexure R21.*** It is submitted that the cost of the tender issued for the planting of 1000 saplings in Phase 1 was 12.5 lakhs. The Respondent No.4 has also awarded a Tender for planting a further 1000 trees in the project area at the cost of Rs. 10.86 Lakhs. In Phase 2,out of 1000 trees, 500 trees already planted balance 500 trees planting under progress. A copy of the Letter of Award for Phase II of Tree Plantation is produced herewith as ***Annexure R22.***

85. It is false to state that the relevant conditions have not been considered. A detailed Environmental Impact assessment had been conducted by the answering Respondent and a Report formulated thereafter. The EC was granted only after the same was scrutinized in detail by the Respondent No.2.It is false to state that Secondary pollution control measures were not envisaged to handle any emergency situations and that risk factors are high. The Respondent No.4 has taken all steps to minimize the risks associated with the Project. It is false to submit that the EIA report has been prepared without any application of mind and that the EC has been issued based on an inchoate report. The Respondent No.4 has drawn up the EIA report based on the Terms of Reference issued by the Respondent

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No.2.All other averments in this paragraph are denied as false and misleading.

86. **Re Para IV(37)-**The whole basis of the Appellant's case is that the Environmental Clearance was issued to the Power Plant to be set up in an eco-sensitive zone. This is clearly an attempt by the Appellant to mislead this Hon'ble Court. As repeatedly stated in the paragraphs above, the Environmental Clearance had been granted to the Respondent No.4 even before the Puttenahalli Lake was notified as an 'eco-sensitive zone' and therefore the requirement to obtain permission from the National Board of Wildlife would not apply. Hence there was no illegality committed by the Respondent No.2 in issuing the Environmental Clearance to the Respondent No.4 without consulting the National Board for Wildlife. All other averments in this paragraph are denied as false except to the extent that it pertains to matters on record.

87. **Re Para IV(38)**- It is submitted that the EIA Report was drawn up after due consideration of all aspects as required by the TOR issued by the Respondent No.2. The EIA Report documents the study of the flora, fauna, aquatic ecology and water quality of Puttenahalli Lake. The EC was granted to Respondent No.4 after consideration of this report on 01/09/2015. All other averments in this paragraph are denied as false.

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88. **Re Para IV(39)**- The averments made herein so far as they relate to a matter on record do not require to be traversed. The land on which the Power Plant is situated was notified as an Industrial Area under the Karnataka Industrial Areas Development Act vide notification dated 26/09/1985. It is submitted that the Respondent No.2, vide its letter dated 19/01/2015 had exempted the project from having to conduct a public consultation as per Section 7(III) (i) (b) of the EIA Notification. The Respondent No.2 subsequently accorded the Environmental Clearance to the above project on 01/09/2015 and the same was advertised on 6th and 8th Sept 2015 as per the directions of Respondent No.2, vide General Conditions No-11 of the EC letter. The Ministry of Environment and Forests thereafter issued an Office Memorandum No..J-11013/36/2014-IA-1 dated 04/04/2016 stating that large scale projects even thermal projects in Industrial areas would not be exempt from holding Public Consultations. It is submitted that the Office Memorandum dated 04/04/2016 was issued the year after the EC was obtained and the EC had been published by Respondent No.4 in the local newspapers. It is further submitted that a bare reading of the EIA notification along with the Office Memorandum clearly shows that the Office Memorandum issued is in the nature of an amendment to the EIA notification, 2006 making an exception previously available to certain industries unavailable thereon and is clearly in the nature of an amendment to the same. Therefore, the Office Memorandum would only apply prospectively and will not apply retrospectively to projects which have already received Environmental Clearances pursuant to the exemption under the EIA Notification,2006. Furthermore, at the

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time the Government Memorandum was issued, Respondent No.4 had already carried out significant work on the project. The averment of the Appellant that the Respondent's project could not have been exempt from public hearing is denied as false. All other averments in this paragraph are completely false and baseless.

89. **Re Para IV(40)**-The Respondent No.4's Power plant is located clearly within a pre-existing Industrial Zone and would only be required to maintain the noise levels specified for such a zone. It is submitted that the surrounding residences and residential complexes have been established only fairly recently. Notwithstanding the above, it is only the turbine and GBC within the Gas power plant that would generate 85 dB(A) when measured at a distance of 1 metre from the gas turbine itself. It is submitted that the sound would decrease significantly as the distance from the turbine is increased. Additionally, the Respondent No.4 is taking steps to install acoustic enclosures/barriers within the gas turbine building , to minimise the sound escaping from the same. The distance between boundary of the Power Plant and the equipment (gas turbine) would be more than sufficient distance for the sound to dissipate significantly. Respondent No.4 is also installing acoustic enclosures and natural barriers by planting a 15 to 20 metre wide buffer zone of trees all along the compound wall to further decrease the sound levels below the specified norms from all the equipment installed within the plant boundary.

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90. The averment that an unbearable noise was being heard in the vicinity of the plant because of unscheduled trials being conducted in the premises is false and baseless. It is false to state that there has been an unabated noise along with continuous vibrations coming from the Power Plant which has started to affect the birds, animals as well as people residing in the vicinity. The averment that alleged noise emanating from the Respondent No.4 is a potential health hazard and that it will adversely affect the health and wellbeing of birds and animals as well as general public including old persons and young children stay in the vicinity is wholly untrue. The averment that there was a noise on the morning of 21st May 2020 which emanated from the Power Plant and existed for 15 minutes is denied as false and the Appellant is put to strict proof of the same. The formal complaint allegedly made by the Appellant and other residences to the KSPCB and the Commissioner BBMP is not within the knowledge of the answering Respondent. It is false to state that there has been any destruction of forest around the Lake or any pollution of the Lake water by discharge of hot water from the Power Plant into it. It is false to state that establishment of the Power Plant and its operation would spell a death knell to birds and animals and consequently the annihilation of the Bird Conservation Reserve. It is also false to state that the same would pose a serious health hazard to the people living in and around Power Plant and upset the ecological balance in the surrounding environment. All other averments in this paragraph are denied as false.

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91. **Re Para IV(41)**-The averments in the paragraph under reply to the extent to which they pertain to documents on record, do not require to be traversed. It is true that the Respondent No.4 has entered into an agreement with M/s GAIL (India) Limited for supply of Natural Gas to the Power Plant. It is submitted that the M/s GAIL (India) Limited herein has built a pipeline from Dabhol to Bangalore extending for about 1000 kms. Only a small part of the pipeline i.e., from the outer ring road to the Respondent No.4's power plant of 12.55 kms has been constructed within the city limits. The averment of the Appellant that the environmental impact of putting up a pipeline from the outer ring road till the proposed Power plant site has not been evaluated is denied as false. The pipeline and its impact has been studied and Respondent No.4 has been assured that precautions have been taken to make sure that the transmission of the natural gas would be safely done by M/s GAIL (India) limited. It is pertinent to mention that underground gas pipelines are in fact being laid across the city of Bangalore for the supply of Natural Gas to residences and residential apartments within the City. All other averments in this paragraph are denied as false.

92. **Re Para IV(42)**-As stated hereinabove, the answering Respondent has taken all steps to ensure that there is minimum adverse impact on the environment surrounding the lake and its plant site. It is submitted that the Respondent No.4 will be following a Zero Liquid discharge condition imposed by the KSPCB in the Consent for Establishment. There will be no discharge into the Lakes and therefore there will be

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no contravention of the Wetland (Conservation and Management) Rules,2010. The Respondent No.4 has considered the principles of Intergenerational Equity and Public Trust Doctrine and has picked an environmentally friendly fuel for generation of power in the Power Plant. The answering Respondent's Plant has been set up in an Industrial area and was exempted from Public Hearing by the Respondent No.2 as per 7(III)(i)(b) of the EIA Notification,2006. All averments in this paragraph except for matters on record are denied as false.

93. **Re Para IV(43)**-The averments in the paragraph under reply to the extent to which they pertain to proceedings before the Hon'ble High Court and documents on record, do not require to be traversed.

Re Grounds:

94. **Re Para V(A):** It is not true to suggest that the power to grant the EC to the Power Plant is only with the Respondent No.1 and not the Respondent No.2. As per the EIA Notification,2006 the Respondent No.4 was categorized as Category 'B1' project and was required to get clearance from the State Level Environment Impact Assessment Authority, i.e. the Respondent No.2. Furthermore, the Power Plant is located in an Industrial Area and the EC for the project was granted to the Respondent No.4 before the Puttenahalli Lake was notified as Bird Sanctuary, therefore the General Condition wherein a Category 'B' project would be treated as a Category 'A' Project would not apply to

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it.It is also false to state that the Respondent No.4's construction of the Power Plant would lead to environmental degradation as well as adversely affect the flow of water into the said lakes through rajakaluves. The existing Rajakaluve that connects Puttenahalli lake to Yelahanka lake running close to the Project premises consists of a marsh that was polluted and dirty. Photographs of the Rajakaluve before improvements made by the Respondent No.4 are produced herewith as ***Annexure R 23***. This area has been improved by the Respondent No.4 by the construction of a box type drain which connects both Puttenahalli and Yelahanka lakes. This construction was undertaken on the behest of the BBMP who had requested the answering Respondent to construct it on their behalf. The area which had become available after the completion of the construction of the box drain was used for planting trees. Presently, the remodeling of storm water drain works has been completed at a cost of Rs.12.22 crores. There will not be any degradation of the Yelahanka and Puttenahalli Lakes on account of the construction of the Power Plant of Respondent No.4. It is pertinent to mention that the Puttenahalli lake lies upstream of the Power Plant and no effluents could possibly be drained into it. In any case the Respondent is abiding by a strict Zero Liquid discharge condition imposed by the Respondent No.2 in the EC and the KSPCB in the Consent for Establishment. On 27/02/2019 the Respondent No.4 invited tenders for a Zero Liquid Discharge (ZLD) System on an Engineering, Procurement and Construction (EPC) basis along with O&M of 5 years.The L1 bidder, M/s Arvind Envisol Limited have been selected and the Letter of

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Karnataka Power Corporation Ltd.
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Award is also placed on M/s Arvind Envisol Limited vide ref. KPCL/CETD/YCCPP/ZLD/1461 dated 30.10.2019. The civil works for the Zero Liquid Discharge system is under progress. The L1 bidder has quoted a price of Rs.69,98,90,295/- for implementation of the ZLD plant comprising of pre-treatment, Reverse osmosis and forced circulation crystallizer with mechanical vapor re-compressors (MVR) plant with 14 months of completion period along with O&M period of 5 years. As a temporary arrangement till the ZLD Plant is set up the Respondent No.4 has set up a Mobile Reverse Osmosis (RO)System which has now been commissioned. The Letter of Award for setting up the Mobile Reverse Osmosis Plant is produced herewith as ***Annexure R24.***All other averments in this paragraph are denied as false except to the extent that they pertain to matters on record.

95. It is false to state that the representations given by the Appellant to the MOEFCC were not considered by it.It appears from Annexure A-8 to the Appeal that the MoEFCC has considered the representation of the Appellant. The Appellant was aware of the same as the correspondence dated 30/07/2018 directing that a factual report be submitted by the Principal Chief Conservator of Forests, MoEFCC was sent to the Appellant also. Thereafter, a survey was conducted (in the presence of members of the Appellant Trust) and a report dated 30/10/2018 was submitted to the MoEFCC. This report has been produced before this Hon'ble Tribunal for the first time in July 2020. The Respondent No.4 has never been aware of the existence of the Report as no copy was sent to it by MoEFCC.

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Karnataka Power Corporation Ltd.
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96. It is false to state that the High Court had erred and had summarily upheld the Environmental Clearances and dismissed the Writ Petition filed by the Appellant. The Appellant has conveniently chosen to remain silent about the fact that a Memo had been filed by the Respondent No.4 before the Hon'ble High Court stating thatin light of Section 14, Section 15 and Section 16 (h) of the National Green Tribunal Act, 2010 which provides that the National Green Tribunal has jurisdiction to adjudicate matters relating to disputes regarding the Environmental Clearance granted and restitution of the environment, the Appellant may be directed to approach the National Green Tribunal and implead themselves in an application bearing No. 57/2017 that was already pending before the National Green Tribunal seeking restitution of the environment and the protection of the Puttenahalli Lake. The High Court upon considering the Memo filed by the Respondent No.4, had rightly held that the Appellant had a remedy of filing an appeal before the National Green Tribunal to challenge the Environmental Clearance granted to the Respondent No.4. The Hon'ble High Court upon considering the Objections filed by the Respondent No. 2 herein and the submissions made by its counsel and that of the Appellant had correctly held that the Environmental Clearance granted was not in violation of any law and had accordingly dismissed the Writ Petition filed by the Appellant. Further even after the Hon'ble High Court had held that the proper forum for the adjudication of the dispute is the Hon'ble National Green Tribunal, the Appellant chose to pursue an appeal to the

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Hon'ble Supreme Court instead of approaching the Hon'ble Tribunal. Therefore, the Appellant is for the first time raising a challenge to the EC in the instant appeal before the Tribunal.

97. The averments in the paragraph under reply to the extent to which they pertain to the recorded proceedings before the Supreme Court and documents on record, do not require to be traversed. However it is pertinent to state that the Supreme Court has not granted leave to the Appellant to challenge the EC. The Order of the Hon'ble Supreme Court stating that if the Appellant initiated 'appropriate proceedings' before the Hon'ble National Green Tribunal; the matter had to be taken up by the Tribunal and decided on merits has been deliberately misinterpreted by the Appellant to make it seem that the Hon'ble Supreme Court had directed that the NGT to entertain the Appeal filed by the Appellant no matter the nature of the reliefs sought and that the delay should be deemed to be condoned. The order of the Hon'ble Supreme Court has clearly been misconstrued in order to serve the interests of the Appellant.

98. **Re Para V (B):**As stated above, the Appellant has concealed the fact that the answering Respondent had filed a Memo before the Hon'ble High Court along with supporting documents seeking a direction to the Appellant herein to approach the National Green Tribunal, being the correct forum for the adjudication of the said issues. The Hon'ble High Court has in its Order dated 08/03/2019 held that the Appellant should have approached the National Green Tribunal. Instead of

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having the matter referred to the National Green Tribunal, the matter was pressed on merits by the Appellant. It is also pertinent to mention that even after the Hon'ble High Court had found that the relief sought for by the Appellant to set aside the Environmental Clearance granted to the Respondent No.4 was appealable only before the National Green Tribunal, the Appellant still sought to prefer the instant Petition before the Hon'ble Supreme Court.

99. It is submitted that commissioning of the Power Plant will be completed soon. As on date the Respondent No.4 has invested a sum of Rs.1518.90 crores on the construction of the Power Plant. The Power Plant will bring relief to the areas of Bangalore which are reeling under a severe shortage of power during the summer months. The proximity of the Power Plant to the city of Bangalore will reduce the transmission losses substantially and increase the total installed capacity of the State. This will enable Respondent No.4 to cater to the domestic and industrial needs of the state and particularly to the peak load demand of the rapidly developing city of Bangalore. The Power Plant provides a dependable source of power and is extremely essential for the stabilisation of the State Power Grid of Karnataka. Therefore, it is false to state that setting aside the impugned Environmental Clearance would be in the interest of the larger public good. On the contrary, the Power Plant is essential to meet the growing demands of the city of Bangalore. All other averments in this paragraph are denied as false except to the extent that they pertain to matters on record.

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100. **Re Para V (C):**It is submitted that the Government of Karnataka had decided to declare the Puttenahalli Lake as a Bird Conservation Reserve on 29/04/2015 and the same was notified in the Official Gazette on 10/09/2015. The EC was given to the Respondent No.4 on 01/09/2015 and the same was advertised in local and national newspapers within a week. Puttenahalli Lake was notified as a Bird Conservation Reserve only on 10/09/2015 after the date of issue of the EC. Therefore, the Project of the Respondent No.3 had been rightly classified as a Category B1 project by the State Expert Appraisal Committee *("SEAC")* of the Respondent No.2, and it was the Respondent No.2 which had the jurisdiction to issue the EC to the Respondent No.4 for the project. It is submitted that the Project boundary is situated 600 meters from Puttenahalli Lake and Government of Karnataka declared Puttenahalli Lake as a Bird Conservation Reserve under Section 36A of the Wildlife Protection Act,1972 with effect from the date of publication of the Notification i.e.10/09/2015 after the grant of the EC. It is submitted that the General Condition would hence not apply to the project as on the date of granting the EC, Puttenahalli Lake had not been notified as an "eco-sensitive zone". Therefore, the contention of the Appellant that SEIAA did not have jurisdiction to grant clearance as on 01/09/2015 is legally untenable as Puttenahalli Lake was declared Bird Conservation Reserve only after the Environmental clearance was granted. In any event, a thorough ecological study including the flora, fauna and water quality of the area has been conducted and the impact on Puttenahalli

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
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Lake has been considered. It is submitted that presently several residential buildings and apartments are discharging their effluents into the Puttenahalli Lake. The impact of this sewage discharge into the lake is far more adverse than any possible impact of the Respondent's project.

101. The allegations that the Respondent No.2 did not have jurisdiction to grant the EC, that the project would fall under 'Category A' and would therefore require the consent of the Respondent No.1, and that the EC is without effect in law, are self-serving and baseless statements. It is also completely false and misleading to state that the present Clearance granted by the Respondent No.2 is void ab initio. The averment that the Appellant had worked with the Lake Development Authority in preparation of the Detailed Project Report for the Lake is not within the knowledge of the Respondent No.4 and the Appellant is put to strict proof of the same. All other averments made by the Appellant in this paragraph are denied as false except to the extent that they pertain to matters on record.

102. **Re Para V(D):**It is false to state that the answering Respondent had obtained the Environmental Clearance for the establishment in violation of the law and without taking into consideration the impact on the Puttenahalli Lake. The Respondent No.4 has conducted a detailed study as per the TOR issued by the SEAC and an Environmental Impact Assessment Report ("EIA Report") was prepared by a consultant accredited by the Ministry of Environment

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
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and Forests who carried out Environment Impact Assessment studies over a period of 3 months. The EIA Report, along with a completed questionnaire, a detailed project report ("DPR") and a covering letter was thereafter submitted to the SEAC based on which the Respondent No.2 issued the Environmental Clearance to the Respondent No.4. It is false to state that the steps taken by the answering Respondent would result in the complete destruction of the Lake. All other averments in the said paragraph are denied as false.

103. **Re Para V(E):**As stated above in the traversal to paragraph 5D it is reiterated that the Puttenahalli Lake was notified as a Bird Conservation Reserve only after the date of issue of the EC i.e only on 10/09/2015. Therefore, the Project of the Respondent No.4 had been rightly classified as a Category B1 project by the SEAC of the Respondent No.2 , and it was the Respondent No.2 which had the jurisdiction to issue the EC to the Respondent No.4 for the project. It is submitted that the Project boundary is situated 600 metres from Puttenahalli Lake and Government of Karnataka declared Puttenahalli Lake as a Bird Conservation Reserve under Section 36A of the Wildlife Protection Act,1972 with effect from the date of publication of the Gazette Notificationi.e.10/09/2015 after the grant of the EC. Therefore, the contention of the Appellant that SEIAA did not have jurisdiction to grant clearance as on 01/09/2015 is legally untenable as Puttenahalli Lake was declared Bird Conservation Reserve after the clearance was granted.

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RAMESH KUMAR
BENGALURU
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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

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104. As per Clause 4(iii) of the EIA Notification,2006, *"All projects and activities included as Category 'B' in the Schedule, including expansion and modernization of existing projects or activities as specified in sub paragraph (ii) of paragraph 2, or change in product mix as specified in sub paragraph (iii) of paragraph 2, but excluding those which fulfill the General Conditions (GC) stipulated in the Schedule, will require prior environmental clearance from the State/Union territory Environment Impact Assessment Authority (SEIAA). The SEIAA shall base its decision on the recommendations of a State or Union territory level Expert Appraisal Committee (SEAC) as to be constituted for in this notification."* The Power Plant having the capacity of 350 MW and falling within an Industrial Area was therefore, rightly classified as a B1 project. Further, as there existed no notified eco-sensitive zone in its vicinity at the time, the General Conditions of the Environmental Notification,2006 would not apply to the project. It is therefore, false to state that the General Conditions of the EIA Notification,2006 were attracted to this case and that the SEIAA would lose its jurisdiction to deal with the proposal and the proposal could only be cleared by the Respondent No.1. All other averments in this paragraph are denied as false.

105. **Re Para V(F):** The Project did not attract the General Conditions of the EIA Notification,2006. On the date on which the Environmental Clearance was given, the Project was Category B1 project as Puttenahalli Lake had not been notified as a "Protected Area" notified under the Wild Life (Protection) Act 1972. Therefore, the Respondent

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
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No.2 had the jurisdiction to grant the Environmental Clearance on that date. It is false to state that the Environmental Clearance granted is bad in law. All other averments in the paragraph are denied as false.

106. **Re Para V(G)** It is submitted that both the Puttenahalli and Yelahanka Lakes would suffer no adverse impact from the Plant's establishment. Further the Respondent No.4 has taken numerous steps to ensure that no damage is caused to either lake. As per the conditions of the EC issued by the Respondent No.2 and the Consent for Establishment issued by the Karnataka State Pollution Control Board, the Respondent is required to fulfill the condition of Zero Liquid discharge, whereby all the waste water generated will be circulated and used within the plant itself and no waste water from the Plant will be let out into the lake. It is important to state that the Respondent's plant is located in an Industrial Area among other industries and factories including a Railways Wheel and Axle Plant and the Federal Mogul Plant. However, the Respondent No.4's project has been singled out for attack by the Appellant. All other averments in this paragraph are denied as false.

107. **Re Para V(H):**It is false to state that the answering Respondent instead of approaching the Respondent No.1 to seek environmental clearance under the EIA Notification,2006 has erroneously approached the Respondent No.2. It is false to state that the Respondent No.2 had not taken into consideration that it did not have

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the jurisdiction to consider the said application and had issued the EC to the answering Respondent without any application of mind. All other averments in this paragraph are denied as false.

108. **Re Para V(I):**It is submitted that the Respondent No.4 has undertaken several steps to ensure that the lake eco-system is preserved. In order to do so, the Respondent No.4 through its consultant, has studied the lake eco-system extensively while drawing up the EIA Report. Further the Respondent will be abiding by the stringent conditions imposed by the Environmental Clearance and the Consent for Establishment issued by the Karnataka State Pollution Control Board, as per which it has to assure that all waste water generated by it should be used within Power Plant for various purposes and would therefore not be released into the lake. The answering Respondent has followed all requirements and conditions and has obtained the Environmental Clearance as per procedure prescribed under law. The Power Plant will not pose a threat to the Lakes. The very purpose of the re-categorization of industries by the CPCB was to list non-polluting or "White industries" who would not have to obtain an Environmental Clearance, and that they would be encouraged and given more help in obtaining finance from lending institutions. The new categorization studied the pollution potential of industries to ensure that industries are established in a manner consistent with environmental objectives. It is submitted that the Natural Gas based Power Plant of the Respondent No.4 is more environmentally friendly than the Diesel based Power Plant operated previously on the site The Respondent

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No.4 has obtained an EC after intense studies of the plant and its surroundings by the consultants. Further, the Respondent No.4 has taken all steps to ensure that the environment around the Plant site would be protected including following a no-discharge condition whereby it would not release any effluents into the lakes. It has also taken up various steps to minimize any air and sound pollution of the environment. The Power plant will not pose a threat to the eco-system of the lakes

109. **Re Para V(J):**It is submitted that the area in which the Power Plant was set up was a notified industrial area. Prior to the establishment of the Combined Cycle Power Plant using Natural Gas, there was a Diesel power plant at the site. The latter was shut down and a more ecologically friendly Natural gas based power plant has now been set up in its place. Diesel based Power Plant was set up as early as 1993. It is submitted that at the time when the DG Plant was established, there was very little development in the area and the area was purely industrial. The area where the DG Plant was located was initially completely isolated and the city grew over the years and due to lack of residential spaces within the vicinity of the city, lands in industrial areas were sought to be utilized for the same. Thereafter, as the city of Bangalore expanded more residences were set up around the industrial area. The Puttenahalli Lake is currently fed by rainwater and from STP effluent discharges from the surrounding apartments. The same came to be notified as Bird Conservation Reserve only as recently as 10/09/2015. Notwithstanding the above, the Respondent No.4 has

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KABADÈ. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
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followed all prescribed rules in obtaining the EC and the same would not come into the teeth of the Guidelines as the industrial site was pre-existing and was not being set up in the vicinity of the Puttenahalli Lake. In fact, the Respondent No.4 has adopted a more environmentally friendly approach by switching from Diesel to Natural Gas. Further, it is reiterated that no effluents will be discharged from the Power Plant into the Lakes as the Respondent is following a strict Zero Liquid discharge condition imposed by the KSPCB in the Consent for Establishment. In any case, the Puttenahalli lake lies upstream of the Power Plant and no effluents could possibly be drained into it.

110. **Re Para V(K):** It is false to state that the Project was set up without considering the hydrology of the region and affects the rajakaluves connecting the Yelahanka and Puttenahalli Lakes and wetlands in the region. It is also false to state that the watershed area of the water bodies in question are being affected prejudicially and that the constructions are contrary to the established law in regard to permissible constructions in the vicinity of water bodies and rajakaluves. It is submitted that all aspects including the hydrology of the area have been taken into account while granting the EC and Consent for Establishment and the Appellant is questioning the same without any scientific basis or study. It is submitted that an Expert Body has studied the environmental impact in a responsible and scientific manner and the same cannot be consigned to trash based on mere false assertions on part of the Appellant which are

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
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unsubstantiated and without scientific merit. All other averments in this Paragraph are denied as false.

111. **Re Para V(L):** It is false to state that the Power Plant is being established in an area where no pollution control measures are possible. The answering Respondent has already stated that it would be reusing any waste water generated and that the same would not be released into the lake. Therefore the waste water generated in the Power Plant will be used within the Plant itself. As per the Karnataka State Pollution Control Board *("KSPCB")*, Consent for Establishment letter dated 02/11/2015, and the EC issued by the Respondent No.2, the treated effluents conforming to the prescribed standards shall be recirculated and reused. The Respondent No.4 is also establishing an Ozonisation plant for water treatment instead of chlorination treatment in the Power Plant at an additional cost of Rs.8 crores to pre-empt any environmental hazards that may be caused by chlorine leakage. It is submitted that there will be no detriment caused directly or indirectly to the Lakes on account of the project of the Respondent No.4.

112. The Respondent No.4 has also been undertaking various other pollution mitigating methods. The Storm water drain adjacent to the site drain has been reconstructed and the area which has become available after the completion of drain is being used for planting trees. The Respondent No.4 is making all efforts to ensure that the ecological balance of the lake is maintained and is taking steps for developing the greenery around the lake. It is submitted that 33

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KABADE. D.R.
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No. 3, Ground Floor, Green Building,
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percent of the total area of the Power Plant site will be reserved for tree plantation. The Respondent No.4 has already taken steps towards plantation of trees in the area of in 2 phases. About 1000 saplings have been planted in the first phase and the planting of 500 more saplings have been completed in the next phase in the vacant areas of the plant. Planting of the balance 500 trees is under progress.

113. It is false to state that the relevant conditions have not been considered. A detailed Environmental Impact assessment had been conducted by the answering Respondent and a Report formulated thereafter. The EC was granted only after the same was scrutinized in detail by the Respondent No.2.It is false to state that Secondary pollution control measures were not envisaged to handle any emergency situations and that risk factors are high. The Respondent No.4 has taken all steps to minimize the risks associated with the Project. It is false to submit that the EIA report has been prepared without any application of mind and that the EC has been issued based on an inchoate report. The Respondent No.4 has drawn up the EIA report based on the Terms of Reference issued by the Respondent No.2.All other averments in this paragraph are denied as false and misleading.

114. **Re Para V(M):**The averments made herein so far as they relate to a documents on record do not require to be traversed. The report submitted by the MOEFCC clearly states that the storm water drain which was flowing between the Puttenahalli and Yelahanka lakes was

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Asst. General Manager (Law)
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carrying sewage from the Puttenahalli Lake downstream to the Yelahanka Lake. The said sewage had spilled over and was flooding the surrounding areas including the site of the Respondent No.4. Therefore, on request of the BBMP, in order to reduce the sewage spillage, the Respondent No.4 constructed a box drain to ease the flow of water from one lake to another. It is false to state that the primary storm water drain is blocked and concretised and this is affecting the water supply to sustain the wetland ecosystem. It is also false to state that KPCL is in violation of the directives passed by this Tribunal with respect to buffer zones. The report also states that the area appears to have undergone "*extensive change in land use pattern in recent times(including the laying of road alongside of the Yelahanka Lake) that might have brought about an alteration in the supply of required quantity of water into the wetland. Factors like soil type, management history, climate and soil landscape process has possibly played a considerable role as well in debilitating the eco system.*"Therefore, the Appellant is selectively reading the MOEFCC report to further its own interests.

115. **Re Para V(N):**The whole basis of the Appellant's case is that the Environmental Clearance was issued to the Power Plant to be set up in an eco-sensitive zone. This is clearly an attempt by the Appellant to mislead this Hon'ble Court. As repeatedly stated in the paragraphs above, the Environmental Clearance had been granted to the Respondent No.4 even before the Puttenahalli Lake was notified as an 'eco-sensitive zone' and therefore the requirement to obtain

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Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
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(Drugs Control Department Premises)
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permission from the National Board of Wildlife would not apply. Hence there was no illegality committed by the Respondent No.2 in issuing the Environmental Clearance to the Appellant without consulting the National Board for Wildlife. All other averments in this paragraph are denied as false except to the extent that it pertains to matters on record.

116. **Re Para V(O):**It is false to state that there will be heat, air, noise and light pollution from the Gas based Combined Cycle Power Plant which will have a direct bearing on the birds in the protected area. It is false to state that changes in air temperature due to stack emissions will result in affecting the migratory pattern of the birds themselves and that there would be deposition of pollutants on the water body and that this issue requires specific consideration. The EIA report is a comprehensive document prepared by specialist consultants and has considered as to whether there would be any impact on the environment and wildlife in the surrounding areas due to the establishment of the Power Plant. All other averments in the paragraph are denied as false.

117. **Re Para V(P and Q):** The averments made herein so far as they relate to documents on record do not require to be traversed. The land on which the Power Plant is situated was notified as an Industrial Area under the Karnataka Industrial Areas Development Act vide notification dated 26/09/1985. It is submitted that the Respondent No.2, vide its letter dated 19/01/2015 had exempted the project from

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having to conduct a public consultation as per Section 7(III) (i) (b) of the EIA Notification. The Respondent No.2 subsequently accorded the Environmental Clearance to the above project on 01/09/2015 and the same was advertised on 6th and 8th Sept 2015 as per the directions of Respondent No.2, vide General Conditions No-11 of the EC letter. The Ministry of Environment and Forests thereafter issued an Office Memorandum No.J-11013/36/2014-IA-1 dated 04/04/2016 stating that large scale projects even thermal projects in Industrial areas would not be exempt from holding Public Consultations. It is submitted that the Office Memorandum dated 04/04/2016 was issued the year after the EC was obtained and the EC was published by Respondent No.4 in the local newspapers. It is further submitted that a bare reading of the EIA notification along with the Office Memorandum clearly shows that the Office Memorandum issued is in the nature of an amendment to the EIA notification, 2006 making an exception previously available to certain industries unavailable thereon and is clearly in the nature of an amendment to the same. Therefore, the Office Memorandum would only apply prospectively and will not apply retrospectively to projects which have already received Environmental Clearances pursuant to the exemption under the EIA Notification,2006. Furthermore, at the time the Government Memorandum was issued, Respondent No.4 had already carried out significant work on the project. The averment of the Appellant that the Respondent No.4's project could not have been exempt from public hearing is denied as false. It is false to state that Environmental Clearance dated 01/09/2015 has been granted in

KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
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violation of the EIA Notification,2006all other averments in these paragraphs are completely false and baseless.

118. **Re Para V(R)-**The Representations made by the Appellant to the Respondent No.1 and 2 are not within the knowledge of the answering Respondent and were only brought to its notice upon the filing of the Writ Petition before the Hon'ble High Court. It is submitted that the representations were without merit and made with the sole objective of harassing the Answering Respondent. It is submitted that representations of the Appellant have subsequently been considered by the MOEFCC. The MOEFCC had apparently conducted a site visit and had submitted a report pursuant thereof. The same has been produced by the Appellant herein as Annexure A8. There has been no environmental degradation caused by the Respondent No.4.

119. **Re Para V(S):**It is false to state that the Respondent No.4 had prior knowledge about the Puttenahalli Lake being declared as a Bird Conservation Reserve. The averment that the establishment of a Gas based Combined Cycle Power Plant within the close vicinity of the Lake would result in the destruction of the Lake eco-system is false and baseless. It is also false to state that the Environmental Clearance dated 01/09/2015 is void abinitio and is nullity since it has been issued without taking into consideration the fact of the protected area. It is false to state that Respondent No.4 has concealed the prior knowledge it had about the intention of the Government of Karnataka in declaring the area as a Bird Conservation Reserve. It is false to state that the

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establishment of a Gas based Combined Cycle Power Plant would cause grave and irreparable damage to the environment and the life of the people residing in the vicinity.

120. **Re Para V(T):**It is false state that Respondent No.4 has deliberately concealed and/orhas submitted false and misleading information to the SEIAA and thereby illegally obtained the present Environmental Clearance. The averment that the RespondentNo.4 has deliberately given false and misleading information in the Application for Environmental Clearance prescribed inForm No.1 submitted by it on 20/12/2014 is untrue. The RespondentNo.4 project is a 'Category B' project and does not attract the general conditions of the EIA Notification, 2006. It is submitted that on the date on which the said application form was submitted to the SEIAA on 20/12/2014 the Puttenahalli Lake had not been notified as a Bird Conservation Reserve. The Respondent No.4 has obtained all required permissions and clearances required for the Project. The Respondent No.4 has not utilised any forest land for the construction of its power plant. All other averments in this paragraph are denied as false and the Appellant is put to strict proof of the same.

121. **Re Para V(U):**It is submitted that EIA report has dealt with all aspects in the terms of reference issued by the State Level Expert Appraisal Committee(SEAC) in its letter dated 01/09/2015.As on the date of the issuance of the TOR or the submission of the EIA report, there were no notified ecologically sensitive areas falling within a 10

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kilometres radius of the project boundary. As stated previously the Puttenahalli Bird Conservation Reserve was notified as such only after the Environmental Clearance had been granted to the Responded No.4 on 10/09/2015. The averments in the paragraph under reply to the extent to which they pertain to documents on record, do not require to be traversed.

122. **Re Para V(V):**It is false to state that Respondent No.4 had prepared the EIA report in contravention of the Terms of Reference and has deliberately provided misleading and false information. It is submitted that there were no notified protected areas within the study area of the EIA report on the date on which it was submitted. There have been no contradictions in the statements made by the Responded No.4. The averments in the paragraph under reply to the extent to which they pertain to documents on record, do not require to be traversed. All other averments in the paragraph are denied as false.

123. **Re Para V(W):**It is false to state that the data and information given in the Questionnaire for appraisal dated 23/07/2015 by the Respondent No.4 regarding the existence of National Parks/Wildlife Sanctuary is false and misleading. It is reiterated that the Puttenahalli Bird Conservation Reserve came to be notified as such only on 10/09/2015 after the Environmental Clearance was granted to the Respondent No.4. Therefore, on the date on which the questionnaire was submitted there was no notified National Park, Wildlife sanctuary etc. falling within7 kms of the periphery of the project.

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
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124. **Re Para V(X):**The averments in the paragraph under reply to the extent to which they pertain to documents on record, do not require to be traversed.It is submitted that there has been no deliberate concealment or suppression of false information and data material to the screening, scoping and appraisal by the answering Respondent. The answering Respondent has no knowledge of any representations made exclusively on this regard to the Respondent Nos.1. It is false to state that there has been any alleged suppression of facts and submissions of false facts by the Respondent No.4. It is false to state that by suppressing or concealing the presence of the Puttenahalli Lake Bird Conservation Reserve, the project proponent had suppressed data which was material to the appraisal of the project. It is also false to state that there was any concealment and submission of misleading data leading to the violation of any provisions of the EIA Notification,2006 which would lead to the cancellation by the MOEFCC. Further there has been no illegal enrichment or fraud played by the Answering Respondent in securing the Environmental Clearance. There has also been no neglect or lack of seriousness on the part of the Respondent No.4 in the process of obtaining the EC. All efforts were made in earnest by the Respondent No.4. All other averments in this paragraph are denied as false.

125. **Re Para (V) Y:** As stated hereinabove, the answering Respondent has taken all steps to ensure that there is minimum adverse impact on the environment surrounding the lake and its plant site. It is submitted that

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RAMESH KUMAR
BENGALURU
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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
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the Respondent No.4 will be following a Zero Liquid discharge condition imposed by the KSPCB in the Consent for Establishment. There will be no discharge into the Lakes and therefore there will be no contravention of the Wetland (Conservation and Management) Rules,2010. The Respondent No.4 has considered the principles of Intergenerational Equity and Public Trust Doctrine and has picked a more environmentally friendly fuel for generation of power in the Power Plant. The answering Respondent's Plant has been set up in an Industrial area and was exempted from Public Hearing by the Respondent No.2 as per 7(III)(i)(b) of the EIA Notification,2006. All averments in this paragraph except for matters on record are denied as false.It is false to state that despite having repeatedly approach the Respondents in respect of the Environmental Clearance granted to the Respondent No.4, the MOEFCC has failed to consider the representation submitted by the Appellant. Annexure A8 to the present Appeal clearly shows that the MOEFCC has acted upon the representation of the Appellant and has conducted a site survey and has given a report regarding the same. It is false to submit that the Environmental Clearance granted the Respondent No.4 is illegal and void and that the thermal power project of the Respondent No.4 would cause grave harm and danger.

126. **Re Limitation:**The contents of this paragraph to the extent that they describe the proceedings before the Hon'ble High Court of Karnataka and the Hon'ble Supreme Court require no traversal. However, the Appellant has conveniently chosen to remain silent about the fact that

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KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

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a Memo had been filed by the Respondent No.4 before the Hon'ble High Court stating that in light of Section 14, Section 15 and Section 16 (h) of the National Green Tribunal Act, 2010 which provides that the National Green Tribunal has jurisdiction to adjudicate matters relating to disputes regarding the environmental clearance granted and restitution of the environment, the Appellant may be directed to approach the National Green Tribunal and implead themselves in an application bearing No. 57/2017 that was already pending before the National Green Tribunal seeking restitution of the environment and the protection of the Puttenahalli Lake. The High Court upon considering the Memo filed by the Respondent No.4, had rightly held that the Appellant had a remedy of filing an appeal before the National Green Tribunal to challenge the Environmental Clearance granted to the Respondent No.4. Even after the Hon'ble High Court had held that the proper forum for the adjudication of the dispute is the Hon'ble National Green Tribunal, the Appellant chose to pursue an appeal to the Hon'ble Supreme Court instead of approaching the Hon'ble Tribunal. It is submitted that the reason the Appellant chose to approach the Hon'ble Supreme Court was because it knew that any challenge to the EC made before the Hon'ble National Green Tribunal would be barred by limitation.

127. It is pertinent to state that the Appellant had not sought to challenge the EC before the Hon'ble High Court and that its prayer had been to direct the Respondent No.1 to consider and respond to the representations dated 25/01/2018 and 08/03/2018 made by the

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Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

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Appellant. Therefore the Appellant is for the first time raising a challenge to the EC in the instant appeal before the Tribunal.

128. It is submitted that the statement that the Hon'ble Supreme Court had ordered that if the Appellant initiated 'appropriate proceedings' before the Hon'ble National Green Tribunal within 4 weeks; the matter had to be taken up by the Tribunal and decided on merits, has been deliberately misinterpreted by the Appellant to make it seem that the Hon'ble Supreme Court had directed that the NGT to entertain the Appeal filed by the Appellant, no matter the nature of the reliefs sought, and that the delay should be deemed to be condoned. The order of the Hon'ble Supreme Court has clearly been misconstrued in order to serve the interests of the Appellant.

129. It is submitted that the Environmental Clearance was issued by Respondent No.4 on 01/09/2015 and the Petition before the Hon'ble High Court was filed on 11/06/2018 i.e. after more than 24 months from the date when the alleged cause of action arose. Even after giving the benefit of the additional sixty days as per the proviso to Section 14 (3), the Application is time barred and cannot be entertained as per Section 14 (3) of the National Green Tribunal Act, 2010. The Application is therefore without jurisdiction as the Act does not permit the Tribunal to condone the delay beyond 60 days and the delay in the present case exceeds two years. The Appellant, being inimical to the answering Respondent's project was very well aware of the fact that the Appellant's frivolous objections would not stand

NOTARY GOVT. OF INDIA RAMESH KUMAR BENGALURU Reg. No. 12313

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scrutiny before the SEAC and the 1st Respondent.. Hence, the Appellant has deliberately waited till all approvals were granted and the construction was in full swing, in order to approach the Hon'ble High Court with an aim to stall the project.

130. Further any challenge to the EC as sought for by the Appellant in the instant Appeal ought to have been made within the period prescribed under Section 16 of the NGT act. However, the Appellant has approached this Tribunal with a delay of over four years and therefore the same is barred by limitation.

131. It is false to state that the present Appeal is within the period of limitation as per Section 14 (3) and Section 15 (3)and section 16 of the National Green Tribunal Act , 2010 and that the limitation for the said purpose commences from 10/06/2020, i.e. the date of the order passed by the Hon'ble Supreme Court . It is submitted that the order of the Hon'ble Supreme Court has been misconstrued by the Appellant. The answering Respondent had filed M.A No. 1527 of 2020 before the Hon'ble Supreme Court seeking a clarification of the Order dated 10/06/2020. The M.A has been disposed of with the following observation: "*However, all contentions of the parties are left open to be decided by the National Green Tribunal*". The necessary implication of the same is that all contentions including that of limitation is left open to be decided by this Hon'ble Tribunal. Therefore, the Supreme Court has clearly held that the delay is not deemed to be condoned.

NOTARY GOVT. OF INDIA RAMESH KUMAR BENGALURU Reg No 12313

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132. It is false to state that the Environmental Clearance challenged in this Appeal is void abinitio and has been granted without jurisdiction. There is no cause of action for the present Appeal. It is false state that the present Appeal is within the period of limitation as provided by the NGT act, 2010. All other averments in this paragraph are denied as false.

133. **Re Grounds for Interim Relief and Interim Prayer:**It is false to state that the operation of the Power Plant would lead to emissions and discharge effluents that would pollute the lakes. The Respondent No. 4 is operating on a Zero Liquid discharge condition. It is false that the Power Plant had been established between the Lake without considering the Hydrology of the region thereby allegedly affecting the Rajakaluves connecting the lakes and wetlands. It is false to state that the Respondent No.2 has no power to issue the Environmental Clearance. It is submitted that even on the date of issuance of the EC the Respondent No.4's Power Plant was rightly classified as a Category B1 project and was therefore required to apply for Environmental Clearance from the Respondent No.2.It is false to state that the Clearance issued to the Respondent No.4 was void and that the Power Plant would lead to the destruction of the Lake completely. The Appellant has not made out any grounds for the issuance of an Interim Order in its favour.

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134. It is submitted that citizens of Bengaluru and the industrial areas of Bengaluru have been suffering due to chronic shortage of power, especially during the summer months. Further, Bengaluru consumes more than 40% of the power generated in the State of Karnataka. Currently, power generated in far off places is being transmitted to Bengaluru which results in transmission losses as well as deprivation of power to other parts of Karnataka. The Power plant will enable Respondent No.4 to cater to the domestic and industrial needs of the state and particularly to the peak load demand of the rapidly developing city of Bangalore. It is further submitted that the Power Plant is extremely essential for the stabilisation of the State Power Grid of Karnataka. Respondent No.4 is presently using renewable sources of energy such as solar and wind etc. for the generation of power. However, as these sources are undependable/ not consistent there is a requirement to have a dependable source of power which can be ramped up to balance the grid when these sources are disrupted and there is a variation of load. The Power Plant would therefore greatly improve the flexibility of the Power Grid by providing electricity to tide over any shortfall that may arise due to temporary non-availability of renewable sources of energy. Further, Gas turbines have a special feature of fast start ups by which the unit is synchronized in a short time. This will clearly stabilize the grid in case of tripping of other power stations connected to a single grid in case of emergency. Therefore, the Power Plant is extremely important for the generation of power within the State of Karnataka as it will be the primary source of power to the city of Bangalore. Therefore, if the operation of the

NOTARY
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GOVT. OF INDIA

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EC granted to the Respondent No.4 is stayed then irreparable harm and hardship will be caused to the Respondent No.4 and to the residents of Bangalore.

135. I state that the Appellant has failed to establish a prima facie case. The balance of convenience lies in favour of the Respondents and no irreparable hardship or injury or damage will be caused to the Appellant if the interim prayer is rejected inasmuch as there will be no outflow of effluents into the Puttenahalli lake by the Respondent No.4 as alleged by the Appellant. In any case the Puttenahalli lake lies upstream of the Power Plant and no effluents could possibly be drained into it. I state that in the instant case no interim relief as prayed for by the Appellant can be granted. It is submitted that EC was granted on 01/09/2015,the Writ Petition was filed in the year 2018 and no interim order was granted in the Writ Petition. The matter was thereafter appealed to the Hon'ble Supreme Court and no interim order was granted before the Hon'ble Supreme Court. To now grant the interim relief as prayed for would prove to be extremely prejudicial and harmful to the Respondent No.4, more so as the commissioning of the Power Plant is nearing completion.

136. **Re Prayer:** I state that the instant Appeal is not maintainable in law or on facts. I state that the Appellant is not entitled to the reliefs claimed in the prayer to this Appeal. It is submitted that the said reliefs are barred by limitation.

NOTARY
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BENGALURU
INDIA

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(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

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Therefore, it is most humbly prayed that this Hon'ble Tribunal may be pleased to dismiss the Appeal filed by the Appellant with costs, in the interests of justice and equity.

Place:

Date:

NOTARY
RAMESH KUMAR
BENGALURU
Reg No 12313
GOVT. OF INDIA

Sworn / Solemnly affirmed and signed before me on this 19 day of 10 2020 at Bengaluru
N.R.Sl.. No. 2582 Corrections : .....
RAMESH KUMAR 19/10/2020
Advocate & Notary, Bengaluru.

KABADE. D.R.
Asst. General Manager (Law)
Karnataka Power Corporation Ltd.
No. 3, Ground Floor, Green Building,
(Drugs Control Department Premises)
Palace Road, Bengaluru - 560 001.

BEFORE ME

AJAY J. NANDALIKE
KAR/1580/2007
ADVOCATE,
BENGALURU

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Annexure-R3

ITEM NO.10 Court 7 (Video Conferencing) SECTION IV-A

S U P R E M E C O U R T O F I N D I A
RECORD OF PROCEEDINGS

Miscellaneous Application No(s). 1527 of 2020 in C.A. No. 2552/2020

YELAHANKA PUTTENAHALLI LAKE AND BIRD CONSERVATION TRUST (REGD.) & ORS. Petitioner(s)

VERSUS 898021

MINISTRY OF ENVIRONMENT FORESTS AND CLIMATE CHANGE & ORS. Respondent(s)

(FOR ADMISSION and IA No.71497/2020-CLARIFICATION/DIRECTION
IA No. 71497/2020 - CLARIFICATION/DIRECTION)

Date : 09-09-2020 These matters were called on for hearing today.

CORAM :
HON'BLE MR. JUSTICE S. ABDUL NAZEER
HON'BLE MR. JUSTICE B.R. GAVAI

Certified to be true Copy
Assistant Registrar (Judl.)
Supreme Court of India

For Petitioner(s) Mr. Sajan Poovayya, Sr. Adv.
Mr. Ajay Nandalike, Adv.
Mr. Tanya John, Adv.
Mr. Chandrashekhar A. Chakalabbi, Adv.
Mr. Prathibhanu Koirala, Adv.
Mr. Ashvini Patil, Adv.
Mr. Abdul Azeem Kalebudde, AOR

For Respondent(s) Ms. Aishwarya Bhati, ASG
Mr. S.S. Javali, Sr. Adv.
Mr. Gurmeet singh Makker, Adv.
Ms. Ruchi Kohli, Adv.
Ms. Vanshja Shukla, Adv.
M/S. Dharmaprabhas Law Associates, AOR

UPON hearing the counsel the Court made the following

O R D E R

Application for Clarification stands disposed of in terms of the signed order.

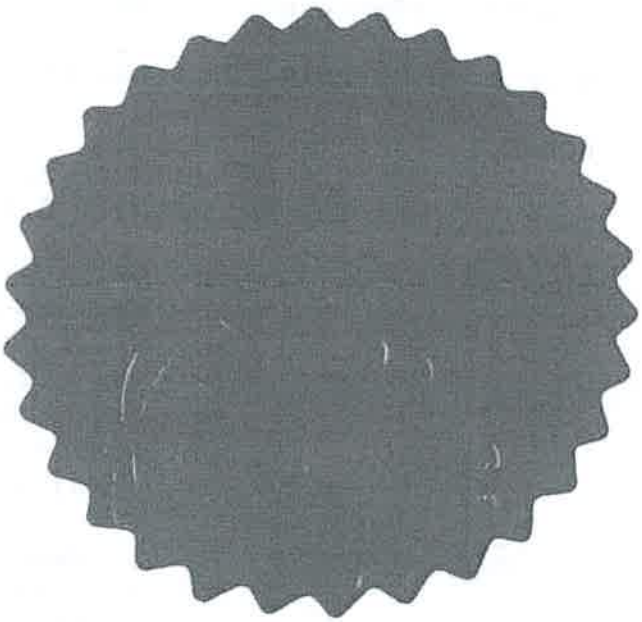
However, all the contentions of the parties are left open to be considered by the National Green Tribunal.

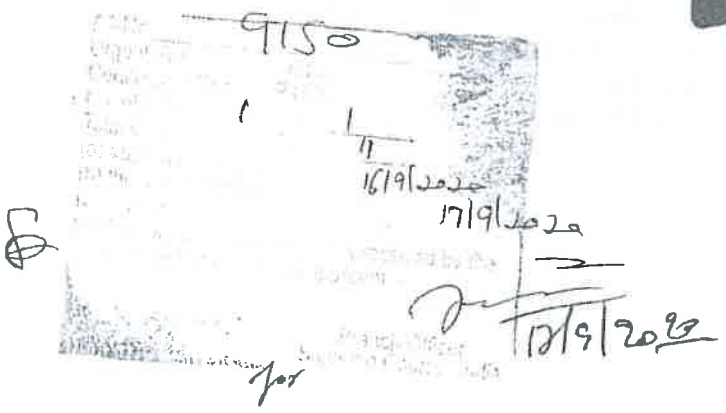
Signature valid

(NEELAM GULATI)
ASTT. REGISTRAR-cum-PS

(BEENA JOLLY)
BRANCH OFFICER

(Signed order is placed on the file)





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IN THE SUPREME COURT OF INDIA
CIVIL APPELLATE JURISDICTION

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Assistant Registrar (Judl.)
19/9/2020
Supreme Court of India

Miscellaneous Application No(s). 1527 of 2020

IN

CIVIL APPEAL No(s). 2552 OF 2020

898022

YELAHANKA PUTTENAHALLI LAKE AND BIRD CONSERVATION TRUST (REGD.) & ORS. Petitioner(s)

VERSUS

MINISTRY OF ENVIRONMENT FORESTS AND CLIMATE CHANGE & ORS. Respondent(s)

O R D E R

Heard learned counsel for the parties.

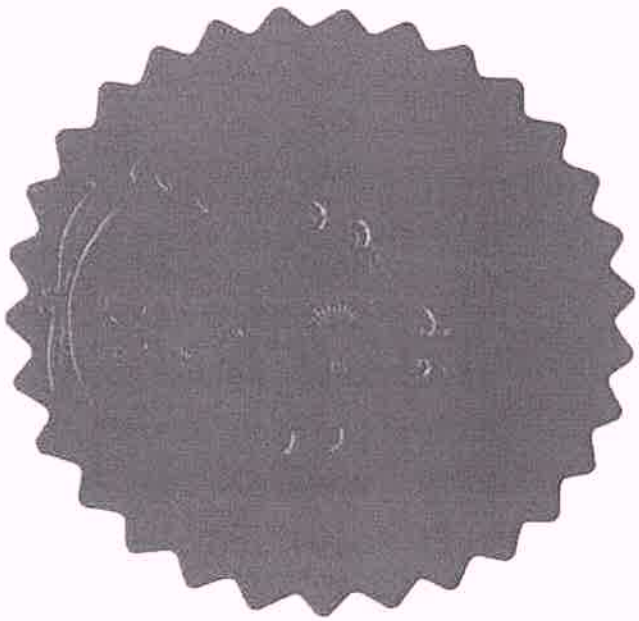
In our view, Order passed by this Court on 10.06.2020 requires no clarification. Application for Clarification stands disposed of accordingly.

However, all the contentions of the parties are left open to be considered by the National Green Tribunal.

.....Sd....J.
(S. ABDUL NAZEER)

.....Sd....J.
(B.R. GAVAI)

NEW DELHI;
SEPTEMBER 09, 2020



A1-No 9158
Urgent Fee Rs 5/-
Certification Fee Rs 10/-
No. of Folio 1 Rs 1/-
Total Cost Rs 16
(a) application filed on 16/9/2020
(b) the date fixed for notice copy 17/9/2020
(c) [illegible] made ready
(d) the date on which the copy is received by the applicant or sent to the applicant

Branch Officer
Supreme Court of India
17/9/2020

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Annexure-R4

PROCEEDINGS OF THE GOVERNMENT OF KARNATAKA

Sub: Establishing 1 x 350 MW Gas Based Power Plant at Yelahanka by dismantling the existing Diesel Generation Plant by Karnataka Power Corporation Limited

Read: KPCL letter No.A1Q5D dated: 22.03.2014 and 10.04.2014

PREAMBLE:

1. KPCL in the letter read above has stated that the Board of Karnataka Power Corporation Limited(KPCL) in its 229th Meeting held on 08.08.2013 had approved inprinciple for conversion of existing Diesel Generation Plant at Yelahanka to Gas Based power plant.

2. Further, based on the Report submitted by M/s Tractable Engineering Pvt. Ltd., New Delhi, the Board of KPCL in its 238th meeting held on 13.02.2014 has decided to replace the existing facility with a Combined Cycle Power Plant of 350 MW capacity for optimizing the infrastructure and resolved as follows:

   a. *Establishing 1x350MW Combined Cycle gas power plants (CCPP) in 1st Stage by dismantling the required existing Structure/system of the DG Plant;*

   b. *Establishing another 350 MW CCPP in 2nd stage depending on cost/availing of gas, cost of generation, load demand and financial viabilities*

3. The following infrastructures are available at the existing DG Plant area for the implementation of the Gas based power plant:

   - 120 acres of land of KPCL is available;
   - The Gas Pipeline is already established by GAIL in the outer-ring road, which could be utilized to get the required gas from the GAIL terminal Point (SV3) and GAIL shall make necessary arrangement for laying pipe line for supply of gas to the proposed plant;
   - BWSSB has established 64 MLD capacity Secondary water treatment plant near Hebbal and has agreed to supply required treated water (22 MLD) to the proposed plant;
   - KPTCL has established 220 KV Substation with 2 x150 MVA 220/66/11kv transformers within the existing DG Plant area, which could be utilized for power evacuation;

5. In order to avoid delay in the process of floating the tender and awarding the work to the successful bidder, which requires sufficient time and to meet the power requirement of the State, KPCL has proposed to award the EPC work of the 1x350 MW Gas based combined Cycle Power Plant to M/s BHEL on MOU basis at a negotiated benchmark price.

6. Further, KPCL has stated that M/s.BHEL vide letter dated: 22.03.2014 has proposed to takeup the implementation of the 1x350 MW Combined Cycle Gas Power Plant (CCPP).

7. After detailed examination of the proposal, the following orders are issued.

GOVERNMENT ORDER NO. EN 28 PPC 2014,
BANGALORE, DATED 28th JULY 2014

Under the circumstances explained above, Government are pleased accord approval for the following:

a) KPCL is permitted to implement 1x350 MW Combined Cycle Gas Power Plant (CCPP) in 1st stage by dismantling the required existing Structure/system of the DG Plant at Yelahanka;

b) KPCL is exempted from KTPP Act, to entrust the work to BHEL on MOU basis as per the Notification No. ಆಇ 418 ತಪ್ರ -12/14 Dated: 01.07.2014 issued by the Finance Department.

c) To entrust the EPC work to M/s BHEL on MOU basis with benchmark prices by conducting further negotiation with M/s BHEL for reduction in the benchmark price to reduce the project cost and tariff to the consumers of the State.

d) To provide similar support to the proposed project also as provided for 700 MW±20% Gas based Bidadi CCPP vide GO dated 05.07.2011, with a debt service liability of Rs.2069 crores during the tenure of the loan.

e) To modify the existing PPA in respect of the existing DG Plant with 108 MW to 350 MW Gas Based Combined Cycle Power Plant with BESCOM.

BY ORDER AND IN THE NAME OF
GOVERNOR OF KARNATAKA,

(K.L.RAVICHANDRA) 28/7/14
DEPUTY SECRETARY TO GOVERNMENT,
ENERGY DEPARTMENT,
☎ 080-22034680.

To: The Compiler, Karnataka Gazette, Government Press for publication and to supply 50 copies to this department.

Copy to:

1. The Accountant General (A&E), Karnataka, Bangalore-1.
2. The Additional Chief Secretary to Hon'ble Chief Minister, Vidhana Soudha, Bangalore.

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3. The Additional Chief Secretary to Government, Finance / Water Resources / Commerce & Industries Departments.
4. The Managing Director, Karnataka Power Corporation Limited, No: 82, Shakti Bhavan, Race Course Road, Bangalore-1. – alongwith the copy of the Notification No. ಆಇ 418 ಪಸಹ -12/14 ದಿನಾಂಕ: 01.07.2014 issued by the Finance Department.
5. The Managing Director, Karnataka Power Transmission Corporation Limited, Kaveri Bhavan, Bangalore-9.
6. The Secretary, Karnataka Electricity Regulatory Commission, M.G. Road, Bangalore-1
7. The Managing Directors, BESCOM / MESCOM / HESCOM / GESCOM / CESC.
8. The Managing Director, Karnataka Renewable Energy Development Limited, No.39, Shanthi Gruha, Place Road, Bharath Scouts and Guides Building, Bangalore-1.
9. The Managing Director, Power Company of Karnataka Limited, Kaveri Bhavan, Bangalore-9.
10. The Chief Electrical Inspector to Government, 32/1, 2nd Floor, Crescent Towers, Crescent Road, Bangalore-1.
11. The Chief Engineer, Load Dispatch Centre, Ananda Rao Circle, Bangalore
12. P.S. to the Chief Secretary to Government, Vidhana Soudha, Bangalore-1.
13. P.S. to Energy Minister, Vidhana Soudha, Bangalore-1.
14. P.S. to the Additional Chief Secretary to Government, Energy Department. Vikasa Soudha, Bangalore-1.
15. P.A. to Deputy Secretary to Government, Energy Department, Vikasa Soudha, Bangalore-1.
16. S.G.F/Spare Copies/Office Copy.

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Annexure-R5

CIN - U85110KA1970SGC001919

KPCL
ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತ
KARNATAKA POWER CORPORATION LTD.,
(A premier power generating company of Government of Karnataka)

CE(EI&TA)/ENV/YEL/635 Dated: 30 -12.2014

Member Secretary,
Karnataka State Environment
Impact assessment Authority,
M.S Building,
Bengaluru-560001

Sir,

Sub: Proposed 1x 350 ± 20% MW Gas based CCPP at Yelakanka- Application for Environmental clearance reg.
Ref: GO No. EN 28 PPC 2014 Bangalore dated 28.7.2014

Karnataka Power Corporation Limited has been permitted to implement 1x350 MW Combined Cycle Gas Power Plant in 1st stage within the Yelahanka DG power Plant premises by Government of Karnataka vide GO referred above.

Pursuant to EIA Notification dated 14th September 2006, issued by MoEF, an application in the prescribed Form No.1 along with the proposed Terms of Reference for addressal of all relevant environmental concerns and Pre-Feasibility Report is submitted herewith for the purpose of scoping and prior environmental clearance to the project.

The processing fee of Rs. 1, 25,000.00 in the form of DD bearing No. 302282 dated 19.12.2014 drawn on Vijaya Bank as per GO No. FEE 46 EPC 2013 Bangalore, dated 10.5.2013 and authorization to sign the Form-1 are also enclosed. Kindly arrange to issue TOR at the earliest.

Thanking You,

Yours Faithfully,
For Karnataka power Corporation Limited

Chief Engineer (EI&TA)

Encl: Form No 1, PFR
Propose Terms of reference
Authorisation & DD
Soft Copy

Office of the Chief Engineer (EI & TA), Sudarshan Complex", 3rd Floor, No. 22/23, Sheshadri Road, Bangalore-560 009.
Telefax : 080-22258451 EPABX : 080-22202950-55 Telegrams : 'MYPOWER'
E mail cetata@karnatakapower.com Website www.karnatakapower.com

FORM – 1

PRE – FEASIBILITY REPORT

&

PROPOSED TERMS OF REFERENCE (TOR)

FOR

PROPOSED 1 x 350 MW YELAHANKA COMBINED CYCLE POWER PLANT

LOCATED AT

DG POWER PLANT, YELAHANKA

DISTRICT: BENGALURU, STATE: KARNATAKA

PROJECT PROPONENT

KARNATAKA POWER CORPORATION LIMITED

CORRESPONDENCE ADDRESS

S MRUTHUNJAYA

CHIEF ENGINEER (E)&TA)

#22/23, SUDARSHAN COMPLEX, 3RD FLOOR

SESHADRI ROAD, BANGALORE (KARNATAKA)

PREPARED BY:

MANTEC CONSULTANTS PVT LTD.

D-36, SECTOR-6, NOIDA, GAUTAMBUDH NAGAR, U.P – 201301

WEBSITE: http://www.mantecconsultants.com

Email- ID: envmantec@yahoo.com

Ph No: +91 – 120 – 4215804, Fax No: +91 – 120 – 4215809

FORM-1

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CONTENTS

- FORM-1
- PRE-FEASIBILITY REPORT
- EXHIBITS

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APPENDIX I

(See paragraph – 6)

FORM 1

(I) Basic Information

S.No.	Item	Details
1.	Name of the Project/s	Yelahanka Combined Cycle Power Plant (YCCPP)
2.	S. No. in the schedule	1 (d) (Thermal Power Plants) as per the Gazette Notification dated 14th September, 2006.
3.	Proposed capacity/area/length/tonnage/ to be handled/command area/lease; area/ number of wells to be drilled	1 X 350 MW
4.	New/Expansion/Modernization	New
5.	Existing Capacity/Area, etc.	Not applicable
6.	Category of Project, i.e., 'A' or 'B'	"B"(Gas based power plant of <500 MW capacity)
7.	Does it attract the general condition? If yes, please specify.	No
8.	Does it attract the specific conditibn? If yes, please specify.	No
9.	Location	
	Plot/Survey/Khasra No.	Within the premises of Yelahanka Diesel Power Plant, comprising Survey Nos.: Puttenahalli Village: 44(p), 45, 46, 47/1-2, 48, 56/1to 9, 57, 58, 59, 60/1-2, 61, 62/1-2, 63, 64, 65, 66/1-2, 67 Kenchenahalli village: 24, 25,, 26/p, 28,p
	Village	Puttenahalli & Kenchenahalli
	Tehsil	Yelahanka
	District	Bengaluru
	State	Karnataka
10.	Nearest railway station / airport along with distance in kms.	Yelahanka Railway Station: 2 km Bangalore International Airport: 25 km
11.	Nearest town, city, District Headquarters along with distance in kms.	Nearest town/city: Bengaluru, 18km Distt. Headquarters: Bengaluru, 18 km
12.	Village Panchayats, ZillaParishad, Municipal Corporation, Local body (complete postal addresses with telephone nos. to be given)	Ward No.2 Chowdeshwary Ward, Bruhat Bengaluru Maha Nagarpalike (BBMP), Yelahanka, Bengaluru - 64 Postal Address of Plant:KPCL DG Plant,Singanayakana Halli P.O, Yelahanka, Bengaluru-560 064
13.	Name of the applicant	Karnataka Power Corporation Limited (a Govt. of Karnataka Enterprise)
14.	Registered Address	Office of the Chief Engineer (El & TA) Karnataka Power Corporation Limited, 22/23, Sudharshan Complex, Sheshadri Road, Bengaluru - 560009
15.	Address for correspondence:	
	Name	Mr. S. Mruthyunjaya
	Designation (Owner/Partner/CEO)	Chief Engineer (El & TA)
	Address	Karnataka Power Corporation Limited, 22/23, Sudharshan Complex, Sheshadri Road, Bengaluru - 560009

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	PIN Code	560 009
	E-mail	ceitakpcl@gmail.com
	Telephone No.	080-22202950-55, 9482500625, 9480182708
	Fax No.	080-22258431
16.	Details of Alternate Sites examined, if any. Location of these sites should be shown on a toposheet.	As the proposal is for implementing a new gas based combined cycle power plant within the existing vacant area in the DG plant area, abandoning the existing DG plant, no other site was considered.
17.	Interlinked Projects	None
18.	Whether separate application for interlinked project has been submitted	Not applicable
19.	If yes, date of submission	Not applicable
20.	If no, reason	Not applicable
21.	Whether the proposal involves approval/ clearance under: a) The Forest (Conservation) Act, 1980 b) The Wildlife (Protection) Act, 1972 c) The CRZ Notification, 1991	No
22.	Whether there is any Govt. order / policy relevant / relating to the site?	No, the project is to be established within the premises of Yelahanka Diesel Power Plant.
23.	Forest land involved (hectares)	Establishment of the plant and facilities does not involve forest land. However, KPCL has sought transfer of approx. 6 hectares of forest land, located adjacent to the site, for plantation purpose.
24.	Whether there is any litigation pending against the project and/or land in which the project is proposed to be set up a) Name of the Court b) Case No. c) Orders/directions of the Court, if any and its relevance with the proposed project.	No

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(II) Activity

1. Construction, operation or decommissioning of the Project involving actions, which will cause physical changes in the locality (topography, land use, changes in water bodies, etc.)

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
1.1	Permanent or temporary change in land use, land cover or topography including increase in intensity of land use (with respect to local land use plan)	No	Land Use: The project will be implemented in the vacant area existing within premises of the existing Yelahanka Diesel Power Plant. Land Cover: The area identified for locating the proposed plant & facilities is vacant area existing in the DG Power plant area, under thin vegetation in the southern part of the proposed plant. For establishing the proposed power plant, the vegetation falling within the identified area will be cleared. Topography: The site is practically level as it is inside the boundary of the existing power plant. The final grade level will be decided considering main power house floor level during detail engineering stage.
1.2	Clearance of existing land, vegetation and buildings?	Yes	Vegetation existing within the area identified for the proposed plant and facilities will be cleared.
1.3	Creation of new land uses?	No	A Gas-based Power Plant will be implemented in the vacant land existing within premises of the Yelahanka Diesel Power Plant.
1.4	Pre-construction investigations e.g. bore holes, soil testing?	Yes	Shallow foundation can be adopted for all the structures. For heavier loads, raft foundations or bored cast in situ piles with sufficient penetration into hard laterite bed with N value more than 50 can be adopted. However this shall be confirmed by fresh Geotechnical investigation at proposed location before starting detail engineering.
1.5	Construction works?	Yes	Fresh constructions for the new plant include: i) Main plant building ii) LNG terminal iii) GTG,HRSG,STG structure iv) Transformer bay v) Switch yard vi) Chimney vii) Water system (RO-DM plant & CW pump house) viii) Desalination Plant ix) Cooling towers and other miscellaneous buildings like Gas metering station, Switch yard control room, Diesel generator building, Fuel pump house,

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			Raw water pump house, access roads, office buildings etc.
1.6	Demolition works?	Yes	The existing Diesel Power Plant will be abandoned. The existing railway siding will be cleared, and replaced by raw water reservoir for the proposed plant. Storage tanks in the IOCL area are under demolition, and the area will be reserved for future expansion.
1.7	Temporary sites used for construction works or housing of construction workers?	No	The existing Office Block in the IOCL Tank Area will be used as construction office.
1.8	Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations	Yes	The project will involve construction of sheds for plant and storage facilities, and erection of plant equipment. The layout of plants has been planned to minimize leveling or cutting work. Surplus earth generated during excavation will be used for filling and landscaping work within the premises.
1.9	Underground works including mining or tunneling?	No	Not applicable.
1.10	Reclamation works?	No	Not applicable
1.11	Dredging?	No	Not applicable
1.12	Offshore structures?	No	Not applicable
1.13	Production and manufacturing processes?	Yes	Air is compressed in a compressor and the air-fuel mixture is injected into the chamber and fired. The hot product of combustion, at 1000 to 1300°C, is expanded in the gas turbine, which drives on one end the generator, where mechanical energy is converted into electrical energy and on the other end an axial flow compressor, which provides the combustion air. The heat content of the exhaust gas from the gas turbine is utilized to produce steam in the heat recovery steam generator (HRSG). The exhaust gas from the gas turbines, at about 599°C, will enter the HRSG boilers, where the residual energy will be utilized for generating HP and LP steam. The steam, in turn, is utilized to generate electrical energy in the steam turbine. The spent steam from the ST is condensed, extracted, de-aerated and recycled back to the HRSG as boiler feed water.
1.14	Facilities for storage of goods or materials?	Yes	The main raw material, natural gas fuel, will be received directly in the Fuel Gas Station through pipeline. Storage of materials will be limited to chemicals for treatment of cooling water and boiler feed water, and regeneration of ion exchange resins.
1.15	Facilities for treatment or disposal of solid waste or liquid effluents?	Yes	Regeneration wastewater from the demineralization unit will be neutralized and directed to the Guard pond, where it will be mixed with effluents from other sources. Plant washings, containing oil & grease, will be

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			passed through Oil Water Separator, followed by discharge into the Guard Pond. Wastewater from the guard pond, with characteristics well within the specified limits, will be discharged in the nearby natural drain.
1.16	Facilities for long term housing of operational workers?	No	There is no provision of additional housing facilities in the project proposal.
1.17	New road, rail or sea traffic during construction or operation?	Yes	The fuel gas will be supplied by GAIL through a pipeline to be laid by GAIL. Approximate length of the pipeline will be 10-12 km, depending on the feasibility of pipeline route.
1.18	New road, rail, air, waterborne or other transport infrastructure including new or altered routes and stations, ports, airports etc?	No	Not applicable.
1.19	Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements?	No	Not applicable.
1.20	New or diverted transmission lines or pipelines?	No	Not applicable.
1.21	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?	No	Not applicable.
1.22	Stream crossings?	No	Not applicable.
1.23	Abstraction or transfers of water form ground or surface waters?	No	Tertiary treated sewage from BWSSB Sewage treatment plant will be used to meet the make-up water requirements of the plant. The total make-up water requirement is estimated as 430m³/h. Adequate secondary treated water is available at BWSSM sewage treatment plants at Hebbal, Allasandra and Jakkur. BWSSM will subject the required quantity to tertiary treatment and supply the tertiary treated water to the site through pipeline.
1.24	Changes in water bodies or the land surface affecting drainage or run-off?	No	No natural drain is located within the area identified for the proposed plant and facilities.
1.25	Transport of personnel or materials for construction, operation or decommissioning?	Yes	Construction phase: Construction material will be sourced from local traders through road route. Plant machinery will be transported up to Yelahanka Railway Station through railway and from there to the site via road route. Construction workers will be mobilized from neighboring villages. Operation phase: Natural gas, the main fuel for the proposed power plant, will be received from GAIL through pipeline. Generated power shall be evacuated at 220 KV level to the Gas Insulated Switchgear (GIS) built within the premises. The nearest substation of KPTCL will be used

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			for connecting Generation 220 KV through 220 KV XLPE Cable.
1.26	Long-term dismantling or decommissioning or restoration works?	Yes	The existing DG power plant will be abandoned.
1.27	Ongoing activity during decommissioning which could have an impact on the environment?	No	NA
1.28	Influx of people to an area in either temporarily or permanently?	No	Most of the workforce will be drawn from local population. The existing housing facilities are adequate to accommodate Managerial and Supervisory staff.
1.29	Introduction of alien species?	No	Not applicable.
1.30	Loss of native species or genetic diversity?	No	Not applicable.
1.31	Any other actions?	No	Not applicable.

2. Use of Natural resources for construction or operation of the Project (such as land, water, materials or energy, especially any resources which are non-renewable or in short supply):

S.No.	Information/checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
2.1	Land especially undeveloped or agricultural land (ha)	No	Total area required for establishing the proposed power plant is approx. 7.8 hectares. The plant will be established within the vacant land available in the existing premises of Yelahanka DG Power plant. Total area of land available within the premises is 40.5 hectares (120 acres), where approx 6 Ha. (15 acres) are under the DG Plant and approx 23 Ha. (56 acres) are vacant or under plantation.
2.2	Water (expected source & competing users) unit: KLD	Yes	Quantity required: 438 m³/h (11 MLD) Source: Sewage treatment plant of BWSSM at Hebbal, Allasandra or Jakkur. The secondary treated sewage will be subjected to tertiary treatment by BWSSM and supplied to the project through pipeline. Competing Users: Presently, adequate quantity of secondary treated water from the plant is not utilized and is let down to natural drain.
2.3	Minerals (MT)	Yes	Natural gas: Approx. 1.40mmscmd
2.4	Construction material – stone, aggregates, sand / soil (expected source – MT)	Yes	Construction materials like stone, aggregates, steel, corrugated sheets and cement will be sourced through local retailers. No quarry will be established at/near the site.
2.5	Forests and timber (source – MT)	No	Not applicable
2.6	Energy including electricity and fuels (source, competing users) Unit: fuel (MT), energy (MW)	Yes	Fuel: Natural gas: Approx. 1.38 mmscmd Electricity: Total power requirement approx. 8 MW. The power will be sourced from the generated power.
2.7	Any other natural resources	No	Not applicable

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	(use appropriate standard units)		

3. Use, storage, transport, handling or production of substances or materials, which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health.

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
3.1	Use of substances or materials, which are hazardous (as per MSIHC rules) to human health or the environment (flora, fauna, andwater supplies)	Yes	Natural gas, approx. 1.40mmscmd, will be used as fuel for power generation. The same will be received with battery limit of the plant through pipeline, to be constructed and operated by GAIL. Storage of natural gas is not proposed. Adequate safety measures for safe handling and storage of fuel gas shall be incorporated in plant design as well during operation for protection against fire and explosion.
3.2	Changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)	No	Not applicable.
3.3	Affect the welfare of people e.g. by changing living conditions?	Yes	The proposed project will facilitate uninterrupted power supply, and will also generate employment opportunities. Welfare schemes under CSR activities are also proposed by the project proponent.
3.4	Vulnerable groups of people who could be affected by the project e.g. hospital patients, children, the elderly etc.,	Yes	Although the project site is located within inhabited areas of the city, adequate measures are incorporated to minimize adverse effects.
3.5	Any other causes	No	Not applicable.

4. Production of solid wastes during construction or operation or decommissioning (MT/month)

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
4.1	Spoil, overburden or mine wastes	No	Not applicable.
4.2	Municipal waste (domestic and or commercial wastes)	Yes	Housing facilities are not proposed. Therefore, domestic and commercial waste generation will be negligible. The same will be disposed along with the existing housing facilities.
4.3	Hazardous wastes (as per Hazardous Waste Management Rules)	Yes	The list of hazardous waste is as follows: 1. Spent oil 2. Used oil containers 3. Oily sludge from Oil-Water Separator

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			4. Spent ion exchange resins These will be disposed through approved vendors/ recyclers.
4.4	Other industrial process wastes	No	Not applicable.
4.5	Surplus product	No	Not applicable.
4.6	Sewage sludge or other sludge from effluent treatment	No	• Oily sludge from Oil-Water Separator will be disposed through approved vendors/ recyclers. • Sewage treatment plant is not proposed.
4.7	Construction or demolition wastes	Yes	Civil construction wastes will be used for land fill during construction. Demolition wastes (oil tanks and railway siding) will be disposed by IOCL.
4.8	Redundant machinery or equipment	No	Not applicable.
4.9	Contaminated soils or other materials	No	Not applicable.
4.10	Agricultural wastes	No	Not applicable.
4.11	Other solid wastes	No	Not applicable.

5. Release of pollutants or any hazardous, toxic or noxious substances to air (Kg/hr)

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources	Yes	Flue gases from combustion of natural gas will be discharged through a stack of 60 m height. Expected characteristics of flue gas are as follows: 1. Flow rate: Approx. 1800000 Nm³/h 2. Discharge temp: 100°C 3. NOx Concn.: Below 50 ppm NOx Concentration in the flue gas shall be maintained by use of Dry Low NOx burners..
5.2	Emissions from production processes	No	Not applicable, as no other production proposed.
5.3	Emissions from materials handling including storage or transport	No	Not applicable, as material handling, storage or transportation not involved.
5.4	Emissions from construction activities including plant and equipment	Yes	The sources of emissions during construction phase are: • Particulate matter emissions during ground clearing. • Particulate matter emissions during cutting & filling. • Fugitive emissions during civil works • Fugitive emissions from vehicular traffic and construction equipment. Control of fugitive emissions will used through water spray and through regular maintenance of construction equipment and

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			vehicles.
	Dust or odours from handling of materials including construction materials, sewage and waste	Yes	The problem of odour is not envisaged. Sewage from the plant shall be treated in septic tanks and disposed in soak pits. Proper management measures will be adopted for control of dust emissions from material handling operations: • Water spraying to prevent dust pollution from different sources during construction. • All transportation vehicles will be suitably covered and overloading of the vehicles will be avoided. • Boundary walls and green belt will be provided for control of fugitive emissions.
5.6	Emissions from incineration of waste	No	Not applicable.
5.7	Emissions from burning of waste in open air (e.g. slash materials, construction debris)	No	Not applicable.
5.8	Emissions from any other sources	No	Not applicable.

6. Generation of Noise and Vibration, and Emissions of Light and Heat:

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data with source of information data
6.1	From operation of equipment e.g. engines, ventilation plant, crushers	Yes	The sources of noise in a power plant are: • ST / GT generator • Other rotating equipment • Combustion induced noises • Flow induced noises • Steam safety valves All the equipment in the waste heat recovery power plant will be designed / operated to have noise level not exceeding 85-90 db (A) measured at a distance of 1.5 m from the equipment.
6.2	From industrial or similar processes	No	No other industrial process, other than power generation, is proposed.
6.3	From construction or demolition	Yes	During demolition and construction phase, sources of noise generation are vehicular movement and operation of demolition/ construction equipment. Following measures are proposed for control of noise and vibration: • High Noise Construction activities will be restricted to day time only. • Regular maintenance, oiling and greasing of vehicles and equipment will be

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			ensured. • Construction materials will be received during day time only.
6.4	From blasting or piling:	No	Not applicable.
6.5	From construction or operational traffic	No	Traffic during construction will be minimum. During operation phase, the fuel will be received through pipeline, and generated power will be evacuated through power transmission lines.
6.6	From lighting or cooling systems	Yes	Cooling tower fans will be designed to ensure noise level below 90 dB at 1.5 meter from source.
6.7	From any other sources	No	Not applicable

7. Risks of contamination of land or water from releases of pollutants into the ground or into sewers, surface waters, groundwater, coastal waters or the sea:

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
7.1	From handling, storage, use or spillage of hazardous materials	No	The proposed project does not involve handling of pollutants which could contaminate land or water.
7.2	From discharge of sewage or other effluents to water or the land (expected mode and place ofdischarge)	No	Sewage generated from toilets and wash rooms will be treated in septic tanks and disposed in soak pits. Concentration of pollutants in the effluent discharged from the Central Monitoring Basin (CMB) into the nearby natural drain will be well within the specified limits.
7.3	By deposition of pollutants emitted to air into the land or into water	No	The only pollutant, of any significance, emitted to air will be NOx contained in the flue gas; Concentration of NOx will be well below the specified limit of 50 ppm, and it will not contaminate land or water.
7.4	From any other sources	No	Not applicable.
7.5	Is there a risk of long term buildup of pollutants in the environment from these sources?	No	Not applicable

8. Risk of accidents during construction or operation of the Project, which could affect human health or the environment

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
8.1	From explosions, spillages, fires etc from storage, handling, use or production of hazardous substances	Yes	The main fuel, natural gas, is highly inflammable, and will be received at plant battery limit through pipeline. Storage of natural gas is not proposed. Adequate safety

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			measures shall be incorporated in the design and construction of the plant to rule out occurrence of fire or explosion. Another flammable material used in the project is HSD, needed for operation of DG sets for emergency power. As the DG sets will be operated rarely, storage of HSD will be less than 1 KL.
8.2	From any other causes	No	Not applicable
8.3	Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslides, cloudburst etc)?	No	Flooding potential of the site is very low. The area is classified as Zone II (least active zone) by Bureau of Indian Standards (BIS) for earthquake sensitivity. Storage of hazardous substances is not envisaged.

9. Factors which should be considered (such as consequential development) which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality

S. No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
9.1	Lead to development of supporting facilities, ancillary development or development stimulated by the project which could have impact on the environment e.g.: •Supporting infrastructure • housing development • extractive industries • supply industries • other	No	The source of raw materials natural gas) and finished products (electric power) rules out the probability of supporting facilities and ancillary development. The project proposal does not involve or encourage housing development in the immediate neighborhood is envisaged. The generated power will ensure un-interrupted supply to the area for domestic, commercial and industrial uses.
9.2	Lead to alter-use of the site, which could havean impact on the environment	No	Not applicable.
9.3	Set a precedent for later developments	No	Not applicable.
9.4	Have cumulative effects due to proximity to other existing or planned projects with similar effects	No	No major fuel processing unit located in the neighborhood.

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(III) Environmental Sensitivity

S.No.	Areas	Name/Identity	Aerial distance (within 15 km.) from Proposed project location boundary
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value	None	Not applicable.
2	Areas which are important or sensitive for ecological reasons- Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests	None	Not applicable.
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration	None	Not applicable.
4	Inland, coastal, marine or underground waters	None	Not applicable.
5	State, National boundaries	None	Not applicable.
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	Railway line Bangalore-Hindupur State Highway National Highway (NH-7)	Adjacent to site Adjacent to site
7	Defence installations	Yelahanka Air Force base	Approx. 3 km
8	Densely populated or built-up area	Yelahanka satellite Town	2 Km
9	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)	Hospitals, Schools Places of worship and other community facilities	2 km
10	Areas containing important, high quality or scarce resources (ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)	Many water bodies Lakes 1. Hebbal lake 2. Yelahanka lake 3. Jakkur lake 4. Allasandra lake 5. Amruthalli lake 6. Nagavara lake 7. Kogilukere	Within 15 Km
11	Areas already subjected to pollution or environmental damage (those where existing legal environmental standards are exceeded)	None	Not applicable.
12	Areas susceptible to natural hazard which could cause the project to present environmental problems (earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions)	Zone II (least active zone) as per the Seismic zone Map of India (IS 1893 (Part 1) 2002)	Not applicable.

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(IV) Proposed Terms of Reference for EIA studies

The structure of the EIA report will conform to the "Generic Structure of Environmental Impact Assessment Document" given under Appendix III of the Notification Dated 14th September 2006. The proposed terms of reference for the EIA report are as follows.

1. Executive summary of the project giving a brief summary of the project with emphasis on the objectives of the proposal, use of resources, justification, etc.
2. Project description
   a) Justification for selecting the proposed site, technology and size
   b) Process description and raw materials
   c) Source of water and its availability, water balance and wastewater generation, treatment and disposal
   d) Details of proposed source-specific pollution control schemes and equipments to meet the national standards.
3. Description of environment: Baseline environmental status of valued environmental components in the study area (area falling within 10 km distance from the project site) for one full season (excluding monsoon season).
   a) Topography details of the project area
   b) Geological features and geo-hydrological status of the study area
   c) Location of the project site and nearest habitats demarcated on a toposheet (1: 50000 scale)
   d) Land-use based on satellite imagery
   e) Demography details of all the villages falling within the study area
   f) The baseline data to be collected from the study area w.r.t. different components of environment viz. air, noise, water, land, and biology and socio-economic.
   g) Site-specific micro-meteorological data
   h) Ecological status (terrestrial and aquatic) of the study area
4. Anticipated environmental impacts and Mitigation Measures:
   a) Impact of the project on the AAQ, noise level, water resources & quality, land use & soil quality, flora & fauna, socio-economic profile, infrastructure, etc. of the area.
   b) Mitigation measures for physical environment
   c) Conservation plan in case of any scheduled fauna
   d) Measures for occupational safety and health of the workers.
   e) Action plan for the greenbelt development
   f) Plan for the conservation of wild fauna in case of likely impact on the surrounding reserve forests
4. Analysis of alternative
   a) Alternate sites considered and the reasons for selecting the proposed site
   b) Alternate technologies and size of operation
5. Environmental monitoring program
   a) Monitoring of pollution at source level
   b) Monitoring of pollutants at receptor level
   c) Monitoring occupational safety and health protection of workers
   d) Details of in-house monitoring capabilities
6. Additional studies
   a) Risk assessment and proposed safeguard measures
   b) Activities proposed under corporate social responsibility
7. Environmental management plan
   a) Organizational structure to ensure proposed post-project monitoring programme
   b) EMP devised to mitigate the adverse impacts
   c) Capital and recurring costs of implementation of EMP
   d) Emergency preparedness plan and disaster management plan.

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I hereby give undertaking that the data and information given in the application and enclosures are true to the best of my knowledge and belief and I am aware that if any part of the data and information submitted is found to be false or misleading at any stage, the project will be rejected and clearance given, if any, to the project will be revoked at our risk and cost.

Date: 19.12.2014
Place: Bengaluru

Mr. S. Mruthyunjaya
Chief Engineer (E) & TA)
Karnataka Power Corporation Limited,
22/23, Sudharshan Complex, Sheshadri Road,
Bengaluru - 560009

Chief Engineer (E&TA)
Karnataka Power Corporation Ltd,
"Sudarshan Complex"
No. 22/23, Seshadri Road
BANGALORE - 560 009

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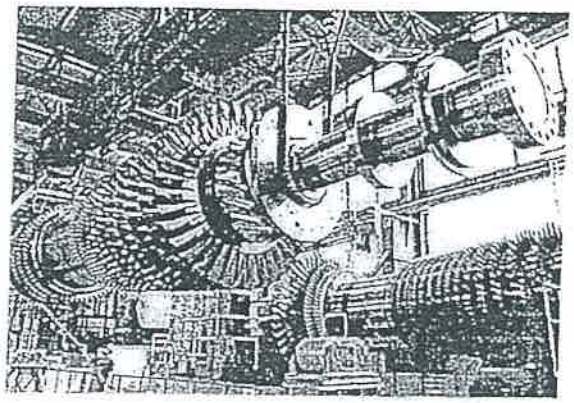
Karnataka Power Corporation Limited

Feasibility Report



1X350 MW
Yelahanka Combined Cycle Power Plant (YCCPP)

Office of the
Chief Engineer (GSW)
Karnataka Power Corporation Limited,
22/23, Sudharshan Complex,
Sheshadri Road,
Bengaluru - 560009

September – 2014
Bangalore

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1.0 Introduction

Karnataka Power Corporation Ltd. (KPCL) is a state owned Public limited Company and is in the business of generation of electric power. KPCL has a total installed capacity of about 6500 MW consisting of Hydro-Electric Stations, Thermal Power Plants (TPP) Windmills and Solar PV Plants.

KPCL also owns & operate 128 MW DG based power plant located at Yelahanka near Bangalore which run on fuels such as Diesel/LSHS/LSFO. KPCL plans to convert this Diesel based power plant to natural gas fired combined cycle power plant to increase the efficiency and to reduce atmospheric Sulphur Dioxide & suspended particulate matter emitting from DG sets.

KPCL appointed Tractebel Engineering Private Limited as Consultant for Preparation of Detail Feasibility Report covering various options for the conversion of Yelahanka DG plant to Gas fired power station.

The consultant M/s Tractebel Engineering Private Limited, New Delhi prepared the Detail Feasibility Report and submitted to KPCL during February 2014. The report was put to 272nd technical Committee of KPCL held on 06.02.2014 and to the 238th board of KPCL held on 13.02.2014 for review and consideration of the proposal.

The 238th KPCL Board meeting held on 13.02.2014 reviewed the report and decided to replace existing facility with combined cycle power plant of 350MW capacity for optimizing the infrastructure and resolved as follows:

a. Establishing 1 x 350MW combined cycle gas power plant (CCPP) in first stage by dismantling the required existing structure / system of the DG plant.
b. Establishing another 350MW CCPP in second stage depending on cost / availability of gas, cost of generation, load demand and financial viabilities.

KPCL put up the proposal to GOK for establishing 1 x 350MW Combined Cycle gas power plant (CCPP) in first stage by dismantling the required existing structure / system of the DG plant.

GOK vide order no. EN28PPC 2014 Bangalore dated 28.07.2014 accorded the approval for implementation of 1X 350MW Combined Cycle gas power plant (CCPP) in first stage by dismantling the required existing structure / system of the DG plant at Yelahanka.
In order to obtain various statutory clearances feasibility report for 1X350MW Yelahanka Combined Cycle Power Plant (YCCPP) is prepared based on the detailed feasibility report submitted to KPCL by the M/s Tractebel Engineering Private Limited.

2.0 Executive Summary

It can be seen from the actual power supply position during the year 2012-13, Bangalore, Southern Region and the Country experienced high to moderate shortages both in terms of energy and peaking availability.

The total energy requirement in the country was 998114 MU and the availability was 911209 MU and the peak demand requirement was 135453 MW against the availability of 123294 MW.As such the deficit in terms of energy and peak demand is around 8.7% and 9.0% respectively.

All the regions in the country namely Northern, Western, Southern Eastern and Northern Eastern regions continued to experience energy as well as peak power shortage of varying magnitude on an overall basis. The energy shortage varied from 3.3% in the western region to 15.5% in the southern region.

The total energy demand of the southern region and Karnataka was 281842 MU and 66274 MU against the availability of 238058 MU and 57044 MU respectively; the total peak demand of 38767 MW in the southern region and in Karnataka 10124 MW against the availability of 31586 MW and 8761 MW respectively. The total deficit in terms of energy is around 15.5% in the southern region, 13.9% in Karnataka alone and in terms of peak demand; the deficit is around 18.5% in the southern region, 13.5 % in Karnataka.

Keeping in view heavy shortages in the southern region and in Karnataka, and the industrial development in Karnataka especially in Bangalore and around Yelahanka, this capacity addition is needed for reducing the gap between the availability and requirement.

Moreover proposed generation by KPCL own plant will give more stability, as it is continuously available. Power from traders / Exchanges can be unstable despite short/med/long term contracts as availability is not guaranteed due to transmission corridor constraints. Hence for grid stability own generation is recommended.

The Yelahanka DG plant is presently running on low load to meet the very essential demand due to non-compliance of the pollution norms as stipulated by the Pollution Control Board and high generation cost. As this plant is situated in the heart of the city, and continued burning of LSHS would violate the pollution norms; so not recommended. Conversion of this plant to higher capacity and burning clean fuel i.e. natural gas is the immediate requirement to meet the strict pollution norms as well as to meet the huge demand keeping in view the developments taking place in an around Yelahanka.

Proposed plans and action required for Yelahanka DG plant

Yelahanka DG power plant has existing 6 no's Pielstick HFO engine running in parallel with the 11/66 kV Grid. The plant has not been utilized optimally due to high cost of generation, non-availability of continuous supply of LSHS fuel. Considering the proximity to the GAIL pipeline network, conversion of this plant to gas, assumes importance for better efficiency and will help existing industry cluster to get continuous supply of power and also enable for industrial growth in Bangalore city.

In this regard the following options have been studied for converting the existing DG plant at Yelahanka from LSHS/HSD to either gas fired power plant or gas fired combined cycle power plant in the plant premises.

Option 1: Conversion of the existing oil fired DG plant to gas fired DG power plant of the same capacity of 128 MW.

Option 2: Implementation of 1X350 MW capacity gas fired combined cycle power plant. The plant shall consist of one block of 350 MW capacity; consisting of one gas turbine (GT) + one heat recovery steam generator (HRSG) + One steam turbine (ST) in multi shaft configuration.

Option 3: Implementation of 2 x 350 MW capacity gas fired combined cycle power plant. The plant shall consist of two blocks of 350 MW capacity each; each block shall consist of one gas turbine (GT) + one heat recovery steam generator (HRSG) + one steam turbine (ST) in multi shaft configuration.

Option 4: Implementation of 1 x 700 MW capacity gas fired combined cycle power plant. The plant shall consist of one block of 700 MW capacity; consisting of two gas turbine (GT) + two heat recovery steam generator (HRSG) + One steam turbine (ST) in multi shaft configuration.

3.0 Yelahanka Project Site Details

Name of the Project	Diesel/LSHS/LSFO fired Yelahanka DG Plant
Project Location	Yelahanka DG plant is located at North of Bangalore along Bangalore – Doodaballapur Hindupur Road situated at Yelahanka about 18 Kms from Bangalore and 25 kms from Bangalore International Airport
Approach	The site is easily approachable through Doodaballapur Bengaluru state highway and approachable from the Bengaluru airport and is 2 to 3 kms from Yelahanka Railway Station
Access to site	By road – through Doodaballapur State Highway
By Railway	Nearest Railway station is Yelahanka -2km and Bangalore city Junction : 20 km
By air	Nearest airport is Bengaluru International Airport -25 km.
Logistics and Infrastructure facilities	The Yelahanka site is approachable through motor able road connecting major state highways and rail as stated above

Land

Total land available : 120Acres (Including 18Acres of Forest Land)

Area allocated to KPTCL for 220/66/11 KV Substation : 14 Acres 24 Guntas

Meteorological data

Temparature	Annual mean of daily maximum 36.2 °C
	Annual mean of daily minimum 11.5 °C
	Design Ambient air Temparature 30.0 °C
Relative Humidity	74% RH
Annual Total Rainfall	970mm
Design Wind Velocity	33 m/s (as per IS 875)

Site Topography

The site is practically level as it is inside the boundary of the existing power plant. Topographical survey of the entire available land has to be done. The final grade level will be decided considering main power house floor level during detail engineering stage.

Soil Profile and Grade Level

The final grade level will be decided considering main power house floor level during detail engineering stage. Suitable drain has to be provided all around the plant to divert rain water flowing from other areas as well as plant area considering the existing nala /natural drain inside the plant premises.

Geo Technical Investigation

Shallow foundation can be adopted for all the structures. For heavier loads, raft foundations or bored cast in situ piles with sufficient penetration into hard laterite bed with N value more than 50 can be adopted. However this shall be confirmed by fresh Geotechnical investigation at proposed location before starting detail engineering.

Before starting detail engineering; appropriate protective/ corrosive measures shall be taken for concrete and reinforcements.

The grade of concrete for all foundations shall be M25/ M30

Yelahanka DG Plant Details at glance

Type and make of engine	Four stroke, medium speed , single acting, non-reversible, turbo charged type, 18 cylinders in V of 45 deg. of SEMT Pielstick make type 18 PC 4.2 V 570 engine
Generator (Make and Capacity)	21.32 MW at 0.9pf, 11kV, 50Hz, manufactured by GEC Alstom, France
Engine Capacity	6 x 21.32 MW installed capacity and presently capacity is limited to 6x18 MW by OEM.
Fuel	These engines are designed to run on multi fuel such as the High Speed Diesel Oil (HSD), Light Diesel Oil, Low Sulphur Furnace Oil (LSFO), and Low Sulphur Heavy Stock (LSHS).
Generator Transformer	The voltage generated is at 11kV and is stepped up to 66kV by 25 MVA transformers and is fed to 66 kV bus.
Power Evacuation	11/66kV substation having 06 numbers of 66 kV lines for power evacuation.
Water Source	Existing Bore-wells (2no.s)

4.0 Brief Details of Infrastructure available around Yelahanka Project Site

A. Land

About 120 acres of land is available within the premises of Yelahanka Diesel Power Plant. Out of which 14 Acres 24 Guntas is handed over to KPTCL for establishing 220kV switchyard.

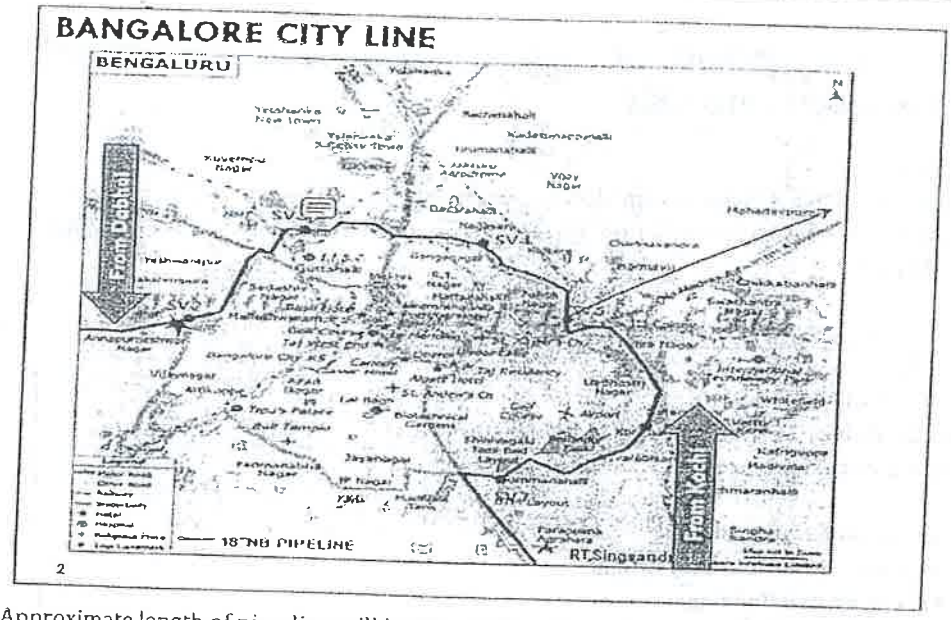
Remaining land is used for establishing the power plant as below:

Description	Area in Acres	
Total Land(A+B+C+D)	**120**	
Allocated to KPTCL for 220/66/11 KV substation(A)	**14 Acres**	**24Guntas**
Existing infrastructure(B)	Acres **31**	Guntas **05**
a) Administrative Blocks	01	
b) Guest House and Play Ground		20
c) Residential Building	04	
d) Overhead Tank	01	
e) DG Plant	15	25
f) IOCL Storage Tanks	4	40
g) Railway Lines	4	
Existing Plantation /Vacant Land (C)	**56**	**11**
Forest land to be handed over KPCL(D)	**18**	

B. Fuel

Natural Gas (NG) is the main fuel for the proposed power plant. Natural gas analysis is attached. The supply of NG is proposed to be available from the GAIL pipeline network at a pressure which will meet the requirement of gas turbines and hence separate gas pressure booster station has not been envisaged. Liquid fuel firing is not envisaged for this plant.

The range of pressure available at GAIL terminal point (42 –55 ksc.) which is sufficient for gas turbine operation. GAIL shall supply gas through 18"NB Gas Terminal at Bangalore BEL Circle-SV3 to plant. Gas pipeline route has been shown below (GAIL Source).



Approximate length of pipe line will be 10 – 12 Kms. depending on the feasibility of pipe routing.

It is proposed to entrust the laying of pipe line from the existing 18"NB Gas Terminal at BEL CIRCLE to Yelahanka DG plant to M/s. GAIL, who are presently doing the transportation of gas in India. In this regard M/s. KPCL have to enter into an agreement / MOM with details of quantity of gas, location etc. Details such as feasibility of pipe routing, cost, execution period etc. (presently 18 months from the date of LOA /Agreement /MOM) are required for the execution of piping and gas supply; to be negotiated with M/s GAIL.

The availability of gas at Yelahanka plant is expected to synchronize with the commissioning of gas power plant (Minimum 28-30 months are required for commissioning of plant)

The final source of fuel and suppliers shall be finalized on the basis of techno economic feasibility and other aspects during the implementation of the power project.

C. Water

64 MLD capacity secondary treatment plant is established by BWSSB at Hebbal. Presently the treated water is not utilized and is let out to natural nala. The secondary treated water can be utilized for the proposed power plant after necessary water treatment. The Hebbal water treatment plant is approximately 10 to 12 kms. from the Yelahanka DG plant.

10 MLD tertiary treatment plant is established by BWSSB at Allasandra near Yelahanka

DG plant. Presently 10 MLD of water is treated and 6 MLD of treated water is utilized by various agencies. With this balance 4 MLD of treated water is available for utilization. The Allasandra water treatment plant is approximately 1 to 2 Kms from the Yelahanka DG plant.

10 MLD tertiary treatment plant is established by BWSSB at Jakkur near Jakkur Lake. Presently 10 MLD of water is treated and 8 MLD of treated water is utilized by various agencies. With this balance 2 MLD of treated water is available for utilization.

The Jakkur water treatment plant is approximately 7 to 8 km from the Yelahanka DG plant.

It is proposed to entrust the laying of pipe line from the existing treatment plant (Hebbal / Allasandra / Jakkur) to Yelahanka DG plant to M/s. BWSSB, who are presently carrying out water supply in Bangalore. In this regard M/s. KPCL have to enter into an agreement / MOM with details of quantity of water requirement, and location etc. Details such as feasibility of pipe routing, cost, execution period etc (presently 12-18 months from the date of LOA /Agreement /MOM are required for execution of the piping and water supply) are to be negotiated with M/s BWSSB before entering into agreement /MOM.

Around 11 MLD (438 m^3/hr) and 21 MLD (875 m^3/hr) of water is required in case of option #2 and option #4 respectively and water requirement for option # 3 is nearly double of water requirement for option #2.

Requirement of water can be met from BWSSB Hebbal Water Treatment plant.

D. Power Evacuation

The details of present infrastructure available and future proposals by M/s. KPTCCL for power evacuation to meet the growing power requirement and to establish power corridor at north Bangalore are stated as below:

M/s. KPTCL have established 220kV substation with 2x150MVA, 220/66/11kV transformers within the plant premises. The substation has a provision of 5 bays (4 I/C feeders and 1 B/C). 220 kV bus bars system is having a current carrying capacity 2500amps with 3" Aluminum tube which is sufficient to carry 700MW plus load.
M/s. KPTCL substation is to be charged and erection of transmission lines are to be taken up.

M/s. PGCIL have established a 400/220kV substation at Singanayakanahalli near Yelahanka which is around 5 to 6 kms. from DG plant. In view of the growing power demand in Bangalore M/s. KPTCL have proposed to establish the following new lines / substation.

1. Construction of 220-220kV Multi-circuit line for a route length of 11 kms from the

Nelamangala-D.B.Pura DC line to the existing 400/220kV Singanayakanahalli (S.N.halli) substation, Yelahanka, Bangalore.

2. Construction of 220-220kV Multi-circuit line for a route length of 10 kms from exsisting 400/220kV Singanayakanahalli station to the exsisting 220/66/11kV DG Plant substation

3. Construction of 220-66kV Multi-circuit line for a route length of 5.73kms partly on multi-circuit multi-voltage towers and partly on DC towers in the existing 66kV DG Plant-Peenya 3&4 corridor.

4. Construction of 220-220kV Multi-circuit line for a route length of 5 kms from the CB halli limits to 220kV Hebbal tap point in the 220kV Nelamangala-Hoody-Peenya corridor.

5. Construction of 66kV DC lines with Drake ACSR conductor from prop 220/66/11kV DG Plant station to link to the nearby DG Plant-Peenya 1,2, 3&4 and Doddaballapura 1&2 lines

In view of the existing infrastructure, Generated power shall be evacuated at 220 kV voltage level to the Gas Insulated Switchgear (GIS) built within the premises. The nearest Substation of KPTCL, 2x150MVA. 220/66/11kVwill be used for connecting Generation GIS 220kV through 220kV XLPE Cable.

The proposed plot plan to KPTCL substation length would be within one KM.

5.0 Demand Analysis and Justification of the Project

It can be seen, from the actual power supply position during the year 2012-13 and the anticipated power supply position during 2013-14 , Bangalore, Southern Region and the Country experienced and expected to experience high to moderate shortages both in terms of energy and peaking availability as given below:

	Energy				Peak			
State/ Region	Requirement	Availability	Surplus(+)/Deficit(-)		Requirement	Availability	Surplus(+)/Deficit (-)	
	MU	MU	MU	%	MU	MU	MU	%
Southern Region	281842	238058	-43784	-15.5	38767	31586	-7181	-18.5
Karnataka	66274	57044	-9230	-13.9	10124	8761	-1363	-13.5
All India	998114	911209	-86905	-8.7	135453	123294	-12159	-9.0

Source: CEA

The table below indicates anticipated power supply position in the Country considering capacity addition of 18432 MW in 2013-14.

	Energy				Peak			
State/ Region	Requirement	Availability	Surplus(+)/Deficit(-)		Requirement	Availability	Surplus(+)/Deficit(-)	
	MU	MU	MU	%	MU	MU	MU	%
Southern Region	309840	250583	-59257	-19.1	44670	33001	-11669	-26.1
Karnataka	75947	58345	-17602	-23.2	11925	8663	-3262	-27.4
All India	1048533	978301	-70232	-6.7	144225	140964	-3261	-2.3

Long Term Forecast at Power Station Bus Bar (Utilities)

The long term demand of electrical energy requirement at the power station bus bar for the year 2016-2017 and 2021-2022 are projected to be 1354874 MU and 1904861MU for the Country. To meet the above energy demand, the corresponding generating installed capacity would be about 200GW and 284 GW respectively. (As per 18th EPS)

Southern Region (SR)

State	Electrical Energy Requirement (MU)			Peak Electric Load (MW)		
	2013-14	2016-17	2021-22	2013-14	2016-17	2021-22
Andhra Pradesh	100906	129767	191912	16990	22445	33194
Karnataka	62980	78637	108012	10198	13010	18403
Kerala	22223	26584	34691	3903	4669	6093
Tamil nadu	95481	119251	171718	15352	20816	29975
Pudduchery	3116	3586	4452	547	630	782
Total SR	284707	357826	510786	43671	57221	82199
All India	1065571	1354874	1904861	152329	199540	283470

As per long term projection of CEA, the energy requirement of Southern Region by 2016-17 will be 357826 MU from 284707 during 2013-14 and peak demand will be 57221MW by 2016-17 from 43671 MW during 2013-14.To meet this huge growth in power demand, large capacity need to be added to the system.

Considering above, the proposed power project of about 700 MW capacity which is expected to be commissioned during 13th Plan period is fully justified from demand supply consideration.

6.0 Study of various configurations

Possibility of achieving around 128 MW with gas engines and brief comparison of different options for Combined Cycle (CC) module with different OEM's; to achieve around 350MW power output in one block or two independent blocks of around 350 MW; and one block of around 700 MW; that can be fitted in the available land has been briefly discussed.

While analyzing the best suitable area for main plant complex keeping in view of land contour, power evacuation and plot area, the eastern part of available land is considered for setting up the main plant.

Option 1:-Conversion of the existing oil fired DG plant to gas fired DG power plant of the same capacity of 128 MW

Proposal No:-A

Duel fuel operation by retrofitting the existing DG engines by M/s Man Diesel and Turbo (OEM) The existing engines are designed to run on multi fuel such as the High Speed Diesel (HSD), Light Diesel Oil (LDO), Low Sulphur Furnace Oil (LSFO), and Low Sulphur Heavy Stock (LSHS).

Proposal No:-B

Replacing of existing multi liquid fuel operated DG engine by new gas engine with alternator Proposed Six Wartsila Gas Engines (W18V50SG) instead of existing 6 no's of Pielstick HFO engines

Options:-2, 3, 4 are Gas Fired Combined Cycle Power Plant (CCPP)

The general layout of Gas Fired Combined Cycle power Plant (CCPP)

The General Layout Plan (GLP) for the project is developed, considering the plot shape, plant contour & available area. The main power house building (Gas turbine, HRSG, steam turbine, Generator Transformer, Cooling tower, etc.) has been considered in the eastern part of the plot to optimize the use of available land. The switchyard is located in the west direction of the main plant building; so that power can be easily evacuated to the 220kV switchyard. However water treatment facilities are located in other area considering the location of water source which is primarily from the Hebbal sewage water treatment plant.

Closed cycle cooling water system with induced draft cooling towers has been proposed for the plant. Water treatment plant viz., DM plant, DM storage tanks, neutralization pit, Clarifloculator, filter house, chemical house, clarified water storage tank and pump house and central monitoring basin have been considered for the general layout plan development.

Keeping in view the nominal capacity, several combination of combined cycle module has been studied to accommodate in the designated area.

Option 2: The configuration of 1GT+1HRSG+1ST in multiple shaft configuration for 1X350 MW.

Option 3: Two blocks of 2x (1GT+1HRSG+1 ST) multiple configuration for 2X350MW

Option 4: One block 2GT+2HRSG+1ST multiple shaft for 1X700 MW are envisaged to fit in the existing area; considering the highest capacity and efficiency.

Gas turbine and steam turbine with their separate generators will be housed in a single building. One overhead crane is considered for handling Gas Turbine & Steam Turbine components during erection and maintenance stages. All auxiliaries of Steam and Gas Turbines, such as Boiler Feed Pump, Condensate extraction pumps etc. will be housed in Gas Turbine cum Steam Turbine building. The Central Control room which comprises of control room panels, consoles, computer room, UPS and batteries shall be located close to the main plant building housing Gas turbine and steam turbine.

Following main components are to be accommodated for a combined cycle power plant.

- Gas turbine
- Steam turbine
- HRSG
- Main stack
- CW system comprise of cooling tower and CW pump house.
- Water treatment plant
- Fuel gas station
- Workshop & stores
- Emergency Diesel Generator

The proposed combined cycle power plant can't be accommodated in the balance vacant land available at Yelahanka DG power station without dismantling the existing one. None of the existing facilities can be used for the proposed combined cycle power plant; as the existing facilities were meant for small capacity unit size plant and not matching the requirement of the upcoming or proposed CCPP.

Implementation of 1 x 350 MW capacity gas fired combined cycle power plant.

Main equipment configuration for 1x 350 MW CCPP:

- One single block to achieve around 350 MW
- Block consists of 1 no. of gas turbine (GT) + 1 HRSG + 1 steam turbine (ST) in multishaft.
- Configuration based on advanced class gas turbine models. Gas turbine and steam turbine would drive separate electric generator.
- Gross power at generator terminals: 340.282 MW
- Approximate auxiliary power consumption: 8.058 MW
- Net power available : 332.224 MW
- Net heat rate : 6423 kJ / kWh (1534.03 kcal/kWh)
- Net efficiency : 56.05%

Comparison between various makes of Gas turbine for above option is as follows:
At site conditions of 30 C, 72%RH and elevation: 900m

Sl.no	Particulars	Unit	Multishaft Configuration		
			Config#1	Config#2	Config#3
1	No. of units	1	1GT+1HRSG+1ST	1GT+1HRSG+1ST	1GT+1HRSG+1ST
2	Make		OEM#1 SGT5 4000F	OEM#2 GE 9FA	OEM#3 Mitsubishi
3	Gross Power	MW	340.282	325.423	393.664
4	Net Power	MW	332.277	317.400	384.498
5	LHV Net Heat Rate	Kj/KWh	6422	6547	6323
6	LHV Net Electrical Efficiency	%	56.05	54.99	56.94
7	Fuel gas consumption	mmscmd	1.38	1.34	1.57

Note : Net Efficiency mentioned above are for actual site conditions and are much higher in ISO condition(58-59%).

Plant area and Land requirement:

- Cooling Tower and Fuel gas station : 13932 sq.m
- Main Plant facilities including GIS : 25522 sq.m
- Water Treatment ,DM plant facilities etc : 7517 sq.m
- Other Balance of plant facilities : 14918 sq.m
- Internal Plant Roads : 16225 sq.
- Total area required : 78114 sq.m

The site is practically level as it is inside the boundary of the existing power plant. Topographical survey of the entire available land has to be done. The final grade level will be decided considering main power house floor level during detail engineering stage.

The proposed combined cycle power plant can be accommodated in the balance vacant land available at Yelahanka DG power station only by dismantling the required structures/system of the existing one. None of the existing facilities can be used for the proposed combined cycle power plant; as the existing facilities were meant for small capacity unit size plant and not matching the requirement of the proposed CCPP.

Fuel :

An adequately fuel gas conditioning system capable of providing clean dry gas as applicable to gas turbine fuel quality and quality will be provided. Each system will consist of emergency stop valves, gas pressure regulating system, knock out drum, filter unit, filter separator, fuel gas heater etc as per requirement.

The Gas turbine will be provided with control & Instrumentation having local control

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panels and remote control facilities.

Quantity for all the options have been provided in the table above. Inlet gas pressure requirement for SGT5 4000F and GE 9 FA machine is around 26 bar ; while in case of Mitsubishi F4 machine, the requirement will be around 35bar.

Water :

It is required for

- Circulated water / CT make up
- Water for bearing cooling and other auxiliary systems through closed loop circulation
- Hot well make up, CCW make up , NOx control (if required)
- Plant services
- Fire fighting
- Total quantity of water required is around : 11 MLD (438 m^3 /hr).

The available source of water in the plant premises (Bore Wells) is not sufficient and the requirement can be met from BWSSB water treatment plant Near Hebbal ,where sufficient quantity (64MLD) of secondary treated water is available.

Power Evacuation :

Generated power shall be evacuated at 220 kV voltage level to the Gas Insulated Switchgear (GIS) built within the premises. The nearest Substation of KPTCL, 2x150MVA, 220/66/11kVwill be used for connecting Generation GIS 220kV through 220kV XLPE Cable. The proposed plot plan to KPTCL substation length would be within one KM

Plant efficiency :

- Power output requirement of around 350MW is possible with Config #1 & Config #2. Efficiency for Config # 1 is better than Config. # 2; therefore fuel gas consumption will be less for higher efficiency machine.

- As the fuel cost is high, considering the life cycle of the project, it will be much beneficial for installation of higher efficient machine.

- Config #3 can be considered depending upon more power requirement. This machine is costlier compared with Config. #1 & Config. #2 and also requires high gas pressure.

Plant availability :-In multiple shafts configuration, in case of unavailability of steam turbine, gas turbine still able to generate power in open cycle mode (with Low efficiency) and meet the power requirement partially. However, now days the advanced gas turbines are very much reliable and serves more than 90% PLF.

Techno commercial analysis :

- The total cost including cost of EPC/Non EPC Works : Rs.1184.62 Crores
- Cost of generation considering the capital cost/operating cost : Rs. 7.83 per unit
- Levellised Tariff @ 90% PLF : Rs 7.71 per unit

Advantages :

- Foot print area required will be less; as there is to accommodate 1GTs, 1HRSGs, and generators.
- Capacity addition to meet the growing power requirement
- Lower tariff Rs 7.83/kWh compared to existing to DG plant/Retrofitting/Gas engine replacement
- Higher efficiency
- No emission hazards as natural Gas is the cleanest burning fossil fuel.

Observation and comments:

Model SGT5 4000F is better for achieving around 350 MW. For achieving more power, Mitsubishi class F4 machine is a better choice being the most efficient.

High inlet gas pressure of the order of 35 bars is required in case of Mitsubishi F4 machine.

For higher power requirement additional 350MW capacity plant can be established in second stage.

Conclusions:

Looking at the industrial growth taking place in and around Yelahanka; and to meet the growing demand of power capacity addition at Yelahanka is very much needed.

Yelahanka is located at a very vantage point near the high paying load center like Bangalore (BESCOM) area, which makes a RLNG based Combined cycle gas power plant is more viable.

Due to vicinity of major load center like Bangalore, the T&D losses would be minimum and therefore, more units could be dispatched to consumers and in turn more revenue will be generated Efficiency of higher capacity advance F-class gas turbines combined cycle power plants of proven designs must be leveraged to use environment friendly fuel like natural gas, RLNG, etc for producing more power and also for optimizing the available land.

Higher Capacity gas turbine based combined cycle power plant will provide an economy of scale benefit (lower CAPEX) as well as highest efficiency (least variable cost).

Total area available within the premises of Diesel Power Plant complex is about 120 acres.

Based on the site visit and studies, and by best engineering practices the proposed combined cycle power plant can be accommodated only by dismantling the required structures/systems of the existing one .None of the existing facilities can be used for the proposed combined cycle power plant; as the existing facilities were meant for small

capacity unit size plant and not matching the requirement of the proposed CCPP.
The main fuel for the power plant will be Natural gas (NG). The gas will be available from the GAIL pipe line network which will be made available within the plant boundary.

The make-up water requirement is proposed to be sourced from Hebbal sewage water treatment plant. Recirculating type cooling water system with Induced draft cooling towers has been considered for this plant.

Necessary provision will be kept to maintain water and air pollution within the prescribed limit.

Generated power will be evacuated at 220 kV voltage level to the GIS type switchyard built within the premises from where it can be further transmitted through state grid transmission lines.

For this size of a plant, the project completion period will be around 30 months from the date of financial closure Commissioning of the plant will be completed in 28 months and another 2 months will be for required for reliability test, performance test before achieving COD.

The financial details of all the four options are given as below:

Sl.no	Options	Total cost, Crores	Cost of generation , Rs/ Unit
1	Option 1A	146.00	10.63
2	Option 1B	443.00	9.17
3	Option 2	1184.62	7.83
4	Option 3	2414.77	7.85
5	Option 4	2380.92	7.83

Difference in cost of generation with respect existing DG Set:

Cost of generation with existing DG set (approx.) : Rs. 16 per unit.
Option 1A (Converting to gas engines by retrofitting) saves : Rs. 5.37 per unit
Option 1B (By replacing new gas engine) saves : Rs. 6.83 per unit
Option 2 saves : Rs 8.17 per unit
Option 3 saves : Rs 8.15 per unit
Option 4 saves : Rs 8.17 Per unit

In view of the above it is concluded that:

- Total area available within the premises of Diesel Power Plant complex is about 120 acres. By best engineering practices the proposed combined cycle power plant can be accommodated only by dismantling the required existing structures/systems of the DG Plant. None of the existing facilities can be used for the proposed combined cycle power plant; as the existing facilities were meant for small capacity unit size plant and not matching the requirement of the proposed CCPP.

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- Establishing 1x350 MW combined cycle gas based power plant (CCPP) in 1st Stage will cater the urgent requirement of growing power demand with lower capital cost.
- M/s KPCL can take up another 350 MW CCPP in 2nd stage depending on the availability of gas and requirement.

Considering the above critical factors which are elaborated, it is concluded that installation of combined cycle power plant of 350MW in 1st stage is feasible at the designated site.

7.0 Description of major equipments / Systems of 1X 350 MW CCPP operating philosophy

The plant consists of one block, consists of (1GT + 1HRSG + 1 ST). In the block GT is connected to its HRSG which supply steam to its steam turbine. The exhaust gas from the gas turbine raises steam in the HRSG in combined cycle operation. A HP-IP bypass system provided ensures that correct steam parameters are achieved before entering steam into the turbine. The bypass system control envisages steam pressure control, steam temperature control and spray water pressure control.

7.1 Operating Regime

The proposed plant will be operated primarily at base-load. However the combined cycle power plant is able to run at part load also with minimum capacity of 40% of its base load. The plant efficiency is the maximum when it operates at base load, but it falls; when the plant operates below its base load.

In principle, the plant will be designed for a design life expectance of 25 years, or 200000 operating hours.

- Usual start up times for Combined Cycle modes are as follows:
- 60 -90 min after a one night stop (hot)
- 120 min after a week-end stop (warm)
- 180 min after five days stop (cold)

7.2 Thermodynamic calculations and heat balances

The thermodynamic cycle of the proposed plant has been modelled in HMBD software which allows the heat and mass balance of a combined cycle power plant. The model is made by TE-IN, using the data received from the client and the software database.

The HMBD is enclosed as Exhibit #9.

For the purpose of the detailed feasibility report the gas turbine in multiple shaft configurations for option # 2 and option #4 has been applied in the model. The performances have been calculated at 30^{0}C temperature on site as indicated in the section 8.1. All performances are valid for new and clean conditions.

7.3 Main stack

The height of the main stack will be 60m.which is in line with the international/local rules, regulations, latest codes & standards.

7.4 Supplementary firing

No supplementary firing is envisaged for the proposed plant.

7.5 Fuel Supply system

The NG requirement works out to be around 1.38 mmscmd for 1x350 MW and 2.76 mmscmd for 2x350MW with 100% load, which can be available from the GAIL pipeline network. Natural gas will be transported to site by pipelines at a pressure; which will meet the requirement of gas turbines. A fuel gas station is to be installed in the vicinity

of plant with metering arrangement. After this metering station, fuel is to be taken to the gas turbine.

7.6 Water Supply System

Approximately 11 MLD(438m^3/hr) make up water will be required for the proposed CCPP of 1x350 MW and 21 MLD (875 m^3/hr) for 2X350MW.

The make-up water requirement is proposed to be sourced from BWSSB Hebbal sewage water treatment plant.

Treated water from Hebbal Sewage Treatment water plant is available through pipes upto the plant water reservoir. Water can be drawn by pump house arrangement. Sufficient quantity of water is available and assured. A buried / above ground water pipe line has to be laid to carry out approx. 900 cubic meter/ hour up to the plant site. Small water storage is proposed to meet the plant water requirement of 4-5 days to meet the emergency requirement

The water analysis provided by KPCL is attached.

In plant storage of two days water requirement has been envisaged.

7.6.1 Water pretreatment plant

To take care of turbidity and suspended solids in the Raw Water a Clarifoculator type of clarifier shall be provided. This clarified water shall be the source of water for:

- DM Plant
- Cooling Tower make up
- Service water
- Potable Water

7.6.2 Cooling water system

Re-circulation type cooling system with cooling tower is proposed for CW system. Cold water from cooling tower will be pumped to condenser and Hot water from Condenser shall be returned to Cooling tower for cooling. Cycles of concentration (COC) is considered to be 5.

Selection of type of Cooling Tower

A comparative study has been carried out between Natural Draft Cooling Towers (NDCT) & Induced Draft Cooling Towers as presented below.

NDCT does not require fans and thus no power consumption but are more capital intensive. The height of the tower is relatively higher than IDCT. The maintenance requirements are much less as compared to IDCT as there are no moving parts.

On the other hand IDCTs are relatively less capital intensive, the height of the tower is less as compare to NDCT but consume power for operation of the fans for entire life of the plant. IDCT is better suited for clear water applications. IDCTs can achieve lower approach temperature (better performance).

Considering the site specific conditions such as ambient air conditions, quality of water to be handled, land availability, plant layout requirements, etc. the selection has to be

made based on Techno-economic analysis.

Techno – economic analysis carried out for selection of type of cooling tower and the findings are presented below.

Sl.no	Description	Mechanical Draft Cooling Tower	Natural Draft Cooling Tower
1	Layout	Lower foot print area required	Higher foot print area required
2	Capital Cost	Base	Relatively Higher
3	Construction Period	Base	Longer Construction Period
4	Fan Power Consumption	Auxiliary Power consumption on account of fans to be considered	No fans envisaged

Based on the above study IDCT is the preferred choice for the power project.

7.6.3 De-mineralized water

The CCPP typically requires a continuous make-up of de-mineralized water to compensate the blow-down and losses of the HRSG and steam system and a discontinuous flow to compensate temporarily drains.

Two types of demineralization could be applied: a classic resin based anion and cation exchanger or a reversed osmosis system. The former system is cheaper in investment cost, more expensive in Opex (cost of chemicals) and produces natrium and chloride effluents. The latter system is more expensive in Capex, does not consume chemicals, does consume electrical power, but has overall lower Opex. Both systems can be followed by a mixed bed exchanger. Resin based exchanger type DM plant is proposed for this plant.

7.6.4 Potable water

A filtration plant will be provided to meet filter water requirement of potable water and other miscellaneous uses.

Potable water will be distributed at various drinking water points and sanitary installations inside the plant, as well as for the safety showers. A dedicated water tank will be provided to meet the potable water requirement.

7.6.5 Utilities

This include the following -Cooling water system,

-Air compressor stations and dryers for service air and instrument air, -Nitrogen bottle racks or tank for purging and preservation -Chemical dosing systems for the boiler and cooling water systems, etc.

7.6.6 Effluents and waste waters

The effluents and the waste water coming from the proposed plant will be collected and treated as follows:

-HRSG blow down and drains will preferably be neutralized and go to CMB.

-Effluents from the raw water treatment and demineralization system will be neutralized and rejected.

Oily waste water will be passed through an oil-water separator, where oil sludge will be collected and remaining clear water will lead to guard pond.

7.7 Major Mechanical Equipment

7.7.1 Gas turbine selected is designed for NG Firing and have an ISO rating of around 291.6 MW. The turbine shall be characterized to the following equipment and accessories:

1. Turbine and Turbine Compartment shall comprises of

- Multistage axial flow corrosion protected compressor.
- Dry low NOx combustor.
- Modulating inlet guide vanes
- On base gas fuel system
- Ignition system
- AC vent fan system
- Vibration sensors, thermocouples.
- Inlet & exhaust plenums.
- Fire CO2 system & detection system
- Online & offline compressor wash piping & nozzle
- Compressor discharge air unit

2 Accessory systems and compartment, Starting System including torque converter, rotor turning device etc.

1 Lubricating and Hydraulic Oil System
2 Inlet Air Cooling System
3 Exhaust System
4 Control Cabinet
5 Diverter Dampers & Guillotine damper

7.7.2 Heat Recovery Steam Generator

HRSG shall receive the exhaust flue gas from the corresponding gas turbine through a duct. The HRSG shall be triple pressure, reheat and natural circulation type in horizontal configuration. Maximum pressure (HP drum) is around 116 bar, Steam outlet temperature will be 565^{0}C.

7.7.3 Steam Turbine

The steam turbine shall be a multi stage, horizontal spindle, impulse, condensing type running at high rpm coupled to a generator. The exhaust steam shall flow downwards to the condenser. Steam flow at full load will be around 240 TPH at high pressure inlet.

The steam turbine shall have the following

- Hydraulically operated stop valve with integral steam strainer for steam inlet.
- Hydraulically operated throttle/ governing valve for inlet steam flow control.

- Warm up & drain valve.
- Gland sealing system.
- Governing oil & lube oil system comprising of oil tank, pumps, strainer, oil coolers, sight glasses etc.
- HP/IP bypass system.
- Turbine integral piping system.
- Electro hydraulic governing system.
- Jacking oil & turning gear system
- Bursting diaphragms.

7.7.4 Generator (Gas turbine/Steam turbine)

The generator will be hydrogen / water cooled driven by Gas turbine & Steam turbine at 3000rpm. The generator shall be three phase, two pole cylindrical rotor directly driven by steam turbine and with reduction gear mechanism by gas turbine. Generator unit shall be designed to operate satisfactorily under prevailing climate condition they shall be suitable for indoor installation on reinforced concrete foundation. Turbine generator unit shall be capable of running connected with utility power grid.

7.7.5 Steam Surface Condenser

i. Design Code	: HEI (Thermal) & TEMA (for mechanical)
ii. Type	: Shell and tube
iii. Construction	: Divided water box

7.7.6 Condensate Extraction Pumps

2 x 100% capacity condensate extraction pumps, one working and one standby would be provided. The pumps would be vertical, canister type, multistage centrifugal pumps driven by AC motors.

7.7.7 Deaerator

One spray cum tray / spray type of deaerator for HRSG's is proposed & shall be provided having a vertical / horizontal de-aerating heater mounted on a horizontal storage tank. LP steam from the LP drum shall supply de -aerating steam and the oxygen in the condensate shall be removed by the scrubbing action of the steam.

The deaerator shall be designed to have a storage capacity of around 10 minutes of feed water supply at design operation point between normal operation level and low level (boiler feed pump trip).

The oxygen content in the deaerator outlet shall not be more than 0.005cc/liter. This will adequately prevent the boiler tubes corrosion. In addition hydrazine dosing in the deaerator / BFP suction will be used for further removal of O2 in the feed water.

7.7.8 Boiler Feed Pumps (HP and IP)

2 X 100 % HP and 2 X 100 % IP Boiler Feed Pumps (BFPs) shall be provided for HRSG. These will be horizontal multi-stage. Each pump shall have balancing leak off connections piped to deaerator and automatic recirculation valves.

Feed control stations (1W+1S for HRSG) shall be provided at feed line discharge to the

HRSG.

7.8 Auxiliary System Equipments

7.8.1 Compressed Air System

2 x 100 % (1W+ 1S) capacity air compressors shall be provided to meet the compressed air requirement of the proposed CCPP for both the Instrument Air and Service Air. Compressors will be oil free, non-lubricated, screw type completed with inlet filter silencers, intercooler, after cooler, necessary instruments and controls etc.

All compressors outlet shall be headered. At a suitable location in the header, a control valve shall be provided such that Control / Instrument air consumption will get first priority under all conditions.

2 x 100 % capacity (1W + 1S) air dryer is proposed to meet the moisture free air for plant instrument air requirement.

Separate air receiver will be provided for instrument and service air i.e. two no's air receivers (one for service air and one for instrument air) will be provided.

7.8.2 Air-conditioning & Ventilation Plant

Air Conditioning system will be provided on those areas where close control of environmental conditions (temperature and humidity) is required.

Air conditioning plant will be provided for the control rooms, DDC room, UPS room, instrumentation testing room, SWAS room, Chemical Laboratory, Offices, C&I and Electrical Laboratories etc. The design will suit the requirement of microprocessor based control system.

The A/C system shall be designed to maintain the following requirements in air conditioned space

Temperature	$24 \pm 1^{\circ}$ C DBT
Relative Humidity	50 + 5%

Ventilation system will be provided on those areas where close environmental control is not required. Adequate ventilation system will be provided in Gas turbine area, Steam Turbine Hall, Switch gear rooms, Pumps houses, MCC room, Battery room, DM plant etc to achieve the dust free comfortable working environment and scavenging out heat gain from various equipments. Ventilation System proposed for important areas are described below:

Area	Type of Fan
Turbine Hall	Roof Extractor with evaporative cooling supply air.
Switch Gear Room, Cable Galleries	Evaporative Cooling
MCC Room, DM Plant room	Ventilation Fan
Battery Room	Exhaust Fan

7.8.3 Auxiliary cooling water system

An auxiliary cooling water system will be used for gas turbine, steam turbine and its auxiliaries like lube oil coolers, generator air coolers, bearing cooling etc.

7.8.4 Cranes and Hoists

Adequate capacity E.O.T crane shall be provided in the power block for lifting / unloading of Heavy equipments and also for erection and maintenance of equipment. For other facilities mobile cranes and hoists will be provided.

7.8.5 Fire Protection System

For protection of the proposed CCPP against fire, all yards and plant would be protected by any one or combination of the following:

- Hydrant system – Distributed throughout the complete Power Plant
- Automatic high velocity water Spray system – Transformers, Turbine oil tanks and Purifier, Lube oil system, Generator Seal Oil System etc.
- Automatic Medium Velocity Water spray – Cable Vaults, Cable Galleries, Switch yard
- Auto-modular CO2system – Control Room, Gas Turbine Enclosure etc.
- Portable and mobile extinguishers – throughout the plant at suitable locations

The fire protection system shall be designed to meet National Fire Prevention Association (NFPA), USA.

The source of water for firefighting will be from clarified water Storage tank.

Suitable fire detection system as necessary for all the above mentioned firefighting system with adequate supervisory circuit will be provided. A computerized analogue, addressable type early warning system shall be provided for entire power plant. Following types of fire detection system shall be provided.

- Smoke detection system – Ionization type, Photo electric type or combination of both Ionization and Photo electric type/multisensor detector.
- Heat detection system – Linear heat sensing cable detector, Quartzoid bulb type heat detection system.

8.0 Civil and Structural

8.1 Major civil works

8.1.1 Land Development

The site is practically level as it is inside the boundary of the existing power plant. Topographical survey of the entire available land has to be done.

The final grade level will be decided considering main power house floor level during detail engineering stage.

Suitable drain has to be provided all around the plant to divert rain water flowing from other areas as well as plant area considering the existing Nala/Natural drain inside the plant premises.

8.1.2 Geo-Technical Data & Foundation System

Shallow foundation can be adopted for all the structures. For heavier loads raft foundations or bored cast in Situ piles with sufficient penetration into hard laterite bed with N value more than 50 can be adopted. However this shall be confirmed by fresh Geotechnical investigation at proposed location before starting detail engineering.

Before starting detail engineering; appropriate protective/ corrosive measures will be taken for concrete and reinforcements.

The grade of concrete for all foundations shall be M25/ M30.

8.1.3 Drainage

The storm water drainage from the plant area is envisaged to be achieved by gravity through open brick masonry / RCC drains, which will finally dispose into the nearby natural drain or may be integrated with the existing drains. Catch drains shall be provided to convey respective buildings drainage in to main drains.

8.1.4 Roads

Double lane road.(7.5 m wide black topping) has been considered all-round the main power house area. Other approaches shall be single lane road.(3.75 m wide black topping) All roads shall be designed and constructed as per the Indian Road Congress recommendations.

8.1.5 Main Plant Building

The main plant block shall consist of steam turbine building, gas turbine building, common control building and facilities building. These buildings shall be of structural steel frame work. The exterior walls of the building for an initial height of 3.00m, shall be of brick masonry and the remaining upper portion of the wall shall be provided with insulated sand-witched permanently color coated metal cladding system. However, the wall in front of transformers shall be of adequate height (about 6.0m) to act as a fire protection wall. All internal walls / partitions shall be of brick masonry / aluminium with glass and Vineratex board panels. The roof of the building shall be of RCC provided over metal deck sheeting. The intermediate floor slabs shall be of RCC. The external walls and firewalls between transformers shall be provided with resin bonded granular textured finish (Vineratex). All internal walls shall be plastered. The flooring shall have

Granite, Vitrified tiles, Kota Stone, Carborandum tiles, Ceramic tiles and Metallic Hardener as required. The ceiling and internal wall shall have a combination of Acrylic Emulsion and Oil Bound Distemper painting over the Plaster of Paris. The structural steel surface shall be painted with epoxy based paint. The rear side of the building i.e. HRSG area up to stack shall be paved.

8.2 Make up Water System

Make-up water for the project is proposed to be drawn from Hebbal water treatment plant.

8.3 Pretreatment Plant (PT) Civil Works

Pretreatment plant shall consist of following structures:

a. RCC clarifier for CW and potable water shall be provided with one no. stilling chamber for dosing of alum, lime, coagulant and chlorine.

b. Chemical house building of RCC framed structure with brick walls shall be provided. The chemical house shall have provision of alum/lime solution preparation tanks, provision to house PT-Chlorination plant equipment and space for storage of chlorine toners and other chemicals like lime, alum etc.

c. RCC clarified water storage tank.

All PT plant structures shall be with concrete of Grade M 30.

8.4 DM Plant Civil Works

DM plant shall consist of following structures:

DM Plant cum Regeneration building shall be two storied R.C.C framed structure.

Flexible pad type foundation using well-graded sand & using bitumastic anticorrosive layer at top shall be provided for DM water storage tanks. One Neutralization pit shall be provided with two compartments. Acid/alkali storage tank supports, effluent drains, neutralization pit, regeneration area and acid/alkali storage area shall be provided with AR brick/tile lining.

All DM plant structures shall be with concrete of Grade M 25.

8.5 CW System

Recirculation type cooling system with cooling tower is proposed for CW system.

The raw water after pre-treatment shall be pumped through clarified water pump house into the cooling tower sump and then to CW pump intake.

The substructure of all pump houses shall be of RCC of grade M 25. The super structure shall be of structural steel with insulated sandwich cladding.

The water is pumped from CW pump house to condenser and from condenser to cooling towers through steel lined concrete encased CW ducts.

The cold water discharge from cooling towers shall flow by gravity to the CW pump house fore-bay through RCC open channel. The concrete grade for proposed open channel shall be M 25.

8.6 Boundary Wall , Fencing and Watch Tower

Requirement for new boundary wall for main plant complex is not envisaged at this

stage as the proposed plant is located inside the existing Diesel Power plant premises. However for water treatment area, fuel gas area requires individual boundary with security arrangement. Chain Link fencing for specific equipments may have to be provided wherever required as per codal requirements during detail engineering.

8.7 Township

No separate township has been proposed for the project. However accommodation for essential staff for the operation of plant shall be provided within the plant premises.

8.8 Infrastructural Facilities

Construction water will be available from the existing bore wells and construction power will be available from the existing source of KPCL.

9.0 Electrical Systems and Equipments

9.1 Design basis

Following design basis shall be considered for design of electrical system.

Design Temperature	50 °C
Voltage levels	
Power evacuation to grid	220 kV
Motors rated 200KW and above	11 kV
Motors rated more than 750W and less than 200 KW	415 V
Motors rated less than or equal to 750W	230 V
Emergency motors and control & protection	220V DC

a. Power voltage and frequency variations :

Voltage variation	+/-10%
Frequency variation	50 Hz (-) 5% to (+) 3%;
Combined Voltage & Frequency variations	+/-10%

b. Fault levels:

Symmetrical RMS fault levels for the various voltage systems for design of breakers will be as under:

220kV system:	40 kA for 1 sec
11 kV system:	40 kA for 1 sec
415 volt system:	50 kA for 1 sec.
DC system:	20 kA

c. Basic insulation level:

The basic insulation impulse levels will be 75 kV peak for 6.6 kV systems and 1050 kV peak for 220 kV systems.

d. Electrical Control and Protection system:

Generators, generator transformers, unit auxiliary transformers, unit/station service transformers, 11 kV switch gear and 415 V switch gear incomers & bus-couplers will be controlled through main plant DCS.

Numerical/ microprocessor based relays will be employed for protection of generators, transformers HT Motors, HT Switchgears ,LT Switchgear and 220 kV switch yard equipment.

9.2 Power Evacuation

Refer Electrical single line diagram

9.3 220 kV Switchyard

220 kV GIS shall be installed in the plant which will evacuate power from the transformer and in turn shall be fed to KPTCL switchyard.

Switchyard operation shall be possible from main control Room as well as from switchyard control room with local/remote provision. Control panel with alarm annunciation will be provided for the operation of switchyard equipments with all indication (close, open & trip) both in Main & switchyard Control room.

The switchyard control building shall house PLCC, relay control panels, ACDB &

switchyard control panel and tariff metering panels. It will also house battery system for PLCC & DCDB.

The Power shall be evacuated from 220 kV switchyard through suitable capacity outgoing transmission lines.

Circuit breakers will be SF6 with 40 kA symmetrical interrupting, triple pole.

9.4 Generator Transformers

The generator transformers for gas turbine and steam turbine will be oil-immersed type with OFAF / ONAF/ONAN cooling suitable for outdoor installation. The voltage ratio will be 220 kV /generating voltage, 500 MVA approximately. The transformer will be, three phase, 50 Hz Delta LV and Star HV, YNd11 vector group, 12% impedance (approx.) suitable for solid grounding of HV neutral. Each transformer will be provided with off load tap changer for (+) and (-) 10% voltage variation in steps of 1.25%. LV side of the transformers will be connected to the respective generator through isolated phase bus duct. HV side will be connected to the 220 kV switchyard through cable / over head conductor. Each transformer will be provided with a lightning surge arrestor on each phase. The G.T shall be designed for back charging.

9.5 Unit Auxiliary Transformer

It is proposed to provide 1 no. Generating voltage/ 11 kV, 40MVA capacity Unit auxiliary Transformer (ONAN/ONAF) cooling suitable for outdoor installation. The transformer will be, 3 phase, 50 Hz Delta HV and Star LV, Dyn11 vector group, 12.5% impedance (approx.) suitable for Resistance grounding of LV neutral. Each transformer will be provided with on load tap changer for (+) and (-) 10% voltage variation in steps of 1.25%. LV side of the transformers will be connected to 11 kV indoor switch gear through cable. HV side will be connected to the isolate phase bus duct.

9.6 Unit Service & Station Service Transformers

Suitable nos. of 11/ 0.433 kV, suitable MVA capacity Outdoor type unit service transformer for supply power to unit auxiliaries. Other details of these transformers are as follows:

	Unit service	Station Service
% Impedance (Approx.)	6.25	6.25
LV Connection	Star	Star
HV Connection	Delta	Delta
LV Neutral Grounding	Solid Grounded	Solid Grounded
Vector Group	Dyn 11	Dyn 11
Cooling	AN	AN
Winding Insulation	Uniform	Uniform
Terminal arrangement		
a) HV b) LV	Cable Cable	Cable Cable
Tap Changer		
Type	Off circuit	Off Circuit
Range %	+/- 5 Steps of 2.5%	+/- 5 Steps of 2.5%

9.7 Generator Circuit Breakers and 11 kV Switchgears

In order to drive startup auxiliaries, power from 220 kV switchyard will be back feed to 11 kV switchgear through GSUT, Unit auxiliary transformer, the GTGs connected to respective step up transformer through generator circuit breakers will be kept in off position during the start up. This will eliminate the need for separate station transformer and associated switchyard bay.

The UAT will be fed from the tee-off bus duct. UAT from generator will feed power to 11 kV Unit auxiliary board. This switchgear will be metal enclosed single front horizontal draw out type for indoor installation.

The 11 kV incomer, bus couplers will be breaker controlled. The motors and outgoing transformer feeders connected to 11kV board will also be breaker controlled.

All 11 kV breakers will be vacuum type having an interrupting capacity of 40 kA (rms) Closing and opening time not exceeding 5 and 4 cycles respectively. The breakers will be trip free with anti-pumping device and operating mechanism of stored energy type with DC motor operated charging of spring. The change over scheme for 11 kV switchgear system shall be manual make before break type.
The CBs will be suitable for local as well as remote operation.
Bus bar will be Sleeved and have shrouds for joints and tap-offs, the switchgear enclosures will have IP 4x degree of protection.

9.8 415 Volt Switchgears

415 volt switchgear will be metal enclosed vertical single/double front draw-out type with incoming cable for indoor installation. Panels will be arranged for bottom entry of cables, as required. The incomers and bus ties of main power cum motor control centers (PMCCs) will be controlled by circuit breakers. Other feeders will be controlled by contactors with MPCBs/SFUs for motors and MCCBs/ACBs for outgoing line feeders.
Circuit breakers will be of air-break type with 50 KA symmetrical interrupting capacity.
The change over scheme in 415V switchgear shall be manual make before break type.
Bus bars will be PVC sleeved and shrouded at joints and will be suitably rated.

9.9 Electric Drives

Electrical drives will be 3 phase 50 Hertz induction motors operating at nominal voltages of 11000 or 415 volts. Motors will be of high efficiency type having higher power factor (at least 0.8) with class 'F' insulation, and temp. rise limit corresponding to insulation class 'B' IP55 enclosure class (with canopy for vertical outdoor motors), designed for direct on-line start. Starting current for large 6.6kV motors (e.g. HP/IP boiler feed pumps) will not exceed 4.5 times the full load current, inclusive of tolerances.

Motor rating will be at least 1.1 times the consumption at the duty point of the driven equipment.

Motors will be capable of starting and accelerating to full speed at 80% of the nominal voltage and will be capable of either two starts in quick succession with third start after 5 minutes in cold condition or two starts at 15 minutes intervals in hot condition; both cases with voltage and frequency variation as per specified limits. Motors will also be capable of restarting under full load after a momentary loss of voltage with the possibility of application of a total of 150% nominal voltage.

Motor torque characteristic will be such as to ensure smooth and rapid starting and acceleration of the driven equipment. Motors will be capable of withstanding 1.6 times the rated torque for 15 second without stalling or without abrupt change in speed.
Motors rated 30 KW & above will be provided with integral space heaters to be switched on while at standstill.

9.10 Protection

Electrical protection proposed for various equipments will be generally as indicated below. However, protection on the 200 kV outgoing circuits will be coordinated with GRID.

9.11 Generator

Two 100% redundant Digital Generator Protection Systems (DGP))/Numerical relays each containing the following minimum functions:

- Over load (49)
- Instant Over current (50/51)
- Under voltage (27)
- Reverse Power (32)
- Low Forward Power (37)
- Loss of excitation (40)
- Current unbalance (46)
- Loss of synchronisms or pole slipping (98)
- Generator Backup Impedance (21)
- Over voltage (59)
- Stator ground detection (64)
- Under / Over frequency (81)
- Generator differential (87G)
- Voltage transformer fuse failure Breaker (GCB) failure (97)
- Breaker trip circuit monitoring (95)
- Anti Pumping Relay (94)
- Overall differential (87GT)
- Dead Machine Protection

9.12 Generator Transformers

- HV restricted earth fault (64)
- Over fluxing (99)
- Backup over current (51)
- Backup ground fault (51N)

- Sudden pressure relay (63)
- High wdg. Temp (49)
- High oil temp (490) PRD operated

9.13 Unit Aux. Transformer

- Differential (87AT)
- LV restricted fault (64R)
- HV Backup over current (50/51)
- Sudden pressure or Buchholz (63)
- High winding oil Temp (49/49)
- PRD operated

9.14 Distribution transformers:

- HV Over current (50-51)
- LV ground fault (51N)
- LV over current (51)
- Buchholz (63)
- Wdg./oil temp (49/490)
- Backup directional over current & E/F (67&67N)

9.15 11 kV switch board/feeders: (Numerical Feeder Protection)

- Inverse/definite time over current (51)
- Ground fault (64)
- Instantaneous short circuit (50)
- Under voltage (27)

9.16 415 Volt switch board feeders:

- Time graded Protection for incomer's feeder (51).
- Short Circuit (Fuse protection)
- Thermal and magnetic o/c for outgoing feeders

9.17 11 kV motors and breaker: (Numerical Protection)

- Short circuit (50) , Negative sequence, earth Fault
- Over current time delayed (51)
- Thermal overload (49)

9.18 Composite motor protection contactor controlled 415 V Motor feeders

- Short circuit (fuses)
- Thermal overload (49)
- Single phasing
- Over current
- Earth fault

9.19 DC System

- Under voltage (27) or no volt relay
- Ground detection
- Multifunction digital (microprocessor based) relays will be provided for generators, transformers, 220kV switchyard and 11/0.415 kV circuit breaker controlled feeders.

9.20 Control Room

There will be a common centralized control room in which facilities for remote control & monitoring of gas turbine, heat recovery steam generator, steam turbine, generators, unit/station controls and 220 kV switchyard control and synchronizing etc. will be provided.

Necessary operation and monitoring for station auxiliaries and 220 kV, 11 kV system will be performed from CRT based operator stations /back up panels.

9.21 DC System

Plant DC System will essentially cater for control/monitoring, alarm/ annunciation of all circuit breakers and spring charging, emergency lube oil pumps and emergency DC lighting.

The system will comprise 2x100% duty 220 V lead acid plant batteries with 2 hr. back up each with Main float plus float cum boost chargers and DC distribution boards using MCCBs in incomer circuits and other feeders. Separate chargers of 110 V DC Output & 48 V DC Output with adequate battery bank capacity will be installed for switchyard equipments and PLCC.

9.22 Power and Control Cables

The HV/LV power cables (AC and DC) will be armored stranded aluminum conductor, extruded XLPE insulated, screened (for HV cables only), and FRLS XLPE overall sheathed. Cables sizes will be determined on basis of de-rating factor according to standards for ambient ground temperature, grouping proximity of cables or on basis of short circuit current capacity to meet the protection requirement. 11 kV cables will be suitable for under grounded system and 415 V cables for earth system. Control cables will be 1100 V grade multi-core stranded copper conductor PVC insulated PVC sheathed and overall FRLS PVC sheathed with minimum 1.5 sq. mm conductor size.

Power & control cables for following essential services will be copper conductor and fire survival type:

- Emergency AC/DC lube oil pumps and Jacking oil pumps
- Turbine barring gear motor
- DC emergency lighting
- Trip commands to main circuit breakers and turbine generator protection circuit.
- Fire fighting system.
- DC battery & charger connections.

9.23 Grounding & Lightning Protection

The system grounding for generator is through NGT to limit fault current to 10 A and 11 kV system neutral grounding through NGR to limit fault current to 300 A. However 415V and secondary side of GT i.e. 220kV side will be through solidly grounded.

Plant Grounding

Separate station ground grid for power station will be provided for grounding of equipment and structures maintaining step and touch potentials within safe limits and ground impedance to 0.5 Ω. Both Station & Switchyard ground grid will be connected. Grounding & lighting protection shall be carried out as per IS 3043 & IS 2309.

Separate grounding bus, independent of station ground bus will be provided for

electronic systems.

Lightning protection for building structures/equipment with high risk factor will be provided. Plant & Switchyard earth mats will be interconnected. There will be separate earth electrodes for Lightning arrester & Lightning masts as per earth mat design.

9.24 Lighting

Lighting system will be with 240 volt AC for normal lighting and DC 220 volts for DC lighting. Normal AC lighting will be from 415V AC supply through a lighting transformer. At least 30% of the normal lighting fixtures will be connected from the emergency lighting distribution board.

Emergency LDB will be fed from emergency bus which has normal 415 V ac supply and standby 415 V ac supply from station DG sets.

Illumination levels at various places will be according to CBIP/CEA.

Basically indoor illumination will be with fluorescent fittings. Sodium vapour lamps will be used in areas such as turbine hall etc. Outdoor illumination will be achieved by Sodium vapour lamps in combination with flood lights. Energy efficient light sources with electronic ballasts & chokes will be used outdoor lighting & street lighting will be switched on/off by light sensitive /time of day switches.

9.25 Emergency Diesel Generator

The plant will be provided with one emergency diesel engine driven generator of required kVA capacities to provide 415V AC auxiliary power for essential services, safe shut down and battery charging in the event of a total blackout. The sizing of the emergency DG set and the emergency supply distribution system will be designed to cater for the emergency AC power requirement of proposed new plant. No DG for black start facility is envisaged for the project.

9.26 Electrical Lab

The power plant shall have one electrical lab for the testing & repair of Electrical equipment. The lab will also be equipped with sophisticated equipment for the maintenance of the various power plant equipments.

10.0 Instrumentation and Control

10.1 General

The function of the Control & Instrumentation system would be to aid the operator in achieving safe and efficient operation of the Combine Cycle Power Plant (CCPP), resulting in cost effective power generation with optimum fuel consumption and reduced emission levels. The C&I system would be of the type which normally relieves the operator of continuous duties and would take real time corrective actions in case of process drift or if unsafe trends or conditions develop in any regime of operation viz. startup, shutdown, normal working and emergency conditions.

10.2 Control Room Configuration & Layout

It is proposed to have an air-conditioned control room common for the operation and control of CCPP along with control equipment room and programmers' room at operating floor. The Gas turbine and generator, Heat recovery steam generator (HRSG) and Steam Turbine Generator along with their associated auxiliaries would be controlled and monitored from the Control Room. The control system electronic cabinets and equipment would be located in air-conditioned control equipment Room (CER) at operating floor.

10.3 Unit Control & Monitoring Philosophy

As per the current practice the main CCPP plant shall be operated, controlled and monitored through Distributed Digital Control Monitoring & Information System (DDCMIS) with monitors / keyboard/mouse devices from central control room. A unit Control Desk (UCD) for mounting monitors / Keyboards/mouse would be provided. In addition, a mosaic type Unit Control Panel (UCP) for mounting a few back up instruments / control devices/hardwired alarm annunciations shall be provided for operation during disturbed / emergency operating conditions in the plant.

The control, monitoring & operation of the auxiliary plants like Water Pre-Treatment Plant, DM Plant, Air Compressors, HVAC Plant, effluent treatment plant, fire protection & detection system etc. shall be carried out from the respective plant's control rooms. However important process parameters and information of abnormalities, alarms etc. of these plants shall be interfaced with main plant DDCMIS system for overall monitoring.

10.4 Instrumentation Philosophy

The plant shall be provided with extensive instrumentation for operation, control, monitoring and protection. Adequate redundancy would be built in the instrumentation to ensure that failure of an instrument would not lead to equipment control failure / trip.

Critical control loops such as Boiler Drum level control, SH steam temp control, hotwell level control etc. shall be provided with three transmitters for 2 out of 3 logic.

Selected non critical control loops shall have redundant field sensors.

All trip interlocks such as Boiler Drum level, turbine lubricating oil failure, condenser vacuum trip etc. shall be provided with three independent sensors used in 2 of 3 logic.

The primary measuring instruments such as local gauges, switches, temperature elements, transmitters etc., for the measurement of parameters like pressure, temperature, level, flow etc., shall be used. All transmitters shall be smart transmitters. SMART transmitters' calibration shall be carried out through a PC based system to be located in the computer room. All temperature elements shall be duplex RTD / TC type. Microprocessor based vibration monitoring system for monitoring of vibration of major equipment / HT drive would also be provided. Vibration switches shall be provided for the CT fans for protection and interlock.

In view of the all round stress on clean environment, environmental monitoring instruments such as NOx analyzers etc. shall also be provided.
All instrumentation mounted in the field shall be as a minimum IP65 construction.
Turbine Supervisory monitoring system would be provided for the GTG & STG set monitoring.

Shaft vibration at all TG bearings including the gear box bearings
Shaft eccentricity
Differential expansion of the turbine
Thrust wear
Casing expansion etc.
All sensors are proximity type. Monitors provide bar graph display of the values and high and Very high limits are provided for alarm and trip functions.
All critical drives such as BFPs, CWPs, CEPs, shall be provided with temperature monitoring of the bearing metal and motor windings.

10.5 Control & Monitoring System for Main CCPP Plant

Control system architecture:

The Gas and Steam turbine generator and their auxiliaries, shall be controlled by their respective control, protection and monitoring systems. These systems shall be functionally separate and independent. The signal exchange / interface required between GTG and STG control systems and DDCMIS for control, protection and operation shall be through redundant software links. HRSGs shall be controlled and monitored through DDCMIS

Balance of plant control system shall be hooked up with DDCMIS through Ethernet/TCP/IP/suitable protocol for monitoring of important parameters, status monitoring of drives/system etc.

Microprocessor based, functionally distributed, hierarchically structured distributed digital control monitoring & information system (DDCMIS) shall be provided for the safe, reliable and efficient operation of Gas Turbine Generator(GTG) and it's auxiliaries, Heat Recovery Steam Generator(HRSG),Steam Turbine Generator (STG) & it's auxiliaries, Station common systems & Electrical System. DDCMIS shall perform modulating controls, sequence control, interlocks & protections, monitoring, alarms, data logging etc. Automatic plant startup/shutdown (APS) and automatic plant

regulation (AVR) systems are envisaged to achieve plant startup and load demands distribution among GTGs from central control room with minimum operator intervention.

The system comprising of one block of single shaft driven steam turbine &gas turbine along with HRSG which shall be highly automated and closely co-ordinate requiring minimum operator interventions for all start up and shut down sequence. However, the control system shall be structured to facilitate operator interventions at any stage of operation and during abnormal mode of operation.

The Generators synchronization shall be through DDCMIS. 6.6 kV and 415 V switchgears, incomers, outgoing feeders, bus-couplers shall be controlled and monitored through DDCMIS form the Central Control Room.

Electrical Panels related to "Unit Auxiliary Control Board", "Station Auxiliary Control Board" and "Bus Transfer System" has been envisaged inside the Electronic Equipment Room complete with all necessary electrical Protection Relays and Protection Hardware for protection of the Electrical system. Operational facility is envisaged from Operator's Console in the CCR through DDCMIS. The status input of all relevant electrical equipment and sub-systems and electrical parameters will be considered as inputs to the DDCMIS for the display of complete status of the electrical status of the system.

It is proposed to use monitors / keyboards/mouse devices for the purpose of control, monitoring, information and alarm as mentioned above. Each of the screens shall be 100% interchangeable (i.e. control or monitoring or alarming function for any part of the plant can be performed from any monitor) and would provide complete control, monitoring, supervisory and display functions for control system variables and control system status. Changes in system configuration, turning constants and similar engineering and maintenance functions shall be done from Engineer / Programmer console.

Adequate numbers of printers shall be provided for logs, reports and alarms. In addition to this, historical data storage and retrieval system shall also be provided.
Built-in diagnostic system for trouble shooting purpose shall be provided.
Alarm Annunciation System and Sequence of Events Recording System (SERS) are envisaged to be performed in DDCMIS itself.

Master and slave clock system or GPS system (getting accurate time from satellite) shall be provided to ensure uniform time indication throughout the plant and also for time synchronization of various microprocessors based control systems.
The Main CCPP – C&I system shall comprise of:

I. Gas Turbine Generator -C&I Systems
GTG-C&I system shall include the following:
1 Sequence Startup and Shut down operation

2 Turbine Speed and load control
3 Turbine exhaust gas temperature control
4 Turbine Protection System
5 Generator, Generator excitation & GCB controls
6 Other miscellaneous GTG related controls

II. Steam Turbine – C&I Systems

STG – C&I system shall include the following:

1 EHG Control System(EHGC) for speed/load control
2 Automatic Turbine Run Up System(ATRS) including synchronization and loading
3 HP Bypass Control System
4 LP Bypass Control System
5 Turbine Stress Control System (TSE)
6 Automatic Turbine Testing System(ATT)
7 Turbine Protection System
8 Turbine Supervisory Instruments(TSI)
9 Gland steam pressure control
10 Generator, Generator Excitation and Generator Transformer breaker Control System
11 STG Area Drains & Vents including Start up Drains & Vents
12 Binary Control of the Auxiliaries of the STG
13 Other miscellaneous STG related Controls.

III. HRSG -C&I System

HRSG -C&I system shall generally include the following:

1 HRSG Protection System
2 Modulating Control of HRSG e.g. HP/LP drums level control, HP/LP final steam temperature control, Diverter damper control etc.
3 Binary Controls of HRSG like exhaust gas guillotine damper control etc.
4 Modulating control of the feed water/condensate cycle e.g. Condenser hotwell level control, deaerator level & pressure control, APRDS control etc.
5 Binary controls of FW/Condensate cycle auxiliaries, steam cycles e.g. HP/LP BFP, CEP, MOVs of drain & vent system etc.
6 Other miscellaneous controls like CWP, ACWP, DMCCWP, CT fans etc.

Electrical Control System eg., "Unit Auxiliary Control Board", "Station Auxiliary Control Board" and "Bus Transfer System", 6.6 kV SWGR & 415V SWGR incomers, bus coupler breaker controls etc.

Panel Cabinet/Enclosures

All transmitters outside the powerhouse building will be housed by sun shade. Other transmitters will be housed in suitable transmitter racks. All panels will be fabricated from 2.0 mm CRCA. Anti-Vibration pads of 15 mm thickness. Maximum panel height shall be 2100 mm.IP-55 protection class (minimum) is envisaged for all outdoor panels and enclosures. Protection class of all panels and enclosures inside electronic

equipment room is envisaged to be IP-32.The finish colors for exterior and interior surfaces shall conform to the following shades Exterior -RAL7032/ 7035 Interior - Brilliant White.

10.6 Control & Monitoring System for Auxiliary Plants

Independent Programmable Logic Control (PLC) / Micro PLC based control system shall be provided for the safe, efficient and reliable operation of auxiliary plants like water pre-treatment plant, DM plant, compressed air system, effluent treatment system etc. with HMI / Conventional operation interface. These systems shall be suitably hooked up with Plant DDCMIS for monitoring of balance of plant system.

Microprocessor based system along with intelligent detectors for Fire Alarm and Protection System shall be provided.

PLC based control and instrumentation for Firefighting system in fire-water pump house shall be provided.

10.7 Switchyard Control

Supervisory control and data acquisition (SCADA) system has been envisaged for the control and monitoring of all relevant status and parameters of switchyard. The system will be integrated with the Plant DDCMIS through software link for monitoring and operational facility from the Central Control Room. Sequence of event recording and disturbance recording facility has been envisaged for the electrical system.

10.8 Steam & Water Analysis System (SWAS)

Recognizing the importance of water chemistry in the power plant a comprehensive Steam and Water Analysis System (SWAS) for the unit is envisaged for on line analysis of chemical parameters at all critical points in condensate, feed water, DM water and steam cycle.

10.9 Power Supply System

To provide AC & DC power supplies to various C&I systems covered under GTG, STG & HRSG C&I systems, following power supply has been envisaged in line with present practices.

Single phase,240V AC,50Hz Uninterrupted Power Supply (UPS) system to feed AC load like Human Machines Interface (HMI) , peripherals of DDCMIS , GTG C&I and STG C&I system etc. If any other voltage levels are required like 24V DC, 110VAC etc, then all necessary conversions shall be provided in the corresponding C&I system. The UPS shall consist of inverters, static switches, batteries, chargers and distribution boards. The UPS would be redundant consisting of 2x100% chargers, 1x100% servo controlled stabilizer, static switches, 2x100% Plante type batteries of one hour duty and 1X100% modular distribution board.

10.10 Control Valves, Actuators & Accessories

Control valves would be pneumatically operated in most of the applications. However, for few applications electric/hydraulic actuators shall be employed. They shall be

hooked up for fail safe operation.

10.11 Instrumentation Cables

All instrumentation cables including both prefabricated and non-prefabricated type shall be with Fire Retardant Low Smoke (FRLS) type Poly Vinyl Chloride (PVC) overall sheath. Multi pair cables of 0.5 sq. mm shall be used extensively for C&I cables. Wherever required prefabricated cables may also be used. Fiber optic cables shall be provided for Remote I/O bus, CCTV, Station LAN etc. as required.

10.12 Public Address System

A central exchange based Public Address (PA) system shall be used to provide proper communication throughout the plant with the help of handset stations, loudspeakers, portable handset stations etc.

10.13 Closed Circuit Television (CCTV) System

In addition to public address system, to provide security and surveillance of different operating areas in the plant, Closed Circuit Television (CCTV) system shall also be provided. Adequate number of cameras with facilities like zoom, pan, tilt etc. shall be provided at various operating areas. The monitors shall be located at control locations such as central control room, operation in-charge room etc.

10.14 Process Connection & Piping

Impulse pipes, instrument air, headers and pipes, tubes, fittings, valves / valve manifolds, thermowells etc. shall be provided on as required basis along with all supports.

All process transmitters/switch devices shall be installed in Local Instrument Enclosures (LIC) in open areas and in Local Instruments Racks (LIR) in covered areas.

10.15 Maintenance & Calibration Equipment

One set of maintenance and calibration equipment has been envisaged. It shall consist of calibration required for maintenance of C&I system / devices used in the unit. The exact equipments / items including those required for maintenance shall be procured as per requirement.

10.16 Plant Communication System

The plant shall be provided with a modern communication system comprising of Plant wide PABX system for telephone communications, covering the plant area and the administrative blocks. A dedicated line is provided for communication with the grid operator.

A wireless communication system for critical operating and maintenance personnel shall also be provided.

11.0 Environmental aspects

The environmental protection measures of the proposed Combined Cycle Power Plant (CCPP) as per Environmental (protection) Rules 1986 issued by Ministry of Environment and Forest, covering the following aspects is presented in this section:

i. Air pollution
ii. Water pollution
iii. Noise abatement
iv. Pollution monitoring and surveillance systems

i. Air Pollution

The proposed plant shall utilize the waste heat from the gas turbine exhaust. NG will be used as a fuel for Gas turbine. NG is the cleanest burning fossil fuel due to negligible Sulphur and ash content.

The main Air pollutants due to burning of fuel are:

i) Sulphur Dioxide (SO2) and
ii) Nitrogen Oxides (NOx)

The Combustion of NG fuels will not produce atmospheric emission of Sulphur dioxide or small particulate matter how ever emission of SO2 is depends upon the "S "contain of the fuel used. Hence only Nitrogen oxides (NOx) will be the air pollutant in flue gas. As per environment norms NOx emission level will be limited to 50 PPM(as per The environmental protection rules 1986). Dry low NOx burners in the combustors of the Gas turbines will be used to reduce the level of NOx emission. Automatic On – line stack monitoring instrument will be provided for monitoring of NOx emission.

ii. Water Pollution

The source of water pollutions are:

h) Cooling tower blow down ii) HRSG blow down iii) Effluent from water treatment (WT) plant iv) Plant (Storm) water drainage v) Sewage from various buildings in the plant vi) Sludge from clarifier

11.1 Regulation for Limiting and Preventing Pollution

11.1.1 Regulation for Limiting Water Pollution

Environmental (protection) Rules 1986 issued by Ministry of Environment and Forest – Schedule1 stipulate the following limits for effluent disposal:

a. Effluent from WT plant: Not specified
b. Steam generator blow down:
-Suspended Solids: < 100 mg/l
-Oil and grease: < 20 mg/l
-Copper (total) : < 1.0 mg/l
-Iron (total) : < 1.0 mg/l
c. Cooling tower blow down
-Free available chlorine: < 0.5 mg/l
- Zinc < 1.0 mg/l
-Chromium (total) : < 0.2 mg/l

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- Phospahte ≤ 5.0 mg/l

- Cooling Tower Blow Down

The cooling tower blow down does not require treatment and shall be partially utilized in the fire fighting system and balance is sent to guard pond for further disposal.

- HRSG Blow Down

The main pollutant in HRSG blow down is pH and temperature of water. Suspended solids and dissolved solids in the blow down water will be negligible. The pH will be in the range of 9.5 to 10.3 and temperature of blow down water will be brought down by water spray from ACW system. Hence the boiler blow down does not require any further treatment to achieve the limit. Also by operating with proper chemistry in the condensate and feed water systems, copper and iron are not present in significant quantities in the blow downstream. The boiler blow down is directed to the guard pond.

- Water Treatment Plant and Filtration Plant Effluent

Effluents from Pre treatment plant and Filtration Plant will be sent to sludge pit wherein sludge shall settle down at bottom and water shall be recovered. Sludge will be disposed from bottom portion of sludge pit at regular intervals and will be used for land filling. Over flow water from sludge pit will be sent guard pond.

- DM Plant Effluent

The effluents from the regeneration of cation resin units in water treatment plant (DM plant) are generally acidic in nature and from anion resin units are alkaline in nature. The combined waste water from DM plant would be neutralized in a neutralizing pit. The neutralized effluent is expected to have suspended solids less than 5 ppm and pH in the range of 6.5 to 8.5. This will be led to guard pond.

11.1.2 Regulation for Preventing Noise Pollution

The sources of noise in a power plant are:

- Steam turbine / Gas Turbine generator
- Other rotating equipment
- Combustion induced noises
- Flow induced noises
- Steam safety valves

As per the Environmental (Protection) Rules 1986, the limits in the noise levels are:

- Industrial area : 75 dB (A) in day time (6 AM to 9 PM) :
  70 dB (A) in night time (9 PM to 6 AM)

The equivalent World Bank norms are:

- Industrial area : 70 dB (A) in day time (7 AM to 10 PM) :
  70 dB (A) in night time (10 PM to 7 AM)

(All the measurements are taken at noise receptors located outside the project boundary).

All the equipment in the waste heat recovery power plant will be designed / operated to have noise level not exceeding 85 -90 db (A) measured at a distance of 1.5 m from the

equipment. Also, all the measures will be taken to limit the noise levels at the plant boundary within the stipulated limits.

Green belt of suitable species approx 10acre (40468.73 Sq.m) will be provided all round the plant. Also, trees will be placed in vacant spaces within the plant area.

11.2 Pollution Monitoring and Surveillance

A well defined environmental monitoring program will be implemented with trained and qualified staff for monitoring of ambient air as well as stack gas quality, blow down water quality from HRSG and effluent water quality to ensure that the quality of effluents is maintained within the permissible level. The quality of the blow down water from the HRSG drum and other water effluents from the plant will be analyzed on a daily basis or as required to ensure that effluents are maintained within the permissible limit.

Following sampling and analyzing devices will be provided in the plant:

i) High volume samplers
ii) Gas monitoring skids
iii) PH meters
iv) Spectro photometers etc.

11.3 Impact of Pollution/Environmental Disturbance

Since all necessary pollution control measures to maintain the emission levels of dust particles, Sulphur dioxide and nitrogen oxides within the permissible limits would be taken and necessary treatment of effluents would be carried out, there shall be no adverse impact on either air or water quality in and around the CCPP on account of installation of the proposed plant.

12.0 Clean Development Mechanism (CDM)

Clean Development Mechanism, aims in assisting developing countries in achieving sustainable development by promoting environmentally friendly investment from Industrialized country governments and businesses. CDM allows industrialized / developed counties to invest in emission reduction projects that generate 'CER" (Certified Emission Reductions) for use by the investing countries or companies against their own emission litigation targets.

Realizing the severity of climate change problem and immediate need for adopting mitigation measures, India has already started promoting clean development mechanisms. Adoption of cleaner fuel like Natural Gas and efficient use of energy specifically in the combined cycle mode of operation could qualify to gain the carbon credits through CDM cycle. This would not only reduce the dependence on fossil fuels in the Industrial systems but also reduce the GHG (Green house Gas) emission.

Central Electricity Authority of India has published the Carbon di-oxide baseline database for the Indian Power Sector to assist CDM project developers for speedy approval of CDM Project.

As per CEA's user guide Ver. 4 released in Oct. 2008, the prevailing baseline emissions based on the data for the FY 2007-08 are shown in Table below.

GRID	Average	OM	BM	CM
NE- WNE	0.81	1.00	0.6	0.8
Southern	0.72	0.99	0.71	0.81
India	0.79	1.00	0.63	0.81

Weighted average emission factor, simple operating margin (OM), build margin (BM) and combined margin (CM) of all grids for FY 2007-08 (inter-Grid and cross-border electricity transfers included), in t CO2/MWh.

Average is the average emission of all stations in the grid, weighted by net generation.

OM is the average emission from all stations excluding the low cost/must run sources.

BM is the average emission of the 20% (by net generation) most recent capacity addition in the grid.

CM is a weighted average of the OM and BM (here weighted 50:50).

Since the emissions are comparatively low, this project may be considered for CDM Benefits

13.0 Man power and organizational

13.1 Operation & maintenance

There is an organizational chart attached for the plant operation & maintenance. Please refer Exhibit #7 The Proposed CCPP is headed by Plant Manager. Plant Manager will be assisted by senior executives. They will hold independent charge of their departments and their functions. Following major Departments are considered:

- Operations
- Maintenance
- Purchase & stores
- Admin and Accounts

General Operation of the station would be the responsibility of Shift in charge (Operation) who will report to the Plant Manager. Shift in charge will be assisted by each discipline engineers & technicians.

The Maintenance wing is headed by Maintenance Manager and would be assisted by Maintenance Engineers who would have adequate technically sound / qualified personnel to look after the maintenance work under respective disciplines. Maintenance wing is expected to take care of routine and preventive maintenance of the plant.

All purchases of materials and services will be handled by P&S Manager. P&S Manager will be assisted by Purchase officer and stores in charge.

Administration and Accounts Department is headed by Admin and Accounts Manager and would be assisted by Administrative executives and Accountants.

Apart from above there will be the requirement of QHSE team.

Total manpower requirement for the proposed plant is thus expected to be 100.

Security officers and Security Guards are not considered in this organization chart. Security staff & guards may be outsourced on fixed term basis.

All the above staffing is based on the O&M philosophy of optimizing the manpower requirement with the benefit of deploying the latest Automation and Control systems. Hence minimum no. of people will be in attendance during the evening and night shifts on the assumption that only temporary and minor works can be carried out during the period.

13.2 Construction

There is an organizational chart attached for the plant construction. Please refer Exhibit #6.

The Proposed CCPP will be headed by project manager for construction. Project manager will be assisted by Planning engineer, construction manager, QHSE manager, corporate affair manager and material manager.

Total manpower requirement for the proposed lant is expected to be around 25.

Security Guards are not considered in this organization chart. Security guards may be outsourced on fixed term basis for construction period.

13.3 Health, Safety and Environment

During construction phase, it will be ensured that proper safety measures for all

workmen, materials & equipments are in place. Provision of all safety notices and safety equipment required for all concerned deem necessary. A safety manual will be developed establishing safety guidelines and requirements for all involved in the project.

13.4 Project Quality Control

A comprehensive quality control organization (Q.C.O.) shall be set up for quality control, inspection and testing, both at the Contractor's workshop, at his subcontractor's workshops and on Site, of all equipment supplied and works performed. This Q.C.O. shall either be a special organization set up by the Contractor and independent of its manufacturing organization either a specialized subcontractor. In the latter case, the selection of this subcontractor has to be approved by the Owner.

Inspection and tests within the Q.C.O

Inspection and tests shall cover all phases of manufacturing and construction to ascertain that all works comply with the specifications and with the applicable codes and standards, that materials and workmanship are of good quality and that all parts of the works are appropriate for the purposes which they were intended to fulfill.

Inspection and testing shall include but not be limited to:

- Acceptance tests on prime materials;
- Welding, fabrication and control procedures qualification;
- Welders, operators and inspectors qualification tests;
- Welding inspection;
- Performance and functional tests on completion;
- Inspection before packing and shipping;
- Inspection at delivery for possible transport damages;
- Dimensional checks;

Follow-up of inspection and tests within the Q.C.O

The quality control organization shall follow-up the inspection and testing to ensure the good quality of the equipment and works and the compliance with the program and with the test procedures. This QCO shall also support the project management organization to monitor the project execution schedule.

Inspection reports, test certificates and record of inspection and tests within the Q.C.O.

After each inspection visit, the Contractor shall send to the Owner an inspection certificate with the relevant test records and certificates. As manufacturing and construction progress, the Contractor shall keep complete files with records of inspection and testing.

These files shall contain, equipment by equipment, all records of inspection and testing such as:

- Material certificates;
- Welding, fabrication and control procedures qualification;
- Welders, operators and inspectors qualification certificates;
- Records of welding inspection;
- Records of heat treatment;
- Certificates of non-destructive testing (US, X-rays, die penetrate, etc.);

- Records of alignment for rotating machinery;
- Records of verticality and tolerance checks;
- Records of start-up tests (vibration, pressure, temperature, flow, etc.);
- Records of functional tests;
- Performance Tests certificates;
- Records of repair works, etc.

13.5 Codes, Standards and Regulations

The Plant shall be designed, built, tested and commissioned according to the most stringent of the following;

a. The mandatory applicable national and international codes, standards and regulations.

b. Unless in contradiction with the local codes, standards & regulations, the plant shall be designed, built & commissioned in conformity with following standards and codes as applicable.

1. ACI : American Council Institute
2. ANSI : American National Standard Institute
3. API : American Petroleum Institute
4. ASCE : American Society of Civil Engineers
5. ASME : American Society of Mechanical Engineers
6. ASTM : American Standard for Testing Material
7. ASHRAE: American Society of Heating, Refrigeration and Air conditioning Engineers
8. AWS : American Welding Society
9. DIN : Deutsche Industrie Normen
10. EDF : Electricity de France
11. HEI : Heat Exchanger Institute
12. HI : Hydraulic Institute
13. ICEA : Insulated Cable Engineers Association
14. IEEE : Institute of Electrical and Electronics Engineers
15. ISO : International Organization for Standardization
16. NFPA : National Fire Protection Association
17. The IEC standards for Electrical system (local standard – NFC)
18. AISC : American Institute of Steel Construction
19. AISE : Association of Iron and Steel Engineers
20. AWWA : American water works Association.

If there is a conflict between codes or standards as stated above, the more stringent code or standard will apply.

In case of discrepancy, the national and local rules take precedence.

Advanced and proven technologies shall be integrated in the design of the plant. Highly efficient and reliable equipment shall be chosen.

The plant shall be designed & constructed to provide all necessary facilities to allow easy and safe operation and maintenance activities.

14.0 Project Implementation Schedule

Project schedule has been developed with the following assumption:

- Zero date has been taken as the date of financial closure.
- • To make the project execution cost low, some activities should be completed before zero date. Proposes to execute a lump sum turnkey EPC contract with an EPC company, thus for 30 months project schedule, some activities are to be started 12 months prior to zero date. Following activities will be completed prior to zero date.
- (i) Appointment of engineering consultants.
- (ii) Appointment for cost evaluation and method of disposal of the existing structures and building/equipment's and system
- (iii) Appointment of EIA consultants
- (iv) All mandatory clearances required to execute the project.

List of Clearances Required

Sl.no	Particulars	Action
1	Land availability	Already available within the premises of Yelahanka DG Power Plant
2	Water requirement and its availability	KPCL has to obtain formal consent from BWSSB / State irrigation department for the drawl of required quantity of water
3	Gas availability	KPCL has to obtain gas allocation certificate from Gas Authority of India Limited for gas allocation
4	Environment and forest Clearence	This project falls under consideration of environmental clearance. As such KSPCB / MoEF to be approached
5	Airport authority clearance for chimney height	KPCL has to initiate action for obtaining clearance from AAI for stack height
6	Power absorption and evacuation plan	PPA has to be signed with KERC
7	Sources of finance	
8	CEA	For enhancement generation capacity.

- (v) Basic engineering and layout.
- (vi) Dismantling and disposing of existing structures and equipment
- (vii) Site leveling and grading works.
- (viii) Floating enquiries for placement of order on EPC contractor.
- (ix) Receipt of offers for EPC contractor.
- (x) Evaluation of offers of EPC contractor.
- (xi) Placement of order on EPC contractor.
- Plant will be commissioned in 28months.
- COD will be after 2months from commissioning of the plant.

The schedule is based on delivery schedule normally provided by suppliers of similar plants with slight variation. However during contract negotiation stage with EPC vendors, this can be further negotiated and can be reduced.

15.0 Project Capital cost and Financial

Detailed cost for 1 x 350 MW:

Project cost excluding IDC	: Rs.1049.82 Crores
IDC & Financing charges	: Rs.134.79 Crores
Total Project cost with IDC	: Rs.1184.61 Crores

16.0 Corporate Social Responsibility (CSR)

The plant authority should consider overall development of manpower of the plant, surrounding areas by building up civic amenities, hospital, school etc. by consulting with local authority.

Financial Appendices

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OPTION #2

M/s. KARNATAKA POWER CORPORATION LIMITED

Project - 1X350 MW (1GT + 1HRSG + 1ST) Combined Cycle Power Plant (CCPP)

PHASING OF EXPENDITURE & IDC CALCULATION

Project Cost without IDC & FC	104982.63	Lakhs
Project Completion Period	30	months
Debt(%)	80	%
Debt (including IDC)	94769.61	Lakhs
Equity(%)	20	%
Equity	23692.40	Lakhs
Project Cost including IDC & FC	118462.0	Lakhs
Rate of interest	12.5	%
Upfront payment	0	%
Interest Tax	0	%
No. of Installment/year	4	
Upfront Equity		

IDC	13479.38	
FC	0.00	
Total	13479.38	11.38 %

Quarterly Installment		1	2	3	4	5	6	7	8	9	10
Phased Expenditure(%)	100%	5%	10%	10%	10%	15%	10%	10%	10%	10%	10%
Phased Expenditure		5249.13	10498.26	10498.26	10498.26	15747.39	10498.26	10498.26	10498.26	10498.26	10498.26
Upfront Payment		0.00									
Fund Requirement arranged from	Equity	1049.83	2099.65	2099.65	2099.65	3149.48	2099.65	2099.65	2099.65	2099.65	2099.65
	Debt	4199.31	8398.61	8398.61	8398.61	12597.92	8398.61	8398.61	8398.61	8398.61	8398.61
Opening Balance	Equity	0.00	1062.95	3215.42	5421.70	7683.15	11064.07	13466.57	15929.13	18453.26	21040.49
	Debt	0.00	4251.80	12861.68	21686.82	30732.58	44256.29	53866.29	63716.54	73813.04	84161.96
Total Equity		1049.83	3162.60	5315.07	7521.36	10832.62	13163.72	15566.22	18028.79	20552.91	23140.14
Total Debt		4199.31	12650.41	21260.30	30085.43	43330.50	52654.90	62264.90	72115.15	82211.66	92560.57
IDC		65.61	264.10	533.16	808.94	1157.24	1514.24	1814.55	2122.37	2437.89	2761.29
Arrangement of Interest & Upfront payment from	Equity	13.12	52.82	106.63	161.79	231.45	302.85	362.91	424.47	487.58	552.26
	Debt	52.49	211.28	426.52	647.15	925.79	1211.39	1451.64	1697.90	1950.31	2209.03
Closing Balance of	Equity	1062.95	3215.42	5421.70	7683.15	11064.07	13466.57	15929.13	18453.26	21040.49	23692.40
	Debt	4251.80	12861.68	21686.82	30732.58	44256.29	53866.29	63716.54	73813.04	84161.96	94769.61
Debt : Equity Ratio		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Net Requirement of Fund	Equity	1062.95	2152.47	3269.23	4413.91	6650.16	6816.41	9112.72	9340.54	11699.95	11992.45
	Debt	4251.80	8609.89	13076.93	17655.65	26600.64	27265.65	36450.89	37362.16	46799.81	47969.80

OPTION #2

M/s. KARNATAKA POWER CORPORATION LIMITED

Project – 1X350 MW (1GT + 1HRSG + 1ST) Combined Cycle Power Plant (CCPP)

COST ESTIMATE AND FINANCIAL ANALYSIS

S.No	Item	Total Cost (in Lakhs)
1.01	**Land and Site Development**	
A.1	Preliminary Expenses	
1	Preliminary Investigation (Land survey, and water testing, soil testing)	50.00
	Sub Total cost of - A.1	50.00
A.2	Land	
1	Green belt development	50.00
2	Intake pumphouse and raw water pipe route and other associated works (ROE)	50.00
3	Gas piping from supplier to power plant site (assumption) (ROE)	20.00
	Sub Total cost of - A.2	120.00
1.02	Civil Works	
1	Site Levelling, Grading & Fencing	50.00
2	Earthwork in Excavation & Filling of plant designated areas and Colony Area	50.00
3	Landscaping & horticulture	25.00
4	Plant area drainage	50.00
5	Plant boundary wall	25.00
6	Fencing & gates	25.00
7	Sanitary & sewage system	50.00
8	Roads and Culverts	50.00
9	Foundation for GTG, HRSG, STG	500.00
10	Power House Building	300.00
11	Cooling Tower (Civil Only)	300.00
12	Structural steel works with fabrication & Erection	600.00
13	Water intake system pipeline laying & Inplant reservoir	600.00
14	WTP, DM Tanks, Misc. Tanks, Effluent Treatment system	600.00
15	Transformer yard and switchyard	150.00
16	LP Piping support & Pipe & cable rack & Pipe trenches	300.00
17	Construction power, water and enabling works	100.00

M/s. KARNATAKA POWER CORPORATION LIMITED

Project – 1X350 MW (1GT + 1HRSG + 1ST) Combined Cycle Power Plant (CCPP)

COST ESTIMATE AND FINANCIAL ANALYSIS

Sr.No	Item	Total Cost (in Lakhs)
18	First Aid, Fire station, etc.	100.00
19	Miscellaneous plant buildings like, stores, ware house, DG rooms, work shop, office & Storage sheds, Residential colony & facilities	400.00
	Sub-total of - 1.02	4275.00

1.03 Plant & Machinery - Mechanical

B.1	Boiler, Turbine and auxiliaries	
1	Gas turbine generator and its auxiliaries (1 set)	41000.00
2	Fuel Gas Station inside the power plant	50.00
3	Gas pipework from supplier terminal point to gas fields upto site including gas conditioning skid and other needed accessories etc	400.00
4	Heat recovery steam generator and its auxiliaries (1 Set)	10000.00
5	Steam turbine generator and its auxiliaries (1 Set)	9000.00
	Sub Cost of BTG and auxiliaries (B.1)	60450.00
B.2	Balance of Plant Mechanical	
1	Raw water intake system including pump	350.00
2	Cooling tower	600.00
3	Plate heat exchanger / Radiator cooler for Auxilary cooling water system	200.00
4	Cooling Water pumps and Misc. pumps with drive, Pipe	600.00
5	Water Treatment plant	700.00
6	Effulent treatment plant	200.00
7	Steel tanks with accessories	100.00
8	Air conditioning and Ventilation systems	200.00
9	Station fire fighting system including hydrant & spray water pumpsets jackey pumpsets, pipework, fire alarm & detection system; foam protection system portable fire extinguishers etc, Misc. Pumps and Drives, LP Piping, Elevtors, etc.	500.00
10	Air compressed system for instruments and service air	150.00

M/s. KARNATAKA POWER CORPORATION LIMITED

Project – 1X350 MW (1GT + 1HRSG + 1ST) Combined Cycle Power Plant (CCPP)

COST ESTIMATE AND FINANCIAL ANALYSIS

Sl.No	Item	Total Cost (in Lakhs)
11	EOT Cranes & Hoists	300.00
12	Laboratory and workshop equipment	200.00
	Sub Total Cost of - BOP (B.2)	**4100.00**
	Total Sub Cost of 1.03)	**64550.00**

1.04 Plant & Machinery - Electrical & Instrumentation

1	Power Transformers -Gas turbine Generator Transformers	700.00
2	Power Transformers -Steam turbine Generator Transformers	500.00
3	Power Transformers -Station Auxiliary Transformers	400.00
4	Power Transformers -Distribution Transformers	250.00
5	HT & LT Bus Ducts	500.00
6	Generator Circuit Breakers	600.00
7	HT & LT Switchgear	900.00
8	DC facilities including batteries; chargers; and distribution boards for unit; and common services, UPS	300.00
9	Power & control cables, cable trays and cable accessories	500.00
10	Generator control panels Generator relay panels	400.00
11	Switchyard including switchyard control & relay panels; main meires; PLCC system equipment	1000.00
12	Station lighting system	100.00
13	Communication system including cables	100.00
14	Grounding & lightning protection	100.00
15	DG set & accessories	200.00

M/s. KARNATAKA POWER CORPORATION LIMITED

Project – 1X350 MW (1GT + 1HRSG + 1ST) Combined Cycle Power Plant (CCPP)

COST ESTIMATE AND FINANCIAL ANALYSIS

No	Item	Total Cost (in Lakhs)
16	Complete Instrumentation system including DCS (Turbines, boiler and BOP) UPS, Battery Charger, Batteries, Lab	700.00
17	Complete Instrumentation signal cable , cable tray and accessories	100.00
18	CCTV including cables	50.00
19	Complete Electrical system which includes transformer, HT & LT panels, cables switch gear, cable & cable trays, lighting	500.00
	Sub Total Cost - 1.04	7900.00

1.05 Total Summary of Project Cost

1	Total of Mechanical & Electricals Equipment Cost [1.03 and 1.04]	72450.00
2	Spares @ 4% on S.No. 1(Included in Sl. No.1)	2898.00
3 a	Excise duty on indigenous equipment @ 12% on S.No. 1 & 2	9041.76
3 b	CESS on ED @ 3% on 3 a.	271.25
4	CST on indigenous equipment @ 2% on S.No. 1 & 2	1687.80
5	Local Transportation with cess & Insurance on equipment @ 2% on S.No. 1 & 2	1506.96
6	Erection, commissioning and supervision at 10% on S.No. 1	7245.00
7	Sub Total of above [S.No. 1 to 6]	95100.77
8	Land Development and Civil works [1.01 & 1.02] (excl. land & green belt, Pipe Line)	4325.00
8	Service Tax @ 4.12% for Civil construction (Sl. No. 1.02)	176.13
9	WCT @ 2% for above excluding land	86.50
10	Sub Total of above [S.No. 7 to 9]	99688.40
11	Contingencies @3% on S.No.10	2990.65
12	Sub Total 1.05 [S.No. 10 & 11]	102679.05
1.06	Total Works Cost	102679.05
1.07	Establishment Charges& Pre operative expenses @ 2% of 1.06	2053.58
1.06	Project Management and Consultancy Charges	250.00
1.07	Project Cost excluding IDC	104982.63
1.09	IDC & financing charges	13479.38
1.10	Total Project Cost with IDC	118462.01

LIFE CYCLE COST ANALYSIS

M/s. KARNATAKA POWER CORPORATION LIMITED

Project - 1X350 MW (1GT + 1HRSG + 1ST) Combined Cycle Power Plant (CCPP)

OPTION #2

Nominal Capacity - MW	350.00

Project Cost	
FC	1164.62
Total in Cr.	1164.62
FINANCING	
DEBT	80%
INR (Million)	947.70
Total Debt Cr.	947.70
EQUITY	20%
INR (Crores)	236.92
Total Cr.	236.924

Plant Availability	90.00
Capacity Utilization from 2nd years onwards	100.00 %
Station Heat Rate	1534.00 kCal/kWh
Auxiliary power consumption	3.00%
Fuel	Natural Gas
Price including Transportation	17.00 US$/MMBTU
	1054.00 Rs./MMBTU
GCV	9340.00 Kcal/SCM
Fuel price escalation	0.00%
Present exch. rate	0.00 Rs./US$
Raw Water Consumption	0.0013 m3/kwh
Raw Water Cost	5.000 Rs/m3
Raw Water escalation	0.00%

Int. on WC	13.00%
Interest on Long Term Loan	12.50%
Debtors Factor	12%
ROE	15.50%
O&M	4.00%
Depriciation	4.67% 2% from 16th year onwards
Escalation	0.000%
Rate of Inflation	5.00%
Rate of Devition	0.00%

Cost of Generation	Rs	7.83 per unit
Levellized tariff @ 90% PLF	Rs	7.71 per unit

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Gas price Rs/1000 m3	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39
Gas Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas price Rs/1000 MJ	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39	39065.39
Raw Water cost	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

Plant Capacity KW	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00
Plant Availability %	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
Capacity Utilization %	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Plant Load Factor %	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
Gross Units Generated	Million Units																								
PLF																									
90.00%	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40	2759.40
Net Units Sent Out	Million Units																								
PLF	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62	2676.62

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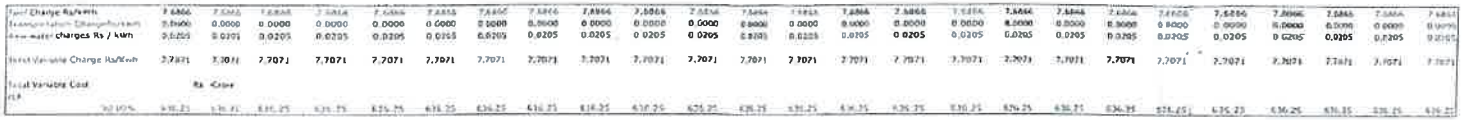

Fuel Charge Rs/kWh	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866	7.6866
Transportation Charge/kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Ash water charges Rs / kWh	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205
Total Variable Charge Rs/kWh	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071	7.7071
Total Variable Cost	Rs. Crore																								
PLF																									
90.00%	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25	636.25

YEAR -->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Fixed cost Rs. Crore																									
Interest on INR Loan	44.20	44.20	42.64	38.21	33.78	29.35	24.92	20.49	16.06	11.63	7.20	2.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	20.69	20.69	20.69	20.69	20.69	20.69	20.69	20.69	20.69	20.69	20.69	20.69	20.68	20.69	20.69	8.86	8.86	8.86	8.86	8.86	8.86	8.86	8.86	8.86	8.86
O&M Charges	17.72	18.61	19.54	20.51	21.54	22.62	23.75	24.93	26.18	27.49	28.86	30.31	31.82	33.41	35.08	36.84	38.68	40.64	42.65	44.78	47.02	49.37	51.84	54.43	57.15
Insurance Charge	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Return on INR Equity	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73	13.73
Interest on Working Capital	24.17	24.24	24.27	24.24	24.22	24.20	24.19	24.17	24.17	24.16	24.17	24.17	24.22	24.34	24.46	24.00	24.46	24.60	24.75	24.91	25.09	25.29	25.49	25.70	25.92
Total Fixed cost	120.82	121.57	120.87	117.39	113.96	110.59	107.27	104.02	100.83	97.70	94.65	91.67	90.47	92.18	93.97	83.26	85.74	87.81	89.99	92.28	95.70	99.25	101.92	106.72	110.64
Fixed Cost per Unit	1.4518	1.4725	1.4643	1.4219	1.3804	1.3396	1.2994	1.2600	1.2214	1.1835	1.1465	1.1104	1.0950	1.1165	1.1383	1.0080	1.0386	1.0637	1.0900	1.1178	1.1592	1.2022	1.2423	1.2928	1.3405

YEAR -->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Cost of Generation in Rs./ KWh	9.17	9.18	9.17	9.13	9.09	9.05	9.01	8.97	8.93	8.89	8.85	8.82	8.80	8.82	8.85	8.72	8.75	8.77	8.80	8.82	8.87	8.91	8.95	9.00	9.05
Levelized Tariff @ 85% PLF	9.02																								

Working Capital																									
Energy Charge	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02	53.02
O&M Charges (1 Month)	1.48	1.55	1.63	1.71	1.79	1.88	1.96	2.08	2.18	2.29	2.41	2.53	2.65	2.78	2.92	3.07	3.22	3.38	3.55	3.73	3.92	4.11	4.32	4.54	4.76
Maintenance Spares, 0% /20% on	5.32	5.58	5.86	6.15	6.46	6.78	7.12	7.48	7.85	8.25	8.66	9.09	9.55	10.02	10.53	11.05	11.60	12.18	12.79	13.43	14.10	14.81	15.55	16.33	17.15
Receivables, Crs (2 Months)	125.14	126.33	126.19	125.61	125.04	124.47	123.92	123.38	122.85	122.33	121.82	121.32	121.12	121.49	121.76	120.00	120.33	120.66	121.04	121.42	121.95	122.56	123.28	123.83	124.49
Total	185.96	186.48	186.70	186.49	186.31	185.16	184.84	184.96	185.90	185.88	185.90	185.96	186.34	187.31	188.17	187.14	188.14	189.23	190.40	191.60	193.24	194.50	196.09	197.71	198.41

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WATER

AND

NATURAL GAS

ANALYSIS REPORTS

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SNEHA TEST HOUSE

No. 7 & 7a, 4th Cross, Muneshwara Chandra Layout 60ft Road, Nagarabhavi, Bangalore - 560 072.
Phone : 23190341, 23390737, 23186113 Mobile : 98440 27167, 90085 68664
E-mail : info.snehatesthouse@gmail.com, snehaplasticproducts@gmail.com, snehanagaraj09@gmail.com
Website : www.sthlab.com

TEST CERTIFICATE

NAME OF THE INDUSTRY & ADDRESS	M/s.IIEM INDIA PVT LTD. BANGALORE PROJECT SITE: HEBBAL 60MLD STP HEBBAL, BANGALORE
TEST REPORT NO	556
SAMPLE PARTICULARS	STP TREATED WATER SAMPLE
TYPE OF SAMPLE	OUT LET WATER
DATE OF COLLECTION	22-08-2013
DATE OF REPORT	26-08-2013

	TEST PARAMETER	UNITS	DERSIABLE LIMIT	RESULTS	TEST PROTOCOL
1	pH value	-----	6.0 - 9.0	7.1	IS:3025(P-11)-1983
2	Total Suspended Solids	mg/L	30.0	24.0	IS:3025(P-17)-1984
3	Total Dissolved Solids	mg/L	-----	785.0	IS:3025(P-16)-1984
4	Conductivity	µS/cm	-----	1344.0	IS:3025 (P-14)-1984
5	Total residual chlorine	mg/L	1.0	0.04	IS:3025 (P-26)-1986
6	Ammonical Nitrogen as N	mg/L	50	1.5	IS:3025(P-34)-1988
7	Free ammonia	mg/L	-----	0.01	IS:3025(P-34)-1988
8	Total Kjeldhal Nitrogen	mg/L	-----	7.68	IS:3025(P- 34)-1988
9	Sodium absorption ratio(max)	mg/L	-----	12.5	IS:3025(P-45)-1993
10	Residual sodium carbonate	mg/L	-----	ND	IS:3025 (P-45)-1993
	BOD in 5 Days at 20°C	mg/L	≤ 20	18.0	IS:3025(P-44)-1993
	COD	mg/L	250	120.0	IS:3025(P-58)-2006
13	Mercury (as Hg)	mg/L	-----	ND	IS:3025 (P-48)-1994
14	Lead (as Pb)	mg/L	-----	ND	IS: 3025(P-47)-1994
15	Cadmium (as Cd)	mg/L	-----	ND	IS: 3025(P-41)-1992
16	Selenium as Se	mg/L	-----	ND	IS:3025(P-52)-2003
17	Total Chromium (as Cr)	mg/L	-----	ND	IS:3025(P-52)-2003
18	Copper (as Cu)	mg/L	-----	ND	IS: 3025(P-42)-1992
19	Zinc (as Zn)	mg/L	-----	ND	IS: 3025(P-49)-1994

CONTD..2

NOTE
1. Test results relate only to the tested samples and applicable parameters. 2. The sample will be preserved for a maximum of 7 days on request.
3. This certificate shall not be reproduced in part or full and cannot be used as evidence in court of law without prior permission in writing.
4. Total liability of our laboratory is limited to the invoice amount. 5. Sample (s) not drawn by us unless otherwise stated.

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SNEHA TEST HOUSE

No. B A 28, 4th Cross, Maruthinagar, Chandra Layout 80ft Road, Nagarabhavi, Bangalore 560 072.
Phone : 23398341, 23380737, 23160113 Mobile : 98440 27167, 98865 85664
E-mail : snehatesthouse@gmail.com, snehalabproducts@gmail.com, snehanagaraj09@gmail.com
Website : www.sthlab.com

TEST CERTIFICATE

20.	Nickel (as Ni)	mg/L	-----	ND	IS:3025(P-54)-2003
21.	Boron (as B)	mg/L	-----	0.2	APHA
22.	Cyanide (as CN)	mg/L	-----	ND	IS: 3025(P-27)-1986
23	Chloride (as Cl) -	mg/L	-----	225.0	IS:3025(P-32) -1988
24	Nitrate (as NO_3)	mg/L	<10	9.0	IS:3025(P-34)-1988
25.	Fluoride (as F)	mg/L	-----	0.4	IS:3025(P-60)-2008
26	Sulphate (as SO_4)	mg/L	-----	19.5	IS:3025(P-24)-1986
27	Potassium (as K)	mg/L	-----	11.0	IS:3025(P-45)-1993
28	Phosphate (as PO_4)	mg/L	-----	0.04	IS:3025(P-31)-1988
29	Arsenic (as As)	mg/L	-----	ND	IS:3025(P-37)-1988
30.	Phenolic compounds	mg/L	-----	ND	IS:3025(P-43)1992
31.	Chlorinated Pesticides	----	Absent	ND	GC-MS
32.	Phosphated pesticides	----	Absent	Absent	

ND: NOT DETECTED

CHECKED BY: Vasudha Kumar C

For SNEHA TEST HOUSE

(Chief Chemist)

NOTE
1. Test results refer only to the tested samples and applicable parameters. 2. The sample will be preserved for a maximum of 7 days on request.
3. This certificate shall not be reproduced in part or full and cannot be used as evidence in court of law without prior permission in writing
4. Total liability of our laboratory is limited to the invoice amount. 5. Sample (s) not drawn by us unless otherwise stated.

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GAS REPORT

Technical details		
Main gas source	RLNG from Dabhol / Dahej	
Gas flowrate	As contracted based on customer requirement	
Gas pressure	As contracted based on customer requirement	
Gas analysis	**Molar fraction %**	
	Carbon Dioxide [CO_2]	: 0.02743
	Carbon Monoxode [CO]	: na
	Hydrogen [H_2]	: na
	Methane	: 91.97691
	Ethane	: 6.75148
	Nitrogen	: 0.02612
	Propane [C_3H_8]	: 0.96059
	I-Butane [i-C_4H_{10}]	: 0.09063
	N-Butane [n-C_4H_{10}]	: na
	I-Pentane [i-C_5H_{12}]	: 0.02093
	N-Pentane [n-C_5H_{12}]	: 0.02545
	Hexane+ [C_6+]	: 0.04037
	Others [H_2O]	: na
	Oxygen	: na

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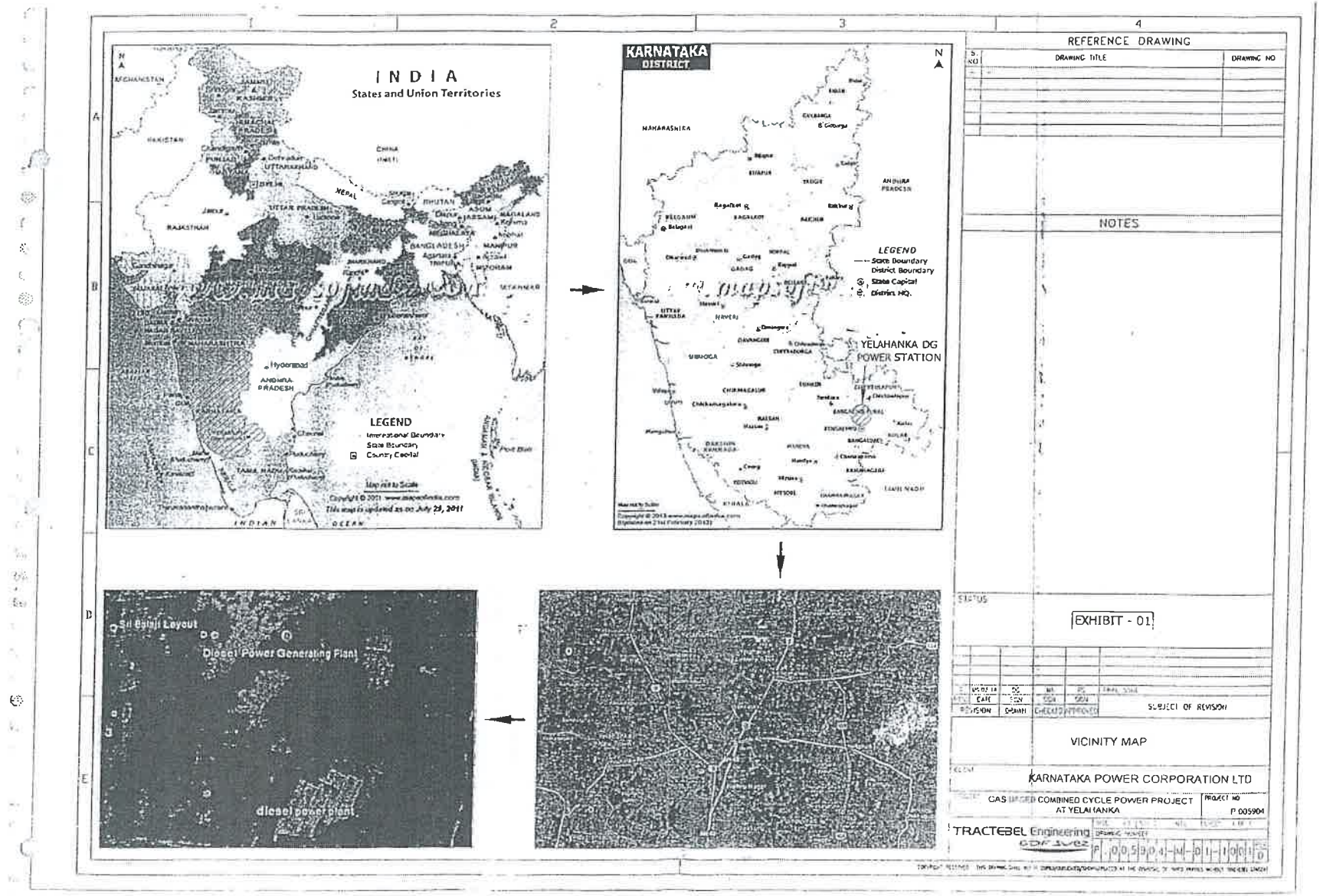
INDIA
States and Union Territories
LEGEND
KARNATAKA
DISTRICT
LEGEND
YELAHANKA DG
POWER STATION
Diesel Power Generating Plant
diesel power plant
REFERENCE DRAWING
S. NO
DRAWING TITLE
DRAWING NO
NOTES
STATUS
EXHIBIT - 01
SUBJECT OF REVISION
VICINITY MAP
KARNATAKA POWER CORPORATION LTD
GAS BASED COMBINED CYCLE POWER PROJECT
AT YELAHANKA
PROJECT NO
P 005904
TRACTEBEL Engineering
P 005904-M-01-100

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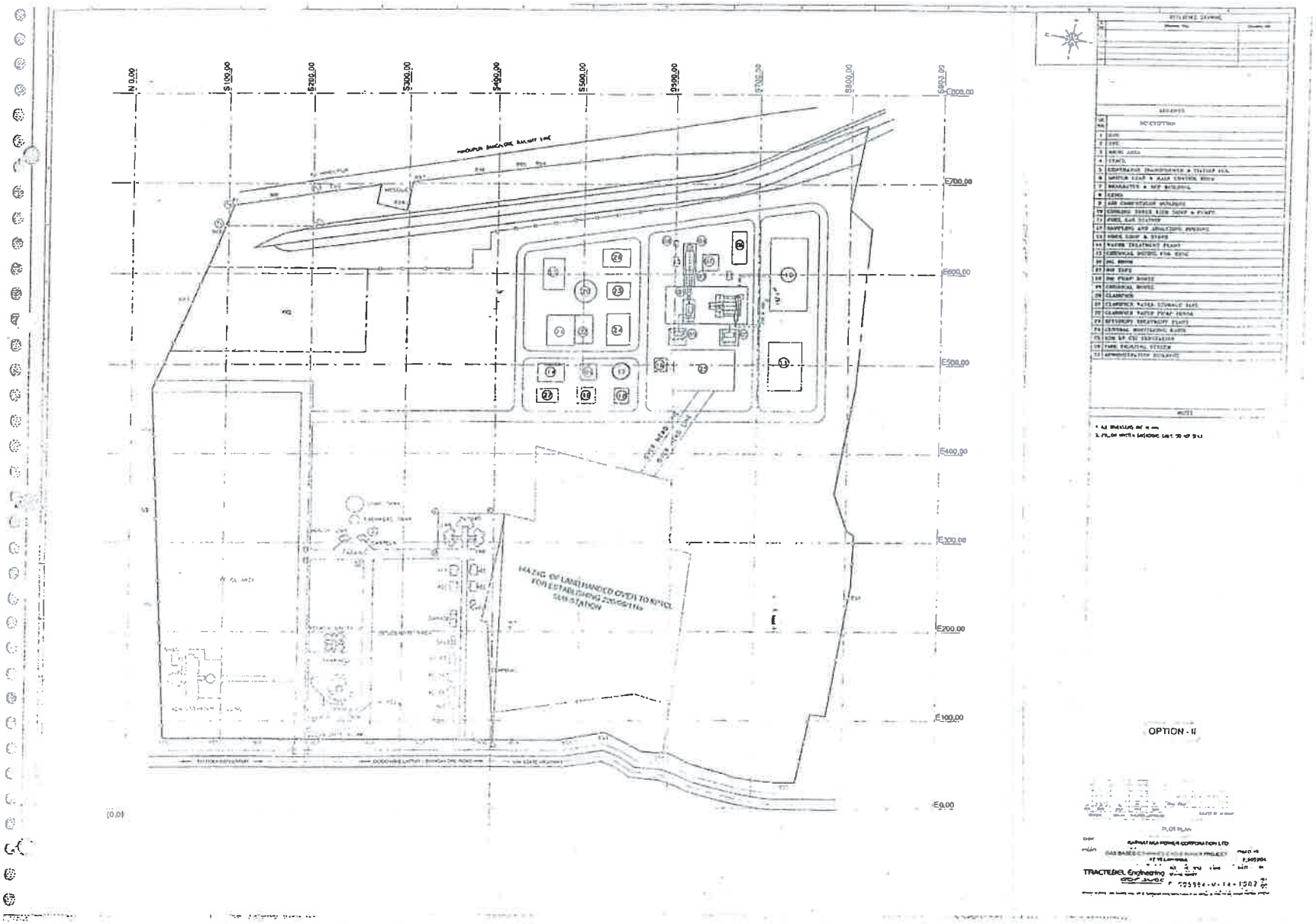
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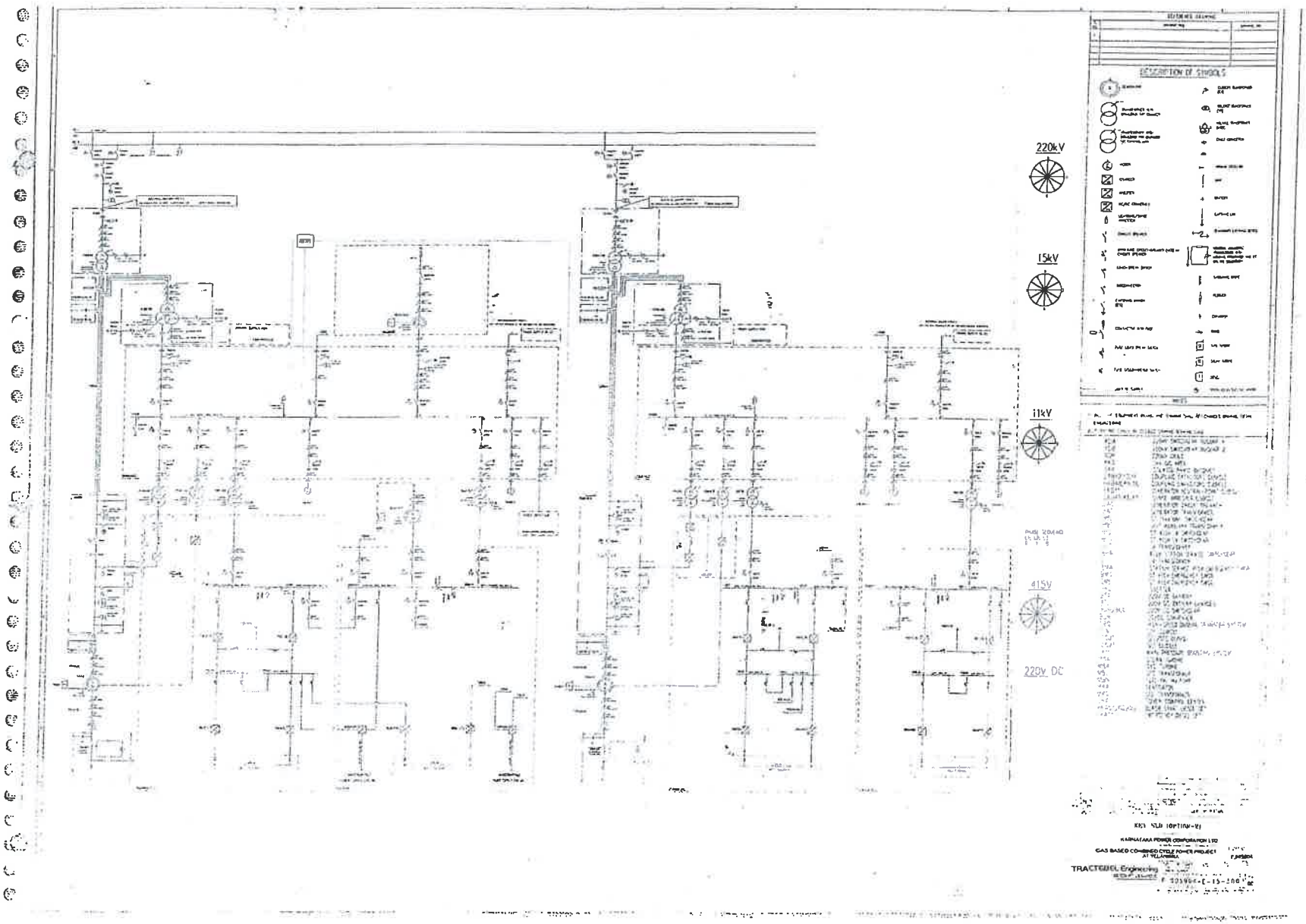
S100.00
S200.00
S300.00
S400.00
S500.00
S600.00
S700.00
S800.00
E700.00
E600.00
E500.00
E400.00
E300.00
E200.00
E100.00
E0.00
OPTION - II
TRACTEBEL Engineering

170


220kV
15kV
11kV
415V
220V DC
DESCRIPTION OF SYMBOLS
TRACTEBEL Engineering

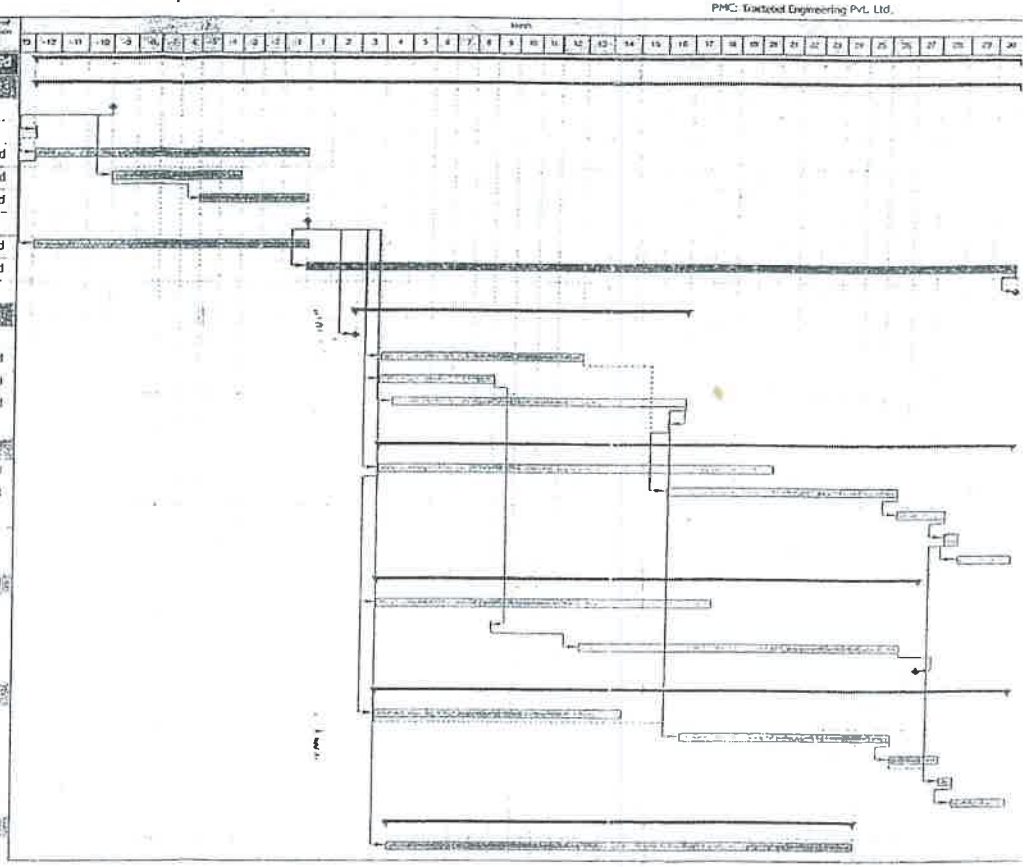
171

TRACTEBEL Engineering
GDF SUEZ

Conversion of DG Generating Power Station (128 MW) to Gas Fired Power Station, Yelahanka

Exhibit: 4
CLIENT: Karnataka Power Corporation Limited
PMC: Tractebel Engineering Pvt. Ltd.

		Original Duration
1 x 350 MW Combined Cycle Power Plant, Yelahanka		1278d
GENERAL		
GEN1000	Appointment of Engineering Consultant	0d
GEN1010	Appointment of EIA Consultant	1d
GEN1020	MOEF Clearance	365d
GEN1030	Basic Engineering and Layout /DBR/ Technical Spec / Data Collection	184d
GEN1040	Floating Enquiries & Order Placement of EPC Contractor.	153d
GEN1050	Appointment of EPC Contractor	0d
GEN1060	Finish of Site Enabling Works	366d
GEN1070	Project Duration from Award of Contractor	914d
GEN1080	Plant COD	0d
CIVIL		
A1080	Commencement of Civil Works	0d
A1100	GT Foundations	273d
A1110	HRSG Foundation Works	155d
A1130	STG Foundations and Building	291d
A1140	Turbine Building EOT Crane	0d
GT Erection and Accessories		
A1150	Fabrication and Delivery Completed	516d
A1160	Erection	315d
A1170	Commissioning	58d
A1180	Synchronisation	15d
A1190	Trial Operation	60d
HRSG Erection and Accessories		
A1240	HRSG fabrication and delivery complete	430d
A1250	HRSG Foundation Readiness	1d
A1260	HRSG Erection	420d
A1270	HRSG Readiness	0d
STG and Accessories		
STG1300	STG fabrication and delivery complete	330d
STG1310	STG Erection	290d
STG1320	Commissioning	61d
STG1330	Synchronisation	15d
STG1340	Trial Run	60d
Balance of Plant Works		
A1350	Balance of Plant Works	624d



PROJECT IMPLEMENTATION SCHEDULE

User Name: Md. Zafar
© Oracle Corporation

Actual Work | Critical Remaining Work | Summary
Remaining Work | Milestone

NOTE :

Layout Name: KPCL
Page: 1 of 1

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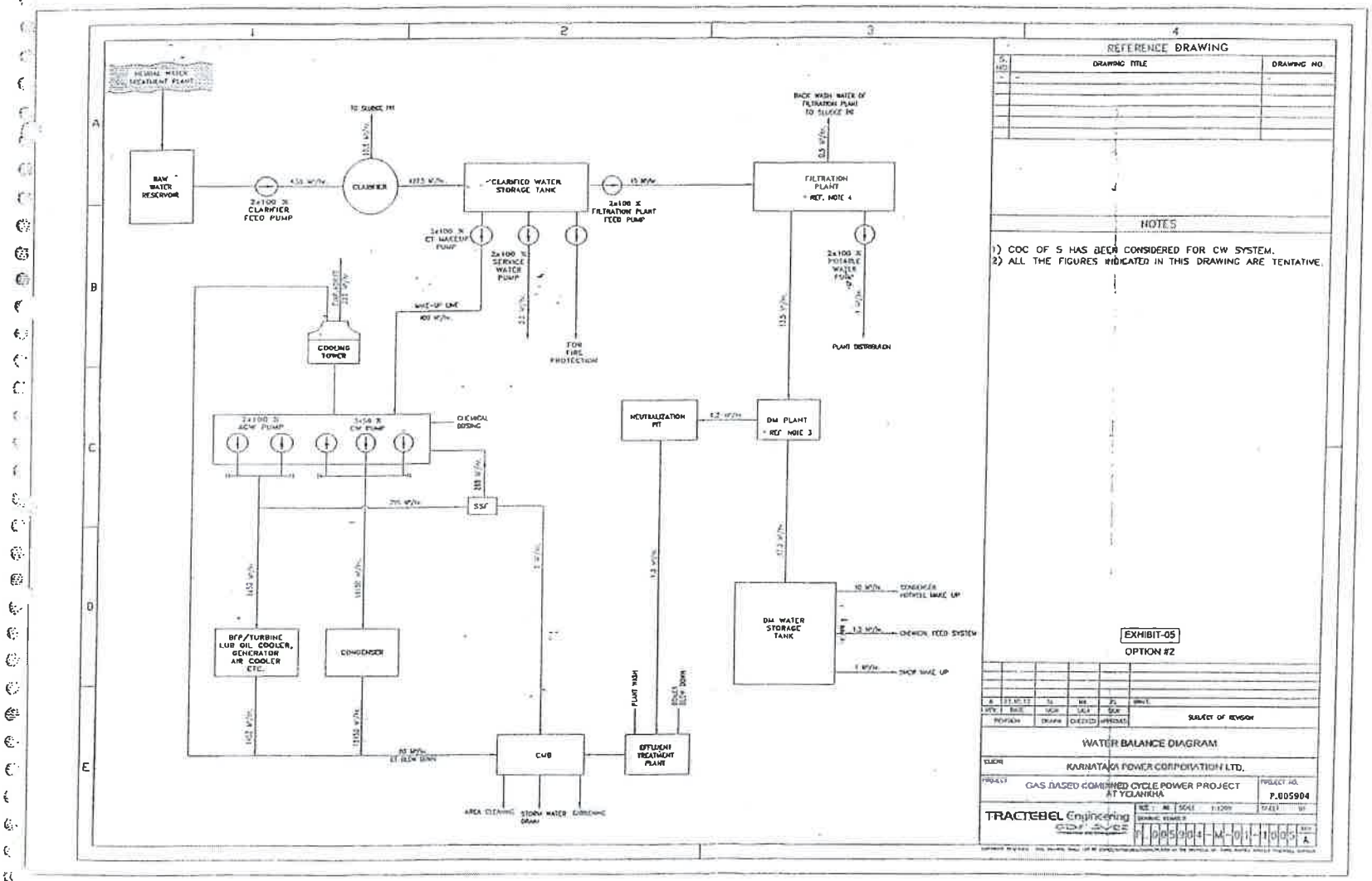
REFERENCE DRAWING
DRAWING TITLE
DRAWING NO.
NOTES
1) COC OF 5 HAS BEEN CONSIDERED FOR CW SYSTEM.
2) ALL THE FIGURES INDICATED IN THIS DRAWING ARE TENTATIVE.
EXHIBIT-05
OPTION #2
RAW WATER RESERVOIR
CLARIFIER
CLARIFIED WATER STORAGE TANK
FILTRATION PLANT
COOLING TOWER
CHEMICAL DOSING
SSF
DM PLANT
NEUTRALIZATION PIT
DM WATER STORAGE TANK
BFP/TURBINE LUB OIL COOLER, GENERATOR AIR COOLER ETC.
CONDENSER
CWB
EFFLUENT TREATMENT PLANT
FOR FIRE PROTECTION
PLANT DISTRIBUTION
WATER BALANCE DIAGRAM
KARNATAKA POWER CORPORATION LTD.
GAS BASED COMBINED CYCLE POWER PROJECT AT YELAHANKA
P.005904
TRACTEBEL Engineering
GDF SUEZ

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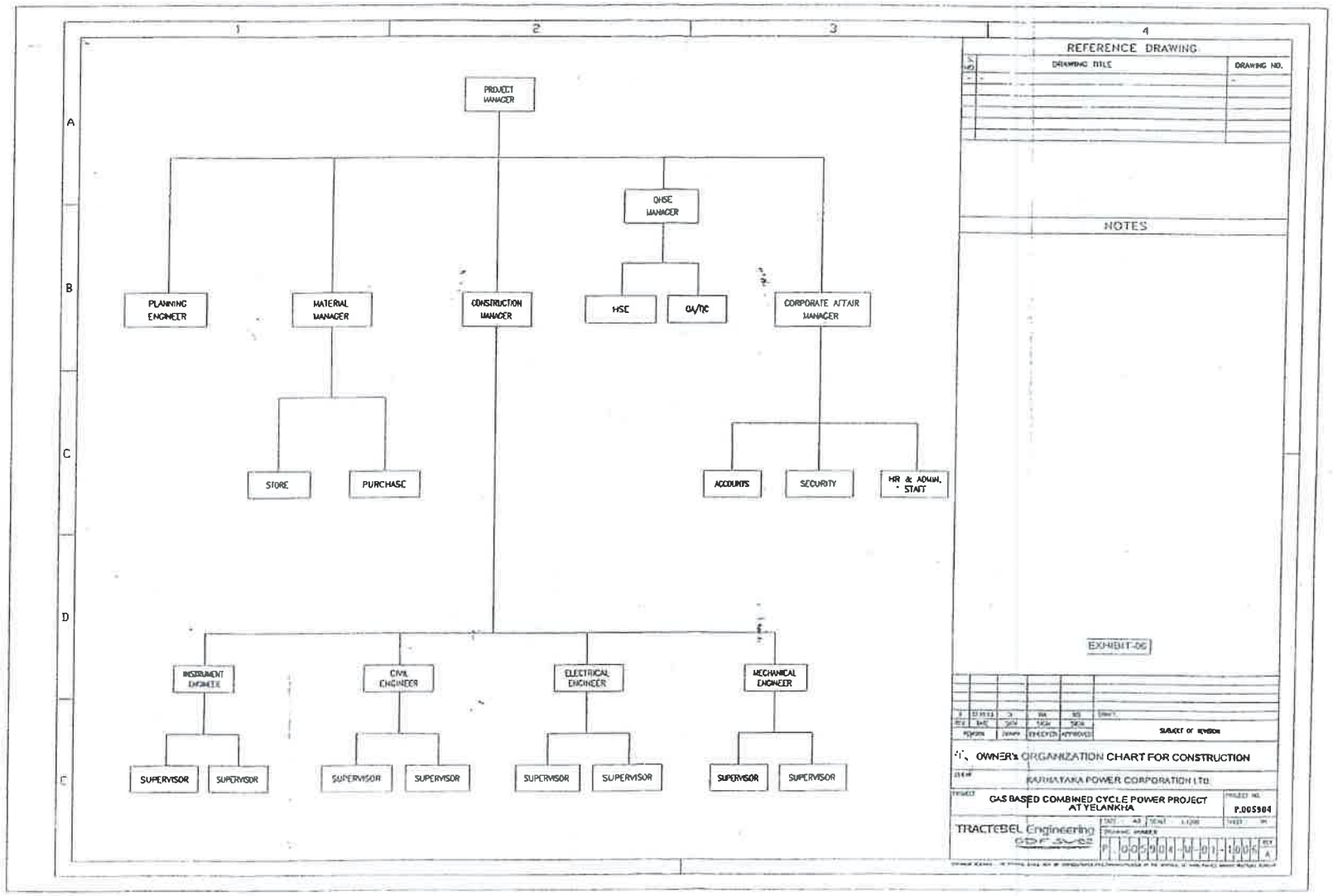
PROJECT MANAGER
PLANNING ENGINEER
MATERIAL MANAGER
CONSTRUCTION MANAGER
OHSE MANAGER
HSE
QA/QC
CORPORATE AFFAIR MANAGER
STORE
PURCHASE
ACCOUNTS
SECURITY
HR & ADMIN. STAFF
INSTRUMENT ENGINEER
CIVIL ENGINEER
ELECTRICAL ENGINEER
MECHANICAL ENGINEER
SUPERVISOR
REFERENCE DRAWING
DRAWING TITLE
DRAWING NO.
NOTES
EXHIBIT-D6
OWNER's ORGANIZATION CHART FOR CONSTRUCTION
KARNATAKA POWER CORPORATION LTD.
GAS BASED COMBINED CYCLE POWER PROJECT AT YELANKHA
P.005904
TRACTEBEL Engineering

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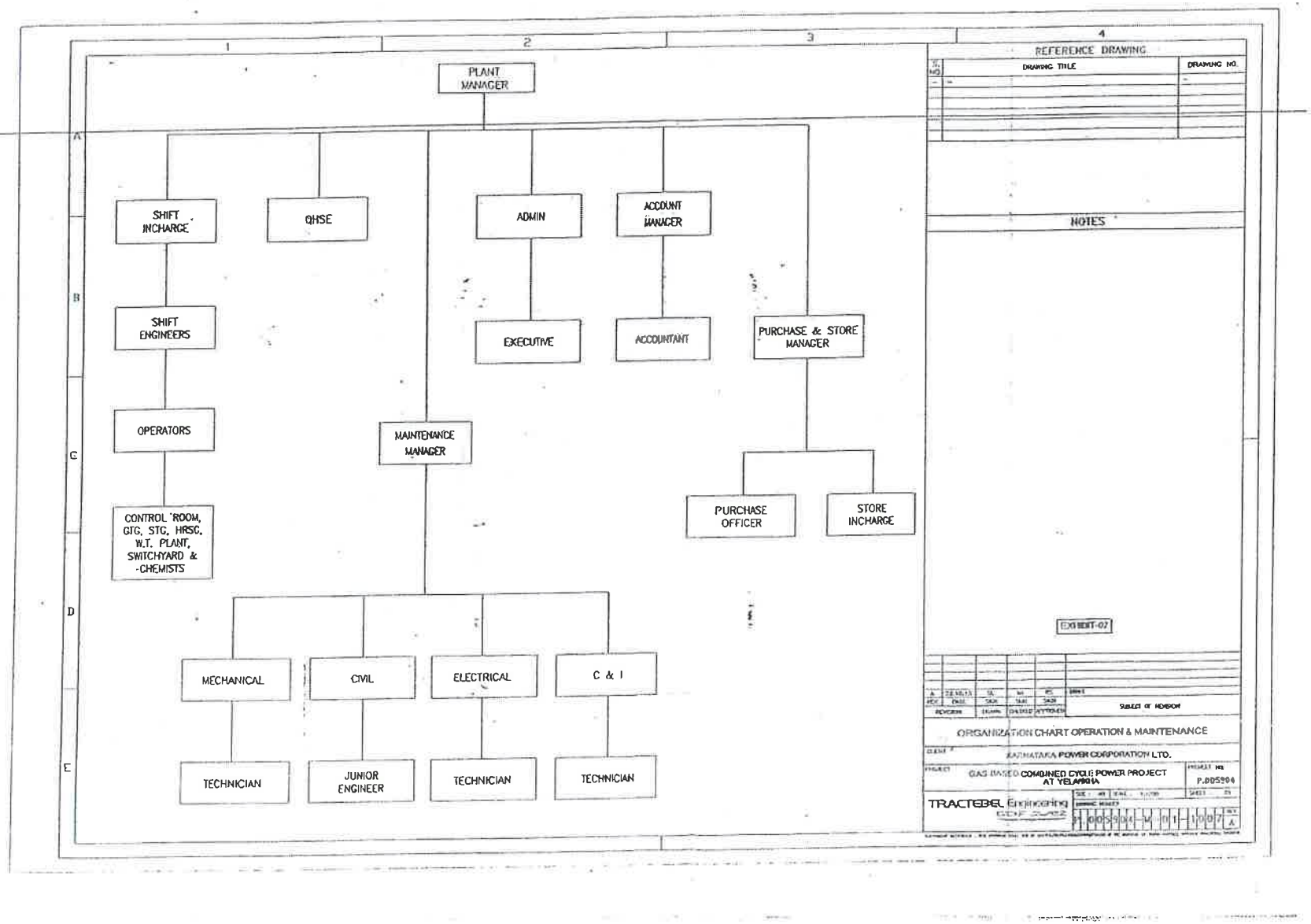
PLANT MANAGER
SHIFT INCHARGE
QHSE
ADMIN
ACCOUNT MANAGER
SHIFT ENGINEERS
EXECUTIVE
ACCOUNTANT
PURCHASE & STORE MANAGER
OPERATORS
MAINTENANCE MANAGER
CONTROL ROOM, GTG, STG, HRSG, W.T. PLANT, SWITCHYARD & CHEMISTS
PURCHASE OFFICER
STORE INCHARGE
MECHANICAL
CIVIL
ELECTRICAL
C & I
TECHNICIAN
JUNIOR ENGINEER
TECHNICIAN
TECHNICIAN
REFERENCE DRAWING
DRAWING TITLE
DRAWING NO.
NOTES
EXHIBIT-07
ORGANIZATION CHART OPERATION & MAINTENANCE
KARNATAKA POWER CORPORATION LTD.
GAS BASED COMBINED CYCLE POWER PROJECT AT YELAHANKA
TRACTEBEL Engineering

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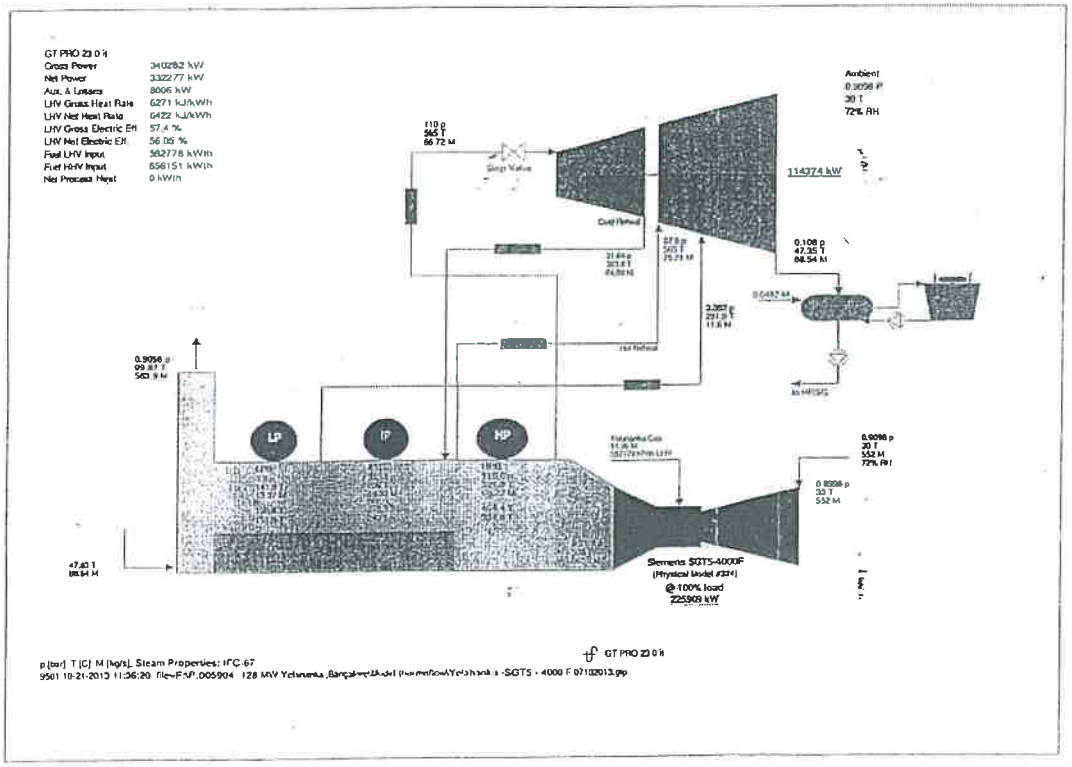

REFERENCE DRAWING

NO.	DRAWING TITLE	DRAWING NO.
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NOTES

EXHIBIT-08A

OPTION #2

REVISION	DRAWN	CHECKED	APPROVED	SUBJECT OF REVISION

PROCESS FLOW DIAGRAM

CLIENT: KARNATAKA POWER CORPORATION LTD

PROJECT: GAS BASED COMBINED CYCLE POWER PROJECT AT YELAHANKA

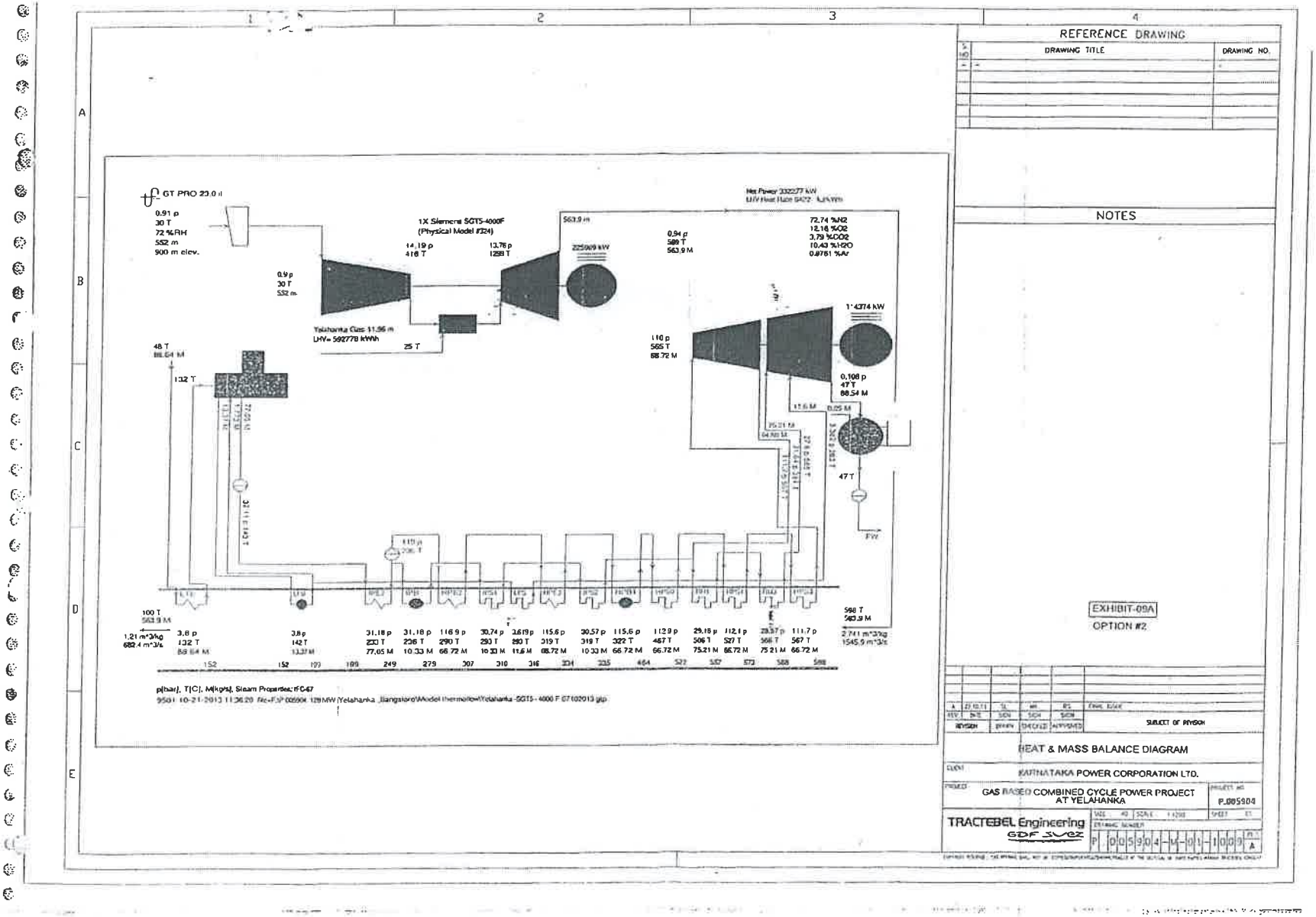
PROJECT NO: P.005904

TRACTEBEL Engineering GDF SUEZ

SHT. NO | SCALE: 1:250 | SHEET NO

DRAWING NUMBER: P 0 0 5 9 0 4 - M - 0 1 - 1 0 0 8 | REV. A

176



REFERENCE DRAWING

DRAWING TITLE	DRAWING NO.

NOTES

EXHIBIT-09A
OPTION #2

REV	DATE	DSN	DWN	CHK'D	APPROVED	SUBJECT OF REVISION
A	27.10.13	TL	MR	RS	ENVIL ISSUE	

HEAT & MASS BALANCE DIAGRAM

CLIENT: KARNATAKA POWER CORPORATION LTD.

PROJECT: GAS BASED COMBINED CYCLE POWER PROJECT AT YELAHANKA

PROJECT NO: P.005904

TRACTEBEL Engineering GDF SUEZ

DRAWING NUMBER: P 005904 M 01 1009 A

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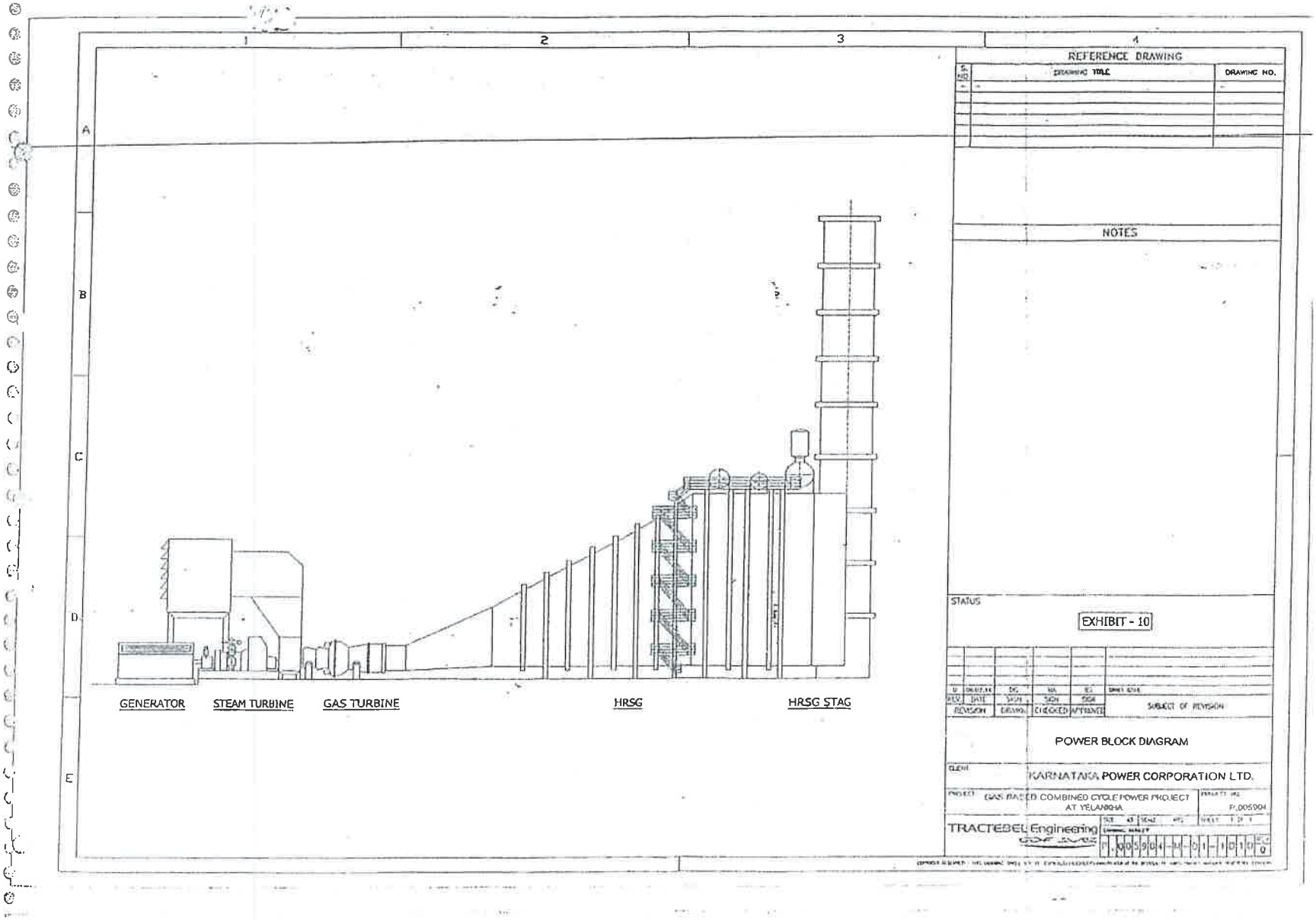
1
2
3
4
A
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C
D
E
GENERATOR
STEAM TURBINE
GAS TURBINE
HRSG
HRSG STAG
REFERENCE DRAWING
SR. NO.
DRAWING TITLE
DRAWING NO.
NOTES
STATUS
EXHIBIT - 10
REVISION
DRAWN
CHECKED
APPROVED
SUBJECT OF REVISION
POWER BLOCK DIAGRAM
CLIENT
KARNATAKA POWER CORPORATION LTD.
PROJECT
GAS BASED COMBINED CYCLE POWER PROJECT
AT YELAHANKA
P.005904
TRACTEBEL Engineering
0.005904-M-01-101
0

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Annexure-R6

By Speed Post

No. SEIAA 20 IND 2014

STATE LEVEL EXPERT APPRAISAL COMMITTEE, (SEAC) KARNATAKA

Department of Ecology and Environment
M.S. Building, Bangalore- 560 001.
Dated: - 19th January 2015.

To

The Chief Engineer (EI & TA),
M/s. Karnataka Power Corporation Ltd.,
122/23, Sudharshan Complex, Sheshadri Road,
Bengaluru-560 009

Sir,

Sub: Proposal for establishment of 1X350MW Gas Based Yelahanka Combined Cycle Power Plant at Sy. Nos. 44(P), 45, 46, 47/1-2, 48, 56/1 to 9, 57, 58, 59, 60/1-2, 61, 62/1-2, 63, 64, 65, 66/1-2, 67 of Puttenahalli village, 24, 25, 26-P, 28P of Kenchanahalli village, Yelahanka, Bengaluru District of M/s. Karnataka Power Corporation Ltd. - ToRs - Regarding.

Please refer to your letter No. CE(EI&TA)/ENV/YEL/833 dated 20.12.2014 along with Form-1 and proposed ToRs as per the EIA Notification, 2006.

2. The proposal is for establishment of 1X350MW gas based combined cycle power plant at Sy. Nos. 44(P), 45, 46, 47/1-2, 48, 56/1 to 9, 57, 58, 59, 60/1-2, 61, 62/1-2, 63, 64, 65, 66/1-2, 67 of Puttenahalli village, 24, 25, 26-P, 28P of Kenchanahalli village, Yelahanka, Bengaluru District.

3. The State Expert Appraisal Committee, Karnataka has considered the project during its meeting held on 13th and 14th January 2015. Based on the consideration of the documents submitted and the presentation made by you and the Environment Consultant, the Committee categorized the said proposal as B1 and has decided to prescribe the following Terms of Reference (ToRs) for preparing draft EIA report for the above mentioned project:

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1. Executive Summary of the project giving a prima facie idea of the objectives of the proposal, use of resources, justification, etc. in addition, it should provide a compilation of EIA report, EMP and the post-project monitoring plan in brief.
2. Conformity of the site with the prescribed guidelines in terms of distance of 500 m from HFL of the river, highways and railway lines should also be shown.
3. All the coordinates of the plant site to be shown on toposheet.
4. The study area should cover an area of 10 km radius around the proposed plant site.
5. Land requirement for the project to be optimized. Item wise break up of land requirement and its availability to be furnished. The norms prescribed by Central Electricity Authority (CEA) should be kept in view. The issue related to land acquisition and R & R should be clearly discussed in EIA report.
6. Location of intake and outfall points (with coordinates) should be given. These locations should be selected based on modeling studies. Details of modeling and the results obtained there from should be furnished. Details of desalination plant, if any, and disposal of sludge.
7. Topography of the area should be given clearly indicating whether the site requires any filling. If so, details of filling, quantity of fill material required, its source, transportation etc. should be given.
8. Impact on drainage of the area and the surroundings.
9. Information regarding surface hydrology, water regime and impact of the same, if any due to the project.
10. Surface water quality of nearby river (60 m upstream and downstream) and other surface drains at eight locations must be ascertained.
11. One season site-specific meteorological data shall be provided.
12. Action plan to follow National Ambient Air Quality Emission Standards issued by the Ministry vide G.S.R. No. 826(E) dated 16th November, 2009 should be included.
13. Ambient air quality at 8 locations within the study area of 10 km aerial coverage from project site.
14. One complete season AAQ data (except monsoon) to be given along with the dates of monitoring. The parameters to be covered shall include SPM, RPM, SO2, NOx, Hg and Ozone (ground level). The location of the monitoring stations should be so decided so as to take into consideration the pre-dominant downwind direction, population zone and sensitive receptors including reserved forests. There should be at least one monitoring station in the upwind direction. There should be at least one monitoring station in the predominant downwind direction at a location where maximum ground level concentration is likely to occur.
15. Impact of the project on the AAQ of the area. Details of the model used and the input data used for modeling should also be provided. The air quality contours may be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any. The wind roses should also be shown on this map.

16. Quantity of fuel required, its source and transportation. Details of gas supply agreement / commitment to be provided.
17. Examine the feasibility of zero discharge. In case of any proposed discharge, its quantity, quality and point of discharge, users downstream etc. should be provided. The effluent shall be treated and reused to meet the service and greenbelt development water requirement.
18. Details of greenbelt i.e. land with not less than 1500 trees per ha giving details of species, width of plantation, planning schedule etc.
19. Detailed R&R plan/compensation package in consonance with the National / State R&R Policy for the project affected people including that due to fuel transportation system / pipeline and their ROW, if any, shall be prepared taking into account the socio economic status of the area, homestead oustees, land oustees, landless labourers.
20. Details of flora and fauna duly authenticated should be provided. In case of any scheduled fauna, conservation plan should be provided.
21. Details regarding infrastructure facilities such as sanitation, fuel, restroom, medical facilities, safety during construction phase etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase.
22. Measures of socio economic influence to the local community proposed to be provided by the project proponent. As far as possible, quantitative dimensions to be given.
23. Environmental Management Plan to mitigate the adverse impacts due to the project along with item wise cost of its implementation.
24. Risk assessment including fire and explosion issues due to storage and use of fuel should be carried out. It should take into account the maximum inventory of storage at site at any point in time. The risk contours should be plotted on the plant layout map clearly showing which of the proposed activities would be affected in case of an accident taking place. Based on the same, proposed safeguard measures should be provided. Measures to guard against fire hazards should also be provided.
25. Any litigation pending against the project and /or any direction /order passed by any Court of Law against the project, if so, details thereof.
26. Details of water balance (water intake, use, wastewater generation) taking into account reuse and re-circulation of effluents. Additional water conservation measures, if any, proposed for the project.
27. Land use of study area should include data about the residential/institutional/nearest village/ township/ locality/ housing society, etc., based on the satellite imagery.
28. If ecologically sensitive attributes fall within a 10 km radius of the project boundary, proponent shall describe the sensitivity (distance, area and significance) and propose the additional points based on significance for review and acceptance by the State Expert Appraisal Committee (SEAC). A map

marking the location of such areas (existing or proposed) duly authenticated by the Chief Wildlife Warden. Ecological sensitive attributes include:

- National Parks.
- Wildlife Sanctuaries Game Reserve.
- Tiger Reserve/Elephant Reserve.
- Breeding Grounds.
- Habitat for migratory birds.
- Areas with threatened (rare, vulnerable, endangered) flora/fauna.
- Wetlands.
- Zoological Gardens.
- Reserved Forests/ Protected Forests.
- Any other closed/protected area under the Wild Life (Protection) Act, 1972, any other area locally applicable.

32. If the plant location falls in a valley, studies on specific issues connected to the management of natural resources.
33. Impact on drainage of the area and the surroundings.
34. Details of rainwater harvesting and its proposed usage in the plant.
35. Action plan for the green belt development Details of greenbelt giving details of species, width of plantation, planning schedule, etc.
36. Green belt shall be developed in atleast 33 % of plant area as per the CPCB guidelines in consultation with the DFO.
37. Proposed measures for occupational safety and health of the workers.
38. Details of alternative sources of energy such as photovoltaic cells use in the plant for various applications.
39. Details on improved technologies.
40. Appropriate monitoring network has to be designed and proposed for regulatory compliance and to assess the residual impacts, if any.
41. Detailed compensation package for the people affected by the project shall be prepared, considering the socio-economic status of the area, homestead oustees, land oustees, and landless labourers.
42. Proposed post-project monitoring programme to ensure compliance to the approved Management Plan including administrative and technical organizational structure.
43. Details of alternative sites for the proposed project.
44. Disaster Management Plan.
45. Source of water for the project and necessary clearance.
46. The EIA studies should also take into account another power plant proposed (if any) in the same village.

47. At least 5 % of the total cost of the project should be earmarked towards the corporate social responsibility and item-wise details along with time bound action plan should be included. Socio-economic development activities need to be elaborated upon.

Additional Corporate Environmental Responsibility:-

(i) (a) Does the company have a well laid down Environment Polity approved by its Board of Directors? If so, it may be detailed in the EIA report.
(b) Does the Environment Policy prescribe for standard operation process/procedures to bring into focus any infringement/deviation/violation of the environmental or forest norms/conditions? If so, it may be detailed in the EIA.

(ii) What is the hierarchical system or Administrative order of the company to deal with environmental issues and for ensuring compliance with the Environmental Clearance conditions details of this system may be given.

(iii) Does the company have a system of reporting of non-compliances/violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism should be detailed in the EIA report.

PLEASE NOTE:

1. The project proponent shall submit an undertaking as a part of the EIA report, owning the contents (information and data) of the EIA report in view of the O. M. No. J-11013/41/2006-IA-II(I) dated: 05.10.2011 issued by MoEF, GoI and
2. The project proponent shall submit the filled up information in the enclosed Format "Declaration by experts contributing to the EIA" thus forming it the first page of their EIA report. Otherwise, it will be at the project proponent's risk.

Additional ToRs:

1. Study of source of water and impact on the competitive users of the treated sewage of BWSSB.
2. Mode of disposal of the DM water reject and its impact.
3. Impact on the Puttenahalli and Yelahanka lakes.
4. Monitoring Methane and Carbon Monoxide along with PM_{10}, $PM_{2.5}$ NO_2 and SO_2
5. Impact of cumulative noise pollution due to the railway station, wheel and axel plant and the proposed activity and mitigation measures thereon.

6. Impact on the Temperature and Humidity levels of the surrounding area due to the proposed activity.
7. Risk assessment and disaster management plan within the plant and in the Surroundings of up to 500 m.

The ToRs prescribed by the State Expert Appraisal Committee, Karnataka should be considered for the preparation of EIA / EMP report for the above mentioned project in addition to all the relevant information as per the Generic Structure of EIA given in Appendix III and IIIA in the EIA Notification, 2006.

The consultants involved in the preparation of EIA/EMP report after accreditation with Quality Council of India/National Accreditation Board of Education and Training (QCI/NABET) would need to include a certificate in this regard in the EIA/EMP reports prepared by them and the data provided by other Organization(s)/Laboratories including their status of approvals etc. In this regard Office Memorandum No. F. No. J-11013/77/2004-IA.II(I) dated 30th June, 2011 available on the MoEF, GoI website http://www.moef.nic.in may please be referred.

(iii) The project is exempted from the applicability of public consultation in accordance with Para 7(i)(III)(i)(b) of the Notification No. S.O.1533(E) dated 14th September 2006 as the proposed activity is located within a notified industrial area.

Yours faithfully

For Secretary,
State Expert Appraisal Committee
(SEAC)

Copy to:-

1. The Secretary, Department of Ecology and Environment, Govt. of Karnataka, Bangalore
2. Chairman, Karnataka State Pollution Control Board, Parisar Bhavan, 4th & 5th Floor, Church street, Bangalore -560 001
3. Guard File.

Annexure- R7

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

FOR

PROPOSED 1 X 350 ± 20% MW YELAHANKA COMBINED CYCLE POWER PLANT

LOCATED AT:

DG POWER PLANT, YELAHANKA

DISTRICT: BENGALURU, STATE: KARNATAKA

PROJECT PROPONENT

KARNATAKA POWER CORPORATION LIMITED

CORRESPONDENCE ADDRESS

N. SHANKAR

CHIEF ENGINEER (EI&TA)

#22/23, SUDARSHAN COMPLEX, 3RD FLOOR

SESHADRI ROAD, BANGALORE (KARNATAKA)

PREPARED BY:

MANTEC CONSULTANTS PVT LTD.

D-36, SECTOR-6, NOIDA, GAUTAMBUDH NAGAR, U.P – 201301

WEBSITE: http://www.mantecconsultants.com

Email- ID: envmantec@yahoo.com

Ph No: +91 – 120 – 4215804, Fax No: +91 – 120 – 4215809

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Appendix

Questionnaire for Environmental Appraisal (Thermal Power Projects)

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CHAPTER-1: EXECUTIVE SUMMARY

1.1 INTRODUCTION

1.1.1 Project Proposal

Karnataka Power Corporation Ltd. (KPCL) is a state owned public limited company and is in the business of generation of electric power. KPCL has a total installed capacity of about 6500 MW consisting of Hydro-Electric Stations, Thermal Power Plants (TPP), Windmills and Solar PV Plants.

KPCL has proposed for the implementation of 1x 350±20% MW capacity gas based Combined Cycle Power project located at north of Bangalore along Bangalore – Doddaballapur Hindupur road situated at Yelahanka about 18km from Bangalore and 25km from Bangalore International Airport.

KPCL plans to implement a natural gas fired combined cycle power plant by abandoning the existing DG plant to increase the efficiency and to reduce atmospheric sulphur dioxide & suspended particulate matter emitting from DG sets.

Considering the proximity to the GAIL pipeline network, conversion of this plant to gas, assumes importance for better efficiency and will help existing industry cluster to get continuous supply of power and also enable for industrial growth in Bangalore city. In view of this, KPCL has proposed to augment the power generating capacity by installing a 1x350±20% MW capacity gas based Combined Cycle Power Plant at Yelahanka .

In this regard, KPCL approached Government of Karnataka for the implementation of 1x350±20% MW capacity gas based combined cycle power plant. Government of Karnataka, vide its order No. EN 28 PPC 2014 dated 27.07.2014 has accorded approval for establishing first block of gas based Combined Cycle Power Plant of 350±20% MW capacity at Yelahanka with RLNG as the fuel.

1.1.2 Purpose of EIA Report

As per the Environmental Impact Assessment Notification, 2006 (No. 1533 dated 14th September 2006), all thermal power plant projects require prior environmental clearance. The proposed project falls under Schedule 1(d) of the EIA Notification (S.O. 1533) dated 14th September 2006 and require Environmental Impact Assessment (EIA) study. As the proposed project is a gas based power plant with less than 500 MW capacity, it falls under Category 'B' of the schedule, and requires clearance from state level Environment Impact Assessment Authority (SEIAA). Accordingly, application seeking terms of reference for EIA studies was made to the Karnataka SEIAA, and the EIA studies were performed on the basis of the terms of reference granted to the proposal. The prime objective of this EIA report is for seeking prior environmental clearance from the Karnataka State Environment Impact Assessment Authority.

1.1.3 Project Location

The project site is located within premises of Yelahanka DG Plant at Yelahanka near Bangalore in the state of Karnataka. The plot of land under the plant premises comprises of land from Puttenahalli & Kenchenahalli Villages of Yelahanka Tehsil in District Bangalore. The DG plant is located at North of Bangalore along Bangalore–Doodaballapur-Hindupur State Highway, situated at Yelahanka, about 18km from Bangalore city. It is located within limits of Bruhat Bangalore Mahanagara Palike.

No ecologically sensitive area, viz., National Park, Wild Life sanctuary, wet-land, biosphere reserves, etc., is located within 10km distance from the site. BSF Compound is located at a distance of approximately 2.75km towards north east, and Yelahanka Air Force Base at approximately 2.9km in the same direction.

1.1.4 Importance of Project

Karnataka has been experiencing power shortage because of the growing demand for power due to rapid economic growth. The state government has taken up various projects in the public and private sector to add capacity. Recognizing the crucial role of power in achieving economic progress, Karnataka was one of the first Indian states to initiate reforms in power sector.

The proposed power project of about 1x350±20% MW capacity which is expected to be commissioned during 13th Plan period is fully justified from the demand supply consideration. Considering the shortage in total energy and peak load requirement of Karnataka State and Bangalore in particular the proposed power project near Bangalore is justified.

1.2 PROCESS DESCRIPTION

The basic principle of the Combined Cycle is simple: burning gas in a gas turbine (GT) produces not only power – which can be converted to electric power by a coupled generator – but also fairly hot exhaust gases.

Air is compressed in a compressor and the air-fuel mixture is injected into the combustion chamber and fired. The hot product of combustion, at 1000 to 1300°C, is expanded in the gas turbine, which drives the generator, where mechanical energy is converted into electrical energy and on the other end an axial flow compressor, provides the combustion air. To reduce the generation of NOx during the combustion process in the GT set, it is proposed to incorporate DLN burners, which would effectively reduce the NOx concentration in flue gas to below 25 ppm level.

In the combined cycle operation, the heat content of the exhaust gas from the gas turbine is utilized to produce steam in the heat recovery steam generator (HRSG). The exhaust gas from the gas turbines, at about 625°C, will enter the HRSG boilers, where the residual energy will be utilized for generating HP and LP steam. The steam, in turn, is utilized to generate electrical energy in the steam turbine. The spent steam from the ST is condensed, extracted, de-aerated and recycled back to the HRSG as boiler feed water. The flue gas, at about 100°C, will be discharged into the atmosphere through stacks of 45m height.

1.3 POLLUTION CONTROL SYSTEM

The various types of pollution from the proposed power plant are categorized under the following types:

- Water Pollution;
- Air Pollution;
- Noise Pollution; and
- Thermal Pollution.

Waste gases of combustion and waste water from different operations are the major waste products discharged from the proposed power plant. As the proposal is for a gas based plant, solid wastes will be, practically, absent. The gaseous and liquid wastes generated in the plant will be treated to conform to the statutory requirements and to suit the environmental status of the surrounding area.

The various proposed pollution control systems are described in the following sections.

1.3.1 Water Pollution

The sources of water pollution are:

- Cooling tower blow down.
- HRSG blow down.
- Effluent from DM plant/ water treatment (WT) plant.
- Plant washings & miscellaneous drains.

The blow down water will be led to the guard pond along with other influents to the guard pond which includes the effluents from the neutralizing pit, RO plant reject, clear water from the outlet of the oil water separator and, HRSG blow down. Water collected in the guard pond will be treated for pH correction and also diluted if required with water drawn from the tertiary water storage tank - to the standards as stipulated by Pollution Control Board. The water collected in the guard pond will be used for plant cleaning, gardening, firefighting, etc. Small quantity water if Remaining is pumped (after 24 hours detention period) to nala after necessary treatment (as per the norms of pollution control board). The final effluents discharged from the Guard Pond will conform to the regulatory standards of Karnataka State Pollution Control Board.

1.3.2 Air Pollution

A Combined Cycle Power Plant (CCPP), using natural gas, is much more environmentally compatible as compared to coal-based power plant of similar capacity. In the absence of coal handling, ash handling and ash disposal areas, fugitive dust emissions and release of pollutants in stack emissions would be significantly lower. As re-gasified LNG is proposed to be used as the only fuel at this plant, particulate emissions will be eliminated. Further, as Sulphur content in the natural gas is very low (less than 24 ppm, w/w), SO_2 emission from the combustion of fuel will also be negligible. Dry Low NOx (DLN) Burners, consisting of two-stage premixed combustor, will be provided to control NOx emissions below 25 ppm level. Appropriate stack height (45 m) in line with the requirement of

regulatory agencies for control of gaseous emissions would be provided. NOx emissions will be controlled as per the regulations of Ministry of Environment, Forest& Climate Change. As the combined cycle plant would be free from particulate emissions, no specific control measures are envisaged.

The guarantee value of NOx for the proposed CCPP is 25 PPM. However, to release the exhaust gases from HRSG to atmosphere to avoid local dispersion as per the norms, a stack height of about 45mtr above the ground level is considered adequate. Automatic On – line stack monitoring instrument will be provided for monitoring of NOx emission.

1.3.3 Noise Pollution

The sources of noise pollution in a power plant are:

- Air inlet & exhaust gas streams
- Steam turbine generator
- Other rotating equipment
- Combustion induced noises
- Flow induced noises
- Steam safety valves

All the equipment in the power plant would be designed to have a total noise level not exceeding 85 dB (A). Generally the manufacturers of the gas turbine generators indicate the following noise level values:

- 85 dB (A) at a distance of 1.5 m from the gas turbines
- 65 dB (A) at a distance of 120 m from the gas turbines

The inlet air and exhaust gas streams would be provided with silencers for noise reduction. Generally there would not be any operators near the gas turbine generator on a continuous basis. However, maintenance personnel working local to gas turbine generator building would be provided with adequate protection against noise. The steam turbine generator would be housed in a closed building thereby reducing the transmission of noise to the outside environment.

1.3.4 Thermal Pollution

The combined cycle power plant envisages installation of unfired heat recovery steam generators to utilize the heat content of the exhaust gas from the gas turbines. Installation of HRSG to recover heat from the gas turbine exhaust gas would enable reduction of the temperature of the exhaust gas to the lowest possible value, thereby reducing the thermal heat discharge into the atmosphere. The flue gas temperature at HRSG exit would be approximately 100 degree Celsius. Simple cycle operation of CCPP is not envisaged and no by-pass stack is provided on the up-stream of the HRSG.

1.4 BASELINE ENVIRONMENTAL STATUS

1.4.1 Study Period & Study Area

The studies were performed to cover the pre-monsoon or summer season (one full season) of the year 2015. Thus, the studies were started on 10th March, 2015 and continued up to 9th June, 2015. The area of influence for the environmental impact assessment was considered as the area falling within 10km radius from the project site. Thus the study area considered for determining the baseline environmental status is the area falling within 10km radius from the project site.

1.4.2 Land Environment

Yelahanka is at a height of about 915 meters (3000 feet) above mean sea level. Due to its higher altitude from mean sea level, it is lush green and has pleasant weather year round. The site is practically level as it is inside the boundary of the existing power plant. The lowest and highest level of elevation of the proposed project is 897m AMSL & 912m AMSL creating a difference of 15m. The land inside the plant is plain and is sloping towards south East.

Soil texture in the study area is silty loam. The levels of main nutrients, viz., nitrogen, phosphorous and potassium are in the range 10.8-14.2mg/100gm, 42.6-50.2mg/100gm and 0.68-0.78mg/100gm, respectively. Based on the soil analysis reports, it is concluded that the soil in the area is fertile.

1.4.3 Climate & Meteorology

Bangalore has a tropical savanna climate (Köppen climate classification Aw) with distinct wet and dry seasons. Due to its high elevation, Bangalore usually enjoys a more moderate climate throughout the year, although occasional heat waves can make summer somewhat uncomfortable.

The proposed site is located in Seismic Zone-II as per the Indian standard IS-1893 (1984). Elevation above mean sea level is 900m above the mean sea level. Basic wind speed 6.86 km/hr. Average rainfall is about 52.8mm.

1.4.4 Air Environment

The ambient air quality survey was conducted for one full season, covering the pre-monsoon season of 2015. The study was started on the studies were started on 10th March, 2015 and continued up to 9th June, 2015. The maximum observed concentrations are given in **Table-1.**

Table 1: Maximum Observed Concentrations Air Pollutants

Sampling location	Maximum observed concentrations, µg/m³							
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	O_3	CO	Hg	CH_4
Anantapura Gate-Project Site	80	46	8.2	17	32	900	--	950
Jarakabande reserve forest (Virasagra)	78	42	7	11	28	730	--	695
Lingarajpura	86	47	11	18	30	980	--	918
Huhasamaranahalli	91	51	12	22	35	1030	--	938
Kenchenahalli	82	46	9.2	15	32	950	--	740
Yelahanka Satellite town	85	48	9.2	20	31	1100	--	980
Marutinagar	81	44	8	16	29	940	--	860
Laxmipura	88	49	10.2	20	33	1010	--	940
National AAQ Standards	100	60	80	80	100	2000	NA	NA

Based on the results of monitoring, it is concluded that the study area has adequate carrying capacity to sustain further industrial development.

1.4.5 Noise Level

Noise levels were measured, using an Integrating sound level meter, at 8 monitoring locations - 5 in industrial areas, one in silence zone, one in residential area and one in industrial areas, and day and night time equivalent noise levels were computed from recorded hourly data. The observed values are well within the specified limits for respective area categories.

1.4.6 Water Environment

To establish the water quality of the study area, 3 ground water and 6 surface water sources were identified and characterized. The ground water charcteristics in the region have been compared with respect to the Drinking Water Quality Standards as per IS:10500. Total dissolved solids, alkalinityy, pH, chloride, sulphate, phosphate and nitrate concentration at all locations in the area are within the desirable limits. However, total hardness concentrations at some locations exceed the desirable limits, but are well within the permissible limits. Rest of the physico-chemical parameters and heavy metals were well within the desirable limits of the standard. The characteristics of surface water samples from the 4 locations are within the tolerance limits for surface water sources under Class B, specified by Central Pollution Control Board.

1.4.7 Biological Environment

The study has been carried out in the entire study area. Out of 86 terrestrial flora belongs to 50 trees, 27 herbs, 5 climbers and 4 shrubs. Sum of 55 faunal species were recorded from the area which belongs to 28 birds, 16 butterflies, 5 mammals, 6 reptiles and amphibians. 8 species of aquatic weed reported and it belongs to 6 different families. Sum of 8 fish species belong to 4 different families.

1.4.8 Socio-economic Environment

The study area constitutes 50 villages and 23 wards as part of study area of Yelahanka. Total population of the study area is 1152241, comprising 601336 males and 550905 females. Sex ratio in the study area is 945 females/1000 males. Total literacy is found to be 907580 in the study area. Main workers constitute 37.91%, whereas marginal workers constitute 9.66% of total population. Within the main workers, cultivators, agricultural workers and other workers constitute 8532, 8221 and 410009, respectively. Due to proximity and ease of access to Bangalore City, medical and educational facilities in the city are available and accessible to the rural areas of the study area.

1.5 ENVIRONMENTAL IMPACT ASSESSMENT

1.5.1 Land Environment

The impacts of the proposed facilities during construction and operation phase are as follows:

- The landfill and excavation activities during construction phase will be limited within area identified for the main plant and raw Water Reservoir. Thus, there is no impact on topography.
- During construction phase some construction waste material will be generated. The civil wastes will be utilized for land fill and the metallic wastes will be disposed as scrap. Thus, it will have no impact on the land environment.
- As natural gas shall be used as main fuel, which will be handled through pipelines, no impact on land environment is envisaged during raw material handling.
- No toxic solid waste will be generated. Sludge from Lamella Clarifier, used oil and used containers will be disposed through CPCB/KSPCB approved vendors. Municipal wastes will be collected in bins and disposed through BBMP facilities. Thus, impact due to disposal of solid wastes is not envisaged.
- As the land is under possession of KPCL and under industrial use, no impact due to change in land use is envisaged.

1.5.2 Air Environment

The particulate matter will be the main pollutant due to the excavations, handling and transport of earth and construction material etc. at site. The other pollutants will be NO_x due to the construction activities like operation of construction equipment and traffic movement.

Since the construction activities is a temporary activity and hence the increase in particulate matter and NO_x will be for short duration and its impact will be felt close to the construction site only. Outside the boundary of project activities, the impacts would be marginal or insignificant.

Air modeling was conducted to analyze the impact on air quality during operational phase and it was seen that there is negligible change in the existing levels, and the resultant GLC's obtained at various locations for the study period are well within the National Ambient Air Quality Standards.

1.5.3 Water Environment

The requirement of water for construction purpose will be met through existing ground water facilities of DG Power Plant and IOCL tank farm. No waste water will be generated during construction phase. As the land preparation does not involve major earth work, surface run-off of excavated soil during heavy rains is not envisaged. The construction work force will utilize the existing rest rooms and toilets of DG Plant and IOCL Tank Farm. Therefore, no impact is envisaged during construction phase.

As the tertiary treatment facilities are being made by BWSSB for exclusive use by the proposed Yelahanka CCPP, impact on water resources and competing users are not foreseen.

The major part of effluent is from blow-down of cooling water from the CW system, RO rejects and UF Backwash. It is observed that the characteristics of wastewater in the Guard Pond will be well within the specified Standards for Wastewater for Discharge into Inland Surface Waters. It is therefore, concluded that discharge of effluents from the Guard Pond in the drain leading to Yelahanka Lake will have no impact on the water quality and aquatic life of the lake.

1.5.4 Noise Environment

The ambient noise level recorded during field studied within distance of 10 km radius from the site ranges between 42-59.2 dB(A). As the ambient noise levels are well within the prescribed noise levels, no increase in the ambient noise levels during construction phase is envisaged. On the basis of the noise modelling done for analysing impacts during operational phase, it is concluded that the existing noise level in the area will remain unchanged. Thus, no impact on the noise level is foreseen.

1.5.5 Biological Environment

The impact of proposed plants on vegetation in the study area may occur through following ways:

During Construction Phase

As the project area is devoid of natural forests, the overall impacts on terrestrial ecosystem (e.g. loss of flora and fauna) will be negligible. The site and area around the site will experience some increase in pollution SPM. Deposition of fugitive dust on pubescent leaves of nearby vegetation may lead to temporary reduction of photosynthesis. Such impacts would, however, be confined mostly to the construction phase and would also be regulated and minimized through adoption of control measures such as paving and surface treatment, water sprinkling .

During Operation Phase

There is only one major gaseous pollutant NOx. As DLN burners shall be incorporated to reduce the formation of NOx, long-term incremental ground level concentration of NOx in the study area due to plant operation will be very low. Thus, impact of the emissions on terrestrial ecosystems is likely to be insignificant. The incremental concentration of NOx at the Jarakabande Reserve Forest during March-May has been computed as 11 $\mu g/m^3$. Thus, no significant changes will be there from present circumstances.

1.5.6 Socio-economic Environment

The proposed project will impart significant positive impact on the economy, employment potential and social structure of the area. In addition to the skilled work-force (100 persons) on permanent rolls of the company, approx. 250 semi-skilled and un-skilled persons will be required, on contract basis, for operation of the plants and facilities. Majority of this work force will be drawn from the local population. Therefore, the proposed project will provide employment opportunities to approx 350 persons from the neighbouring poulation.

1.6 ENVIRONMENTAL MANAGEMENT PLAN

1.6.1 Air Environment

The proposed mitigation measures to be followed during construction and operation of the proposed facilities are as follows:

- Generation of atmospheric dust during construction phase due to movement of vehicles and earthmovers as well as due to filling and leveling shall be controlled through spray of water.
- The afforestation plan shall be aimed to cover all the vacant areas near the boundary walls.
- NOx concentration in the flue gas shall be monitored continuously by on-line monitor.
- Bypass stack shall not be provided.

1.6.2 Biological Environment

The following mitigation measures are proposed:

- It shall be ensured that all the pollution control/ environment management systems are commissioned as a part of main plant equipment, before the commencement of the operation of the project.
- For Ecological improvement and attenuation of air pollutants (mainly NO_2) in source receptor pathway and in order to improve the vegetation cover, it is suggested to carry out green belt development and plantation over an area of approx. 4 hectares.
- Routine monitoring of pH of waste water discharged from the Guard Pond.
- Blow down from the cooling water system will be taken from the basin of the cooling tower.
- In consultation with Fisheries Department, every year about 50,000 fish lings of "Dodda Gende" and other local variety will be fed to Puttenahalli and Yelahanka Lakes to maintain a healthy fish population.
- Studies will be conducted regarding the Impact of the Plant on the Fish population in the above lakes once in every two years for a period of 10 years after the commissioning of the Plant. In the event of any adverse effects due to the establishment of the plant, necessary mitigate measures would be taken.

1.6.3 Water Environment

The following mitigation measures shall be practiced:

- All the trade effluents will be transferred to the Guard Pond, after appropriate treatment, through pipelines.
- Tanks for effluents from DM unit and floor washings will be provided with impermeable lining.
- In cooling water system, a minimum of three cycle of concentration will be practiced.
- Wastage and spillage of water shall be avoided.
- From the Guard Pond, pipelines will be provided for irrigation of afforested areas. Use of raw/process waste for irrigation shall be strictly prohibited.
- Sewage from toilets and washrooms will be treated in septic tanks and disposed in soak pits.
- The final effluent, before discharge, will be diluted by raw water, before discharge into the drain to maintain the TDS concentration at approx 2000 mg/l.

1.6.4 Noise Environment

The following mitigation measures shall be practiced:

- The inlet air and exhaust gas streams would be provided with silencers for noise reduction.
- Adequate measures have been incorporated in the proposed plant for control of noise and vibration from the different equipment. This control of noise within the plants is through the provision of silencers, hoods, and acoustic walls to the noise generating equipment. Suppliers of Steam Turbines, Generator and Compressors shall ensure that the noise levels from these equipment do not exceed desirable noise level of 90 dB(A).
- For mitigation of noise, a proper green belt development program has been formulated, which would further attenuate noise to bring its level down within acceptable levels.
- The control rooms shall be provided with acoustic glass walls to protect the workers from higher noise level. As the operational staff shall remain within the control rooms for most of the time, they will be exposed to the higher noise levels for very short duration. During the visits to the areas of higher noise levels, the operational and maintenance personnel will use earplugs as a safety measure.
- Control of vibration shall be achieved by providing proper foundation and alignment to the vibration generating heavy equipment. Moving parts of equipment and earthmovers shall be properly maintained and lubricated to minimize the generation of noise.

1.6.5 Green Belt Development

An area of approximately 9 ha (approx. 33% of total land area) has been identified for plantation and green belt development The project area land, in the present form, is suitable for the growth of tree species. Locally available species of trees, known to prosper well in the area will be preferred for plantation to promote the greenbelt in the study area.

1.6.6 Corporate Social Responsibility

The project proponents are aware of their social responsibilities and are committed to undertake welfare schemes under CSR scheme. On grant of necessary clearances for establishing the proposed

project, the company will take up the matter with appropriate authorities, discuss the proposed CSR scheme for the nearby villages, and implement the same as per MOU with the authorities.

1.6.7 Occupational Health & Safety

In addition to the safety measures incorporated at design stage, the following control and mitigation measures are proposed.

- Formation and functioning of EHS Cell under Manager (EHS)
- Training to all employees for EHS policy, basic life support, first aid, and fire-fighting
- Routine health checkup of employees
- Emergency preparedness
- Work-zone ambient air quality monitoring
- Introduction and strict compliance of work permit system and use of applicable PPEs
- Training on industrial hygiene

The following general safety measures will also be followed.

- Awareness about the hazardous substance handled in the project and the associated risks.
- Personnel engaged in handling of hazardous substance will be trained to respond in an unlikely event of emergencies.
- Safe work practices and work permit system will be developed and implemented.
- Adequate firefighting facilities, including dry chemical powder type, water CO_2 type and foam type extinguishers and sand buckets will be provided at appropriate locations.
- Personnel will be trained to combat the events of fire and exposure to chemical hazards.
- The firefighting system will be tested and maintained as per relevant standards.

1.6.8 Environmental Monitoring

A detailed environmental monitoring plan, including ambient air quality, work zone air quality, ground water quality, noise level, status of green belt & plantation, employees' health, energy & resources consumption, etc. for the proposed project has been outlined. Automatic continuous monitoring of NOx is also proposed.

CHAPTER-2

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CHAPTER-2: INTRODUCTION

2.1 PURPOSE OF REPORT

Karnataka Power Corporation Ltd. (KPCL), a state owned Public limited Company engaged in the business of generation of electric power, propose to establish and operate a 350±20% MW natural gas fired combined cycle power plant in the premises of the Diesel based power plant at Yelahanka. The proposed plant will generate power from a Gas Turbine and a HRSG based Steam Turbine. As per the Environmental Impact Assessment Notification, 2006 (No. 1533 dated 14th September 2006), all thermal power plant projects require prior environmental clearance. The proposed project falls under Schedule 1(d) of the EIA Notification (S.O. 1533) dated 14th September 2006 and require Environmental Impact Assessment (EIA) study. As the proposed project is a gas based power plant with less than 500 MW capacity, it falls under category 'B' of the schedule, and requires clearance from state level Environment Impact Assessment Authority (SEIAA). Accordingly, application seeking terms of reference for EIA studies was made to the Karnataka SEIAA, and the EIA studies were performed on the basis of the terms of reference granted to the proposal. The prime objective of this EIA report is for seeking prior environmental clearance from the Karnataka State Environment Impact Assessment Authority.

Additional objectives of the EIA study are:

- To describe the Project and associated activities together with the need for implementation of the Project;
- To establish existing baseline status of different components of the environment so as to facilitate visualization of post-project scenario;
- To identify and quantify the environmental impacts associated with the project and recommend appropriate mitigation measures;
- To propose mitigation measures to minimize environmental deteriorate on and nuisance during construction and operation of the Project.
- To identify, assess and specify methods, measures and standards, to be to be taken into consideration during detailed engineering design, construction and operation of the project;
- To identify and justify the scope for post-project environmental monitoring to ensure the implementation and the effectiveness of the environmental protection and pollution control measures; and
- To identify any additional studies necessary to fulfill the objectives to the requirements of this EIA Study.

2.2 IDENTIFICATION OF PROJECT & PROJECT PROPONENT

2.2.1 Project Proponent

Karnataka Power Corporation Ltd. (KPCL) is a state owned Public Limited Company and is in the business of generation of electric power. For over three decades, the Karnataka Power Corporation

has been a prime mover and catalyst behind key power sector reforms in the state – measures that have spiraled steady growth witnessed in both industrial and economic areas. Right from the year of inception, in 1970, KPCL set its sights on "growth from within" meeting growing industry needs and reaching out to touch the lives of the common man, in more ways than one.

KPCL today has an installed capacity of 6498.91 MW of hydel, thermal, solar and wind energy, with 9500 MW in the pipeline. The 1720 MW Raichur Thermal Power Station located in Raichur district is accredited with ISO 14001-2004 certification for its environment protection measures. From an industry vantage point, KPCL has raised the bar on the quality of deliverables and is constantly working at lowering the cost per megawatt – a commendable cost-value equation that has become a benchmark on the national grid. KPCL's stock in trade is industry proven – well-established infrastructure & modern, progressive management concepts and a commitment to excel, helping it meet the challenges of the rising energy demands of Karnataka.

The leverage point of KPCL initiatives are its resource management strengths – right across planning, financing and project engineering. KPCL also has a high rating in terms of project completion and commissioning within the implementation calendar.

KPCL also owns a 128 MW DG power plant located at Yelahanka near Bangalore which runs on fuels such as Diesel/LSHS/LSFO. The DG power plant has ceased operation since August, 2013 due to non-compliance of the pollution norms as stipulated by the Pollution Control Board and also due to high generation cost.

2.2.2 Project Proposal

KPCL plans to implement a new natural gas fired combined cycle power plant in the vacant area available in the DG plant premises to increase the efficiency and to reduce atmospheric sulphur dioxide & suspended particulate matter emitting from DG sets.

Considering the proximity to the GAIL pipeline network, implementation of a new gas based power plant assumes importance for better efficiency and will help existing industry cluster to get continuous supply of power and also enable for industrial growth in Bangalore city. In view of this, KPCL has proposed to augment the power generating capacity by installing a 1x350±20% MW capacity gas based Combined Cycle Power Plant at Yelahanka.

In this regard, KPCL approached Government of Karnataka for the implementation of 1x350±20% MW capacity gas based combined cycle power plant. Government of Karnataka, vide its order No. EN 28 PPC 2014 dated 27.07.2014 has accorded approval for establishing first block of gas based Combined Cycle Power Plant of 350±20% MW capacity at Yelahanka with RLNG as the fuel.

2.3 BRIEF DESCRIPTION OF PROJECT

2.3.1 Nature of the Project

The project proposal is for generation of electric power in a combined cycle gas turbine, using natural gas as the source of thermal energy. The thermal energy generated from combustion of

natural gas will drive the turbine, and residual heat of the gas stream exiting the turbine will be utilized to generate steam, which in turn, will generate electric power in steam turbine. Natural Gas (NG), the main fuel for the proposed power plant, will be supplied by GAIL. For this, GAIL has made preliminary route survey from tap off location at SV3B/Hebbel flyover junction to KPCL, Yelahanka. The water requirement for the proposed plant will be met by the tertiary treated sewage water from BWSSB treatment plant Jakkur /Puttenahalli, which are around 4-6km away from the plant site.

2.3.2 Size & Magnitude Operations

The main plant equipment consists of Gas Turbine Generator (GTG) and auxiliaries, Heat Recovery Steam Generator (HRSG) and auxiliaries including main stack, Steam Turbine Generator (STG) and auxiliaries, and gas forwarding station including gas booster station. The possible configuration of the main equipment shall be one block of 1GT+1HRSG+1ST in multiple shaft configurations with separate electrical generator for GT and ST to achieve 350±20% MW.

The Combined Cycle Power Plant (CCPP) with GTG of advanced technology is the most fuel-efficient form of electric power generation. The heat in the exhaust of gas turbine is recovered by generating steam in the HRSG. By maximizing the heat recovery and efficient utilization of the steam in steam turbine, the overall combined cycle efficiency can be improved.

It is proposed to evacuate the generated power from the nearest Yelahanka 220/66/11kV substation of KPTCL established within the plant premises. The generated power shall be evacuated at 220 kV voltage level. The proposed 1x350±20% MW CCPP switch yard is around 500 Meter away from the KPTCL substation. In this regard M/s KPCL have initiated discussions with M/s KPTCL to provide the power evacuation scheme and MOM is enclosed as Appendix #10. The design/erection of necessary power evacuation lines would be done by M/s KPTCL.

2.3.3 Project Location

The project site is located within premises of Yelahanka DG Plant at Yelahanka near Bangalore in the state of Karnataka. The plot of land under the plant premises comprises of land from Puttenahalli & Kenchenahalli Villages of Yelahanka Tehsil in District Bangalore. The DG plant is located at North of Bangalore along Bangalore–Doodaballapur-Hindupur State Highway, situated at Yelahanka, about 18 km from Bangalore city. It is located within limits of Bruhat Bangalore Mahanagara Palike. General location of the project site is shown in Figure-1.

Geographical location (co-ordinates of four corners of the DG Plant campus) of the site is given below. Corner coordinates of the project site is shown in map given in Figure-2.

- 13°7'03.78"N to 77°34'40.43"E
- 13°7'08.84"N to 77°34'59.33"E
- 13°6'47.68"N to 77°35'11.97"E
- 13°6'42.78"N to 77°34'47.19"E

Elevation of the land under KPCL control varies from 910 m above MSL at the northern boundary to 900 m at the southern boundary. The project will be located in the northern part of the plot, where the average elevation is approx. 909 m above mean sea level. A natural drain (uncontrolled), passing from west to east, is located in the southern part of the plot.

The site is located at north of Bangalore along Bangalore – Doodaballapur Hindupur highway and is situated at Yelahanka about 18 km from Bangalore city and 25 km from Bangalore International Airport. Nearest railway station to project site is Yelahanka and Bangalore city junction, which are 2 km and 20 km away respectively. The Yelahanka site is approachable through motorable road connecting major state highways and rail as stated above.

No ecologically sensitive area, viz, National Park, Wild life sanctuary, wet-land, biosphere reserves, etc., is located within 10 km distance from the site. BSF Compound is located at a distance of approx. 2.75 km towards north east, and Yelahanka Air Force base at approx. 2.9 km in the same direction. Ecological sensitivity map of the proposed project site has been shown in Figure-3 and its details are given in Table-2.

Table 2: Environmental Sensitivity around Project Site

S.No	Areas	Name/Identity	Aerial distance (within 10 km.)
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	Railway line Bangalore–Hindupur State Highway National Highway (NH-7)	Adjacent to site Adjacent to site Approx. 3 km
7	Defence installations	Yelahanka Air Force base	2 Km
8	Densely populated or built-up area	Yelahanka Satellite Town	2 km
9	Areas occupied by sensitive man-made land uses *(hospitals, schools, places of worship, community facilities)*	Hospitals, Schools Places of worship & other community facilities	Within 10 Km
10	Areas containing important, high quality or scarce resources *(ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)*	Hebbel lake Yelahanka lake Jakkur lake Allasandra lake Amruthalli lake Nagavara lake Kogilukere lake Chikkabanavara lake Kammagondahalli lake Rachenahalli lake	Within 10 Km
12	Areas susceptible to natural hazard which could cause the project to present environmental problems	Zone II (least active zone) as per the Seismic zone Map of India (IS 1893 (Part 1) 2002)	Not applicable.

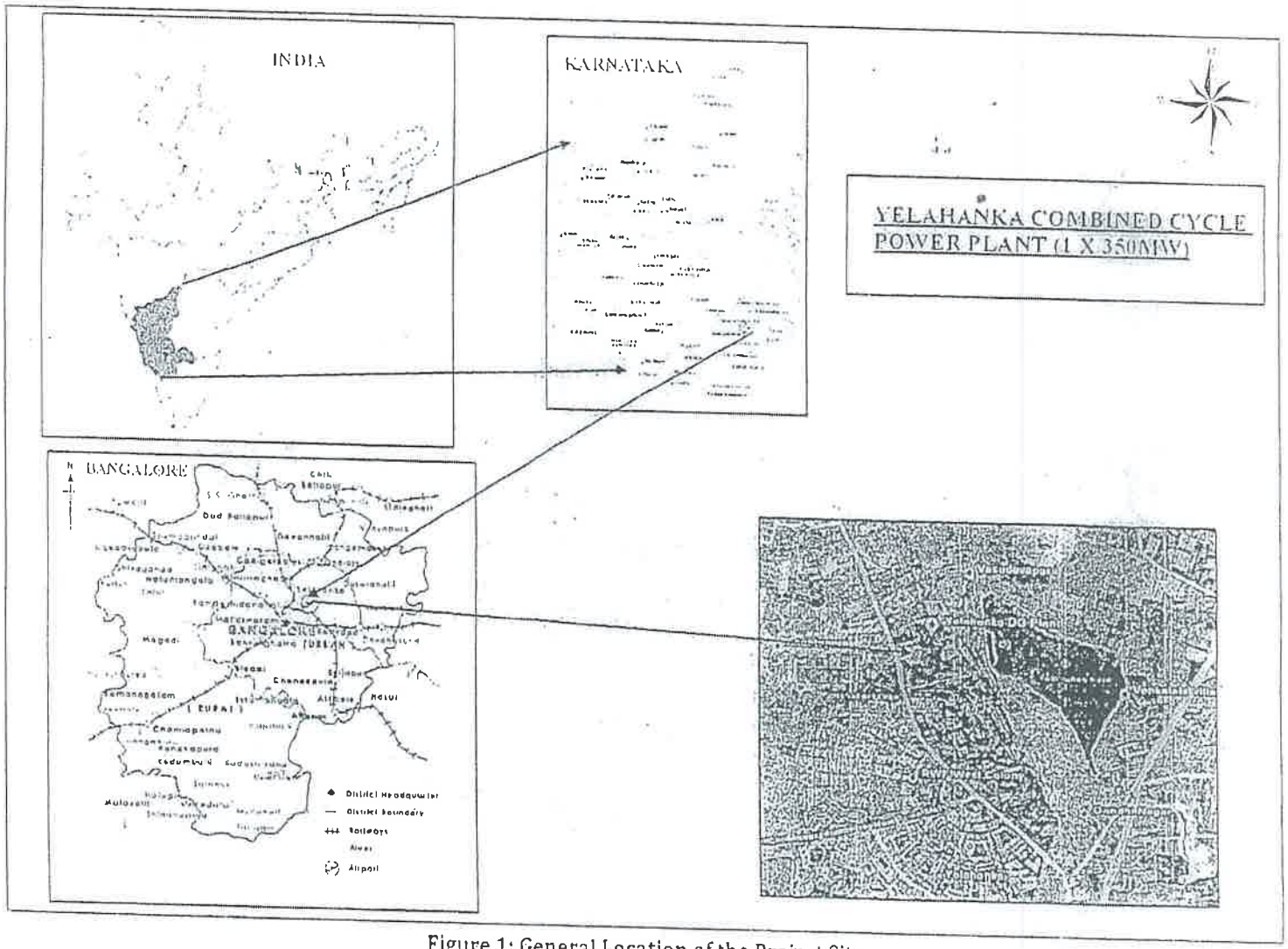

Figure 1: General Location of the Project Site

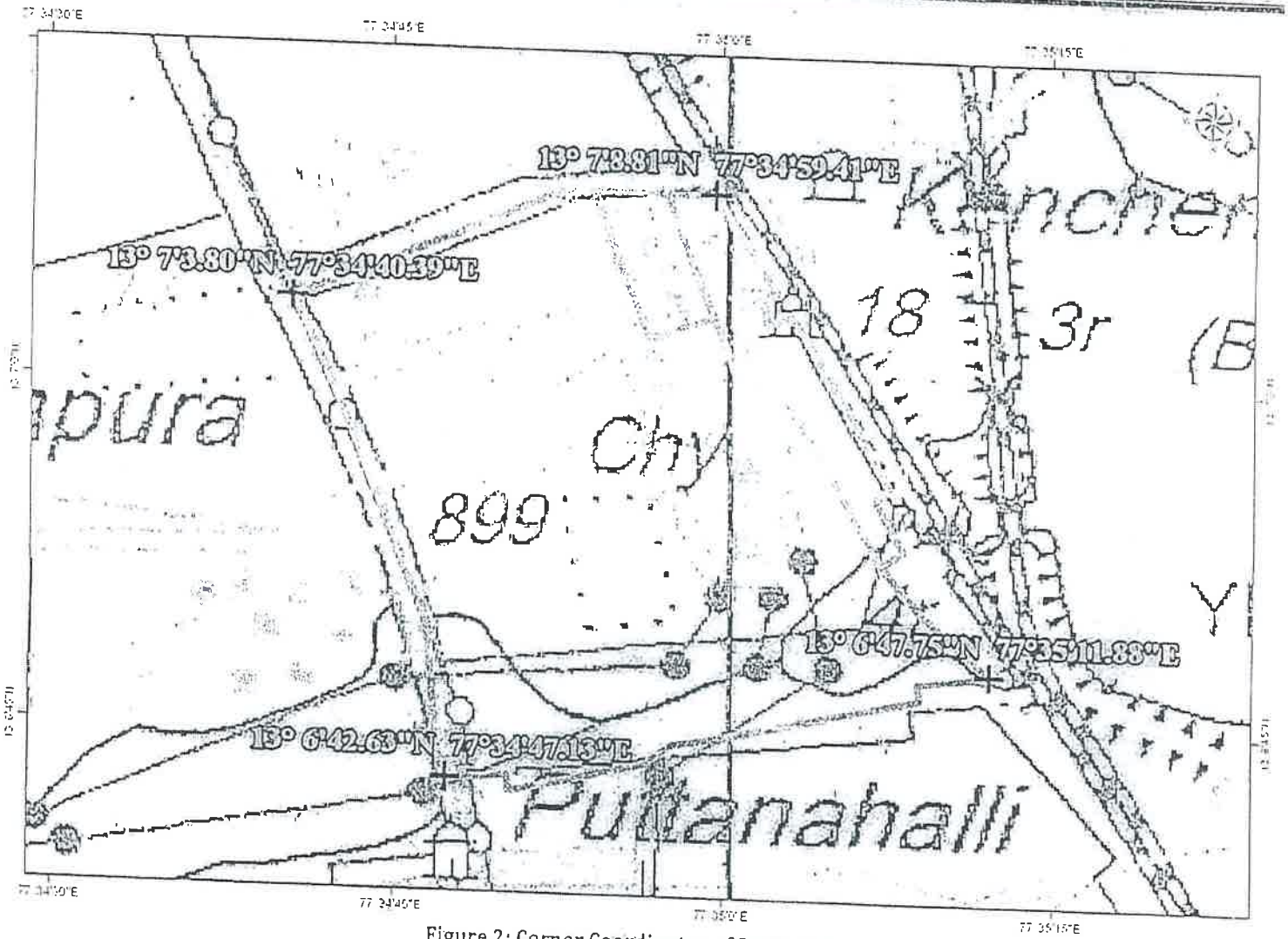

Figure 2: Corner Coordinates of Project Site

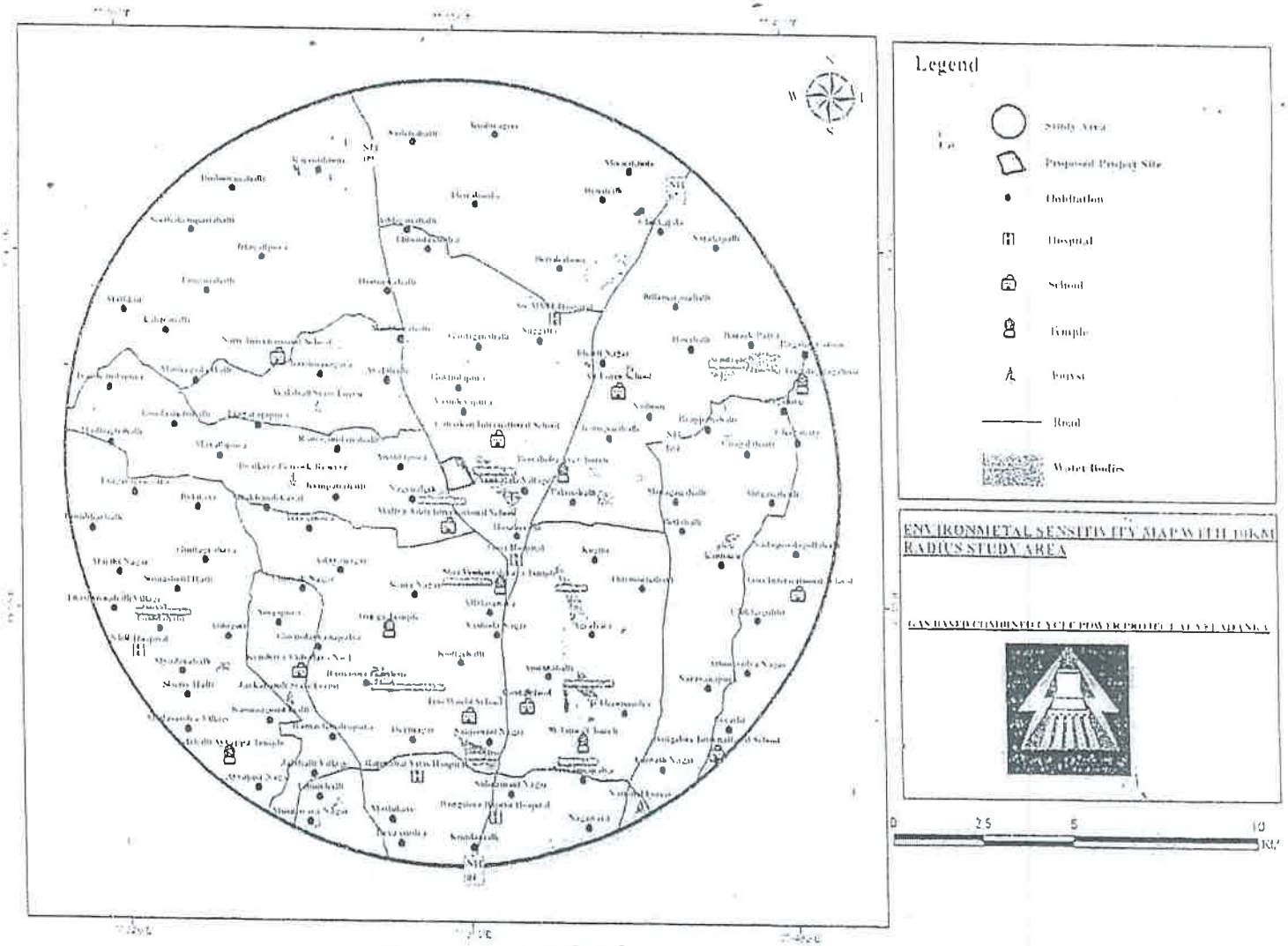

Figure 3: Environmental Sensitivity Map of Project Site

2.4 IMPORTANCE OF THE PROJECT

2.4.1 Installed Capacity & Planned Generation Capacity

Karnataka has been experiencing power shortage because of the growing demand for power due to rapid economic growth. The state government has taken up various projects in the public and private sector to add capacity. Recognizing the crucial role of power in achieving economic progress, Karnataka was one of the first Indian states to initiate reforms in power sector.

The core issue in power supply in Karnataka is the status of demand & supply to ensure that there is no shortage in supply in the State. The State of Karnataka has been facing power shortage as it is a progressive state and there is ever growing demand for power. The state government has been planning through various means for capacity addition for adding more power to the grid to meet the growing demand.

Apart from augmenting its generation, the state has been importing power from central power-generating stations, from neighboring states, and also through energy exchanges for minimizing power shortages. In addition, the state government is taking steps for conservation of energy through demand side management programs. In cases where it is highly difficult to bridge the supply-demand gap, load shedding is imposed.

Southern region grid comprises the states of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Pondicherry. The grid map of Karnataka State and Bangalore is enclosed in Figure-4 & 5 respectively.

Based on the data available with CEA, the total installed generation capacity in Karnataka State, as on 2013-2014 is 14017 MW. The installed generating capacity of the existing power stations, projects under execution, projects under planning as well as Karnataka's share from central sector projects for the period 2013 to 2017 as per the data available are shown in the next section.

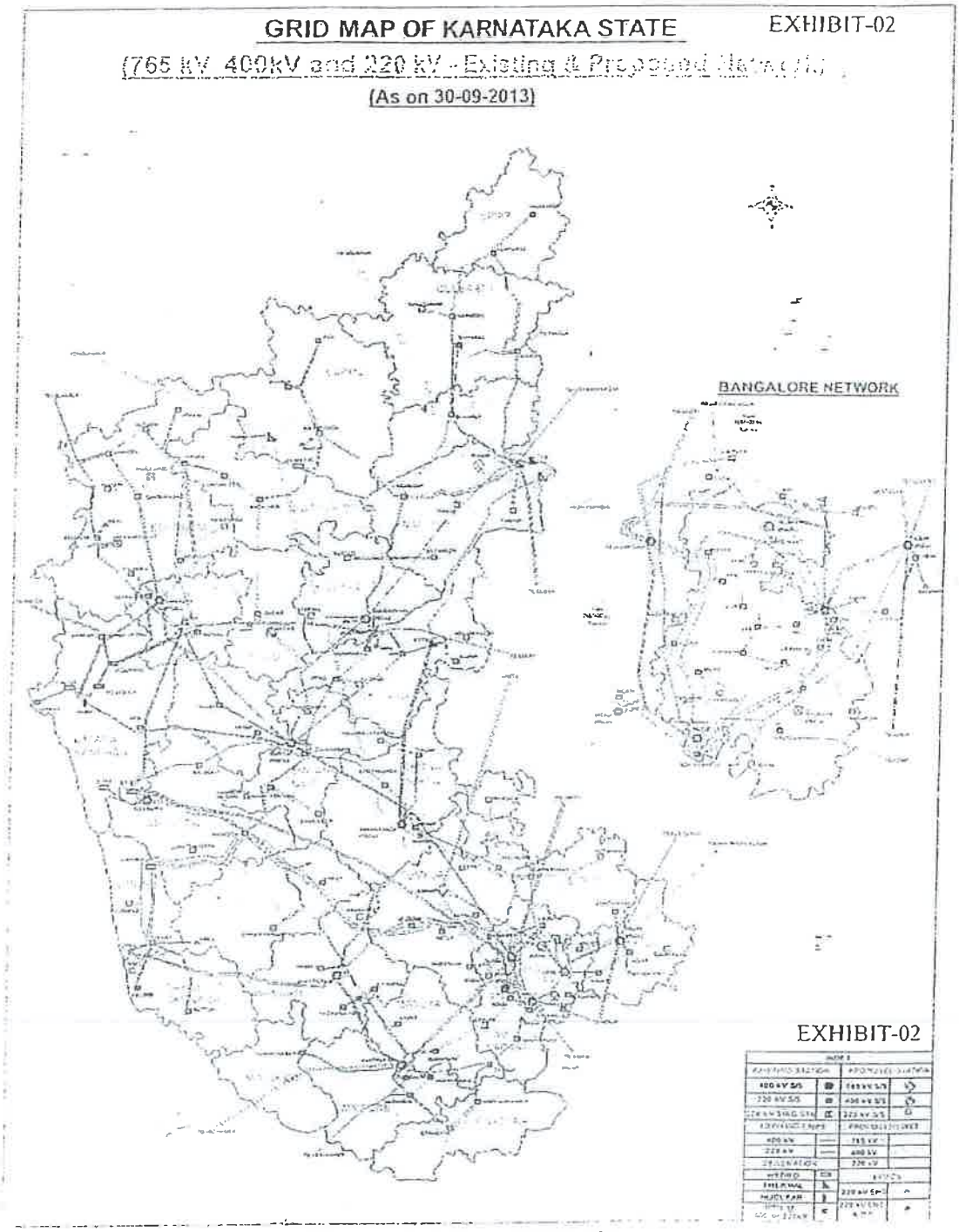

Figure 4: Grid Map of Karnataka

220 220

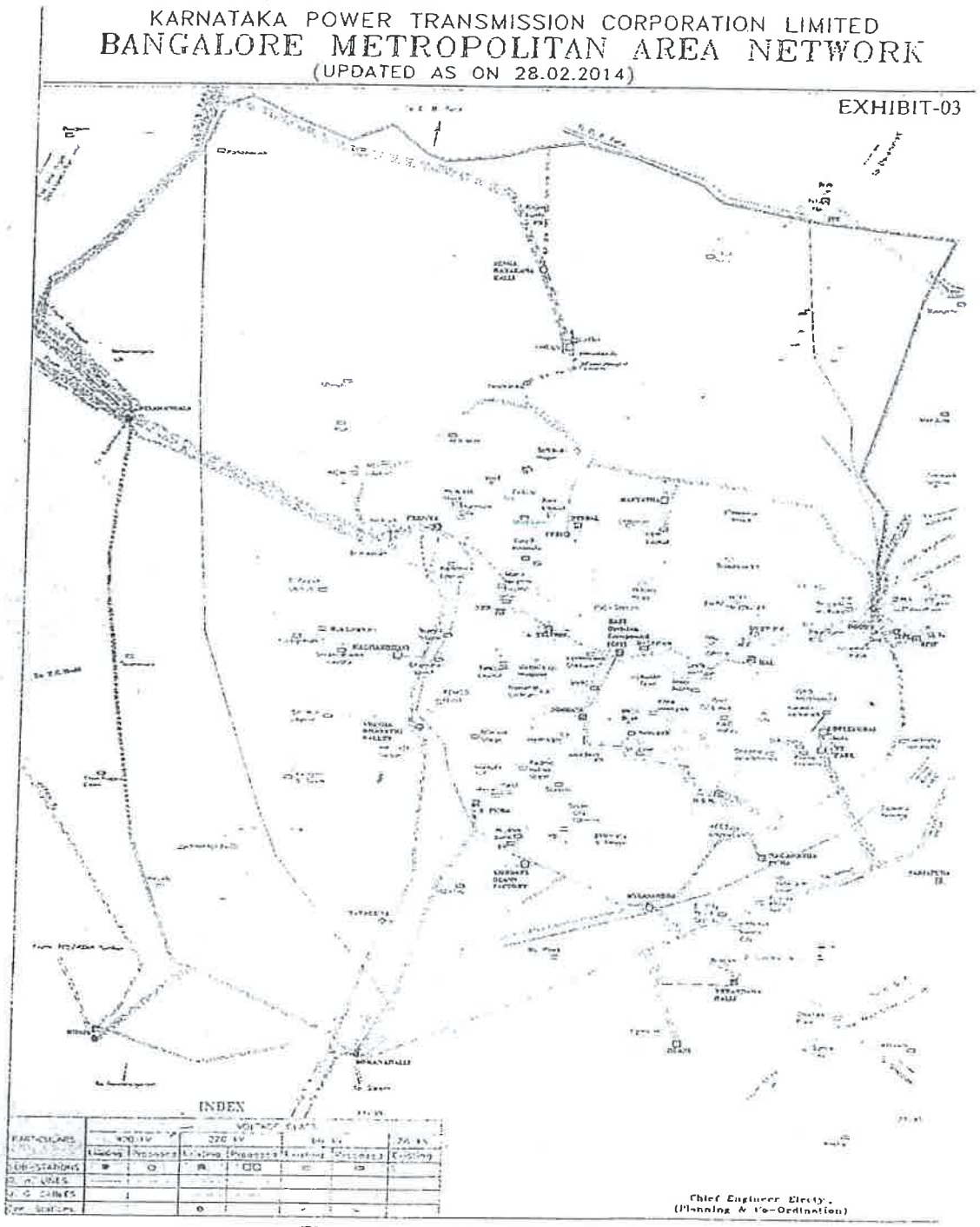

Figure 5: Grid Map of Bangalore

Table 3: Installed Capacity & Energy Generation in Karnataka

Source		2009-10	2010-11	2011-12	2012-13	2013-14
Public Sector (KPCL)						
a) Hydel	MW	3637	3652	3652	3652	3652
b) Wind energy	MW	4.555	4.555	4.555	4.555	4.555
c) Thermal	MW	1970	2220	2240	2720	2720
d) Diesel plants	MW	108	108	108	108	108
e) Solar PV plant	MW	6	6	9	14	14
Total		**5725.56**	**5990.56**	**6013.56**	**6498.56**	**6498.56**
Private Sector						
f) IPP Thermal	MW	109	709	709	1550	1550
g) Mini Hydel	MW	572	656	656	701	701
h) Wind energy	MW	1513	1670	1976	2177	2177
i) Co-generation & Biomass	MW	766	744	1001	1171	1171
Total	MW	2960	3779	4342	5599	5599
Central Generating Station Allocation	MW		1596	1700	1836	1919
Total installed capacity	**MW**	**8686**	**11366**	**12056**	**13934**	**14017**
Electricity Generation						
k) Hydel (KPCL)	MU	12249	10543	13989	10022	12825.5
l) Thermal(KPCL)	MU	13263	10434	12813	12723	15827.7
m) Diesel (KPCL)	MU	494	490		189	23.87
n) Wind (KPCL)	MU	13	16	13	13	13.67
o) Solar PV plant	MU	3	7	8	23	17.82
p) Private sector	MU	5546	8984	16903	16914	17059
Total		**31566**	**30474**	**43726**	**39884**	**45767.5**
Electricity imports						
i) Central projects	MU	10974	11041	11575	11619	7452
ii) Other States	MU	35	5757	1627	5870	7374
Total	MU	11009	16798	13202	17489	14826
Total Electricity supply	MU	42575	47272	56928	57373	60593.5

Table 4: Share of Power Generation Capacity from CGS (in MW)

S. No.	Source	Allocation to Karnataka Share
1	Ramagundam Stage I & II (Units 1 to 6)	423
2	Ramagundam Stage III (Unit 7)	106
3	MAPS	33
4	NLC TPS II Stage I	130
5	NLC TPS II Stage II	176
6	NLC TPS I (Expansion)	108
7	Kaiga (1&2)	121
8	Kaiga 3rd& 4th Unit	132
9	Simhadri Unit	212
10	Talcher Stage II	388
11	Vallur I & II	89
	Total	1919

2.4.2 Status of Electric Generation & Supply

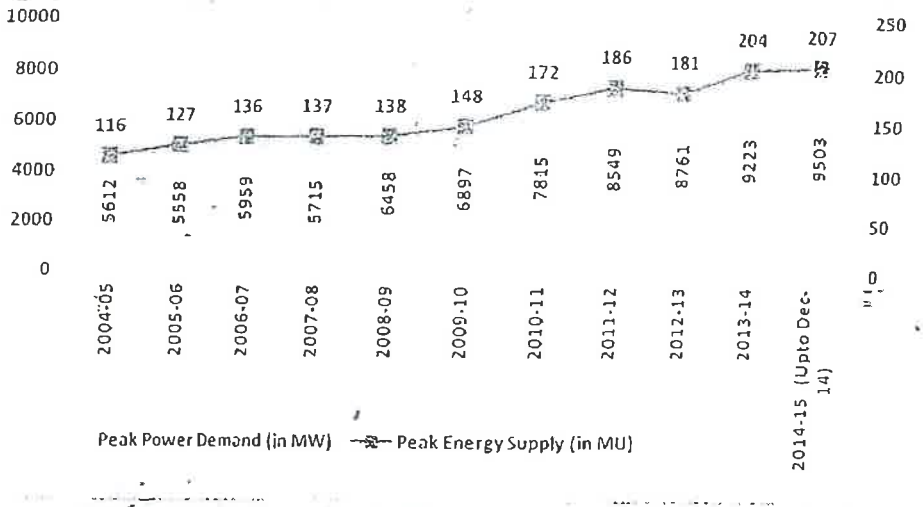

Figure 6: Peak Power Demand & Energy Supply Trend in Karnataka

It may be observed from the above graph shown in Figure-6 that both the peak demand and peak energy supply per day are showing increasing trends since 2007-08. The peak demand met during 2013-14 was 9223 MW, and in 2014-15 it was 9503MW which indicates an increase of 3.04%. The

anticipated peak demand during 2014-15 is likely to be around 9600 MW. The demand for electrical energy has been steadily increasing at the rate of 6-8 % in the State of Karnataka due to rapid industrialization and urbanization.

The peak power demand and the expected energy requirement as projected in the Eighteenth Electric Power Survey of India for the period 2012-2013 to 2016-2017(12th Five year plan) is shown in Table-5 & 6 respectively.

Table 5: Actual Power Supply In Terms of Energy & Peak Load Demand (2013-14)

	Energy requirement (MU)			Peak load(MW)		
	Demand	Availability	Shortage/ excess	Demand	Availability	Shortage/ excess
All India	1002257	959829	(-)4.2%	135918	129815	(-)4.49%
Southern region	277245	258444	(-)6.8%	39015	36018	(-)7.68%
Karnataka	64150	58052	(-)9.5%	9940	9223	(-)7.21%

(As per LGBR 2014-15 by CEA)

Table 6: Anticipated Power Position In Terms of Energy & Peak Load Demand (2014-15)

	Energy requirement (MU)			Peak load MW		
	Demand	Availability	Shortage/ excess	Demand	Availability	Shortage/ excess
All India	1048672	995157	(-)5.1%	147815	144788	(-)2.0%
Southern region	298180	260366	(-)12.7%	41677	32423	(-)22.2%
Karnataka	69596	59593	(-)4.4%	10772	8137	(-)24.5%

(As per LGBR 2014-15 by CEA)

It can be seen, from the actual power supply position during the year 2013-14 and the anticipated power supply position during 2014-15, Karnataka, Southern Region and the Country experienced and expected to experience high to moderate shortages both in terms of energy and peaking availability.

Bangalore City Energy Consumption

According to the BESCOM data, the peak demand of Bangalore city was 1134 MW during 2003-04 which rose to around 2002 MW by 2010-11 and is expected to grow @ 5.71% and 5.74% during 12th and 13th plan respectively from the base year 2010-11 in spite of 8.46% actual growth from 2003-04 to 2010-11. As the result of the study of pattern of utilization of various categories, the peak electric load will be 2805 MW and 3717 MW by the end of 12th (2016-17) and 13th (2021-22) plan respectively.

The total electricity consumption of the Bangalore city during the year 2010-11 was 10299 MUs and is expected to increase to 14465 MU and 18972 MU during the year 2016-17 and 2021-22 respectively with the compounded growth rate of 5.82 & 5.71% from the base year 2010-11.

Considering above, the proposed power project of about 1x350±20% MW capacity which is expected to be commissioned during 13th Plan period is fully justified from the demand supply consideration. Considering the shortage in total energy and peak load requirement of Karnataka State and Bangalore in particular the proposed power project near Bangalore is justified.

2.5 SCOPE OF THE STUDY

2.5.1 Environmental Clearance Process

The environmental clearance process in India is made up of the following phases:

- Screening
- Scoping and consideration of alternatives
- Baseline data collection
- Impact prediction, assessment of alternatives, delineation of mitigation measures and environmental management plan
- Preparation of draft EIA report and submission to State Pollution Control Board
- Public consultation
- Preparation of Final EIA report, addressing the issues raised during public consultation.
- EIA appraisal by competent authority and decision on prior environmental clearance.

2.5.2 Regulatory Scoping

Scoping refers to the process by which the Expert Appraisal Committee determines detailed and comprehensive Terms of Reference (TOR) addressing all relevant environmental concerns for the preparation of an Environment Impact Assessment (EIA) Report in respect of the project or activity for which prior environmental clearance is sought. The Terms of Reference are determined by the committee on the basis of the information furnished in the prescribed application Form1 and pre-feasibility report.

The proposal including Form-1, PER and proposed ToR was submitted to State Expert Appraisal Committee (SEAC) Karnataka vide letter no. CE(EI&TA)/ENV/YEL/833 dated 20.12.2014. The SEAC has considered the project during its meeting held on 13th& 14th January 2015. Based on the submission and presentation, the SEAC has issued the TOR for the EIA study on vide letter No. SEIAA 20 IND 2014 dated 19.01.2015. A copy of the same has been annexed as Annexure-1.

2.5.3 Compliance of Terms of Reference

The statement of compliance to the terms of reference is as follows in Table-7.

Table 7: Statement of ToR Compliance

S. No.	Terms of Reference	Compliance
1.	Executive Summary of the project giving a prima facie idea of the objectives of the proposal, use of resources, justification, etc. in should provide a compilation of EIA report, EMP and the post-project monitoring plan in brief.	Executive summary of the project has been included as Chapter-1 in the report.
2.	Conformity of the site with the prescribed guidelines in terms of distance of 500 m from HFL of the river, highways and railway lines should also be shown.	No river is located near the site. Yelahanka DG Power Plant area is located between Bangalore-Doddaballapura Road and Railway line.
3.	All the coordinates of the plant site to be shown on toposheet.	Corner coordinates of the plant site have been shown in toposheet and is provided in Subsection-2.3.3 of Chapter-2.
4.	The study area should cover an area of 10 km radius around the proposed plant site.	The study area covers the area falling within 10 km radius around the site. Study area map has been given in Subsection-4.1.2 of Chapter-4.
5.	Land requirement for the project to be optimized. Item wise break up of land requirement and its availability to be furnished. The norms prescribed by Central Electricity Authority (CEA) should be kept in view. The issue related to land acquisition and R&R should be clearly discussed in EIA report.	Land requirement of the project is given in Subsection-3.2.3 of Chapter-3.
6.	Location of intake and outfall points (with coordinates) should be given. These locations should be selected based on modeling studies. Details of desalination plant, if any, and disposal of sludge.	Not applicable, as the raw water requirement will be made from treated water of Jakkur and Puttenahalli STP. Desalination plant is not required.
7.	Topography of the area should be given clearly indicting whether the site requires any filling. If so, details of filling, quantity of fill quantity of fill material required, its source, transportation etc. should be given.	Topography of the project site is given in Subsection-4.2.2 of Chapter-4.
8.	Impact on drainage of the area and the	There will be no impact on the drainage area as existing gentle slope towards

	surroundings.	south will be maintained.
9.	Information regarding surface hydrology, water regime and impact of the same, if any due to the project.	Hydro-geology details are given in Subsection-4.2.4 of Chapter-4.
10.	Surface water quality of nearby river (60 m upstream and down steam) and other surface drains at eight locations must be ascertained.	Water quality has been studied and its detail is provided in Section-4.7 of Chapter-4.
11.	One season site-specific meteorological data shall be provided.	Site specific meteorological data for one season has been given in Subsection-4.4.2 of Chapter-4.
12.	Action plan to follow National Ambient Air Quality Emission Standards issued by the Ministry vide G.S.R. No. 826(E) dated 16th November, 2009 should be included.	The only pollutant likely to be discharged from proposed plant is NOx. DLNx burner will be provided to minimize the concentration of NOx. Details are given in Section-10.3 of Chapter-10.
13.	Ambient air quality at 8 locations within the study area of 10 km aerial coverage from project site.	Ambient air quality at 8 locations within the study area of 10 km aerial coverage from project site has been studied and its details are given in Subsection-4.5.2 of Chapter-4.
14.	One complete season AAQ Data (except monsoon) to be given along with the dates of monitoring. The parameters to be covered shall include SPM, RPM, SO_2, NO_x Hg and Ozone (ground level). The location of the monitoring stations should be so decided so as to take into consideration the pre-dominant downwind direction, population zone and sensitive receptors including reserved forests. There should be at least one monitoring station in the upwind direction. There should be at-least one monitoring station in the predominant downwind direction at a location where maximum ground level concentration is likely to occur.	One complete season AAQ Data has been collected and analyzed. The results are compiled and given in Subsection-4.5.6 of Chapter-4.
15.	Impact of the project on the AAQ of the area. Details of the model used and the input data used for modeling should also be provided. The air	Impact of project on AAQ of the area has been analyzed with the help of air modeling and its details are given in

	quality contours may be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any. The wind roses should also be shown on this map.	Section-5.3 of Chaper-5.
16.	Quantity of fuel required its source and transportation. Details of gas supply agreement / commitment to be provided.	Details of fuel to be used are given in Subsection-3.2.1 of Chapter-3.
17.	Examine the feasibility of zero discharge. In case of any proposed discharge, its quantity, quality and point of discharge, users downstream etc. should be provided. The effluent shall be treated and reused to meet the service and greenbelt development water requirement.	In a gas based power plant where the most of the input water is used for make-up to the cooling water system, it is not feasible to achieve zero effluent discharge. However, water requirement for green belt & plantation, make-up to fire water system and plant washings will be met from treated waste water from the guard pond.
18.	Details of greenbelt i.e. land with not less than 1500 trees per ha giving details of species, width of plantation, planning schedule etc.	Greenbelt development details are given in Subsection-10.5.1 of Chapter-10.
19.	Detailed R&R plan/ compensation package in consonance with the National / State R&R Policy for the project affected people including that due to fuel transportation system / pipeline and their ROW, if any, shall be prepared taking into account the socio economic status of the area, homestead oustees, land oustees, landless labourers.	Proposed plant is to be setup in the existing Yelahanka DG Plant land acquired by KPCL. There will be no project affected family so no R7R plan is required. Regarding fuel transportation system and water pipeline, route survey is being conducted by M/s Gail and BWSSB respectively.
20.	Details of flora and fauna duly authenticated should be provided. In case of any scheduled fauna, conservation plan should be provided.	Authenticated list of flora and fauna is attached as Annexure-1. Conservation plan is provided in Subsection 10.5.4 of Chapter-10.
21.	Details regarding infrastructure facilities such as sanitation, fuel, restroom, medical facilities, safety during construction phase etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase.	Existing infrastructure facilities in the DG Plant and IOCL tank farm will be utilized. No truck movement during operation phase is envisaged.

22.	Measures of socio economic influence to the local community proposed to be provided by the project proponent. As far as possible, quantitative dimensions to be given.	Corporate social responsibility details are given in **Subsection-10.6** of **Chapter-10.**
23.	Environmental Management Plan to mitigate the adverse impacts due to the project along with item wise cost of its implementation.	Environmental management plan along with cost is given in **Chapter-10.**
24.	Risk assessment including fire and explosion issues due to storage and use of fuel should be carried out. It should take into account the maximum inventory of storage at site at any point in time. The risk contours should be plotted on the plant layout map clearly showing which of the proposed activities would be affected in case of an accident taking place. Based on the same, proposed safeguard measures should be provided. Measures to guard against hazards should also be provided.	Risk assessment study has been carried out with the help of risk assessment modeling and its details are provided in **Section-8.1** of **Chapter-8.** Disaster Management Plan has been given in **Section-8.3** of **Chapter-8.**
25.	Any litigation pending against the project and / or any direction / order passed by any Court of Law against the project, if so, details thereof.	No litigation is pending against the project.
26.	Details of water balance (water intake, use, wastewater generation) taking into account reuse and re-circulation of effluents. Additional water conservation measures, if any, proposed for the project.	Water balance for the proposed project is given in **Subsection 3.2.2** of **Chapter-3.**
27.	Land use of study area should include data about the residential / institutional/ nearest village/ township/ locality/ housing society, etc. based on satellite imagery.	Land-use study of the study area is given in **Section-4.3** of **Chapter-4.**
28.	If ecologically sensitive attributes fall within a 10 km radius of the project boundary, proponent shall describe the sensitivity (distance, area and significance) and propose the additional points based on significance for review and acceptance by the State Expert Appraisal Committee (SEAC). A map marking the location of such areas (existing or proposed) Duly authenticated by the Chief Wildlife Warden. Ecological sensitive	Environmental sensitivity map of the project study area along-with its details are provided in **Subsection-2.3.3** of **Chapter-2.**

	time bound action plan should be included. Socioeconomic development activities need to be elaborated upon	
	Additional Corporate Environmental Responsibility: 1. (a) Does the company have a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report. (b) Does the Environment Policy prescribe for standard operation process / procedures to bring into focus any infringement/ deviation/violation of the environmental or forest norms/conditions? If so, it may be detailed in the EIA.	No Environmental policy is laid down by the Board of Directors. However, the individual power plants have their own environmental policy complying to QMS (ISO 9001:2008), EMS (ISO 14001:2004) and OHSAS (OHSAS 18001:2007) certified and all the norms required under environmental management system and Occupational Health and Safety related features are being complied with.
	2. What is the hierarchical system or Administrative order of the company to deal with environmental issues and for ensuring compliance with the Environmental Clearance conditions details of this system may be given.	All Environmental Issues and ensuring compliance with the EC conditions are routed through Unit Head and then to the Board of Directors of the Company.
	3. Does the company have a system of reporting of non-compliance/violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism should be detailed in the EIA report.	All Environmental Issues and ensuring compliance with the EC conditions are routed through Unit Head and then to the Board of Directors of the Company. The Chairman and Managing Director apprise the Board of Directors regarding Compliances/ violations of the Environmental Norms of the company.
Additional ToRs:		
	1. Study of source of water and impact on the competitive users of the treated sewage of BWSSB.	The raw water will be sourced from Jakkur and Puttenahalli STP of BWSSB. The tertiary treatment plant at Jakkur and the STP at Puttenahalli are being implemented by BWSSB for specific use by the proposed plant.
	2. Mode of disposal of the DM water reject and its impact.	DM water along with back wash from UF and rejects from RO will be neutralized and discharged into the guard pond along with cooling water blow-down and BFW

		blow down. If required, the effluent will be diluted with raw water to bring down the TDS level to approximately 2000mg/l before discharge into the drain leading to Yelahanka Lake.
	3. Impact on the Puttenahalli and Yelahanka lakes.	Impact on lakes has been given in Section-5.6.3 of Chapter-5.
	4. Monitoring Methane and Carbon Monoxide along with PM_{10}, $PM_{2.5}$, NO_2 and SO_2	Monitoring data for the said parameters have been provided in Subsection-4.5.6 of Chapter-4.
	5. Impact of cumulative noise pollution due to the railway station, wheel and axel plant and the proposed activity and mitigation measures thereon.	Noise pollution data have been collected, compiled and analyzed with the help of noise modeling and its details are given in Section-5.5 of Chapter-5.
	6. Impact on the Temperature and Humidity levels of the surrounding area due to the proposed activity.	The HRSG system will effectively reduce the temperature of flue gas to approx 97°C. Further, as the fuel to air ratio will be approximately 33, the moisture content in the flue gas will also be comparatively low.
	7. Risk assessment and disaster management plan within the plant and in the Surroundings of up to 500m.	Details of risk assessment and disaster management plan have been provided in Chapter-8.

2.5.4 Brief Description of EIA Studies

The study area of the EIA covers an area within 10 km radius around the proposed project site. The scope of the study comprises of the following stages:

- Description of the proposed project, description of proposed site and surrounding area, description of alternate sites, and analysis of alternatives.
- Establishing baseline data of the study area.
- Identification of expected pollution load due to various activities during construction and operational phases of the project.
- Impact Assessment to predict the post-project scenario, including prediction of increase in levels of pollutants in the study area due to the proposed activity.
- Environmental Management Plan outlining the measures for improving the environment quality and scope for sustainable development in future.
- Risk Assessment and Disaster Management Plan, Occupational Health and Safety Plan and Green Belt Development Plan.

	attributes include. • National Parks • Wildlife Sanctuaries Game Reserve • Tiger Reserve / Elephant Reserve • Breeding Grounds • Habitat for migratory birds • Areas with threatened (rare, vulnerable, endangered) flora/ fauna • Wetlands • Zoological Gardens • Reserved Forests / Protected Forests • Any other closed/ protected area under the Wild Life (Protection) Act, 1972, any other area locally applicable.	
32.	If the plant location falls in a valley, studies on specific issues connected to the management of natural resources.	Plant site is located in plains.
33.	Impact on drainage of the area and the surroundings.	There will be no impact on the drainage area as existing gentle slope towards south will be maintained.
34.	Details of rainwater harvesting and its proposed usage in the plant.	Rainwater harvesting is not proposed.
35.	Action plan for the green belt development Details of greenbelt giving details of species, width of plantation, planning schedule, etc.	Action plan for green belt development is given in Subsection-10.5.3 of Chapter-10.
36.	Green belt shall be developed in at least 33% of plant area as per the CPCB guidelines in consultation with the DFO.	Green belt will be developed in 9 ha which is 33% of the plant area i.e. 26.4 ha.
37.	Proposed measures for occupational safety and health of the workers.	Details of occupational safety and health measures are given in Subsection-8.2 of Chapter-8.
38.	Details of alternative source of energy such as photovoltaic cells use in the plant for various applications.	No alternative source of energy will be utilized.

39.	Details on improved technologies.	Details of DLN Combustion technology for maintaining NOx concentration in the flue gas at 25 ppm level have been provided in **Subsection-10.3.2 of Chapter-10.**
40.	Appropriate monitoring network has to be designed and proposed for regulatory compliance and to assess the residual impacts, if any.	Environmental monitoring program has been provided in **Chapter-7.**
41.	Detailed compensation package for the people affected by the project shall be prepared, considering the socio-economic status of the area, homestead oustees, land oustess, and landless labourers.	Not applicable, as the proposed project will be located within premises of the existing Yelahanka DG Power Plant.
42.	Proposed post-project monitoring programme to ensure compliance to the approved Management Plan including administrative and technical organizational structure.	Post-project environmental programme, with organizational set-up for environmental management and monitoring is described in **Chapter-7.**
43.	Details of alternative sites for the proposed project.	Alternative sites were not considered, as the proposed project will be implemented within premises of existing Yelahanka DG Power Plant, which has been shut down to high production cost and environmental issues.
44.	Disaster Management Plan.	Disaster Management Plan has been given in **Section-8.3 of Chapter-8.**
45.	Source of water for the project and necessary clearance.	Make-up water for the project will be tertiary treated sewage water from Hebbel and Puttenahalli STPs of BWSSB. Necessary clearance has been accorded and allotment made by BWSSB **(Annexure- 4).**
46.	The EIA studies should also take into account another power plant proposed (if any) in the same village.	There is no such proposal for implementation in near future.
47.	At least 5% of the total cost of the project should be earmarked towards the corporate social responsibility and item-wise details along with	Budgetary details for CSR have been given in **Subsection-10.6.4 of Chapter-10.**

	time bound action plan should be included. Socioeconomic development activities need to be elaborated upon	
	Additional Corporate Environmental Responsibility: 1. (a) Does the company have a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report. (b) Does the Environment Policy prescribe for standard operation process / procedures to bring into focus any infringement/ deviation/violation of the environmental or forest norms/conditions? If so, it may be detailed in the EIA.	No Environmental policy is laid down by the Board of Directors. However, the individual power plants have their own environmental policy complying to QMS (ISO 9001:2008), EMS (ISO 14001:2004) and OHSAS (OHSAS 18001:2007) certified and all the norms required under environmental management system and Occupational Health and Safety related features are being complied with.
	2. What is the hierarchical system or Administrative order of the company to deal with environmental issues and for ensuring compliance with the Environmental Clearance conditions details of this system may be given.	All Environmental Issues and ensuring compliance with the EC conditions are routed through Unit Head and then to the Board of Directors of the Company.
	3. Does the company have a system of reporting of non-compliance/violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism should be detailed in the EIA report.	All Environmental Issues and ensuring compliance with the EC conditions are routed through Unit Head and then to the Board of Directors of the Company. The Chairman and Managing Director apprise the Board of Directors regarding Compliances/ violations of the Environmental Norms of the company.
Additional ToRs:		
	1. Study of source of water and impact on the competitive users of the treated sewage of BWSSB.	The raw water will be sourced from Jakkur and Puttenahalli STP of BWSSB. The tertiary treatment plant at Jakkur and the STP at Puttenahalli are being implemented by BWSSB for specific use by the proposed plant.
	2. Mode of disposal of the DM water reject and its impact.	DM water along with back wash from UF and rejects from RO will be neutralized and discharged into the guard pond along with cooling water blow-down and BFW

		blow down. If required, the effluent will be diluted with raw water to bring down the TDS level to approximately 2000mg/l before discharge into the drain leading to Yelahanka Lake.
	3. Impact on the Puttenahalli and Yelahanka lakes.	Impact on lakes has been given in Section-5.6.3 of Chapter-5.
	4. Monitoring Methane and Carbon Monoxide along with PM_{10}, $PM_{2.5}$, NO_2 and SO_2	Monitoring data for the said parameters have been provided in Subsection-4.5.6 of Chapter-4.
	5. Impact of cumulative noise pollution due to the railway station, wheel and axel plant and the proposed activity and mitigation measures thereon.	Noise pollution data have been collected, compiled and analyzed with the help of noise modeling and its details are given in Section-5.5 of Chapter-5.
	6. Impact on the Temperature and Humidity levels of the surrounding area due to the proposed activity.	The HRSG system will effectively reduce the temperature of flue gas to approx 97°C. Further, as the fuel to air ratio will be approximately 33, the moisture content in the flue gas will also be comparatively low.
	7. Risk assessment and disaster management plan within the plant and in the Surroundings of up to 500m.	Details of risk assessment and disaster management plan have been provided in Chapter-8.

2.5.4 Brief Description of EIA Studies

The study area of the EIA covers an area within 10 km radius around the proposed project site. The scope of the study comprises of the following stages:

- Description of the proposed project, description of proposed site and surrounding area, description of alternate sites, and analysis of alternatives.
- Establishing baseline data of the study area.
- Identification of expected pollution load due to various activities during construction and operational phases of the project.
- Impact Assessment to predict the post-project scenario, including prediction of increase in levels of pollutants in the study area due to the proposed activity.
- Environmental Management Plan outlining the measures for improving the environment quality and scope for sustainable development in future.
- Risk Assessment and Disaster Management Plan, Occupational Health and Safety Plan and Green Belt Development Plan.

The baseline environmental scenario has been established through primary data generated in the study area and secondary data available at site/ published in literature. The field monitoring was performed during the pre-monsoon (summer) season from March, 2015 to May, 2015. The EIA Report is based on primary data for meteorology, air quality, water quality, ecology, soil and noise and simultaneously secondary data for all other environmental components from March to May, 2015. The baseline environmental scenario has been presented in Chapter-4.

2.5.5 Structure of EIA Report

The EIA report has been structured as per Appendix-III of the EIA Notification, 2006 (Generic structure of environmental impact assessment document), the ToR prescribed by the Karnataka SEIAA, and the nature of the proposed project. Structure of the present EIA report is presented in Table-8.

Table 8: Structure of EIA Report

Chapter	EIA Structure	Contents
1.	Executive Summary	Summary of the EIA report, giving prima facie idea of the goals, objectives, significance and other salient features of the project.
2.	Introduction	Purpose of the report Identification of project & project proponent Nature, size, and magnitude of operations Location (maps showing general location, specific location, project boundary & project site layout) Need & Importance of the project Proposed schedule for approval and implementation Scope of the study – details of regulatory scoping carried out (as per Terms of Reference)
3.	Project Description	Type of project Technology and process description, including drawings showing process flow charts, project layout, components of project etc. Description of control/ mitigation measures incorporated into the project to meet environmental standards, environmental operating conditions, or other EIA requirements. Raw materials – source, quantity and mode of transportation Employment and Project Cost
4.	Description of the Environment	Study area, period, components & methodology Establishment of baseline for valued environmental components, viz., land, air, water, noise, ecology and socio-economics, as identified in the scope

5.	Anticipated Environmental Impacts & Mitigation Measures	Details of environmental impacts due to project location, possible accidents, project design, project construction, regular operations, final decommissioning or rehabilitation of a completed project Measures for minimizing and / or offsetting adverse impacts identified Irreversible and Irretrievable commitments of environmental components Mitigation measures
6.	Analysis of Alternatives	In case, the scoping exercise results in need for alternatives: Description of each alternative Summary of adverse impacts of each alternative Mitigation measures proposed for each alternative and Selection of alternative
7.	Environmental Monitoring Program	Technical aspects of monitoring the effectiveness of mitigation measures (incl. Measurement methodologies, frequency, location, data analysis, reporting schedules, emergency procedures, detailed budget & procurement schedules)
8.	Additional Studies	Risk assessment Social Impact Assessment. R&R Action Plans
9.	Project Benefits	Improvements in the physical infrastructure Improvements in the social infrastructure Employment potential –skilled; semi-skilled and unskilled Other tangible benefits
10.	Environmental Management Plan	Description of the administrative aspects of ensuring that mitigation measures are implemented and their effectiveness monitored, after approval of the EIA
11.	Disclosure of Consultants Engaged	The names of the Consultants engaged with their brief resume and nature of Consultancy rendered

2.6 PROPOSED SCHEDULE FOR APPROVAL & IMPLEMENTATION

2.6.1 Project Schedule

The project schedule for the proposed power plant has been prepared on the following basis:

- Zero date for the project program has been considered as the date of placement of order (LOA) for supply and services of combined cycle power plant equipment.
- It has been assumed that the statuary clearances by different agencies of the government would be obtained prior to placement of order for main plant equipment.
- Financial closure for funding the project requirement.
- The synchronisation and trial operation of the unit in combined cycle mode is proposed to complete within thirty (30) months from the zero date/effective date.

However by closely monitoring the supply, erection and commissioning activities (with best efforts schedule) the unit synchronisation and trial operation can be completed within twenty eight (28) months from the date of zero /effective date. The commercial operation (COD) of the combined cycle power plant can be completed within three (3) months after synchronisation.

The list of important activities and clearances required for the projectare given in Table-9.

Table 9: Important Activities and Clearances

S.No.	Particulars	Action
01	Land availability	Already available within the premises of Yelahanka DG power plant. Getting clear title deed in favor of KPCL is under progress.
02	Water requirement and supply arrangements	KPCL has obtained formal consent from BWSSB for the supply of tertiary treated water of required quantity from their treatment plants to the proposed site.
03	Gas requirement and supply arrangements	M/s GAIL has agreed to supply the required qty. of Gas to Yelahanka project and necessary modification in the existing GT agreement by changing the delivery point and rescheduling of the supply date is required.
04	Environment and forest Clearance.	EIA studies are under progress. MOEF has issued TOR for the same. Studies are likely to complete within 3-4 months.
05	Airport authority clearance for chimney height restriction.	KPCL has obtained clearance from AAI for stack height restriction.
06	Power purchase arrangements.	Existing PPA has to be modified with KERC and BESCOM.
07	Power evacuation and connectivity	M/s KPTCL have agreed to evacuate the generated power from Yelahanka 220/66KV substation. Charging of Yelahanka substation by constructing new 200/66KV transmission lines is under progress.
08	Statuary clearances	KPCL has already obtained NOC from AAI, Health, & Fisheries Departments and action has already been taken for obtaining NOCs from Archeology, Defence etc.,
09	Land survey and fixing plant boundaries	KPCL has completed survey work and has fixed the plant boundaries.
10	Dismantling of required structures/systems of the existing DG plant	KPCL/IOCL have initiated action for dismantling the railway marshaling yard and all the available infrastructures of IOCL.
11	Remodeling/restructuring of existing Raja Kaluve	BBMP has permitted KPCL to take up the work of remodeling the existing Raja Kaluve
12	Sources of finance	Combination of debt and equity with financial institutions/commercial banks.
13	CEA	For enhancement of generation capacity

2.6.2 Project Execution

It is proposed to execute the project through an engineering, procurement, construction (EPC) contract. The EPC contractor will be responsible for detailed engineering, procurement, project management, construction, testing, commissioning up to satisfactory performance test and handing over.

Considering the necessity of the power requirement and also delay in finalising the EPC contract through tender basis, it is proposed to entrust the EPC works to M/s BHEL on nomination basis by bench marking the cost of EPC works.

In this regard GoK vide order no. EN 28 PPC 2014 dated 27.07.2014 has accorded approval for establishing first block of gas based combined cycle power plant of 350 MW capacity at Yelahanka with LNG as the fuel and has exempted M/s KPCL from the KTPP act and permitted KPCL to implement the project by entrusting EPC works to M/s BHEL. To speed up the implementation of the proposed project, pending all the statuary clearance mentioned above, KPCL have issued LOI for the implementation of 1x 350+20% MW CCPP EPC works.

CHAPTER-3

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CHAPTER-3: PROJECT DESCRIPTION

3.1 GENERAL DESCRIPTION

3.1.1 Type of Project

The proposed project will be a gas fired combined cycle power plant. Gas turbine and steam turbine with their separate generators will be housed in a single building. One overhead crane is considered for handling Gas Turbine & Steam Turbine components during erection and maintenance stages. All auxiliaries of Steam and Gas Turbines, such as Boiler Feed Pump, Condensate extraction pumps etc. will be housed in Gas Turbine cum Steam Turbine building. The Central Control room which comprises of control room panels, consoles, computer room, UPS and batteries shall be located close to the main plant building housing Gas Turbine and Steam turbine.

Following main components are to be accommodated for a combined cycle power plant.

- Gas Turbine and Generator
- Steam Turbine and Generator
- HRSG (Heat Recovery Steam Generator)
- 220KV Switch yard
- Main Stack
- CW system comprise of cooling tower and CW pump house
- Water Treatment Plant
- Fuel Gas Station
- Workshop & Stores
- Emergency Diesel Generator

3.1.2 Salient Features of the Project

Salient features of the proposed Yelahanka Combined Cycle Power Plant of M/s KPCL are given below in Table-10:

Table 10: Salient Features of the Proposed Project

S. No.	Items	Details
1	Project Name	Yelahanka Combined Cycle Power Plant
2	Project proponent	Karnataka Power Corporation Limited
3	Type of Project	New Project
4	Location	Yelahanka DG plant, S N Halli post, Near Puttenehalli, Bangalore district, 560064 India
5	Proposed Plant Capacity	350±20% MW
6	Area available for locating the	26.4 ha.

	project	
7	Raw Materials & Utilities	Natural gas (RLNG): 1.47 MMSCMD, from GAIL up to project premises. Make-up water: 14.4 MLD, tertiary treated sewage water from BWSSB STP.
8	Air Pollution Control Facilities	DLN combustion system in GT,
9	Watse Water Management	Neutralization and Oil water separator, follwed by Guard Pond,
10	Domestic Sewage	Septic tanks and soak pits,
11	Solid Waste Management	Not applicable – no solid waste
12	Hazardous Waste Management	Spent oil and oil sludge from ETP will be disposed through approved vendors.
13	Area Under Green Belt	More than 33% of project area.
14	Annual Stream Days	365 days
15	Manpower Requirement	Departmental: 100 Contract: 250
16	Project time & Schedule	28-30 months
17	Project Cost	1571.2 Crores

3.1.3 Plant Layout

Plant layout for the proposed YCCP is planned considering the future expansion and identifying the required structures/systems to be dismantled by optimizing the available land and infrastructure. Out of the 120 acres of land available within the premises of Yelahanka diesel power plant, 14acres 24 guntas have been handed over to KPTCL for establishing 220kV switchyard, and 18 acres are forest/lake land. Thus, the net land available under KPCL possession is 87 acres 16 guntas. In the present project location, the available infrastructure/facilities of the existing DG plant like power house building with all equipment /system, switch yard, all the BOP's like oil handling system, fire station, work shop, store building and IOCL infrastructure for receiving, storage and oil handling system required for DG plant are not suitable for the proposed CCPP. Existing facilities like Administrative Building, Guest House & Play Ground, Residential Buildings and Overhead Tanks will be utilized for the proposed project. For present, the DG Power plant and its associated facilities will also be left as such. However, the IOCL oil storage tanks and the railway siding are in the process of dismantling, and the available area will be utilized for the proposed project and its future expansion.

Hence some of the systems/structures are to be dismantled in order to implement the 1st stage gas based CCPP and all systems. Considering the above, the net area available for locating the plants and providing for future expansion is 64 acres 51 guntas or 26.4 hectares. The available land is sufficient for establishing gas based combined cycle power plant of 1X350±20% MW capacity in 1st stage and similar capacity plant in 2nd stage after dismantling the some of the existing DG plant facilities as well as for provision of green belt.

The General Layout Plan (GLP) for the project is developed, considering the plot shape, plant contour, available area after dismantling of existing IOCL Storage Tanks and railway siding. The main power house building (Gas turbine, HRSG, steam turbine, Generator Transformer, Cooling tower, etc.) has been considered in the northern part of the plot to optimize the use of available land. The switchyard is located in the south direction of the main plant building; so that power can be easily evacuated to the 220kV switchyard. However water storage and treatment facilities are located in area along eastern boundary of the plot, presently occupied by the railway lines.

Closed cycle cooling water system with induced draft cooling towers has been proposed for the plant. Water treatment plant viz., R.O. Plant, DM plant (Mixed Bed Column), DM storage tanks, neutralization pit, filter house, chemical house, water storage tank and pump house and central monitoring basin have been considered for the general layout plan development.

Keeping in view the nominal capacity, several combination of combined cycle module has been studied to accommodate in the designated area.

The suitability of the site for locating 1X350±20% MW has been determined by the following major considerations:

- Availability of space for locating the main plant, transformer yard, switchyard and all the balance of plant facilities required.
- Availability of adequate space for construction activities.
- Availability of proper road or rail access to the plant site for movement of equipment, construction materials, pipes, chemicals, etc.
- Suitability / feasibility of fuel gas supply.
- Availability of a reliable source of raw water adequate to meet the plant water requirements.
- Suitability of land from topographical and geological considerations.
- Convenience of interconnection with grid for evacuation of the power generated.
- Environmental impact.

The main plant equipment consists of Gas Turbine Generator (GTG) and auxiliaries, Heat Recovery Steam Generator (HRSG) and auxiliaries including main stack, Steam Turbine Generator (STG) and auxiliaries, and gas forwarding station including gas booster station. The possible configuration of the main equipment shall be one block of 1GT+1HRSG+1ST in multiple shaft configurations with separate electrical generator for GT and ST to achieve 350±20% MW.

The Combined Cycle Power Plant (CCPP) with GTG of advanced technology is the most fuel-efficient form of electric power generation. The heat in the exhaust of gas turbine is recovered by generating steam in the HRSG. By maximizing the heat recovery and efficient utilization of the steam in steam turbine the overall combined cycle efficiency can be improved.

Property plan and plot plan for the proposed unit are given in Figure-7 & 8 respectively.

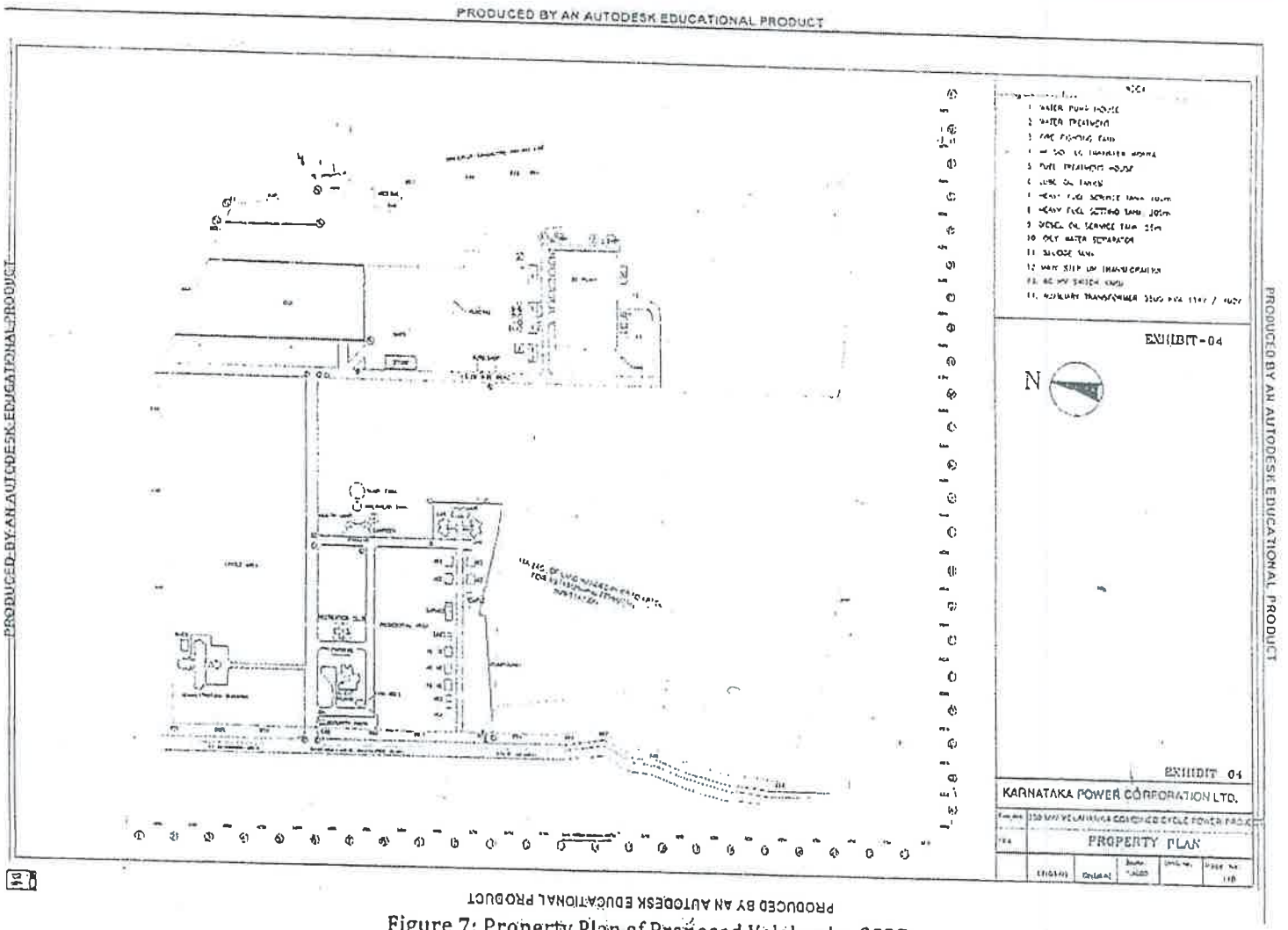

Figure 7: Property Plan of Proposed Yelahanka CCPP

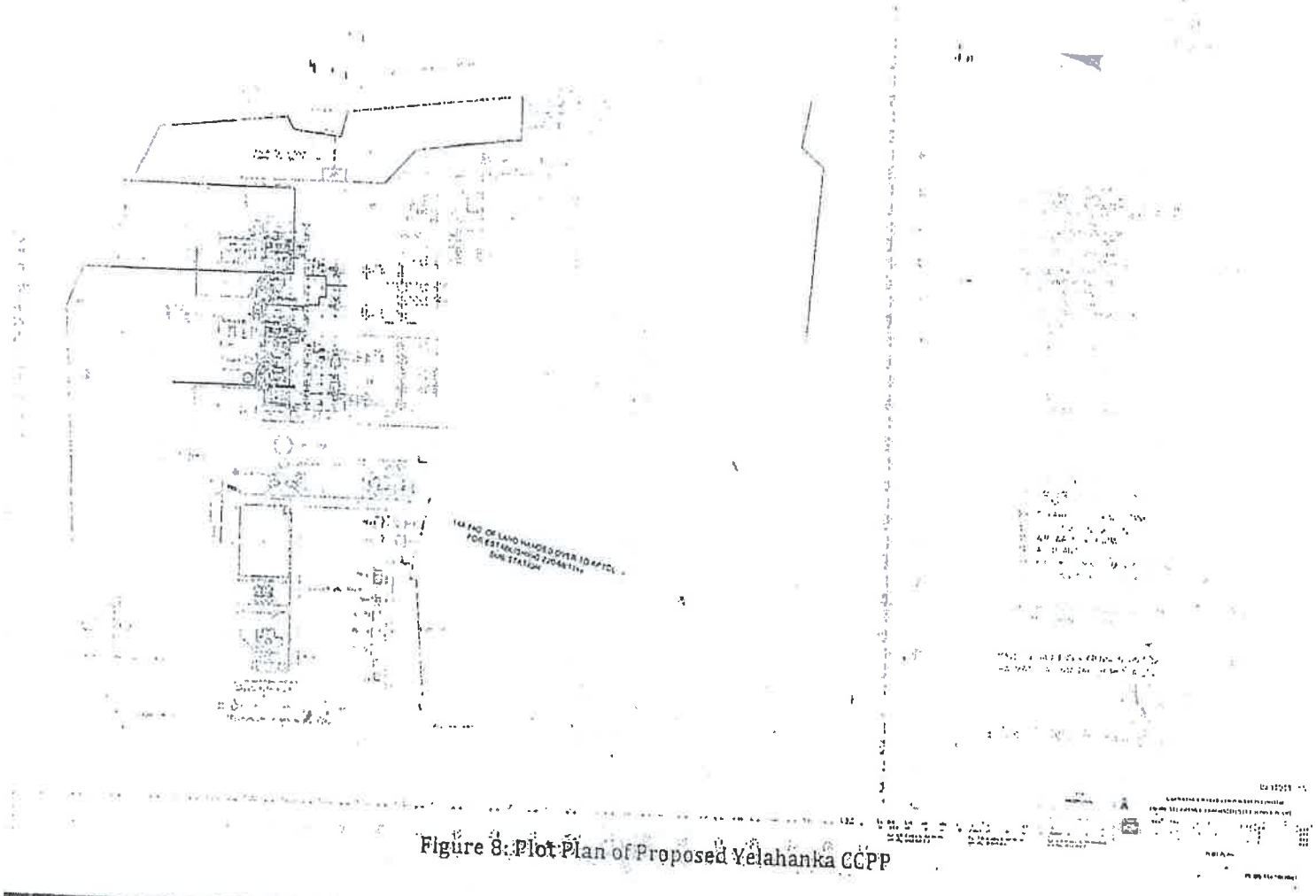

Figure 8: Plot Plan of Proposed Yelahanka CCPP

3.2 RAW MATERIALS & INPUTS

3.2.1 Fuel Availability & Linkage

The fuel for the proposed combined cycle power plant at Yelahanka will be Natural Gas/RLNG (NG). No secondary fuel will be used as a standby or as an emergency fuel. The gas turbine for this power plant will be designed for gaseous fuel operation with Natural Gas/RLNG as the fuel. No supplementary firing in the HRSG is envisaged. A separate metering station, conditioning skid and gas booster station shall be set up in the plant premises.

Availability of gas at project site would coincide with the completion of construction of the power plant. The daily natural gas requirement is estimated as 1.4 MMCMD. The estimated annual gas requirement for CCPP with 100 % gas fuel firing, with 85% PLF and base load operation of the gas turbines will be around 0.35 Million Tonnes per Annum (MTA) for the 1st stage of 350±20% MW CCPP and will be around 0.7 Million Tonnes per Annum considering the second stage of similar capacity.

M/s GAIL has already completed the execution of gas pipe line work from Dabhol to Bangalore and has a terminal point at Bidadi. Further M/s GAIL has executed the gas pipe line all around Bangalore along ring road to meet the domestic and industrial gas requirement of Bangalore. M/s KPCL has approached M/s GAIL regarding the Gas Transport Agreement (GTA) and for the Gas Supply Agreement (GSA). M/s GAIL has agreed to supply the required gas to the proposed Yelahanka CCPP. M/s KPCL shall finalize source of fuel and suppliers on the basis of techno economic feasibility and other aspects during the implementation of the power project.

With the Karnataka/Central Government initiative in making gas available to Bangalore at competitive gas price, the proposed project becomes more feasible.

3.2.2 Water Requirement

Water is required for condenser cooling, cooling of various auxiliaries of gas turbine generators (GTGs), steam turbine generators (STGs), etc. Major consumptive requirements are demineralised water for HRSG feed water make-up, make-up to the CW system, service and potable water system. The water system consists of various sub-systems listed below:

- Raw water supply system
- Cooling water (CW) system
- Auxiliary cooling water (ACW) system
- CW make up water system
- Reverse Osmosis (RO) and De-mineralized (DM) plant
- Service and potable water system
- Fire protection system
- CW treatment plant
- Chemical laboratory equipment
- Ozone generation plant for CW system

- Effluent disposal system

The total water requirement for the 1x350±20% MW capacity CCPP at Yelahanka is about 14.4 MLD (600 m^3/hr.).The proposed water balance diagram for the plant is shown in **Figure-9**. Break-up of water requirement for different purpose is shown in **Table -11.**

Table 11: Break-up of Water Requirement

S. No.	Purpose	Requirement	
		m^3/day	m^3/hr
1.	Cooling water system		
a.	Evaporation and drift losses in cooling tower	8400	350
b.	Blow-down from cooling tower	4200	175
2.	RO and DM Plant (including service water & domestic water requirement)	1320	55
3.	Dilution water to Guard Pond	480	20

The water to the power plant will be sourced from the tertiary treated sewage water from nearby BWSSB treatment plants. BWSSB has established 10 MLD capacity tertiary treatment plants at Jakkur and Allasandra near Yelahanka and is proposing to increase the capacity of the Jakkur treatment plant to meet the 1st stage requirement of Yelahanka CCPP. BWSSB has carried out the feasibility study and preliminary works required for the supply of tertiary treated water to the proposed Yelahanka CCPP. In this regard KPCL have deposited the amount required for the proposed works.

It is propose to entrust the total works of water supply including establishing the tertiary treatment plant with necessary discharge pumps, piping from treatment plant to Yelahanka CCPP raw water reservoir, construction, operation and maintenance of the plant to M/s BWSSB.

M/s BWSSB have agreed to supply the required quantity tertiary treated water to proposed Yelahanka CCPP from Jakkur treatment plant. The analysis of tertiary treated water to be supplied by BWSSB is shown in Appendix #3. In order to avoid further treatment at Yelahanka Plant; it is propose to get the tertiary treated water with required quality to be directly used for industrial use /non-potable purpose. (With TDS around 600-800).

The total raw water requirement of the plant is around 14400 M^3/day (approximately 600 M^3/h). Tertiary treated water drawn from the sewage treatment plant will be stored in the tertiary water storage tank of 114000M^3 capacity, which will be sufficient to cater around six (6) days of raw water requirement of the plant. The tank will also have an adequate reserve and dead storage to cater to the requirements of the fire protection system.

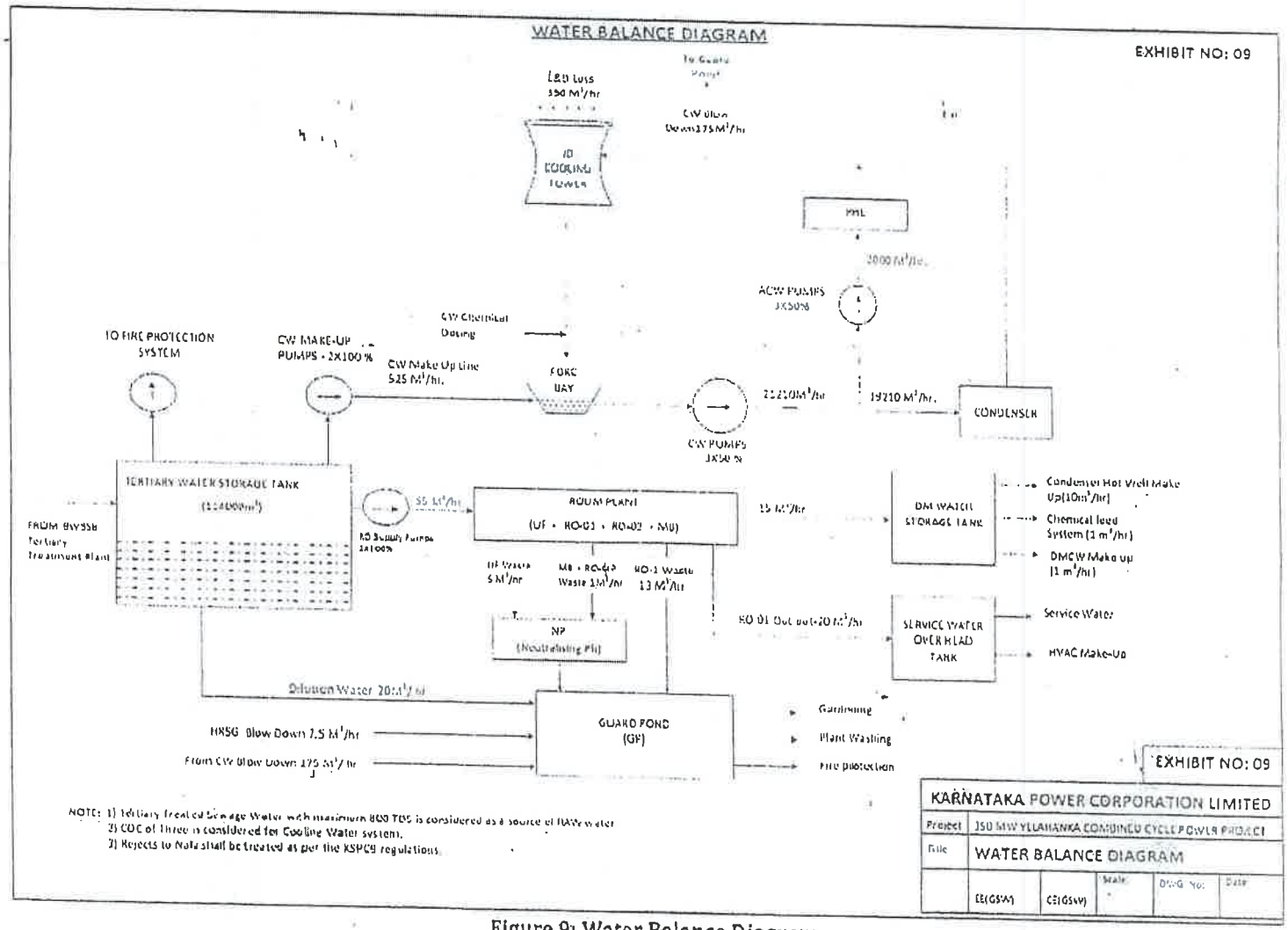

Figure 9: Water Balance Diagram

The raw water pump house located adjacent to the tertiary water storage tank will be of jack well type. In order to remove organic /micro organism, the raw water will be subjected to chlorination for prevention/ control of growth of algae. The chlorination dosing system equipment and the MCC will be housed separately in a common building adjacent to the raw water pump house.

Water requirement will be met from Jakkur Sewage treatment plant of BWSSB which is approximately 6 to 8 km respectively from the Yelahanka DG plant. Presently treatment plant is working to its full capacity and the treated water is not utilized and is let out to natural nala. BWSSB has proposed to enhance the capacity of Jakkur treatment plant by establishing 15 MLD new tertiary treatment plant with latest technology to meet the water quality and quantity requirement of proposed Yelahanka CCPP.

3.2.3 Land Requirement

Out of 120 acres of land available within the premises of Yelahanka Diesel Power Plant, approx. 14 Acres have been handed over to KPTCL for their 220 KV switch yard and 18 Acres are Forest land. Present land use of the balance land (approx. 88 acres) under KPCL control is given in Table-12.

Table 12: Present Use of Land (approx. 88 acres) Under KPCL Control

Description		Area in Acres	
		Acres	Guntas
Existing infrastructure		31	05
i.	Administrative blocks	01	
ii.	Guest house and Play ground		20
iii.	Residential building	04	
iv.	Overhead tank	01	
v.	DG Plant	15	25
vi.	IOCL Storage tanks (to be dismantled)	04	40
vii.	Railway lines (to be removed)	04	
Existing plantation /Vacant land		56	11
Total land		88	

The proposed plants and facilities will be accommodated within part of the existing plantation & vacant land and the land presently occupied by redundant IOCL storage tanks and railway line. Therefore, the total land available for location the plant facilities and future expansion and green belt development is 65 acres or 26.4 hectares. Satellite imagery of the project area, showing areas under different use is presented in Figure-10.

Proposed plant area with break-up is given below:

- Transformer Yard : 0.4 ha
- Switch Yard : 0.8 ha
- Guard-pond/ETP : 0.05 ha
- Cooling Tower : 0.24 ha

- Raw Water Reservoir : 2.3172 ha
- Cooling Tower : 0.15 ha
  (For Gas Booster Compressor Unit)
- Future Expansion : 4.0 ha

All the required infrastructure facilities like administrative building, guest house, residential buildings, green belt development, and compound wall, already exist. Open nallah (Raj Kaluve) is passing within the plant boundary and has occupied more area. The area surrounding nallah is not being used optimally. The existing nallah (Raja Kaluve) can be converted to box type concrete nallah and surrounding area can be back filled to develop the green belt.

Figure 10: Satellite Imagery Showing Proposed Project Site

3.3 PROCESS DESCRIPTION

3.3.1 Combined Cycle Process

The term "combined cycle" refers to the combining of multiple thermodynamic cycles to generate power. Combined cycle operation employs a heat recovery steam generator (HRSG) that captures heat from high temperature exhaust gases to produce steam, which is then supplied to a steam turbine to generate additional electric power. The process for creating steam to produce work using a steam turbine is based on the Rankine cycle.

The basic principle of the Combined Cycle is simple: burning gas in a gas turbine (GT) produces not only power – which can be converted to electric power by a coupled generator – but also fairly hot exhaust gases. Basic principle of combined cycle is shown below in Figure-11 diagrammatically.

Air is compressed in a compressor and the air-fuel mixture is injected into the combustion chamber and fired. The hot product of combustion, at 1000 to 1300°C, is expanded in the gas turbine, which drives the generator, where mechanical energy is converted into electrical energy and on the other end an axial flow compressor, provides the combustion air. To reduce the generation of NOx during the combustion process in the GT set, it is proposed to incorporate DLN burners, which would effectively reduce the NOx concentration in flue gas to below 25 ppm level.

In the combined cycle operation, the heat content of the exhaust gas from the gas turbine is utilized to produce steam in the heat recovery steam generator (HRSG). The exhaust gas from the gas turbines, at about 625°C, will enter the HRSG boilers, where the residual energy will be utilized for generating HP and LP steam. The steam, in turn, is utilized to generate electrical energy in the steam turbine. The spent steam from the ST is condensed, extracted, de-aerated and recycled back to the HRSG as boiler feed water. The flue gas, at about 100°C, will be discharged into the atmosphere through stacks of 45m height. Process Layout of proposed plant is given in Figure-12.

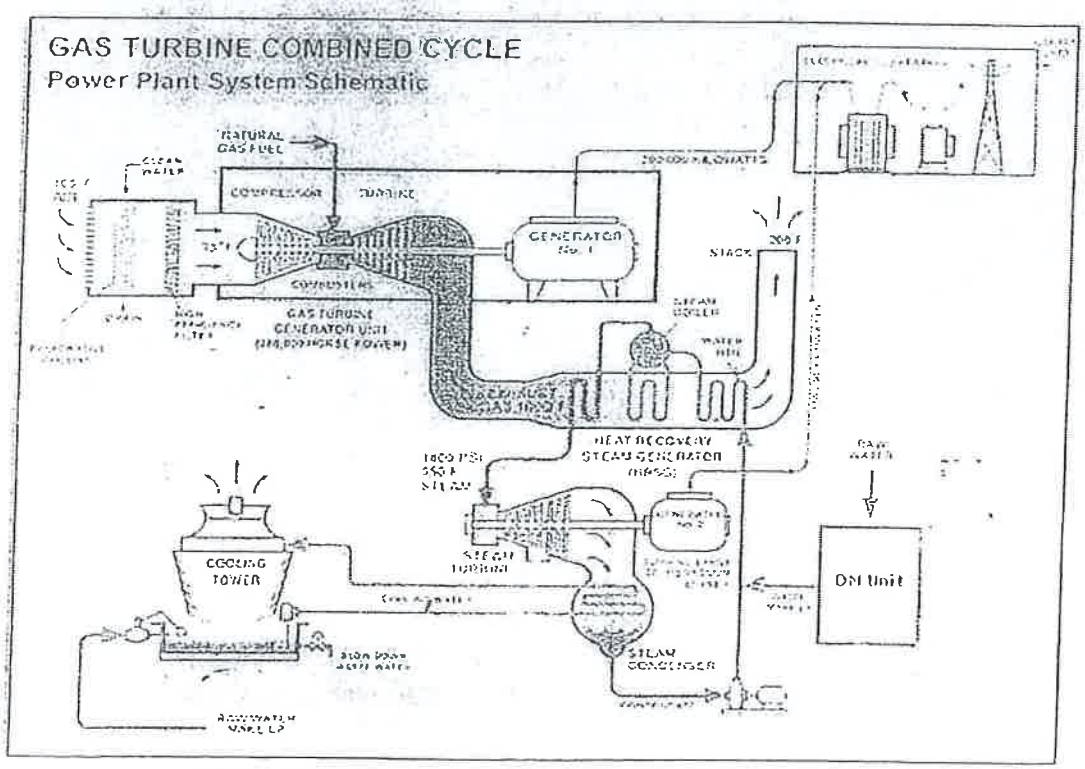

Figure 11: Working Principle of Combine Cycle Power Plant

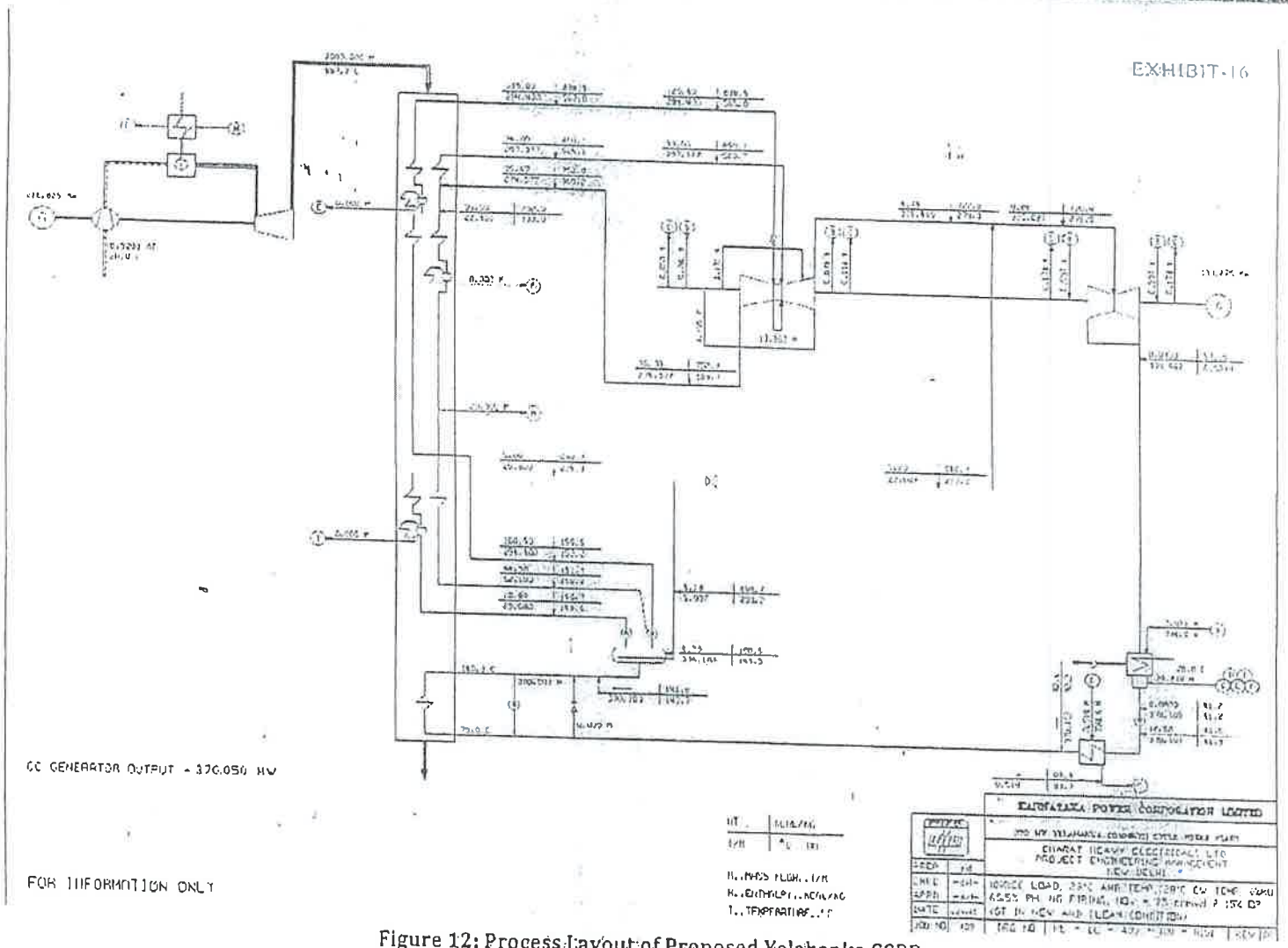

Figure 12: Process Layout of Proposed Yelahanka CCPP

3.3.2 Plant Configuration

The possible configuration of the main equipment shall be one block of 1GT+1HRSG+1ST in multiple shaft configurations with separate electrical generator for GT and ST to achieve 350±20% MW. General configuration of GT/HRSG/ST in plant is shown **Figure-13.** One power-generating module with one of the above configurations is proposed to be installed of nominal capacity of 350±20%MW (depending upon the final configuration of gas turbine module). Natural gas has been considered as the basic fuel for the plant. Natural gas consumption for operation at capacity has been estimated to the order of 1.46 MCMD.

The gas turbine generator would essentially comprise the following:

- Gas turbine section
- Compressor section
- Combustion system
- Fuel system
- Lubricating and hydraulic system
- Inlet and exhaust systems
- Fire protection system
- Cooling system
- Starting system

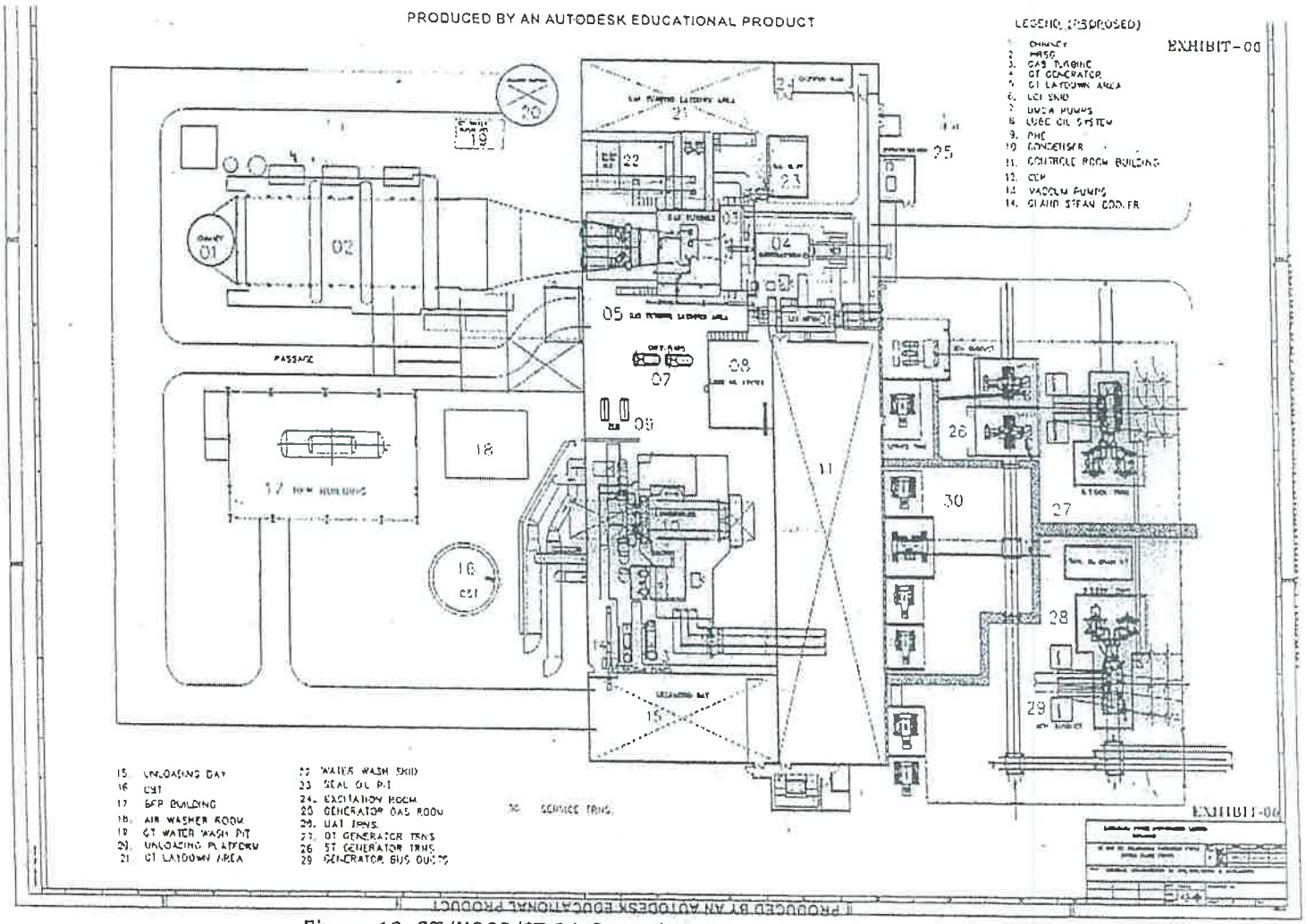

Figure 13: GT/HRSG/ST Configuration of the Proposed Yelahanka CCPP

3.3.3 Gas Turbine Feature

3.3.3.1 Gas Turbine

The gas turbine would consist of a multistage compressor and turbine. The compressor would be of axial flow with 18 stages with modulating guide vanes. Inter stage air extractions are used for cooling and sealing air for turbine nozzles, wheel spaces and bearings, and for surge control during start up.

The turbine section has three stages of nozzles (stationary blades) with air cooling provided to all three stages. The first stage and second stage nozzles are cooled by a combination of film cooling (gas path surface), impingement cooling, and convection cooling in the vane and side wall regions. The third stage is cooled by convection.

3.3.3.2 Combustion System

The gas turbine units would have combustors with Natural Gas/RLNG firing capability. These combustors chambers are arranged around the periphery of the compressor discharge casing. The major components of combustion system are Dry Low Nox (DLN) Combustor, Combustion liners, Transition pieces, Spark plugs, Cross fire tubes, Flame detectors etc.

The combustion of air and fuel mixture takes place in the combustors and the hot combustion gases would be expanded in the gas turbine which would drive the generator and the axial flow air compressor, which would provide the combustion air. The compressor would be provided with inlet vane control system for regulating the airflow and to improve the part load efficiency of the GTG. The gas turbine units would drive the generator directly at 3000 rpm.

3.3.3.3 Fuel System

The fuel system modulates the gas fuel flow to the turbine. Fuel gas system requires that the gas be supplied to the fuel control system at the proper pressure and temperature to maintain proper gas flow and required temperature to maintain the hydrocarbon super heat. The major components of fuel gas system are stop/speed ratio control valves, vent valves, fuel manifold and nozzles, consolidated fuel gas conditioning system, fuel gas filters, heater.

3.3.3.4 Air Inlet System

The gas turbine performance and reliability are the function of the quality and cleanliness of the air entering the turbine .Therefore for most efficient operation , it is necessary to treat the ambient air entering the turbine and filter out the contaminants . The function of the air inlet system is to maintain the quality of air under various temperature, humidity and contamination conditions etc.

The inlet air system would consist of a filter house with self-cleaning pulse jet type single stage static air filters, ducting and silencer. The system would draw atmospheric air into the gas turbine compressor unit. Air intake silencer would be provided to suppress the noise in the intake air system. Cooling system for the combustion air at gas turbine inlet is not being considered for this project.

3.3.3.5 *Heat Recovery Steam Generator (HRSG)*

The HRSG will be unfired heat recovery system. It will be designed for sliding pressure operation on HP and LP sides. Heat transfer surfaces shall be of finned type tube. A condensate pre-heater shall be added at the low temperature zone of HRSG to bring down the flue gas temperature thereby increasing the efficiency by increasing the heat extraction from exhaust gases.

The HRSG would be of triple pressure, reheat natural circulation, and feed water heating, unfired, horizontal gas flow type each with a self-supporting stack of BHEL design of Module of Steam Generator (MSG). The HRSG is provided with super heater, re heater, evaporator and economizer for HP, IP and LP circuits. Steam and water flow is counter current in all the heat transfer section to maximize the effectiveness of the HRSG.

HRSG would be complete with inlet ducts, super heater section, re heater section, attemperators, evaporators, steam drums, economizer and feed water heater, interconnecting piping, valves, thermal insulation and lagging, HRSG casing(ducting) , exhaust ducts, dampers, expansion joints, platforms and ladders with HRSG main chimney. Feed water and steam sampling arrangements as required would be provided. A condensate pre-heater to recover the thermal energy of the hot gas to the maximum extent will be provided apart from the super-heater, evaporator and economizer sections. Steam temperature control would be achieved with spray water attemperation for both main steam and reheat steam.

The exhaust gas is directed through the GT exhaust duct to the HRSG for operation in the combined cycle mode. Solid /serrated spiral finned tubes of suitable fin parameters are used for all heat transfer surfaces considering the usage of cleaner fuel in the gas turbine.

3.3.3.6 *Exhaust System*

The exhaust system would allow the exhaust gas to escape through the HRSG. After exiting from the last stage of turbine, the exhaust gas enters the diffuser section in which portion of the dynamic pressure is recovered and the gas flows axially in to the exhaust system. The exhaust system would comprise of exhaust diffuser silencer, dampers and ducting, expansion joints etc.

The height of the HRSG stack would be about 45mtr above the ground level which is considered adequate as Natural Gas/RLNG contain negligible sulphur which is the minimum requirement as per CEA/MOEF norms. The gas turbine units would have an enclosure around the base frame for reducing the noise level to acceptable limits. A fire detection and carbon dioxide protection system would be provided to protect the gas turbine and its auxiliaries against fire hazard.

HRSG chimney shall be of self-supported, straight cylindrical type chimney shall be designed as per IS 6533. Chimney shell shall be made of MS (as per IS 2062), cage ladder and platforms to approach aviation lamps and sampling ports are to be envisaged. Thermal insulation is to be provided throughout the length of chimney.

3.3.3.7 *Feed Water System*

A constant pressure de-aerator has been proposed for feed water heating and de-aeration of the HRSG feed water. The de-aerator would be located on a separate structure over the feed water pump close to the HRSG. The de-aerator is provided to remove the dissolved corrosive gases from the feed water. The oxygen is reduced to5cc/1000 liters and carbon-dioxide is reduced to untraceable limits. Access to the de-aerator floor will be through a platform of the HRSG.

De-aerator is a direct contact type heater and is located between LP Heaters and Boiler feed pump in a regenerative cycle. The de-aerator feed water heater would be a direct contact type or spray type of de-aerator arrangement. The feed water storage tank would have an adequate storage capacity of about six minutes under 100% maximum continuous operation of the HRSG. The de-aerator would be located at a suitable elevation to provide the required net positive suction head for the feed water pumps.

The feed water system delivers feed water contained in the feed water storage tank to HRSG. Two 100% capacity combined HP/IP boiler feed water pump and two 100% capacity combined LP boiler feed water pump delivers the feed water through the HP and IP economizers to their respective HP and LP steam drums. Feed water is tapped from the intermediate pressure economizer outlet for the use as the heat source in the fuel gas performance heater located near gas turbine. No separate IP pump is provided but an inter-stage tap off to the IP circuit is provided from the HP feed water pumps. The feed water flow to the HRSG would be regulated through feed water control valves (feed control station).

Chemical Dosing: To maintain the quality of the feed water, chemicals are dosed in the LP and HP side of the feed water cycle as well in the ECW system. LP dosing consists of three dosing systems i.e. Hydrazine, Ammonia, and NaOH dosing system. The residual oxygen present in the feed water is detrimental to feed water equipments. In order to control the same, continuous dosing of hydrazine is done at the de-aerator out let. Boiler feed water/condensate water should have requisite PH in order to protect the system from corrosion. In order to control the same, dosing of dilute solution of Ammonia is done at the CEP discharge header. Sodium Hydroxide (NaOH) dosing system is provided to dose NaOH solution in equipment cooling water lines (DMCW) to increase PH up to 9.5. Each system would be complete with solution preparation-cum-feed tanks, agitators / mixers, metering pumps, piping, valves and fittings.

3.3.3.8 *Steam Turbine Generator (STG)*

The Turbine is off condensing type, tandem compound with separate HP/IP and LP cylinders. The combined HP/IP cylinder is of reverse flow design with high pressure and intermediate pressure blading. LP cylinder is of double flow type. The turbine is basically engineered on reaction principle with throttle governing to drive alternating current full capacity turbo generator. The readily designed HP & LP modules are combined and sized to required power output, steam parameters and cycle configuration to give the most economical turbine set.

The STG shall be fitted with valves & actuators, turbine governing system, turbine monitoring system, closed circuit oil supply system for bearings, high pressure control oil system.

The salient features of turbine are;

- Reaction blades with high stages efficiency
- State of the art low-pressure blading under high efficiency
- Flexibility of operation with quick start-ups and loadings
- Wide range of frequency for continuous operation
- Balancing of rotors at rated speed and over-speeding
- Sophisticated control and monitoring equipment

Steam is generated at three (3) pressure levels, namely high pressure (HP), intermediate pressure (IP) and low pressure (LP) in the HRSG. While HP steam is admitted to the steam turbine through a set of emergency stop and control valves, IP and LP steam would be injected into the steam turbine at an appropriate stage through the injection control valves. The turbine control would be of electro - hydraulic type with hydro-mechanical system as a backup. The STG would be complete with lube oil and control oil system, jacking oil system, governing system, protection system and gland sealing steam system.

Intermediate pressure (IP) and low pressure (LP) bypass systems of 100% HRSG capacity for dumping the HP, IP and LP steam to the condenser during start up and turbine trip conditions would be provided.

3.3.3.9 Condensing System

The steam turbine would be provided with a two pass divided water box, surface type condenser fixed to the turbine exhaust for condensing the exhaust steam from the steam turbine supported on the springs. The condenser will be suitably designed to use tertiary treated sewage water for condenser cooling. The condenser would have 90-10 Cu-Ni tubes in the condensing zone and stainless steel tubes in the air cooling zone with carbon steel tube sheets. Two (one working and one standby) mechanical vacuum pumps would be provided for evacuation of air from the condenser. Two condensate extraction pumps (CEP) (one working and one standby) of vertical canister type would be provided to pump condensate from the condenser hot well to the de-aerator through condensate pre-heater of the HRSG with the assistance of three (3x50%) Condensate Pre-heater Recirculation (CPHRC) pumps.

3.4 PLANT UTILITY SYSTEM

3.4.1 Fuel Gas System

Natural gas/RLNG from the gas grid will be supplied from tap-off provision at GAIL's SV Station SV-3B/ Hebbel flyover junction located on outer ring road to KPCL, Yelahanka site boundary limits at a pressure of 17-18 kg/cm²(g) through pipe line from M/s GAIL. Due to lying of pipe line in congested city area limits, it may not possible to supply the gas at higher gas pressure. The gas

turbine would require the Natural gas/RLNG at a pressure of about 35 kg/cm² (g) to 40 kg/cm² (g) near the GT inlet. Hence, gas booster station with two gas centrifugal compressors (1working and 1 stand by) with all accessories is proposed for this project.

The gas being supplied would be metered at the site with a separate metering arrangement. Further filtration and conditioning of the gas would be carried out. The scheme of fuel gas system is shown in Figure-14.

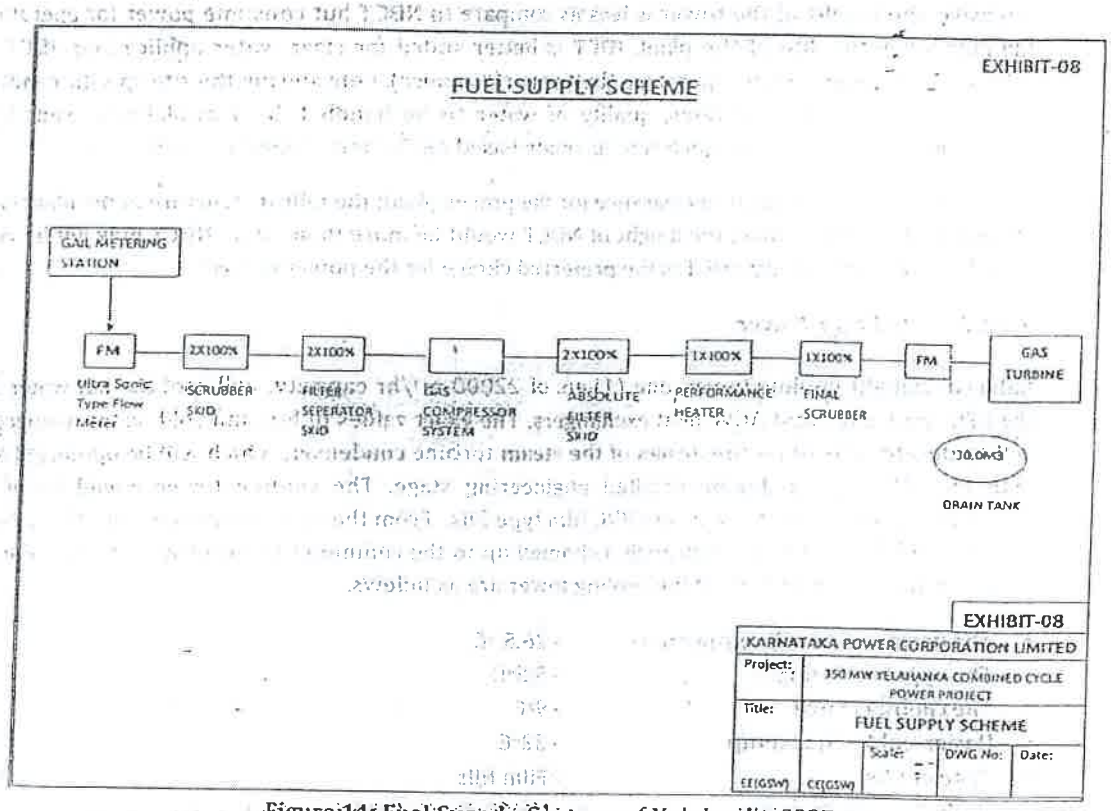

Figure 14: Fuel Supply System of Yelahanka CCPP

3.4.2 Cooling Water System

An open type closed cycle cooling system with one no. Induced Draft Cooling Tower (IDCT) is proposed, considering limited availability of water at the site. Cold water from cooling tower will be pumped to condenser and hot water from condenser shall be returned to cooling tower for cooling. Cycles of concentration (COC) is considered to be three (3). The circulating water quantity required for cooling of the condenser and GTG & STG auxiliaries is estimated to be about 18200 m³/h and 2000 m³/h respectively.

3.4.2.1 *Selection of Type of Cooling Tower*

A comparative study has been carried out between Natural Draft Cooling Towers (NDCT) & Induced Draft Cooling Towers as presented below.

NDCT does not require fans and thus no power consumption but are more capital intensive. The height of the tower is relatively higher than IDCT. The maintenance requirements are much less as compared to IDCT as there are no moving parts. On the other hand IDCTs are relatively less capital intensive, the height of the tower is less as compare to NDCT but consume power for operation of the fans for entire life of the plant. IDCT is better suited for clear water applications. IDCTs can achieve lower approach temperature (better performance). Considering the site specific conditions such as ambient air conditions, quality of water to be handled, land availability, plant layout requirements, etc. the selection has to be made based on Techno-economic analysis.

KPCL needs to obtain aviation clearance for the power plant; the tallest structure in the plant can be of only 45 m height. Since, the height of NDCT would be more than 70 m, NDCT may not be viable. Based on the above study, IDCT is the preferred choice for the power project.

3.4.2.2 *Cooling Tower*

Induced draught cooling tower, one (1) no. of 22000 m^3/hr capacity, will cool the hot water from the STG condenser and ACW heat exchangers. The exact values of hot and cold water temperature will be decided based on the design of the steam turbine condenser, which will be optimized along with the CW system during detailed engineering stage. The cooling tower would be of RCC construction with an RCC basin and PVC film type fills. From the cooling tower basins, the re cooled water would flow by gravity through a channel up to the common CW fore bay and sump ahead of the CW pump house. Details of the cooling tower are as follows.

- The design wet bulb temperature - 26.5 °C.
- The approach temp - 5.5°C
- The cooling range - 9°C
- Design cold water temp - 32°C
- Type of fills - Film fills
- Basin Storage Capacity - Minimum six (6) minutes of design capacity

3.4.2.3 *Chemical Dosing System*

The circulating water has impurities that induce the scale formation on the condenser tubes, increase corrosion. To prevent this, CW treatment is carried out. The CW treatment system mainly consists of scale inhibitor/corrosion inhibitor dosing system and biocide dosing system. Considering the alkalinity of the raw water (20-30PPM) H_2SO_4 dosing is proposed. To prevent scaling arising due to the operation of CW system, chemical dosing system with scale inhibitor / dispersant is envisaged. In order to prevent /minimize growth of algae in the CW system, biocide dosing system is proposed instead of chlorination system. The chemicals dosed will possess anti-corrosive, anti-scalant and dispersing properties.

3.4.2.4 *Cooling Tower Blow-down*

Due to evaporation loss in the cooling tower (evaporative cooling), the concentration of dissolved solids in the circulating cooling water increases with each cycle. To maintain the concentration of the solids within acceptable limit, a fraction of the circulating water is removed from the system and this is termed as blow-down from cooling tower. To make-up the losses due to evaporation, drift and blow-down, water will be added to the system. Evaporation and drift loss is dependent on the cooling range. Thus quality of make-up water will decide quantity the blow-down and the cycle of concentration to be adopted and shall govern the make-up water quantity. The blow-down water from the CW system (cooling tower basin) will be led to a guard pond, treated along with the other effluents collected in the guard pond.

3.4.2.5 *Cooling Water Make-up System*

Raw water from the tertiary water storage tank will be used as make-up for the circulating water system. Motorized butterfly valves with isolation valves will be provided along the CW make-up line for controlling the flow of make- up water. The make-up water will flow by gravity from the storage tank to the CW sump.

3.4.3 Water Treatment System

To meet the de-mineralized water requirements of the HRSG boilers and water of higher purity for makeup to the HVAC system and miscellaneous services such as washing, canteen and toilets, An RO and DM Plant is proposed. The RO-DM system will consist of

- Pressurized Ultra Filtration System (UF)
- Reverse Osmosis System (RO1)
- Reverse Osmosis System (RO2)
- Degasser System
- Mixed bed System (MB)

The service and potable water requirements of the plant will around 20 M³/hr and will be tapped from RO-1 permeate. The service and potable water system will cater to the plant potable water system requirements, makeup to the HVAC system and other miscellaneous services such as plant washing, canteen and toilets. Water will be pumped to the service water overhead tank of 200m³ capacity from where water will flow by gravity to various consumption points.

Pressurized Ultra Filtration System

The chlorinated tertiary treated water from raw water storage tank is passed through 500 micron strainers and then fed into pressurized UF system and UF permeate is collected in UF permeate tank. The strainers are back washed /flushed periodically and the waste is collected in a proposed neutralizing pit.

3.4.3.2 *Reverse Osmosis System (RO1)*

Water from UF permeate is supplied to RO stage 1 system consisting of cartridge filter and high pressure feed pumps (1w+1s). These pumps will pump the filtered water under high pressure through RO membranes. Acid and scale inhibiting chemicals will be dosed to the filtered water for protection of RO membranes. The permeate is collected in RO-1 Permeate Tank. A portion of RO-1 permeate is utilized for service water purpose (20 m^3/hr).

3.4.3.3 *Reverse Osmosis System (RO2)*

RO1 permeate is collected in RO-1 permeate tank. The RO -1 permeate from the permeate tank is sent to RO-2 through RO-2 feed pumps (1w+1s) for further treatment. RO-1 brine is disposed off to guard pond while RO -2 reject is routed to inlet of RO-1.

3.4.3.4 *Degasser*

RO-2 permeate is further passed though degasser tower for reducing the dissolved CO2 and stored in degasser water storage tank from where it is admitted to Mixed Bed system to get the desired water quality. The permeate water from the degasser tower prior to being let to the storage tanks will be subjected to pH correction by the caustic dosing system provided for the purpose.

3.4.3.5 *Mixed Bed System*

The mixed bed unit will be designed to produce de-mineralized water required for HRSG feed water make-up and GT inlet air cooler makeup. The plant is designed for a feed water make-up at 3 % HRSG MCR along with the makeup requirement for GT inlet air cooling. The plant will consist of two (2) streams of mixed bed units, each of 50 % capacity. Each stream will be designed for a productive run of 16hrs in a day and the units will be brought out-of-service for regeneration/ maintenance. Each stream will be designed for a flow rate of 25.5 m^3/hr and will be designed for a productive output of 312m^3/Day. The treated output (DM water) will have a conductivity of less than 0.1 micro-mho/cm and silica less than 0.015PPM. DM water from the outlet of the mixed-bed unit will be stored in two (2) Nos. DM water storage tanks, each of 400 m^3 capacity and in condensate storage tank of 300 m^3 capacities. DM water from these tanks will be supplied as feed make-up to HRSGs and makeup for GT inlet air coolers, by two (2) nos. (1 w + 1 s) DM water transfer pumps. MB regeneration waste is routed to neutralizing pit.

3.4.3.6 *Neutralization Pit*

The backwash water from the filters of the RO pre-treatment plant and the regeneration effluent from the DM plant will be led to the neutralizing pit. The pit will be in two compartments of 50 M^3capacity (each). Facilities for addition of acid/ alkali for neutralizing the effluent are proposed. The neutralized effluent will be led to the guard pond by two (2) Nos. (1w +1s) neutralizing system pumps. The RO plant reject will also be led to the guard pond.

3.4.4 Fire Protection System

Fire protection system comprises different fire protection facilities to protect the plant against any fire hazard. The fire protection system consists of:

- Hydrant system for different areas of the plant.
- High velocity water spray protection system for transformers & turbine lube oil tanks.
- Medium velocity water spray system for cable galleries.
- Portable extinguishers and hand appliances for extinguishing small fires in different areas of the plant.
- Carbon dioxide flooding system for GTG and the local electrical containers / control cubicles room, which is a part of the GTG package.
- Mobile fire tender

Requirements of the plant hydrant and spray systems is handled by two (2) numbers of vertical turbine type firewater pumps each of capacity 410m³/hr and 88 MWC discharge head (1 motor driven and 1 diesel engine driven).

Two jockey pumps (1 motor driven and 1 diesel engine driven) each of capacity 15m³/ hr and 90 MWC discharge head (1W+1S), two air compressors (1W+1S), and one hydro -pneumatic tank of capacity 18 m³ are provided for make up of the system leakages and for maintaining the system pressure. All the pumps are located at the raw water pump house. Motor driven and corresponding diesel driven pumps are interchangeable in respect of speed, capacity etc.

Starting of fire protection systems will be automatic while stopping of the pumps will be manual. Reserve storage will be provided in the raw water storage tank to cater to the requirements of fire protection system

3.4.5 Effluent Disposal System

The various waste-water generated in the combined cycle power plant shall be handled as below.

- The cooling tower blow down shall be transferred to the guard pond.
- HRSG blow down and drains shall be pumped to the guard pond.
- Reject from the RO plant, backwash from filters and regeneration effluents from the mixed bed units will be led to the neutralizing pit, treated and led to the guard pond.
- Effluent after plant washing, cleaning, etc. will be led to the guard pond.
- Plant drains from SG/TG area will be led to a sump, which will also collect oily wastes from transformer area. These oily effluents will be further treated in an oil-water separator in lamella clarifier for removal of oil traces. The clear water will be led to the guard pond while the dirty oil will be disposed off in drums separately.

Treated effluents from the lamella clarifier shall conform to

- Suspended solids maximum of 100mg/l
- Oil traces maximum of 10mg/l

All the liquid effluent after required treatment shall be led to guard pond which acts as an equalization basin. The pond will have 24 hours of detention period calculated on the average flow of effluents. Ideal effluent disposal schemes have to be devised to achieve the maximum reuse of effluent collected.

The water collected in the guard pond will be treated for pH correction. A provision for dilution line to draw water from the raw water storage tank would be made to treat the water collected in the guard pond in case the disposed water exceeds the standards stipulated in the Environment (Protection) Rules. The water will be then pumped to raja Kaluve leading to Yelahanka lake, located within the plant boundary.

A portion of the water collected in the guard pond will be reused for gardening purpose and development of green belt. All the efforts shall be made for reusing the remaining substantial portion of effluent water within the plant. It is proposed divert sanitary waste to soak pits /septic tanks.

3.4.6 Chimney System

HRSG chimney shall be of self-supported, straight cylindrical type chimney shall be designed as per IS 6533. Chimney shell shall be made of MS (as per IS 2062), cage ladder and platforms to approach aviation lamps and sampling ports are to be envisaged. Thermal insulation is to be provided throughout the length of chimney.

3.5 CONTROL & MITIGATION MEASURES

3.5.1 General

The various types of pollution from the proposed power plant are categorized under the following types:

- Water Pollution;
- Air Pollution;
- Noise Pollution; and
- Thermal Pollution.

Waste gases of combustion and waste water from different operations are the major waste products discharged from the proposed power plant. As the proposal is for a gas based plant, solid wastes will be, practically, absent. The gaseous and liquid wastes generated in the plant will be treated to conform to the statutory requirements and to suit the environmental status of the surrounding area.

The various proposed pollution control systems are described in the following sections.

3.5.2 Water Pollution

The sources of water pollution are:

- Cooling tower blow down.
- HRSG blow down.
- Effluent from DM plant/ water treatment (WT) plant.
- Plant washings & miscellaneous drains.

The blow down water will be led to the guard pond along with other influents to the guard pond which includes the effluents from the neutralizing pit, RO plant reject, clear water from the outlet of the oil-water separator and HRSG blow down. Water collected in the guard pond will be treated for pH correction and also diluted if required with water drawn from the tertiary water storage tank - to the standards as stipulated by Pollution Control Board. The water collected in the guard pond will be used for plant cleaning, gardening, firefighting, etc. Small quantity water if Remaining is pumped (after 24 hours detention period) to nala after necessary treatment (as per the norms of pollution control board). The final effluents discharged from the Guard Pond will conform to the regulatory standards of Karnataka State Pollution Control Board.

3.5.3 Air Pollution

A Combined Cycle Power Plant (CCPP), using natural gas, is much more environmentally compatible as compared to coal-based power plant of similar capacity. In the absence of coal handling, ash handling and ash disposal areas, fugitive dust emissions and release of pollutants in stack emissions would be significantly lower. As re-gasified LNG is proposed to be used as the only fuel at this plant, particulate emissions will be eliminated. Further, as Sulphur content in the natural gas is very low (less than 24 ppm, w/w), SO_2 emission from the combustion of fuel will also be negligible. Dry Low NOx (DLN) Burners, consisting of two-stage premixed combustor, will be provided to control NOx emissions below 25 ppm level. Appropriate stack height (45 m) in line with the requirement of regulatory agencies for control of gaseous emissions would be provided. NOx emissions will be controlled as per the regulations of Ministry of Environment, Forest& Climate Change. As the combined cycle plant would be free from particulate emissions, no specific control measures are envisaged.

The guarantee value of NOx for the proposed CCPP is 25 PPM. However, to release the exhaust gases from HRSG to atmosphere to avoid local dispersion as per the norms, a stack height of about 45mtr above the ground level is considered adequate. Automatic On – line stack monitoring instrument will be provided for monitoring of NOx emission.

3.5.4 Noise Pollution

The sources of noise pollution in a power plant are:

- Air inlet & exhaust gas streams.
- Steam turbine generator
- Other rotating equipment
- Combustion induced noises
- Flow induced noises
- Steam safety valves

All the equipment in the power plant would be designed to have a total noise level not exceeding 85 dB (A). Generally the manufacturers of the gas turbine generators indicate the following noise level values:

- 85 dB (A) at a distance of 1.5 m from the gas turbines
- 65 dB (A) at a distance of 120 m from the gas turbines

The inlet air and exhaust gas streams would be provided with silencers for noise reduction. Generally there would not be any operators near the gas turbine generator on a continuous basis. However, maintenance personnel working local to gas turbine generator building would be provided with adequate protection against noise. The steam turbine generator would be housed in a closed building thereby reducing the transmission of noise to the outside environment.

3.5.5 Thermal Pollution

The combined cycle power plant envisages installation of unfired heat recovery steam generators to utilize the heat content of the exhaust gas from the gas turbines. Installation of HRSG to recover heat from the gas turbine exhaust gas would enable reduction of the temperature of the exhaust gas to the lowest possible value, thereby reducing the thermal heat discharge into the atmosphere. The flue gas temperature at HRSG exit would be approximately 100 degree Celsius. Simple cycle operation of CCPP is not envisaged and no by-pass stack is provided on the up-stream of the HRSG.

3.6 MANPOWER

The employees of the existing DG based Power Plant will be utilized for operation and maintenance of the proposed plant. The proposed staffing is based on the O&M philosophy of optimizing the manpower requirement with the benefit of deploying the latest Automation and Control systems. Total manpower requirement for the proposed plant is expected to be 350, comprising 100 departmental employees and 250 persons on contract basis. Security staff & guards will be outsourced on contract basis. Necessary training for operation and maintenance of the combined cycle power plant will be provided before commissioning of the project.

The plant will be operated in 3 shifts. However, minimum no. of people will be in attendance during the evening and night shifts on the assumption that only temporary and minor works can be carried out during the period.

The Proposed CCPP will be headed by Plant Manager. Plant Manager will be assisted by senior executives. They will hold independent charge of their departments and their functions. Following major Departments are considered:

- Operations
- Maintenance
- Purchase & stores
- Admin and Accounts

General Operation of the station would be the responsibility of Shift in charge (Operation) who will report to the Plant Manager. Shift in charge will be assisted by each discipline engineers & technicians.

The Maintenance wing is headed by Maintenance Manager and would be assisted by Maintenance Engineers who would have adequate technically sound / qualified personnel to look after the maintenance work under respective disciplines. Maintenance wing is expected to take care of routine and preventive maintenance of the plant.

All purchases of materials and services will be handled by P&S Manager. P&S Manager will be assisted by Purchase officer and stores in charge.

Administration and Accounts Department is headed by Admin and Accounts Manager and would be assisted by Administrative executives and Accountants.

Apart from above there will be the requirement of QHSE team.

Security officers and Security Guards are not considered in this organization chart. Security staff & guards may be outsourced on fixed term basis.

3.7 PROJECT COST

Summarized version of the project capital cost for 1 x 350 ±20% MW YCCPP is given below:

- Project cost excluding IDC : Rs. 1395.86 Crores
- IDC & Financing charges : Rs. 175.31 Crores
- Total Project cost with IDC: Rs. 1571.18 Crores

CHAPTER-4

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CHAPTER-4: DESCRIPTION OF ENVIRONMENT

4.1 INTRODUCTION

4.1.1 Environmental Aspects

To assess the impact from the proposed project unit and its management, it is important to determine the baseline status of the environment in the area of influemce. The aspects considered and covered under the study are topography, physiography, water environment, climate & meteorology, air environment, biological environment, noise environment, soilenvironment, land use and socio-economic environment. This chapter provides the description of the studies and findings during the baseline studies in the area of influence.

4.1.2 Study Area

The area of influence for the environmental impact assessment was considered as the area falling within 10km radius from the project site. Thus the study area considered for determining the baseline environmental status is the area falling within 10km radius from the project site. Geographically, the project site is located at latitude 13°6'47.68"N to 13°7'3.78"N and longitude 77°35'11.97"E to 77°34'40.43"E. The study area for the EIA study is covered in Survey of India Toposheet Nos. 57G/12 (1:50000 scale), and is spread around Village-Puttenahalli&Kenchenahalli, Teshil Yelahanka, District-Bengaluru, Karnataka. The map showing the study area is given in Figure-1S.

4.1.3 General Methodology

Ambient air quality, water quality, ambient noise level, on-site meteorological data and soil quality has been assessed through sampling and monitoring performed by Mantec Environmental Laboratory, which is MoEF&CC approved and NABL accredited. These were performed through sampling/monitoring at appropriate numbers of representative sampling/ monitoring locations. Baseline status of ecology & bio-diversity, soco-economic profile, climatological data, geology & topography, ground water resources, etc. were collected from secondary sources, including published data, and authenticated through field surveys and interactions.

4.1.4 Study Period

The studies were performed to cover the pre-monsoon or summer season (one full season) of the year 2015. Thus, the studies were started on 10th March, 2015 and continued up to 9th June, 2015.

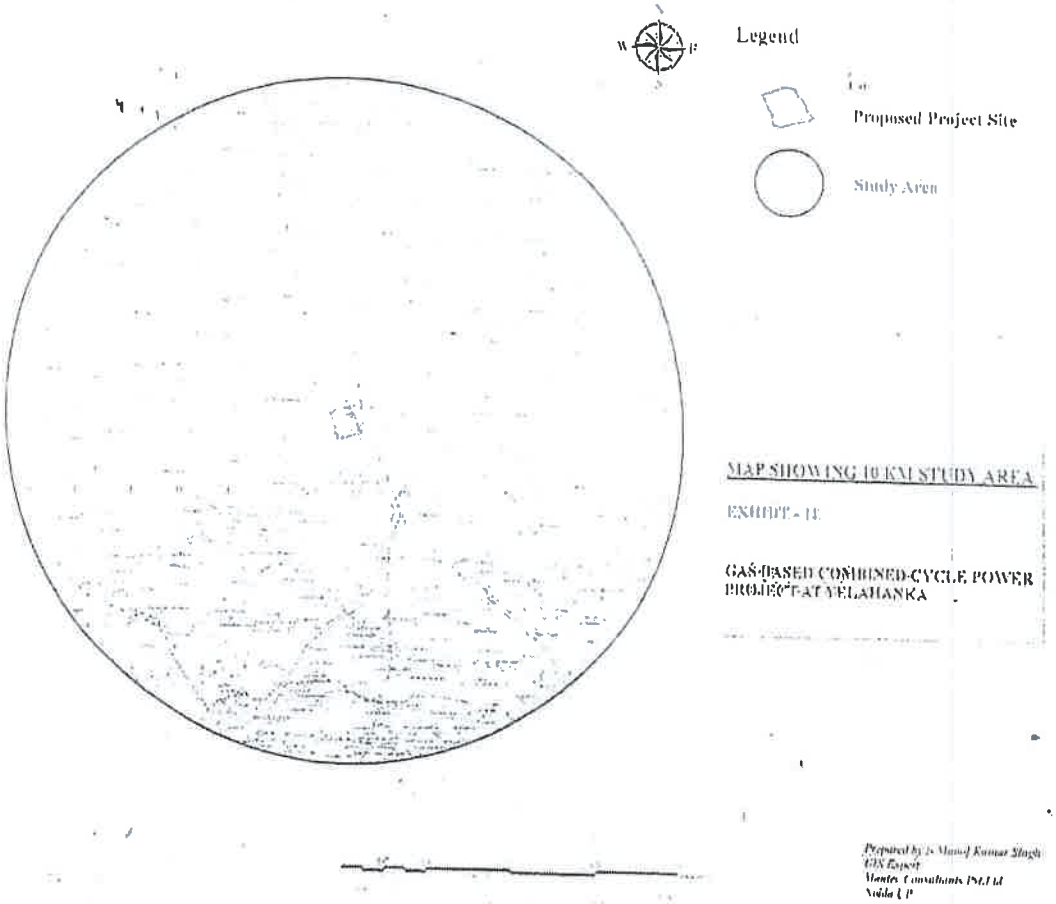

Figure 15: 10km Radius Study Area Map

4.2 LAND ENVIRONMENT

Studies on land use aspects of eco-system play an imperative role in identifying susceptible issues and to take appropriate action to uphold ecological equilibrium in the region. The main objective of this section is to provide a baseline status of the study area covering 10-km radius around the existing plant site so that temporal changes due to the industrial activities on the surroundings can be assessed in future.

4.2.1 General Setting of Site & Study Area

The proposed site is located in the Village-Puttenahalli&Kenchenahalli,Teshil Yelahanka, District-Bengaluru, Karnataka. The land proposed to be utilized for establishing plant is thevacant area existing within premises of the existing Yelahanka Diesel Power Plant. There are other major industries such as Wheel and Axel plant andBharath Electronics Factoryin the study area. The major features falling within the 10 km radius study area is given below in Table-13.

Table 13: Environmental Setting of the Study Area

PARTICULARS	DETAILS
Nearest Town	Bengaluru, 18 km
Nearest Highway	Bangalore–Hindupur State Highway, adjacent to site National Highway (NH-7), 3.km
Nearest Railway Station	Yelahanka Railway Station, 2 km
Nearest Airport	Bangalore International Airport, 25 km
Protected / Reserved Forest	No
Ecologically sensitive areas viz. National Parks, WL Sanctuaries etc.	No
Archaeological Sites	Pre-Historic site at Chikkajala (8.5 kms Radial distance from the Proposed plant site)
List of water bodies	Hebbal lake Yelahanka lake Jakkur lake Allasandra lake Amruthalli lake Nagavara lake Kogilukere lake Chikkabanavara lake Kammagondahalli lake Rachenahalli lake
Seismic zone	Zone II (least active zone) as per the Seismiczone Map of India [IS1893 (Part 1) 2002]

4.2.2 Topography & Drainage

Yelahanka is at a height of about 915 metres (3000 feet) above mean sea level. Due to its higher altitude from mean sea level, it is lush green and has pleasant weather year round.

The site is practically level as it is inside the boundary of the existing power plant. The lowest and highest level of elevation of the proposed project is 897m AMSL & 912m AMSL creating a difference of 15m. The land inside the plant is plain and is sloping towards south East.

Major part of the district is drained by Shimsha, Arkavathy and Kanva rivers of Cauvery basin i.e. Bangalore north and South taluks (Catchment area of 468 sq.km which includes Nelamangala and Magadi taluks of Bangalore rural also). Anekal taluk is drained by Ponnaiyar basin.

Pennar & Ponnaiyar Basin

Pennar

Pennar basin extends over an area of 55213 sq. km. which is nearly 1.7% of the total geographical area of the country. It is bounded on the north by the Erramala range, on the east by the Nallamala and Velikonda ranges of the Eastern Ghats, on the south by the Nandidurg hills and on the west by the narrow ridges separating it from the Vedavati valley of the Krishna basin. The basin lies in the States of Andhra Pradesh and Karnataka. The important soil types found in the basin are red soils, black soil, sandy soil and mixed soil. The culturable are of the basin is about 3.54 M. ha which is about 1.8% of the total culturable area of the country.

The State-wise distribution of drainage area is given below:

State	Drainage Area (km^2)
Karnataka	6937
Andhra Pradesh	48276
Total	55213

Ponnaiyar

The Ponnaiyar Basin is the second largest interstate East flowing river basin among the 12 basins lying between the Pennar and Cauvery basins. It covers a large area in the state of Tamil Nadu besides the areas covered in the states of Karnataka and Andhra Pradesh. It lies between East longitude 77° 33' to 79° 47' and North latitude 11° 45' to 13° 30' The Basin is bounded on the North -West and South by various ranges of the Eastern Ghats like the Velikonda Range, the Nagari hills, the Javadu hills, the Shevaroy hills, the Chitteri hills and the Kalrayan hills and in the East by the Bay of Bengal.

The Ponnaiyar drains an area of 16,019 SqKms out of which nearly 77 percent lies in Tamil Nadu. The State wise distribution of the drainage area is as follows:

State	Drainage Area (km²)	
Karnataka	3,530	22.0
Andhra Pradesh	210	1.3
Tamil Nadu	12,279	76.7
Total	16,019	100.0

The Ponniyar or the Dakshina Pinakini River rises near Hongashenhalli village at an elevation of about 900 m amsl at North latitude 13°25' and East longitude 77°58' in the Kolar district of Karnataka state. From its origin, the river Ponniyar generally flows in the Southern direction for a length of 79 km. through Kolar and Bangalore districts of Karnataka before entering the Dharmapuri district of Tamil Nadu. The river flows another 247 Kms generally in the South-Easterly direction in the districts of Dharmapuri, Vellore, Tiruvannamalai, Cuddalore and Villupuram . The river then flows in Easterly direction below the Tirukoyiluranicut for another 70 Kms before finding its way into Bay of Bengal. The river Ponnaiyar branches into two, the Gadilam and the Ponnaiyar below the Tirukoyilurani cut. The Gadilam joins the Bay of Bengal near Cuddalore and the Ponnaiyar near the Union Territory of Pondicherry. On its way, the river receives a number of small streams and rivulets.

The Ponnaiyar basin is covered by the Archaean rocks such as Pyroxene granulites, Quartzite, Ferruginous Quartzite, Amphibolites, Gneiss and Hornblende biotite gneiss with younger intrusive of Pegmatite and Dolerite in the central and western parts . The eastern part is covered by the cretaceous formation of argillaceous, calcareous sandstone with clay and limestone. The tertiary formation is of Cuddalore sandstones and the recent formation of river alluvium and coastal alluvium.

4.2.3 Geology

Physiographically the district can be divided into rocky upland, plateau & flat topped hills at an general elevation of about 900amsl with its major part; sloping towards south and south east forming pediplains interspersed with hills all along the western part. The pediplains form the major part of the district underlain by granites and gneisses with the highest elevation of 850 to 950 m amsl. Major part of the pediplain constitute low relief area having matured dissected rolling topography with erosional land slope covered by a layer of red loamy soil of varied thickness. Major part of the pediplains is dissected by streamlets flowing in southern direction.

4.2.4 Hydro-geology

Ground water occurrence, movement and recharge to aquifers are controlled by degree of weathering, fracture pattern, geomorphological setup and rainfall. Granites and Gneisses of peninsular gneissic group constitute major aquifers in the urban district. Ground water occurs in phreatic conditions in the weathered zone and under semi confined to confined conditions in fractured and jointed rock formations. Laterites of Tertiary age occur as isolated patches capping crystalline rocks in Bangalore north taluk and ground water occur in phreatic condition. Alluvium of 20m thick, which occur along the river courses, though of limited thickness and aerial extent possess substantial ground water potential.

Behaviour of Groundwater

Behavior of groundwater level is essentially controlled by physiography, lithology and rainfall. In a normal year deepest ground water level is generally recorded during April-May and shallow water level during October-November. In general, pre-monsoon depth to water levels ranges from 2.00 to >10.00 m bgl. Post-monsoon depth to water level ranges from 1.77 to 12.02 m bgl.

4.3 LAND-USE& LAND-COVER OF STUDY AREA

The objectives of land use/ Land cover studies are:

- To determine the present land use pattern;
- To ascertain the temporal changes in land use pattern due to construction and operation phase.

4.3.1 Methodology

Satellite data:- The land use of the study area is studied and analyzed by using the latest available satellite imagery.

Topographical map of study area:- The Survey of India topographical map of 57G/12 on 1:50,000 scale covering 10 km study area, was used as reference map for geo-referencing of the remote sensing data.

Ground control point has been collected for geo-referencing process for ortho-rectification. Base maps are studied for classification of land use classes.

4.3.2 Land use /Land Cover Map

The study area of 10-km around the plant boundary is considered in the land use pattern study. The study area theoretically covers an area of 31415.93 ha within the circle encompassed by 10-km radius around the project site.

For computation of the land use pattern in the study area ERDAS IMAGINE-9.2, Arc GIS and AUTO CADD software are used. The geographical area of all settlements covered within the study area is considered. The land use is classified into 6 classes - viz. Settlement, agricultural land, waste land, forest cover, and water bodies.

Table-14 presents the areas under different land uses. Break-up of land use in the study area has also been presented through Figure-16. Land-use/land-cover map of the study area has been presented in Figure -17.

Table 14: Land-use Classification of Study Area

Class Name	Land-use area (SqKm)	Land-use (%)
Agriculture	176.65	56.21
Settlement	117.38	37.35
Vegetation	7.41	2.36
Waste Land	7.45	2.37
Water Bodies	5.39	1.72
Total	**314.28**	**100**

Land-use of Project Area:

Prior to acquisition from individual owners, the land identified for the project was agricultural land under private ownership. The project area was covered with crops, and a small man made pound. The project area had no tree cover.

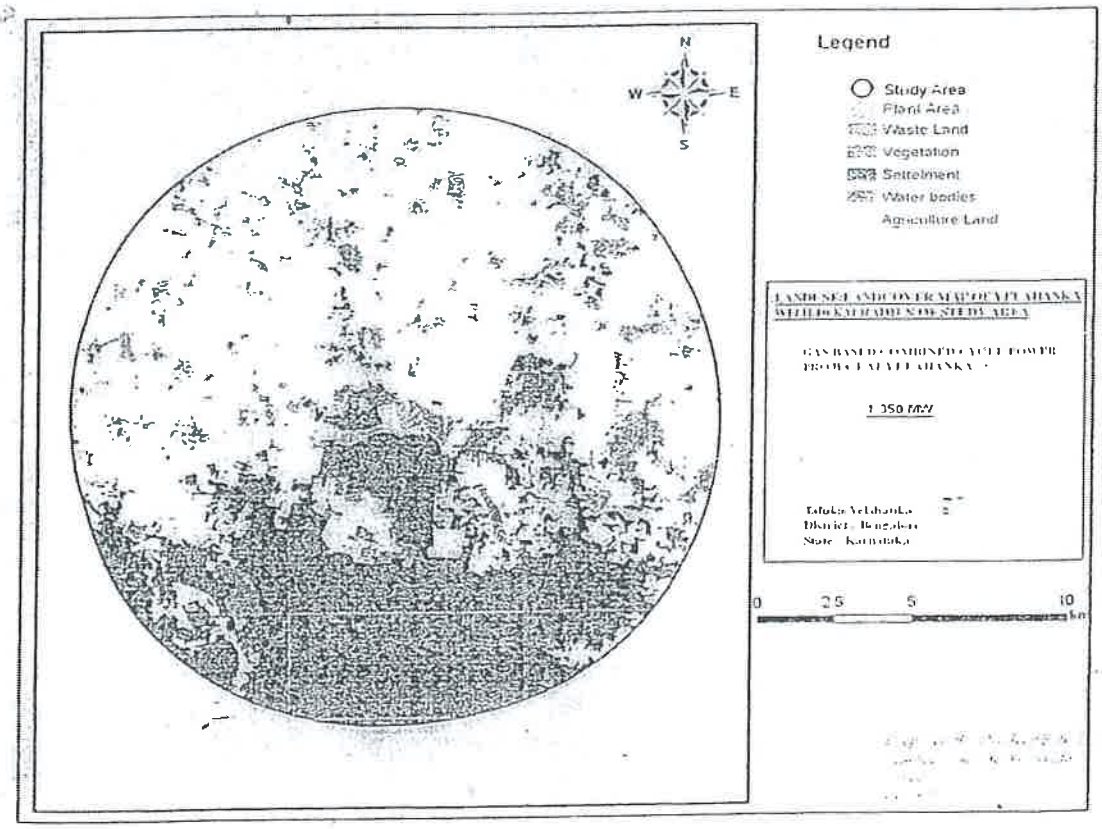

Figure 16: Land-use/Land-cover Map of Study Area

The soils of the districts can be broadly grouped into red loamy soil and lateritic soil.

Red loamy soils generally occur on hilly to undulating land slope on granite and gneissic terrain. It is mainly seen in the eastern and southern parts of Bangalore north and south taluks.

Laterite soils occur on undulating terrain forming plain to gently sloping topography of peninsular gneissic region. It is mainly covered in Anekal taluk and western parts of Bangalore North and south taluks.

Site Specific Soil

Top layer (0.5M) of soil is brownish red clay with silt sand and gravel followed by Sandy silt (up to 5 m) and pink yellowish grey sand up to 20m depth.

4.3.3 Methodology for Soil Quality Monitoring

Sampling and analysis was conducted as per established standard methods and procedures prescribed in IS 2720 and ASTM. Soil samples were collected from agricultural fields by ramming a hand auger into the soil upto a depth of 90 cm. At each of the sampling location, soil samples were collected from three different depth viz. 30 cm, 60 cm and 90 cm below the surface and homogenized. The homogenized samples were then packed in a polythene plastic bag and sealed. The sealed samples were sent to the Laboratory for analysis. The physical, chemical and heavy metal concentrations were determined for all the samples.A number of parameters were determined, which are indicative of physical, chemical and fertility characteristics.

4.3.4 Soil Monitoring Locations

The Soil Monitoring was conducted for studying the various parameters at four different locations within the study area, including one within the project area and three at other locations in the study area. The locations of the Soil Quality Monitoring are summarized in Table-15 and shown in **Figure-17**. The sampling locations are chosen based on the proximity of the location to the project site.

Table 15: Soil Monitoring Locations

S.No.	Location Code	Sampling station	Location w.r. to the site	
			Distance, km	Direction
1	S1	Reserve Forest (Lingarajapura)	3.8	NW
2	S2	Project Site	00	00
3	S3	Reserve Forest (Virasagara)	4.2	W
4	S4	Reserve Forest (Kammagondanahalli)	7.3	SW

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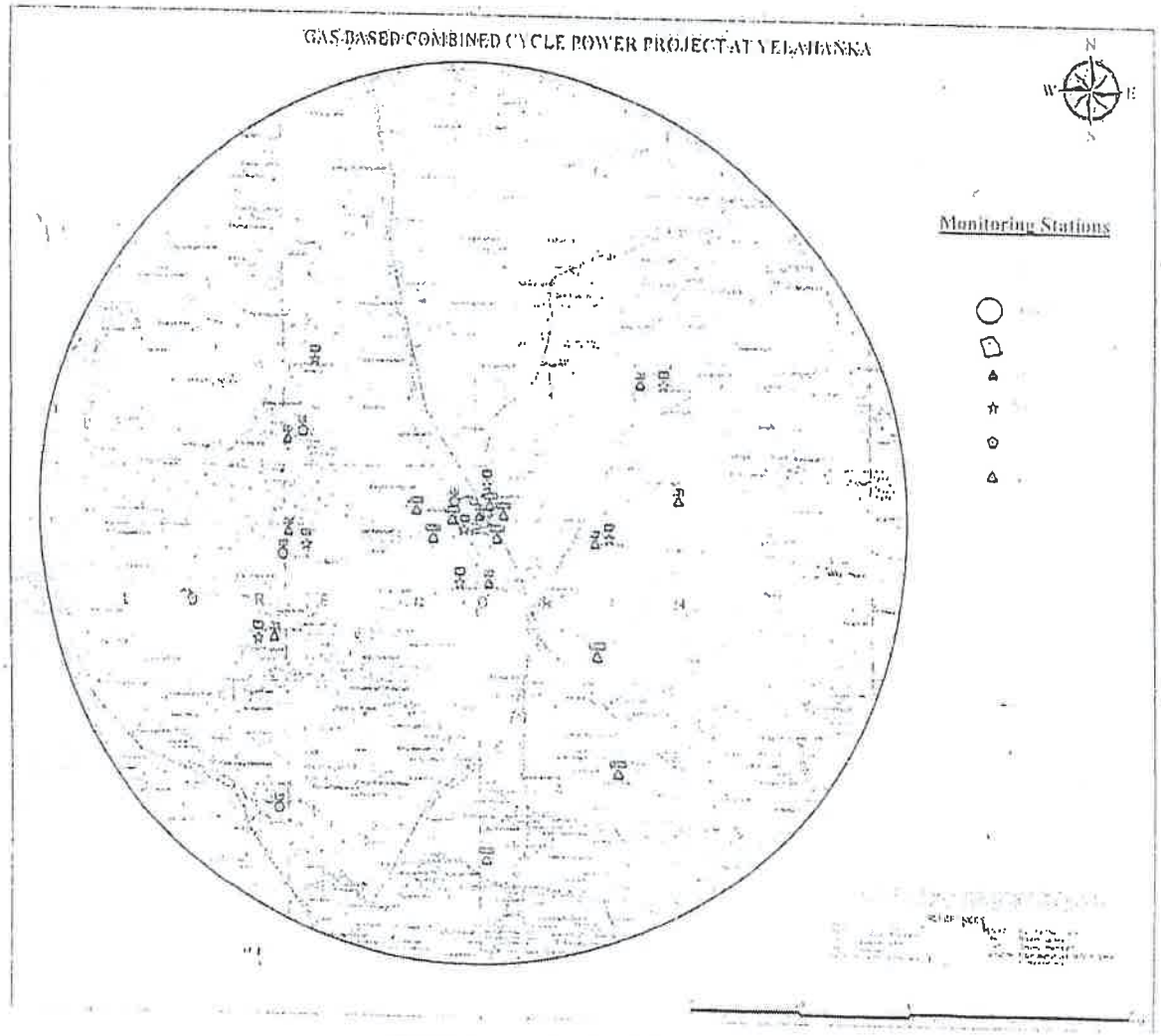

Figure 17: Monitoring Location Map

4.3.5 Soil Characteristics of the Study Area

Soil samples collected from four locations were analyzed for various parameters and the respective results are given in Table-16.

Table 16: Soil Analysis Results of Study Area

S. No	Parameter	Unit	Soil Monitoring Location			
			S1	S2	S3	S4
			Reserve Forest Lingarajapura	Reserve Forest Virasagara	Anandpura Gate-Project site	Reserve Forest kammagondanahalli
1.	pH	-	7.72	7.64	7.56	7.68
2.	Bulk Density	gm/cm³	1.48	1.51	1.55	1.51
3.	Conductivity	µmhos/cm	425	432	428	442
4.	Moisture	%	18	21	18	17
5.	Texture	-	Silt loam	Silt loam	Silt loam	Silt loam
6.	Sand	%	33	40	42	38
7.	Clay	%	10	10	8	10
8.	Silt	%	56	50	50	52
9.	Sodium	mg/100gm	42	44	47	40
10.	Potassium	mg/100gm	0.70	0.74	0.78	0.68
11.	CEC	meq/100gm	7.34	7.68	7.48	7.84
12.	Nitrogen	mg/100gm	12.4	10.8	14.2	12.8
13.	Phosphorous	mg/100gm	44.7	42.6	50.2	48.4
14.	Calcium	meq /100gm	4.8	4.2	3.8	4.6
15.	Magnesium	meq /100gm	3.1	2.6	2.4	2.8
16.	Porosity	%	39.2	40.7	41.5	40.3
17.	Sodium absorption ratio	-	2.2	2.6	2.8	2.3
18.	Water Holding Capacity	%	40.4	41	44	42
19.	Permeability rate	cm/hr	16	12	14	18
20.	P_2O_5	%	38.9	41.2	40.3	39.3

Based on the above mentioned analysis reports, it is concluded that the soil in the area is fertile. Soils from all the four locations are silt loam. The levels of main nutrients, viz., nitrogen, phosphorous and potassium are in the range 10.8-14.2mg/100gm, 42.6-50.2mg/100gm and 0.68-0.78mg/100gm, respectively.

4.4 CLIMATE & METEOROLOGY

4.4.1 Climate & Long term Meteorology

Bangalore has a tropical savanna climate (Koppen climate classification Aw) with distinct wet and dry seasons. Due to its high elevation, Bangalore usually enjoys a more moderate climate throughout the year, although occasional heat waves can make summer somewhat uncomfortable. The coolest month is December with an average low temperature of 15.4°C (59.7°F) and the hottest month is April with an average high temperature of 36°C (97°F). The highest temperature ever

recorded in Bangalore is 38.9°C (102°F) (recorded in March 1931). However, the suburbs of bangalore recorded temperatures as high as 41°C (106°F) which are now part of present day Bangalore. The lowest ever recorded is 7.8°C (46°F) (recorded in January 1884). Winter temperatures rarely drop below 12°C (54°F), and summer temperatures seldom exceed 37°C (99°F). Bangalore receives rainfall from both the northeast and the southwest monsoons and the wettest months are September, October and August, in that order. The summer heat is moderated by fairly frequent thunderstorms, which occasionally cause power outages and local flooding. The heaviest rainfall recorded in a 24-hour period is 179 millimetres (7 in) recorded on 1st October 1997.

IMD is not having a Meteorological observatory at Yelahanka and hence Metrological data of Bangalore city is considered which is given below in Table-17 & 18.

Table 17: Climatological Normal data for Bangalore - Temperature & Rainfall

Month	Mean of Air temperature, °C				Rainfall	
	Daily max	Daily min	Highest in month	Lowest in month	Monthly Total (mm)	No. of rainy days
January	27.1	15.2	29.9	12.5	2.4	0.2
February	29.9	16.8	32.5	13.6	6.2	0.4
March	32.6	19.5	34.8	16.2	12.1	0.7
April	34	21.6	36.1	18.8	39.2	2.7
May	33.1	21.4	36	18.9	107.1	6.3
June	29.3	20	33	18.8	79.1	6
July	28	19.6	31.3	18.4	108.7	7.8
August	27.5	19.5	30.2	18.4	127.8	9.8
September	28.1	19.4	30.6	17.9	226.4	10
October	28	19.1	30.3	16.4	142.3	7.4
November	26.9	17.3	29.4	13.6	63.6	4
December	26.1	15.9	28.7	12.7	23.8	1.8

Table 18: Climatological normal data for Bangalore - Wind speed & Direction

Month		Percentage no. of days with wind from								
		N	NE	E	SE	S	SW	W	NW	Calm
January	I	0	9	69	13	1	1	0	0	7
	II	1	13	62	11	1	1	0	1	1
February	I	0	4	46	21	4	7	2	1	15
	II	1	11	54	17	1	2	2	1	11
March	I	0	1	27	20	6	18	8	2	18
	II	2	10	48	23	1	3	1	2	10
April	I	1	1	6	10	8	30	19	5	20
	II	4	11	36	23	1	3	4	4	14
May	I	1	1	1	2	2	21	51	12	9

	II	5	8	10	6	3	13	24	20	11
June	I	0	0	0	0	0	34	60	5	1
	II	1	0	1	0	0	27	59	10	2
July	I	0	0	0	0	0	35	60	4	1
	II	0	0	0	0	1	27	63	7	2
August	I	0	0	0	0	0	26	67	5	2
	II	1	0	0	0	0	18	65	13	3
September	I	2	1	2	1	1	19	50	14	10
	II	3	2	3	2	1	17	39	20	13
October	I	2	10	26	6	2	11	20	7	16
	II	8	17	22	5	1	7	13	9	18
November	I	2	24	45	7	1	2	3	3	13
	II	7	26	38	8	1	1	2	3	14
December	I	1	25	63	6	0	0	0	0	5
	II	2	24	58	7	0	1	0	0	8

4.4.2 Site Specific Climatology & Micro-meteorology

Site specific meteorological data was collected by establishing an automatic weather station near the site. At the monitoring station, hourly average values of the following parameters were collected for one full season from March to May, 2015. The summarized result of meterological data collected during study period is given below in Table -19.

- Wind speed
- Wind direction
- Atmospheric temperature
- Relative humidity
- Cloud cover
- Rainfall

The recorded meteorological data have been used as input for dispersion modeling.

Table 19: Site Specific Meteorological Data

Month	Temperature (°c)			Wind Velocity (km/hr)			Rainfall(mm)			Relative Humidity(%)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
March	38	19	28.65	20.4	0.5	6.7	101.2	0	12.1	100	10	56.18
April	39	17	28.9	19.5	0.7	6.65	165.2	0	39.2	100	17	65.54
May	37	21	29.6	21.6	0.6	7.23	287.1	0	107.1	100	24	73.52

The proposed site is located in Seismic Zone-II as per the Indian standard IS-1893 (1984). Elevation above mean sea level is 900m above the mean sea level. Basic wind speed 6.86 km/hr. Average rainfall is about 52.8mm.

4.4.3 Wind Speed and Direction

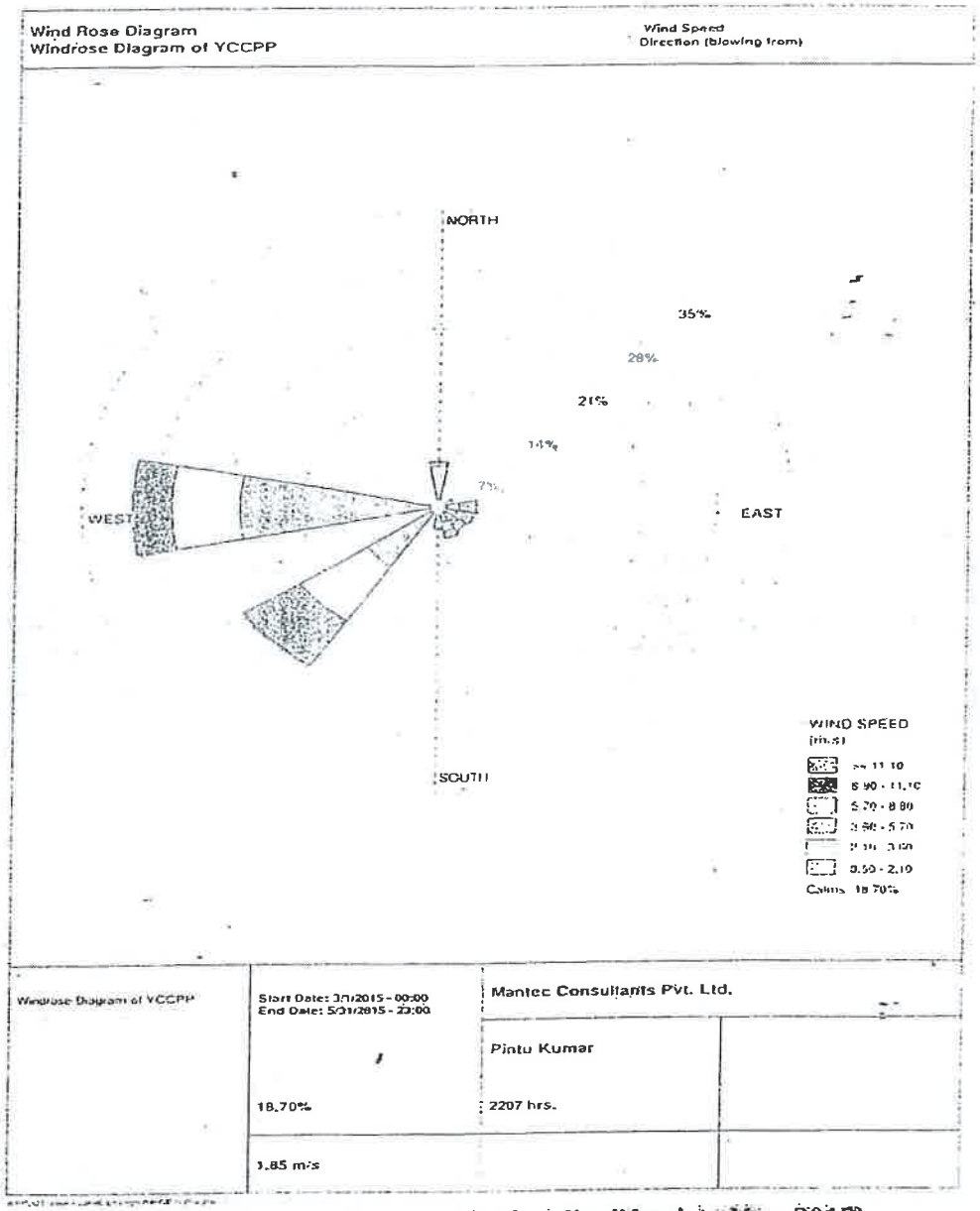

Figure 18: Windrose Diagram at Project Site (March to May, 2015)

The wind speed was recorded in the range <0.5 (calm) to a maximum of 8.8 m/s, with an average value of 1.85 m/s. The wind rose, based on the hourly observations, has been presented in Figure-18. It can be observed that the pre-dominant wind direction is west (approx. 30%), followed closely

by southwestern (approx. 23%) winds. South (approx. 6%), southeast & east (approx. 5%) are also worth mentioning.

Table 20: Frequency Distribution of Wind Direction and Speed Classes

S. No.	Wind Directions	Frequency of observed wind speed (m/s) class, %					
		0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	>8.8	Total
1	N	4.94	0.36	0.27	0.00	0.00	5.57
2	NNE	0.09	0.09	0.09	0.00	0.00	0.27
3	NE	0.05	0.14	0.32	0.05	0.00	0.54
4	ENE	0.23	0.27	1.18	0.05	0.00	1.72
5	E	1.09	1.22	1.72	0.27	0.00	4.30
6	ESE	2.13	0.68	1.09	0.27	0.00	4.17
7	SE	2.13	0.41	1.00	0.14	0.00	3.67
8	SSE	1.95	1.09	0.91	0.05	0.00	3.99
9	S	1.13	1.40	0.23	0.05	0.00	2.81
10	SSW	0.09	0.23	0.00	0.00	0.00	0.32
11	SW	8.79	7.97	6.48	0.27	0.00	23.51
12	WSW	0.09	0.05	0.00	0.00	0.00	0.14
13	W	19.84	6.34	3.85	0.00	0.00	30.03
14	WNW	0.05	0.00	0.00	0.00	0.00	0.05
15	NW	0.09	0.00	0.05	0.00	0.00	0.14
16	NNW	0.05	0.00	0.00	0.00	0.00	0.05
17	Calms						18.75
	Total	42.71	20.24	17.16	1.13	0.00	100.00

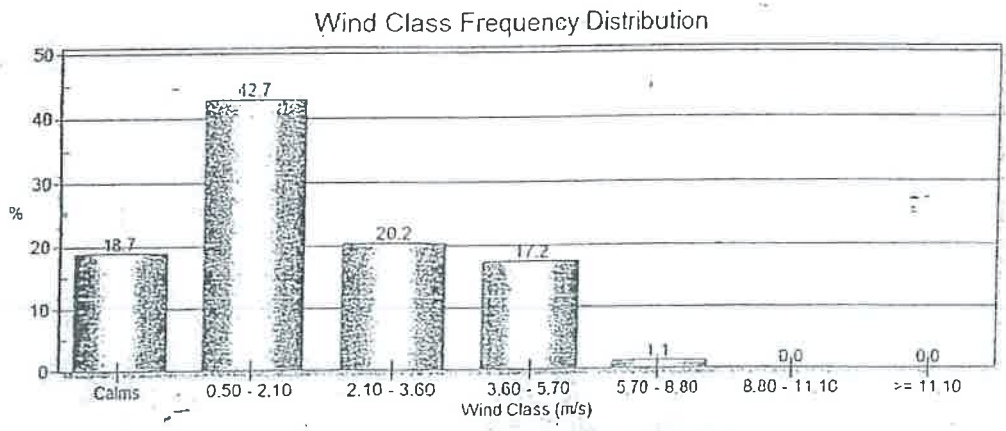

Figure 19: Graph of Wind Speed Classes

4.5 AMBIENT AIR QUALITY

4.5.1 General Description

The proposed site is located to the north of Bangalore City, at a distance of approx. 18km at Yelahanka, which is a taluka in Bangalore district of State Karnataka. The site is easily approachable through Doodaballapur Bengaluru state highway. No human settlement is located within the site, and the nearest human settlement is a small Village (Kenchenhalli).

4.5.2 Monitoring Stations

The following criteria were taken into consideration during selection of the sampling stations:

- Topography of the area
- Human settlements within the study area
- Safety, accessibility and non-interference with general routine of the people residing near the station
- Prediction of maximum concentration through mathematical modeling for the proposed source details and under prevailing meteorological conditions in the region
- Representation of the area

Based on the above considerations, six sampling locations were selected for ambient air quality survey. Locations of the sampling stations are described in Table-21, and presented on the study area map in Figure-17.

Table 21: Location of Ambient air Quality Survey Stations

Station Code	Sampling Location & source	Location w.r.t. project site	
		Distance, km	Direction
A1	Anantapura Gate, Project Site	0	0
A2	Jarakabande reserve forest (Virasagra)	4	W
A3	Lingarajpura	4	NW
A4	Hunasamaranahalli	4.6	NE
A5	Kenchenahalli	4.4	E
A6	Yelahanka Satellite town	1.2	S
A7	Marutinagar	2.4	SE
A8	Laxmipura	4.9	SW

4.5.3 Sampling Period, Frequency and Parameters

The ambient air quality survey was conducted for one full season, covering the pre-monsoon season of 2015. The study was started on 2nd March, 2015 and continued up to 30th May, 2015. Sampling was performed with the frequency of 2 days/week per location to determine 24-hourly average concentrations. The sampling was started between 7 to 9 AM in the morning and

terminated after 24 hours on the next morning. The air pollution parameters covered under the survey are PM_{10}, $PM_{2.5}$, NO_2, Sulphur dioxide (SO_2), O_3, CO, Hg, CH_4.

4.5.4 Sampling and Analytical Procedure

A brief summary of the sampling and analytical procedures followed during the survey is presented in Table-22.

Table 22: Methodology for Ambient Air Quality Measurement

S. No.	Pollutant	Method of measurement	Ref to Standard
1	Sulphur dioxide (SO_2)	Improved West and Gaeke	IS : 5182 (Part-2)
2	Nitrogen dioxide (NO_2)	Modified Jacob & Hochheiser	IS : 5182 (Part-6)
3	Particulate matter PM_{10}	Gravimetric	IS : 5182 (Part-23)
4	Particulate matter $PM_{2.5}$	Gravimetric	IS : 5182 (Part-23)
5	Carbon Monoxide (CO)	NDIR Spectroscopy	IS : 5182 (Part-10)
6	Mercury (Hg)	Mercury Analyzer	APHA Air
7	Methane (CH_4)	Gas Chromatography	IS : 5182 (Part-17)
8	Ozone (O_3)	Chemical Method, 2009	IS : 5182 (Part-9)

4.5.5 Air Quality Standards

The National Ambient Air Quality Standards for the above mentioned pollutants, notified vide NAAQS Notification dated 18th November, 2009, are presented in Table-23.

Table 23: National Ambient Air Quality Standards

S. No.	Pollutant	Time weighted Average	Concentration in Air	
			Industrial, residential, rural and other areas	Ecologically sensitive area (notified by Central Govt.)
1	Sulphur dioxide (SO_2), µg/m³	Annual*	50	20
		24 Hours**	80	80
2	Particulate matter PM_{10}, µg/m³	Annual*	60	60
		24 Hours**	100	100
3	Particulate matter $PM_{2.5}$, µg/m³	Annual*	40	40
		24 Hours**	60	60
4	Nitrogen dioxide (NO_2), µg/m³	Annual*	40	30
		24 Hours**	80	80
5	Carbon Monoxide (CO)	1 Hour*	4000	4000
		8 Hours**	2000	2000
6	Ozone (O_3)	1 Hour*	180	180
		8 Hours**	100	100

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly or at uniform interval.

** 24 hourly, 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

4.5.6 Results

The results of ambient air quality monitoring at the 6 sampling location have been presented in Tables 24 to 31.

Table 24: Ambient Air Quality Results at Anantapura Gate-Project Site (A1)

Month	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)	O3 (µg/m³)	CO (µg/m³)	Hg (µg/m³)	CH4 (µg/m³)
March	02.03.2015	75	35	7.7	16	27	780	ND	625
	03.03.2015	79	37	6.6	13	28	810	ND	740
	09.03.2015	76	40	7.8	15	24	740	ND	522
	10.03.2015	73	34	6.4	10	29	600	ND	530
	16.03.2015	76	36	0	10	30	750	ND	630
	17.03.2015	80	38	7.3	17	32	760	ND	480
	22.03.2015	75	40	6.4	16	25	900	ND	430
	23.03.2015	78	35	8.0	14	26	770	ND	620
April	01.04.2015	78	40	0	11	24	680	ND	555
	02.04.2015	75	38	7.6	15	28	790	ND	720
	09.04.2015	78	34	7.4	16	26	810	ND	550
	10.04.2015	76	45	6.5	15	25	720	ND	398
	17.04.2015	77	39	7.6	12	27	800	ND	920
	18.04.2015	74	41	8.2	11	28	830	ND	660
	24.04.2015	78	37	6.8	17	25	690	ND	715
	25.04.2015	77	35	7.4	15	24	750	ND	650
May	01.05.2015	79	39	5.8	12	26	840	ND	872
	02.05.2015	76	35	0	11	28	760	ND	950
	09.05.2015	78	39	5.8	14	30	700	ND	430
	10.05.2015	76	42	6.2	13	31	740	ND	325
	16.05.2015	77	34	6.5	15	26	770	ND	690
	17.05.2015	78	36	7.4	17	24	710	ND	880
	24.05.2015	77	46	7.6	14	27	750	ND	765
	25.05.2015	75	37	6.4	16	28	800	ND	780
Maximum		80	46	8.2	17	32	900	--	950
Minimum		73	34	0	10	24	600	--	325
Average		76.71	38.15	5.98	13.92	27.08	759.62	--	642.77
98 percentile		79.54	45.54	8.108	17	31.54	872.4	--	936.2

Table 25: Ambient Air Quality Results at Jarakabande Reserve Forest (Virasagra) (A2)

Month	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)	O3 (µg/m³)	CO (µg/m³)	Hg (µg/m³)	CH4 (µg/m³)
March	02.03.2015	78	37	4.8	10	26	590	ND	440
	03.03.2015	77	34	6.4	9.6	23	710	ND	432
	09.03.2015	70	39	6	9.8	25	680	ND	410
	10.03.2015	76	38	6.8	9.4	28	730	ND	350
	16.03.2015	70	37	6.2	10	27	690	ND	534
	17.03.2015	78	40	7	11	26	640	ND	644
	22.03.2015	72	38	5.0	9.6	25	700	ND	500
	23.03.2015	78	35	6.2	10	22	650	ND	436
April	01.04.2015	70	38	0	9.7	23	560	ND	545
	02.04.2015	68	38	4.9	9.4	24	700	ND	348
	09.04.2015	74	37	5.5	10	28	620	ND	400
	10.04.2015	75	38	6.7	11	25	430	ND	452
	17.04.2015	72	35	6.2	10	22	600	ND	574
	18.04.2015	78	38	5.4	9.7	27	540	ND	499
	24.04.2015	69	36	0	9.3	26	520	ND	541
	25.04.2015	70	40	4.4	9.6	24	650	ND	690
May	01.05.2015	72	39	6.5	10	23	710	ND	546
	02.05.2015	72	36	6.6	9.8	27	460	ND	462
	09.05.2015	69	39	0	9.5	26	660	ND	695
	10.05.2015	77	34	5.6	10	25	660	ND	400
	16.05.2015	71	39	4.6	9.9	26	510	ND	392
	17.05.2015	70	41	5.9	11	27	440	ND	420
	24.05.2015	68	36	5.0	10	26	570	ND	543
	25.05.2015	76	42	5.8	11	24	630	ND	656
Maximum		78	42	7	11	28	730		695
Minimum		68	34	0	9.3	22	430		348
Average		72.92	37.69	4.94	9.98	25.19	608.08		498.15
98 percentile		78	41.54	6.908	11	28	720.8		692.7

Table 26: Ambient Air Quality Results at Lingarajpura (A3)

Month	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)	O3 (µg/m³)	CO (µg/m³)	Hg (µg/m³)	CH4 (µg/m³)
March	04.03.2015	78	42	6.5	16	28	980	ND	790
	05.03.2015	82	44	7.2	12	30	800	ND	645
	11.03.2015	76	45	8.8	14	29	870	ND	600
	12.03.2015	79	41	6.5	15	26	790	ND	530
	18.03.2015	76	46	0	9.8	25	980	ND	337
	19.03.2015	75	43	5.5	11	27	780	ND	615
	24.03.2015	79	47	9.2	18	29	800	ND	787
	25.03.2015	77	45	7.2	13	26	700	ND	450
April	03.04.2015	82	44	0	9.5	27	960	ND	555
	04.04.2015	81	46	7.4	11	26	710	ND	538
	11.04.2015	84	43	10	15	24	970	ND	635
	12.04.2015	83	45	6.9	13	29	810	ND	513
	20.04.2015	86	43	0	10	30	940	ND	540
	21.04.2015	76	44	7.5	14	28	850	ND	640
	27.04.2015	81	41	9.5	12	30	960	ND	378
	28.04.2015	75	46	7.4	16	29	720	ND	512
May	03.05.2015	78	42	7.8	12	26	800	ND	731
	04.05.2015	77	46	11.0	16	28	830	ND	918
	11.05.2015	80	44	7.3	10	30	790	ND	317
	12.05.2015	75	46	6.5	14	25	950	ND	683
	18.05.2015	77	42	8.4	15	29	700	ND	342
	19.05.2015	79	44	8	10	30	770	ND	542
	26.05.2015	78	40	7.4	12	28	880	ND	690
	27.05.2015	76	45	6.2	10	25	740	ND	440
Maximum		86	47	11	18	30	980		918
Minimum		75	40	0	9.5	24	700		317
Average		78.79	43.88	6.66	12.92	27.62	836.92		575.50
98 percentile		85.08	46.54	10.54	17.08	30	980		859.12

Table 27: Ambient Air Quality Results at Hunasamaranahalli (A4)

Month	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)	O3 (µg/m³)	CO (µg/m³)	Hg (µg/m³)	CH4 (µg/m³)
March	04.03.2015	78	48	9.8	16	27	930	ND	620
	05.03.2015	80	47	10.5	22	32	850	ND	840
	11.03.2015	86	51	9.8	18	26	690	ND	440
	12.03.2015	79	49	10.3	17	29	730	ND	530
	18.03.2015	84	45	11	20	35	760	ND	810
	19.03.2015	78	46	10.2	18	30	730	ND	618
	24.03.2015	91	48	9.2	16	27	1030	ND	930
	25.03.2015	87	46	7.2	13	34	700	ND	938
April	03.04.2015	79	50	12	15	26	760	ND	736
	04.04.2015	81	48	6.4	12	26	660	ND	910
	11.04.2015	86	45	10.2	21	33	950	ND	615
	12.04.2015	83	50	9.9	19	27	1020	ND	518
	20.04.2015	87	46	9.5	15	30	980	ND	715
	21.04.2015	82	44	9.5	18	31	730	ND	880
	27.04.2015	81	47	7.8	17	28	830	ND	694
	28.04.2015	85	49	9.2	19	29	770	ND	852
May	03.05.2015	79	45	7.8	12	30	780	ND	875
	04.05.2015	86	51	8.1	13	26	750	ND	830
	11.05.2015	80	46	12	22	28	830	ND	770
	12.05.2015	78	44	7.2	13	30	940	ND	758
	18.05.2015	87	48	9.4	15	32	930	ND	340
	19.05.2015	82	45	10.2	18	26	980	ND	640
	26.05.2015	78	44	8.8	14	27	850	ND	824
	27.05.2015	84	45	7.4	12	29	740	ND	410
Maximum		91	51	12	22	35	1030	—	938
Minimum		78	44	6.4	12	26	660	—	340
Average		82.54	47.00	9.3	16.50	29.2	831.2	—	706.6
98 percentile		89.16	51	12	22	34.54	1025.4	—	934.32

Table 28: Ambient Air Quality Results at Kenchenahalli (A5)

Month	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)	O3 (µg/m³)	CO (µg/m³)	Hg (µg/m³)	CH4 (µg/m³)
March	04.03.2015	76	45	6.6	12	28	800	ND	442
	05.03.2015	72	46	7	15	26	890	ND	336
	11.03.2015	82	39	6.8	14	29	750	ND	558
	12.03.2015	80	44	5.5	12	27	930	ND	735
	18.03.2015	82	45	0	10	28	770	ND	682
	19.03.2015	78	43	9.2	15	25	880	ND	567
	24.03.2015	72	40	7.9	13	32	790	ND	380
	25.03.2015	77	44	6.4	11	28	810	ND	485
April	03.04.2015	73	43	0	10	30	860	ND	680
	04.04.2015	82	39	8.6	13	27	940	ND	740
	11.04.2015	74	44	7.5	11	24	740	ND	700
	12.04.2015	72	45	7.2	15	27	830	ND	690
	20.04.2015	78	43	8.7	13	26	790	ND	410
	21.04.2015	74	38	8.4	12	28	690	ND	512
	27.04.2015	81	46	7.6	13	25	830	ND	450
	28.04.2015	77	44	7.7	15	31	950	ND	650
May	03.05.2015	80	45	8.1	14	27	850	ND	510
	04.05.2015	76	39	5.3	12	24	840	ND	550
	11.05.2015	75	43	7.6	14	32	770	ND	670
	12.05.2015	73	38	0	10	24	740	ND	475
	18.05.2015	76	44	8.8	13	25	800	ND	730
	19.05.2015	72	38	5.6	9.3	26	850	ND	740
	26.05.2015	78	45	9	14	28	750	ND	565
	27.05.2015	74	44	7.7	12	32	890	ND	730
Maximum		82	46	9.2	15	32	950	—	740
Minimum		72	38	0	9.3	24	690	—	336
Average		76.42	42.62	6.40	12.56	27.50	822.31	—	579.35
98 percentile		82	46	9.108	15	32	945.4	—	740

Table 29: Ambient Air Quality Results at Yelahanka Satellite Town (A6)

Month	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)	O3 (µg/m³)	CO (µg/m³)	Hg (µg/m³)	CH4 (µg/m³)
March	07.03.2015	80	45	8.8	15	24	980	ND	853
	08.03.2015	85	44	9	18	27	1100	ND	925
	14.03.2015	82	48	7.5	11	24	770	ND	680
	15.03.2015	78	45	8.8	19	27	990	ND	548
	20.03.2015	75	38	6.7	12	26	750	ND	450
	21.03.2015	74	42	6.9	13	28	830	ND	934
	27.03.2015	76	44	7.6	13	25	950	ND	830
	28.03.2015	82	43	6.8	12	24	810	ND	754
April	06.04.2015	80	46	9	20	26	920	ND	790
	07.04.2015	80	43	8.6	17	24	790	ND	820
	14.04.2015	81	46	8.5	16	27	780	ND	847
	15.04.2015	83	41	7.7	15	23	1050	ND	470
	22.04.2015	82	45	8.2	15	26	890	ND	930
	23.04.2015	76	46	9.2	20	28	910	ND	711
	28.04.2015	78	44	8.4	16	25	840	ND	552
	29.04.2015	81	45	7.2	15	31	980	ND	850
May	06.05.2015	85	43	5.0	14	24	1020	ND	963
	07.05.2015	79	42	8.4	17	27	980	ND	980
	14.05.2015	84	46	8.2	16	24	1000	ND	498
	15.05.2015	83	42	6.4	11	27	860	ND	820
	21.05.2015	74	39	8.9	15	25	970	ND	867
	22.05.2015	77	44	5.7	11	26	840	ND	512
	29.05.2015	85	45	8.8	15	24	1000	ND	728
	30.05.2015	79	43	7.4	16	28	690	ND	760
Maximum		85	48	9.2	20	31	1100		980
Minimum		74	38	5	11	23	690		450
Average		79.96	43.65	7.77	15.12	25.92	903.46		750.08
98 percentile		85	47.08	9.108	20	29.62	1077		972.18

Table 30: Ambient Air Quality Results at Marutinagar (A7)

Month	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)	O3 (µg/m³)	CO (µg/m³)	Hg (µg/m³)	CH4 (µg/m³)
March	07.03.2015	78	37	4.7	10	27	730	ND	665
	08.03.2015	81	44	5.5	12	24	810	ND	735
	14.03.2015	76	38	0	11	29	790	ND	705
	15.03.2015	70	38	8.0	13.0	23	710	ND	688
	20.03.2015	70	39	4.8	14	26	920	ND	820
	21.03.2015	74	35	6.2	12	27	830	ND	850
	27.03.2015	78	40	5.5	11	25	760	ND	415
	28.03.2015	80	39	6.3	11	23	940	ND	780
April	06.04.2015	72	44	7.7	12	28	930	ND	745
	07.04.2015	71	38	5.0	10	24	750	ND	731
	14.04.2015	69	36	6.8	11	28	820	ND	440
	15.04.2015	75	35	7.2	12	29	760	ND	795
	22.04.2015	76	38	0	11	27	790	ND	813
	23.04.2015	73	40	6.6	12	23	730	ND	530
	28.04.2015	80	39	6.8	13	24	770	ND	672
	29.04.2015	77	39	7.9	14	28	740	ND	498
May	06.05.2015	75	43	6.2	12	23	750	ND	742
	07.05.2015	73	37	4.8	11	28	710	ND	586
	14.05.2015	70	35	0	10	25	910	ND	860
	15.05.2015	74	37	5.9	13	29	760	ND	480
	21.05.2015	78	38	6.1	16	26	800	ND	800
	22.05.2015	77	41	7.0	11	23	780	ND	525
	29.05.2015	80	39	7.8	13	26	720	ND	462
	30.05.2015	76	35	6.0	12	27	670	ND	590
Maximum		81	44	8	16	29	940	-	860
Minimum		69	35	0	10	23	670	-	415
Average		75.13	38.58	5.42	12.04	25.92	788.08	-	661.62
98 percentile		80.54	44	7.954	15.08	29	935.4	-	855.4

Table 31: Ambient Air Quality Results at Laxmipura (A8)

Month	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)	O3 (µg/m³)	CO (µg/m³)	Hg (µg/m³)	CH4 (µg/m³)
March	04.03.2015	84	46	5.2	11	30	960	ND	750
	05.03.2015	80	44	8.2	13	26	870	ND	560
	11.03.2015	85	47	8.7	14	31	950	ND	380
	12.03.2015	88	45	10	18	30	820	ND	490
	18.03.2015	79	46	6.5	15	32	960	ND	930
	19.03.2015	85	47	7.2	10	27	920	ND	670
	24.03.2015	83	44	9.2	17	29	770	ND	572
	25.03.2015	77	42	9.6	18	26	1010	ND	920
April	03.04.2015	78	43	5.8	11	30	970	ND	380
	04.04.2015	81	42	6.4	17	27	980	ND	530
	11.04.2015	76	48	10.2	20	32	810	ND	478
	12.04.2015	83	47	9.9	16	27	780	ND	847
	20.04.2015	76	49	7.6	12	31	730	ND	528
	21.04.2015	86	45	5.7	18	25	980	ND	846
	27.04.2015	81	44	8.8	12	26	830	ND	940
	28.04.2015	77	43	9.2	19	31	920	ND	520
May	03.05.2015	86	42	10	18	30	850	ND	875
	04.05.2015	76	46	9.4	17	25	1000	ND	442
	11.05.2015	80	49	7.9	10	33	950	ND	877
	12.05.2015	79	47	7.2	14	26	820	ND	882
	18.05.2015	78	45	9.4	18	31	940	ND	446
	19.05.2015	77	47	10	20	26	960	ND	710
	26.05.2015	86	44	9.5	15	26	950	ND	620
	27.05.2015	76	44	5.9	10	27	970	ND	495
Maximum		88	49	10.2	20	33	1010		940
Minimum		76	42	5.2	10	24	730		380
Average		80.71	45.27	8.19	15.12	28.5	901.5		654.2
98 percentile		87.08	49	10.108	20	32.54	1005.4		935.4

4.5.7 Analysis and Interpretation of Data

Analysis and interpretation of ambient air quality data collected during the study period, including comparison with air quality standards is as follows.

4.5.7.1 *Particulate Matter (PM_{10})*

Concentrations of particulate matter less than 10 µm size (PM_{10}) in the study area were observed from the minimum of 68 µg/m³ to the maximum value of 91 µg/m³. The minimum concentrations observed at the 8 sampling stations were in the range 68 µg/m³ to 78 µg/m³, whereas the maximum concentrations were observed in the range 80 to 91 µg/m³, and the average concentrations in the range 72.9 to 82.5 µg/m³. The concentration of 98th percentile is observed between 78 to 89.16 µg/m³. The maximum observed values at all the 8 locations are well below the ambient air quality standard (100 µg/m³) for Industrial, residential, rural and other areas. Based on the results of monitoring, it is concluded that, with respect to ambient PM_{10} concentrations, the study are has the carrying capacity for controlled industrial development.

4.5.7.2 *Particulate Matter ($PM_{2.5}$)*

Concentrations of particulate matter less than 2.5 µm size ($PM_{2.5}$) in the study area were observed from the minimum of 34 µg/m³ to the maximum of 51 µg/m³. The minimum concentrations observed at the 8 sampling stations were in the range 34 µg/m³ to 44 µg/m³, whereas the maximum concentrations were observed in the range 42 to 51 µg/m³, and the average concentrations in the range 37.6 to 47 µg/m³. The concentration of 98th percentile is observed between 41.54 to 51 µg/m³. The maximum observed values at all the 8 locations are well below the ambient air quality standard (60 µg/m³) for Industrial, residential, rural and other areas. Based on the results of monitoring, it is concluded that, with respect to ambient $PM_{2.5}$ concentrations, the study are has the adequate carrying capacity for controlled industrial development.

4.5.7.3 *Sulphur Dioxide (SO_2)*

Sulphur dioxide concentrations in the study area were observed from the minimum of 0 µg/m³ to the maximum value of 12 µg/m³. The minimum concentrations observed at the 8 sampling stations were in the range 0µg/m³ to6.4 µg/m³, whereas the maximum concentrations were observed in the range 8 to 12 µg/m³, and the average concentrations in the range 4.9 to 9.3 µg/m³. The concentration of 98th percentile is observed between 6.908 to 10.54 µg/m³. These maximum observed values are well below the ambient air quality standard, (80 µg/m³) for Industrial, residential, rural and other areas. Based on the results of monitoring, it is concluded that, with respect to ambient sulphur dioxide concentrations, the study are has adequate carrying capacity to sustain further industrial development.

4.5.7.4 *Nitrogen Dioxide (NO_2)*

Nitrogen dioxide concentrations in the study area were observed from the minimum of 9.3 µg/m³ to the maximum value of 22 µg/m³. The minimum concentrations observed at the 8 sampling stations were in the range 9.3 µg/m³ to 12 µg/m³, whereas the maximum concentrations were observed in the range 11 to 22 µg/m³, and the average concentrations in the range 9.8 to 16.5µg/m³. The concentration of 98th percentile is observed between 15 to 22 µg/m³. These maximum observed values are well below the ambient air quality standard (80µg/m³) for Industrial, residential, rural and other areas. Based on the results of monitoring, it is concluded that,

with respect to ambient nitrogen dioxide concentrations, the study are has adequate carrying capacity to sustain further industrial development.

4.5.7.5 *Carbon Monoxide (CO)*

Carbon monoxide concentrations in the study area were observed from the minimum of 430 µg/m³ to the maximum value of 1100 µg/m³. The minimum concentrations observed at the 8 sampling stations were in the range 430 µg/m³to 730 µg/m³, whereas the maximum concentrations were observed in the range 730 to 1100 µg/m³, and the average concentrations in the range 608 to 903.4 µg/m³. The concentration of 98th percentile is observed between 720 to 1077 µg/m³. These maximum observed values are well below the ambient air quality standard (2000 µg/m³) for Industrial, residential, rural and other areas. Based on the results of monitoring, it is concluded that, with respect to ambient carbon monoxide concentrations, the study are has adequate carrying capacity to sustain further industrial development.

4.5.7.6 *Ozone (O3)*

Carbon monoxide concentrations in the study area were observed from the minimum of 22 µg/m³ to the maximum value of 35 µg/m³. The minimum concentrations observed at the 8 sampling stations were in the range 22 µg/m³to 26 µg/m³, whereas the maximum concentrations were observed in the range 28 to 35 µg/m³, and the average concentrations in the range 25.1 to 29.1 µg/m³. The concentration of 98th percentile is observed between 28 to 34.5 µg/m³. These maximum observed values are well below the ambient air quality standard (100 µg/m³) for Industrial, residential, rural and other areas. Based on the results of monitoring, it is concluded that, with respect to ambient ozone concentrations, the study are has adequate carrying capacity to sustain further industrial development.

4.5.7.7 *Mercury (Hg)*

Mercury (Hg) was below detection limits in all the samples.

4.6 NOISE LEVEL

4.6.1 Effects of Noise

Noise can be defined as unwanted sound or sound in the wrong place at the wrong time. Noise can also be defined as any sound that is undesirable because it interferes with speech and hearing, is intense enough to damage hearing, or is otherwise annoying. It has an adverse effect on human beings and their environment, including land, structures and domestic animals. Noise can also disturb natural wildlife and ecological systems.

Almost all noise problems involve three basic elements, viz., the noise source, the transmission path, and the receptor. In environmental noise, one is usually concerned with sound propagation through air. Sound, as a disturbance propagating through air, is a wave-propagating phenomenon. Sound propagation from a source to a receptor depends upon the properties of the atmosphere and the presence of any object in the transmission path. Sound undergoes absorption, diffraction,

scattering, reflection, etc. during transmittance. One of the most important considerations during assessment of noise impact is the effect of wave divergence.

Environmental noise can have several effects varying from hearing loss to annoyance. Sufficiently loud noise may:

- cause hearing loss or health damage;
- interfere with work tasks, specially those involving concentration of mind;
- interfere with speech communication;
- affect inter-room privacy;
- interfere with sleep; and
- cause annoyance.

The damage risk criteria for hearing, enforced by the U.S. Occupational Safety and Health Administration and established to reduce hearing loss, are as follows:

Maximum allowable duration/days, hours	Noise level, dBA (slow Response)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

Any community noise exposure comparable to those shown above is clearly unacceptable and constitutes a community health hazard. In community noise exposure, annoyance and physiological damage can occur at much lower noise levels. For example, sleep interference begins to occur at around 45 dBA. Adverse community response and complaints start at around 70 dBA level. However, noise levels upto 65 dBA are generally acceptable and continued exposure to higher noise levels may cause hearing loss, leading to hearing handicap and deafness. In most cases, hearing loss is caused by a gradual shifting of threshold of hearing due to repeated exposure to noise. Background noise in the environment may interrupt speech communication, may cause awakening from sleep, can keep one from falling asleep and can also affect the quality of sleep.

4.6.2 Ambient Noise Level Standards

The Ministry of Environment & Forests, Government of India, has notified the ambient air quality standards in respect of noise for different area categories vide gazette notification dated February 14, 2000 under the Environment Protection Act (1986). These standards are given in Table-32.

Table 32: Ambient Air Quality Standards in respect of Noise

Area Code	Category of Area	Noise dB(A) Leq	
		Daytime*	Nighttime*
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Note:

1. *Day Time is reckoned between 6AM and 9PM*
2. *Night Time is reckoned between 9PM and 6AM.*
3. *Silence Zone is defined as area upto 100 metres around such premises as hospitals, educational institutions and courts. The silence zones are to be declared by the competent authority. Use of vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones.*
4. *Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.*

- *dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is related to human hearing.*
- *"A", in dB(A), denotes the frequency weighing in the measurement of noise and corresponds to frequency response characteristics of the human ear.*

4.6.3 Noise Monitoring Locations

The proposed site is located near Bangalore–Doddaballapur Hindupur road. The main noise generating source in the area of influence is traffic on the roads. To determine the present noise level in the study area, 8 monitoring locations were selected. Out of these, 5 are located in commercial areas, 1 in silence zone area, 1 in industrial zone area and 1in residential area. The sampling locations are described in Table-33 and shown on the study area map in Figure-17.

Table 33: Location of Noise Monitoring Stations

Station Code	Sampling Location	Area category	Location w.r.t. project site	
			Distance, km	Direction
N1	Project site	Industrial Area	0.0	--
N2	Jarakabande reserve forest (Virasagra)	Silence Zone	3.6	W
N3	Krishnarajapuram	Commercial Area	4.5	NW
N4	Hunasamaranahalli	Commercial Area	5	NE
N5	Kenchenahalli	Commercial Area	0.4	E
N6	Yelahanka Satellite town	Commercial Area	1.1	S
N7	Marutinagar	Commercial Area	2.7	E
N8	Laxmipura	Rural & Residential Area	5.3	SW

4.6.4 Methodology

The intensity of sound energy in the environment is measured on a logarithmic scale and is expressed in a decibel (dB) scale. Ordinary sound level meter measures the sound energy that reaches the microphone by converting it into electrical energy and then measures the magnitude in dB. In a sophisticated type of sound level meter, an additional circuit (filters) is provided, which modifies the received signal in such a way that it replicates the sound signal as received by the human ear and the magnitude of sound level in this scale is denoted as dB(A). The sound levels are expressed in dB(A) scale. Noise levels were measured using an integrating sound level meter manufactured by Cygnet (Model No. 2031). It has an indicating mode of Lp and Leq. Keeping the mode in Lp for few minutes and setting the corresponding range and the weighting network in "A" weighting set the sound level meter was run for one hour time and Leq was measured at all locations. Day time Leq and night time Leq values were computed from these measured 1 hour Leq values. The day noise levels represent the value during 6.00am to 10.00pm and night noise levels, during 10.00pm to 6.00am at all the eight locations covered under the study.

4.6.5 Results and Discussion

The day and night time L_{eq} values generated during the measurements carried out during pre-monsoon season of 2015 are given in Table-34. It can be observed that the existing day and night time noise levels are well within the standards specified for respective area categories.

Table 34: Ambient Noise Levels within the Study Area

Location Code	Location Name	Area Category	Noise Level dB(A)	
			Day (Ld)	Night (Ln)
N1	Project site	Industrial Area	59.2	52.4
N2	Jarakabande reserve forest (Virasagra)	Silence Zone	42	36
N3	Krishnarajapuram	Commercial Area	50.4	44.7
N4	Hunasamaranahalli	Commercial Area	50.8	42.2
N5	Kenchenahalli	Commercial Area	51.9	42.7
N6	Yelahanka Satellite Town	Commercial Area	52	48
N7	Marutinagar	Commercial Area	45.5	40.6
N8	Laxmipura	Rural & Residential Area	45	39

4.7 WATER ENVIRONMENT

4.7.1 General

The water resources, both surface and ground water, play an important role in the day to day life as well as in development of an area. Accordingly, the water resources of the area have been studied to establish the baseline status of water resources and quality in the study area. Assessment of baseline data on water environment includes:

- Identification of surface water sources

- Identification of ground water sources
- Collection of representative water samples for characterization
- Analyzing water samples for physico-chemical and biological parameters.

4.7.2 Water Resources

4.7.2.1 *Ground water*

Ground water is an important source of water for the villages in the study area. Ground water is used for cooking, washing, cattle and irrigation purposes. Generally, every village has hand pumps and few open wells to draw water for domestic use. In a normal year deepest ground water level is generally recorded during April-May and shallow water level during October-November. During summer (pre-monsoon) season, the depth of water table varies from 2.00 to 10.47 m bgl and during post-monsoon season from 1.77 to 12.02m bgl. The water level fluctuation during 2006 study reveals that, there is a rise of 0.18 to 5.89 m in parts of Anekal and Bangalore south district and marginal fall of 0.18 to 1.27m in Bangalore north district.

4.7.2.2 *Surface Water*

There are a number of lakes in the study area. Yelahanka has several lakes surrounding it, adjoining: Old Yelahanka, Puttenhalli, Attur, Jakkur and Allalasandra. Most of these are either dry or are in bad condition due to emptying of untreated sewerage effluents into them.

4.7.3 Water Quality

4.7.3.1 *Sampling Locations*

For characterization of water resources of the study area, 3 ground water and 6 surface water sources were selected. Details of the selected samplesources, and their location with respect to the site are presented in **Table-35**. The location of these sampling stations has been shown on the study are map in **Figure-17.**

Table 35: Details of Water Sampling Locations

Station Code	Location & Source	Location w.r.t. project site	
		Distance, km	Direction
SW1	Yelahanka lake	0.4	E
SW2	Puttenahalli lake	0.6	W
SW3	Hebbal Lake	7.3	S
SW4	Rachnahalli Lake	6	SE
SW5	Jakkur Lake	3.6	SE
SW6	Drain Near Anand Pur gate	--	--
GW1	Anantpura	0.8	W
GW2	Puttenahali	0.3	S
GW3	Kenchenahalli	0.2	E

4.7.3.2 Methodology

Water samples were collected by grab sampling from all the sampling locations and analyzed for relevant physical, chemical and bacteriological parameters. Collection and analysis of the samples was carried out as per established standard methods and procedures, prescribed by CPCB, relevant IS Codes and Standard Methods of Examination of Water. During the study period, 1 set of samples was collected from each sample source, and analyzed for relevant physical and chemical characteristics. This report presents data for the pre-monsoon season 2015.

Analysis of the parameters like temperature, pH, dissolved oxygen and alkalinity were carried out at the sampling stations immediately after collection of samples with the help of Field Analysis Kits. For analysis of other parameters, the samples were preserved and brought to laboratory at Noida. The metallic constituents like arsenic, mercury, lead, cadmium, chromium, copper, zinc, selenium, iron and manganese were analyzed with Atomic Absorption Spectroscope.

4.7.3.3 Surface Water Characteristics

The characteristics of surface water samples from the 6 locations within the study area are presented in Table-36, and have been compared with the tolerance limits specified by Central Pollution Control Board for surface water sources under Class B. Salient features of surface water samples collected from the study area are as follows.

a) The pH values were observed in the range 7.19 to 8.3 units, which are well within the desirable range of 6.5-8.5 except for 1 location where pH is found to be 8.79.
b) Fluoride concentrations were obsered from 0.73 to 0.92 mg/l, and are within the tolerance limits of 1.5 mg/l.
c) Phenolic compounds, arsenic and chromium were found below their detection limits, i.e., below 0.001, 0.01 and 0.05 mg/l, respectively.

Table 3.6: Surface Water Quality Results

Sl No.	Parameters	Units	SW1	SW2	SW3	SW4	SW5	SW6
1.	Colour	Hazen Units	<5	<5	<5	<5	<5	<5
2.	Odour	-	Un objectionable	Un objectionable	Un objectionable	Un objectionable	Un objectionable	Un objectionable
3.	Taste	-	*Not done	*Not done	*Not done	*Not done	*Not done	*Not done
4.	Turbidity	NTU	NA	NA	NA	NA	NA	NA
5.	pH	-	8.31	7.42	8.17	7.19	7.29	8.79
6.	Total Dissolved Solids	mg/l	882	720	1961	887	2339	543
7.	Alkalinity as $CaCO_3$	mg/l	339	277	1020	338.6	979	208
8.	Total Hardness as $CaCO_3$	mg/l	243	164.8	572.7	168.9	272	247
9.	Calcium as $CaCO_3$	mg/l	111	119.5	169	119.5	123.6	132
10.	Magnesium as $CaCO_3$	mg/l	132	45	403.8	49	148	115
11.	Chloride as Cl	mg/l	192	124	257	171	182	114
12.	Nitrate as NO_3	mg/l	4.89	5.14	8.94	7.32	6.59	4.31
13.	Sulphate as SO_4	mg/l	46.7	61.7	49.7	48.7	50.72	39.76
14.	Phenolic Compound	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
15.	Copper as Cu	mg/l	0.06	0.068	0.084	0.073	0.036	0.062
16.	Fluoride as F	mg/l	0.82	0.8	0.92	0.85	0.89	0.73
17.	Cadmium	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
18.	Selenium as Se	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
19.	Mercury as Hg	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
20.	Total Arsenic as As	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
21.	Lead as Pb	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
22.	Zinc as Zn	mg/l	0.62	0.57	0.79	0.67	0.85	0.43
23.	Iron as Fe	mg/l	0.17	0.15	0.21	0.18	0.25	0.14
24.	Manganese as Mn	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
25.	Chromium as Cr^{+6}	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
26.	Boron as B	mg/l	ND	ND	ND	ND	ND	ND
27.	Anionic Detergents	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
28.	Dissolved oxygen	mg/l	6.9	7	6.1	6.8	5.90	7.2
29.	BOD	mg/l	24	25	27	25	28.50	22
30.	COD	mg/l	72	80	84	76	88.00	68
31.	O& G	mg/l	ND	ND	ND	ND	ND	ND
32.	Total Coliform	MPN/100ml	11000	988	788	646	610.0	75000
33.	Fecal Coliform	MPN/100ml	1300	699	1566	319	842.0	9800

4.7.3.4 Groundwater Characteristics

The characteristics of ground water samples from the 3 locations within the study area are presented in Table-37 against the Indian Standards for Drinking Water (IS:10500). Salient features of ground water samples collected from the study area are as follows.

a) The pH values were observed in the range 7.56 to 7.95 units, which are well within the desirable range of 6.5-8.5.
b) Total dissolved solids were observed in the range 332 to 879 mg/l. The TDS values are well within the permissible limits of 2000 mg/l.
c) Total hardness doen not exceed the desirable limits and permissible limits.
d) Alkanity, calcium and magnesium concentrations are within the permissible limits.
e) Chloride, sulpahate, nitrate, phosphate and fluoride concentrations are within the desirable limits for drinking water at all locations.
f) Faecal and total coliform organisams were not detected in any of the 3 samples.
g) All the other parameters were observed within the desirable limits for drinking water.

Table 37: Groundwater Quality Results

S.No.	Parameters	Units	GW1	GW2	GW3
1.	Colour	Hazen Units	<5	<5	<5
2.	Odour	-	Un objectionable	Un objectionable	Un objectionable
3.	Taste	-	*Not done	*Not done	*Not done
4.	Turbidity	NTU	6	4	3
5.	pH	-	7.56	7.62	7.95
6.	Total Dissolved Solids	mg/l	332	867	879
7.	Alkalinity as $CaCO_3$	mg/l	114	355	347
8.	Total Hardness as $CaCO_3$	mg/l	131.8	395.5	392.5
9.	Calcium as $CaCO_3$	mg/l	61.8	144	115
10.	Magnesium as $CaCO_3$	mg/l	70	251	177
11.	Chloride as Cl	mg/l	81.7	203	207
12.	Nitrate as NO_3	mg/l	3.85	2.98	3.34
13.	Sulphate as SO_4	mg/l	23.4	38.9	32.1
14.	Phenolic Compound	mg/l	<0.001	<0.001	<0.001
15.	Copper as Cu	mg/l	<0.01	<0.01	<0.01
16.	Fluoride as F	mg/l	0.54	0.96	0.60
17.	Cadmium	mg/l	<0.001	<0.001	<0.001
18.	Selenium as Se	mg/l	<0.01	<0.01	<0.01
19.	Mercury as Hg	mg/l	<0.001	<0.001	<0.001
20.	Total Arsenic as As	mg/l	<0.01	<0.01	<0.01
21.	Lead as Pb	mg/l	<0.01	<0.01	<0.01
22.	Zinc as Zn	mg/l	0.32	0.63	0.65
23.	Iron as Fe	mg/l	0.1	0.16	0.18
24.	Manganese as Mn	mg/l	<0.02	<0.02	<0.02
25.	Chromium as Cr^{+6}	mg/l	<0.05	<0.05	<0.05
26.	Boron as B	mg/l	ND	ND	ND
27.	Anionic Detergents	mg/l	<0.05	<0.05	<0.05

28.	Dissolved oxygen	mg/l	NA	NA	NA
29.	BOD	mg/l	NA	NA	NA
30.	COD	mg/l	NA	NA	NA
31.	O&G	mg/l	ND	ND	ND
32.	Total Coliform	MPN/100ml	Absent	Absent	Absent
33.	Fecal Coliform	MPN/100ml	Absent	Absent	Absent

4.8 BIOLOGICAL ENVIRONMENT

4.8.1 General

The prevailing and expected power shortages in the future years, necessitates augmentation of power generation capacity in the state of Karnataka. In view of this, KPCL proposes to augment the power generating capacity by installing a 1x350±20% MW capacity gas based Combined Cycle Power Plant at Yelahanka . Biological environment comprises of all living creatures of the studied area. The biological study of the area was carried out to understand the ecological status, to generate baseline information and to predict the probable impacts due to the proposed project on the biological environment. Therefore, a detailed survey was conducted in the project area to collect the baseline information on terrestrial and aquatic bio-diversity within 10 km radius from the project site.

4.8.2 Terrestrial Ecology

4.8.2.1 Forest Types of the Study Area

The state of Karnataka is a part of the highly biodiversity rich regions of India. The state is endowed with great diversity of climate, topography and soils. It spans the seacoast with rich aquatic biodiversity and mangrove swamps at the mouths of estuaries. It harbours verdant tropical evergreen forests, paddy fields, coconut and areca nut orchards on the narrow coast flanked by the hills of Western Ghats. It bears deciduous woods, scrub jungles, fields of sugarcane, cotton, groundnut, ragi and jowar in the Deccan plateau. The different environmental regimes support their own characteristic set of vegetation and animals. Karnataka supports 10% of total tiger population and 25% of elephant population of the country.

The state has around 4500 species of flowering plants, 600 species of birds, 160 species of mammals, 160 species of reptiles (turtles, snakes, lizards and crocodiles), 70 species of frogs, and 800 species of fish. These figures give a good account of the floral and faunal diversity of the state.

The wealth of diversity of domesticated plants and animals in farms also holds much promise. The hill chain of Western Ghats is known to have greater diversity of wild relatives of cultivated plants than any other region of comparable size in the world. The aquatic biodiversity in Karnataka is very rich and harbors many endemic species.

4.8.2.2 Forest Types

Karnataka is one such state where it has magnificent forests in the India from the evergreen forests of Western Ghats to scrub or thorny forests in plain areas.

The following forest types can be distinguished:

1) South Indian Thorn Scrub type – 5B/DS1,
2) South Indian Dry Deciduous type – 5A/C3,
3) This is further sub-divided into:
    a. The Hardwickia type
    b. South Indian dry mixed deciduous type.
4) The South Indian Tropical Moist Deciduous type – 3B/C2,
5) The Bamboo type forests and
6) The Evergreen Shola type – 1A/C3.

Forest's have been declining due to increased population growth, industrialization and urbanization. The population growth from the cities into suburban and peri-urban areas have either permanently replaced the forest by other land uses or degraded it to varying degrees. The study area consist mixed type forest.

4.8.3 Methodology

Flora: Random quadrates methods were used for floral diversity study. Quadrates of 10m x 10m were laid for tree composition and 1m x 1m for shrubs & herbs at each sampling site. The list of all groups of plants like herbs, shrubs & trees were prepared which were encountered during the survey. Representative samples were also collected for those elements which could not identify during the survey. The same were identified consulting the local flora other published literatures & the photographs of the species.

Fauna: Mammals were recorded through sighting them in the area directly during the survey. Nocturnal were identified through indirect reporting like sign survey, pellets observation etc. Birds were identified through field observation; taking the photographs, recording the sound etc. as directs means. However, help of local people was also taken to inventories the birds and animals of the area through indirect method of cross questioning and filling up of questionnaire.

4.8.4 Flora of the Project Area

The field survey to conduct studies for baseline data were made using standard methods for which the sampling sites were selected based on topography and floristic composition within the study area. Plants of Ornamental, fodder, timber species and medicinal use were listed. Sanctuaries, National park, Biosphere reserve and Migratory routes have not occurred in the study area.

A total of 33 species were recorded belong to 20 families as given in **Table-38.** 33 species recorded in core study area, which belongs to 15 trees, 15 herbs, 02 shrubs and 1 climber shown in **Figure-20.** The maximum species recorded in the study area falls in the family Poaceae, Fabaceae and Myrtaceae. 58 plants fall in proposed plant area that will be compensating in green belt.

86 species were recorded in buffer area in which belongs to 50 trees, 27 herbs, 5 climbers and 4 shrubs. Sum of 36 families recorded belong to Fabaceae, Poaceae and Myrtaceae followed by Amaranthaceae, Annonaceae, Bignoniaceae and Phyllanthaceae shown in **Figure-21.** The listed

plants are classified in family wise distribution shown in Figure-22. The listed plants were also classified on the basis of their uses such as medicinal, ornamental, timber, edible and fodder given Table-39.

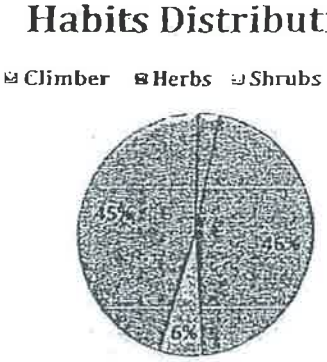

Figure 20: Habit Distribution Pattern in Core Zone

Table 38: List of Flora Present in Core Zone

S. No.	Scientific Name	English Name/ Local Name	Family	Habit
1.	*Celosia argentea*	Cockscomb/ Annesoppu	Amaranthaceae	Herbs
2.	*Mangifera indica*	Mango/ Mavina mara	Anacardiaceae	Tree
3.	*Polyalthia longifolia*	MastiTree/ Ubbina	Annonaceae	Tree
4.	*Centella asiatica*	Indian Pennywort/ ondelaga	Apiaceae	Herbs
5.	*Phoenix sylvestris*	Wild Date Palm/ ichalu	Arecaceae	Tree
6.	*Parthenium hysterophorus*	Congress Grass/ kaamgressu gida	Asteraceae	Shrubs
7.	*Markhamia lutea*	Markhamia/ Kumkuma	Bignoniaceae	Tree
8.	*Terminalia arjuna*	Arjuna/ Holimathi	Combretaceae	Tree
9.	*Ipomoea alba*	Moonflower/ Candra pushpa	Convolvulaceae	Climber
10.	*Cyperus odoratus*	Fragrant Sedge/ abdahullu	Cyperaceae	Herbs
11.	*Albizia lebbeck*	Bage	Fabaceae	Tree
12.	*Cassia Fistula*	Golden Shower/ Phalus	Fabaceae	Tree
13.	*Prosopis cineraria*	Banni	Fabaceae	Tree
14.	*Tamarindus indicus*	Tamarind/ Hunise	Fabaceae	Tree
15.	*Leucas aspera*	Common Leucas/ Tumbe guda	Lamiaceae	Herbs
16.	*Ocimum adscendens*	Tulasi/ Basil	Lamiaceae	Herbs
17.	*Sida acuta*	Common Wireweed/ Bheemana kaddi	Malvaceae	Herbs
18.	*Azadirachta indica*	Indian Lilac/ Turakabevu	Meliaceae	Tree
19.	*Artocarpus heterophyllus*	Jack fruit/ Halasina hannu	Moraceae	Tree
20.	*Callistemon viminalis*	Bottlebrush	Myrtaceae	Tree
21.	*Eucalyptus tereticornis*	Eucalyptus	Myrtaceae	Tree
22.	*Psidium guajava*	Guava/ Seebe-hannu	Myrtaceae	Tree
23.	*Oxalis corniculata*	Creeping Wood Sorrel/	Oxalidaceae	Herbs

		Pullampurchi		
24.	*Phyllanthus amarus*	Black Catnip/ Nela Nelli	Phyllanthaceae	Herbs
25.	*Emblica officinalis*	Gooseberry/ bettadanellikai	Phyllanthaceae	Tree
26.	*Bambusa stricta*	Bidiru	Poaceae	Herbs
27.	*Bambusoideae*	Bamboo	Poaceae	Herbs
28.	*Chloris barbata*	Swollen Finger Grass/ sevaragu	Poaceae	Herbs
29.	*Chrysopogon zizanioides*	Vetiver/ Lavancha	Poaceae	Herbs
30.	*Cynodon dactylon*	Bermuda grass/ garikehullu	Poaceae	Herbs
31.	*Dactyloctenium aegyptium*	Crowfoot grass/ kaadu raagi hullu	Poaceae	Herbs
32.	*Perotis indica*	Indian Comet Grass/ narimisai-hullu,	Poaceae	Herbs
33.	*Lantana camara*	Lantana/ Kakke	Verbenaceae	Shrub

Table 39: List of Flora Noted in Buffer Area (10 km radius of the plant)

S.No.	Scientific Name	English Name/ Local Name	Family	Habit	Uses
1.	*Bougainvillea glabra*	Bougainvillea	Nyctaginaceae	Climber	Ornamental
2.	*Cardiospermum halicacabum*	Balloon Vine/ agniballi	Sapindaceae	Climber	Medicinal
3.	*Hemidesmus indicus*	Indian Sarsaparilla/ Sogade	Apocynaceae	Climber	Medicinal
4.	*Ipomoea alba*	Moonflower/ Candra pushpa	Convolvulaceae	Climber	Medicinal, ornamental
5.	*Jasminum grandiflorum*	Jasmine / ajjege	Oleaceae	Climber	Ornamental & medicinal
6.	*Achyranthus aspera*	Chaff Flower/ Uttrani	Amaranthaceae	Herbs	Medicinal
7.	*Amaranthus spinosus*	Mulla-dantu	Amaranthaceae	Herbs	Medicinal
8.	*Asparagras racemosus*	Wild Asparagus/ aheruballi	Asparagaceae	Herbs	Medicinal
9.	*Bambusa stricta*	Bidiru	Poaceae	Herbs	
10.	*Bambusoideae*	Bamboo	Poaceae	Herbs	Economic
11.	*Borreria articularis*	Jointed Buttonweed/ madanagamti	Rubiaceae	Herbs	Medicinal
12.	*Celosia argentea*	Cockscomb/ Annesoppu	Amaranthaceae	Herbs	Ornamental
13.	*Centella asiatica*	Indian Pennywort/ ondelaga	Apiaceae	Herbs	Medicinal
14.	*Chloris barbata*	Swollen Finger Grass/ sevaragu	Poaceae	Herbs	Fodder
15.	*Chrysopogon zizanioides*	Vetiver/ Lavancha	Poaceae	Herbs	Fodder
16.	*Cleome monophylla*	Spider Flower	Cleomaceae	Herbs	Medicinal
17.	*Cynodon dactylon*	Bermuda grass/ garikehullu	Poaceae	Herbs	Fodder
18.	*Cyperus odoratus*	Fragrant Sedge/ abdahullu	Cyperaceae	Herbs	
19.	*Dactyloctenium aegyptium*	Crowfoot grass/ kaadu raagi hullu	Poaceae	Herbs	Fodder, Medicinal
20.	*Eleusine indica*	Indian Wiregrass/ Bilwagaja	Poaceae	Herbs	Fodder
21.	*Emilia sonchifolia*	Purple Sow Thistle/ elikivi gida	Asteraceae	Herbs	Medicinal
22.	*Euphorbia hirta*	Asthma Weed/	Euphorbiaceae	Herbs	Medicinal

		Kempuneneyakki			
23.	*Evolvulus alsinoides*	Dwarf Morning Glory/ Vishnykranti	Convolvulaceae	Herbs	Medicinal
24.	*Leucas aspera*	Common Leucas/ Tumbe guda	Lamiaceae	Herbs	Medicinal
25.	*Mimosa pudica*	Touch Me Not/ Lajja	Fabaceae	Herbs	-
26.	*Ocimum adscendens*	Tulasi/ Basil	Lamiaceae	Herbs	Medicinal
27.	*Oxalis corniculata*	Creeping Wood Sorrel/ Pullampurchi	Oxalidaceae	Herbs	-
28.	*Perotis indica*	Indian Comet Grass/ narimisai-hullu,	Poaceae	Herbs	
29.	*Phyllanthus amarus*	Black Catnip/ Nela Nelli	Phyllanthaceae	Herbs	Medicinal
30.	*Sida acuta*	Common Wireweed/ Bheemana kaddi	Malvaceae	Herbs	Medicinal
31.	*Sida cordata*	Long Stalk Sida/ bekkinathale gida	Malvaceae	Herbs	Medicinal
32.	*Tridax procumbens*	Tridax Daisy/ jayanthi	Asteraceae	Herbs	Medicinal
33.	*Catharanthus roseus*	Broom grass/ batla hoo	Apocynaceae	Shrub	Ornamental
34.	*Lantana camara*	Lantana/ Kakke	Verbenaceae	Shrub	Ornamental
35.	*Croton bonplandianum*	Alpa bedhi soppu	Euphorbiaceae	Shrubs	Medicinal
36.	*Parthenium hysterophorus*	Congress Grass/ kaamgressu gida,	Asteraceae	Shrubs	
37.	*Acacia ferruginea*	Rusty acacia/ banni	Mimosaceae	Tree	Medicinal/ timber
38.	*Aegle marmelos*	Bilvapatre	Rutaceae	Tree	Medicinal / fruit
39.	*Albizia lebbeck*	Bage	Fabaceae	Tree	Timber
40.	*Annona recticulata*	Custard Apple/ Ramphal	Annonaceae	Tree	Edible, medicinal
41.	*Araucaria columnaris*	Christmas Tree	Araucariaceae	Tree	Ornamental
42.	*Artocarpus heterophyllus*	Jack fruit/ Halasina hannu	Moraceae	Tree	Edible
43.	*Azadirachta indica*	Indian Lilac/ Turakabevu	Meliaceae	Tree	Medi
44.	*Borassus flabellifer*	olegari	Arecaceae	Tree	Edible
45.	*Butea monosperma*	Flame of the Forest/ Muttagamara	Fabaceae	Tree	Ornamental
46.	*Callistemon viminalis*	Bottlebrush	Myrtaceae	Tree	Ornamental
47.	*Cassia Fistula*	Golden Shower/ Phalus	Fabaceae	Tree	Ornamental + timber
48.	*Ceiba speciosa*	Silk Floss	Malvaceae	Tree	Ornamental
49.	*Cocos nucifera*	Coconut/ tenginakayi	Arecaceae	Tree	Edible
50.	*Couroupita guianensis*	Cannon-ball/ Nagalingam	Lecythidaceae	Tree	Ornamental
51.	*Dalbergia latifolia*	Rosewood/ beete	Fabaceae	Tree	Timber
52.	*Dalbergia sissoo*	Indian Rosewood/ agaru	Fabaceae	Tree	Timber
53.	*Emblica officinalis*	Gooseberry/ bettadanellikai	Phyllanthaceae	Tree	Medicinal
54.	*Eucalyptus tereticornis*	Eucalyptus	Myrtaceae	Tree	Timber
55.	*Ficus glomerata*	Cluster Fig/ Rumadi	Moraceae	Tree	Medicinal
56.	*Fiscus religiosa*	Sacred fig/	Moraceae	Tree	Medicinal

57.	*Gmelina arborea*	White Teak/ kulimavu	Lamiaceae	Tree	Medicinal, Timber
58.	*Jacaranda mimosifolia*	Jacaranda	Bignoniaceae	Tree	ornamental
59.	*Lagerstroemia speciosa*	Pride Of India/ Challa/ maruva	Lythraceae	Tree	Ornamental & medicinal
60.	*Limonia acidissima*	Wood Apple/ Belada Hannu	Rutaceae	Tree	Edible
61.	*Madhuca latifolia*	Butter Tree/ ippe	Sapotaceae	Tree	Medicinal
62.	*Mangifera indica*	Mango/ Mavina mara	Anacardiaceae	Tree	Ornamental
63.	*Markhamia lutea*	Markhamia/ Kumkuma	Bignoniaceae	Tree	Ornamental
64.	*Michelia champaca*	Sampige	Magnoliaceae	Tree	Medicinal & timber
65.	*Millettia pinnata*	Indian Beech/ Honge	Fabaceae	Tree	Timber/ Medicinal/ Economical
66.	*Millingtonia hortensis*	Indian Cork/ Beratu	Bignoniaceae	Tree	Ornamental/ Timber
67.	*Mimusops elengi*	Indian Medlar/ Ranjal	Sapotaceae	Tree	Medicinal
68.	*Muntingia calabura*	Singapore Cherry/ Gasagase hannina mar	Muntingiaceae	Tree	Medicinal/ Timber
69.	*Murraya koenigii*	Curry Tree/ Karibevu	Rutaceae	Tree	Edible & Medicinal
70.	*Neolamarckia cadamba*	Kaduavalatige	Rubiaceae	Tree	Timber
71.	*Nyctanthes arbor-tristis*	Night-flowering Jasmine/ Goli	Oleaceae	Tree	Ornamental
72.	*Parkia biglandulosa*	Badminton- ball / shivalingamara	Fabaceae	Tree	Timber
73.	*Phoenix sylvestris*	Wild Date Palm/ ichalu	Arecaceae	Tree	Edible
74.	*Phyllanthus emblica*	Indian Gooseberry/ Bettada nellikaayi	Phyllanthaceae	Tree	Medicinal & edible
75.	*Polyalthia longifolia*	Mast Tree/ Ubbina	Annonaceae	Tree	Ornamental & timber
76.	*Prosopis cineraria*	Banni	Fabaceae	Tree	Timber
77.	*Psidium guajava*	Guava/ Seebe-hannu	Myrtaceae	Tree	Edible
78.	*Pterocarpus santalinus*	Red Sandalwood/ Kempugandha	Fabaceae	Tree	Timber, Medicinal
79.	*Saraca asoca*	Achenge	Fabaceae	Tree	Medicinal
80.	*Swietenia mahagoni*	Indian Mahogany/ Mahogany gida	Meliaceae	Tree	Timber
81.	*Syzygium aromaticum*	Clove/ Luvunga	Myrtaceae	Tree	Medicinal
82.	*Syzygium cumini*	Black Plum/ Neerale	Myrtaceae	Tree	Edible
83.	*Tamarindus indicus*	Tamarind/ Hunise	Fabaceae	Tree	Edible
84.	*Terminalia arjuna*	Arjuna/ Holimathi	Combretaceae	Tree	Ornamental
85.	*Terminalia catappa*	Indian Almond/ Kadubadami	Combretaceae	Tree	Timber
86.	*Thespesia populnea*	Indian Tulip/ Arasi	Malvaceae	Tree	Medicinal

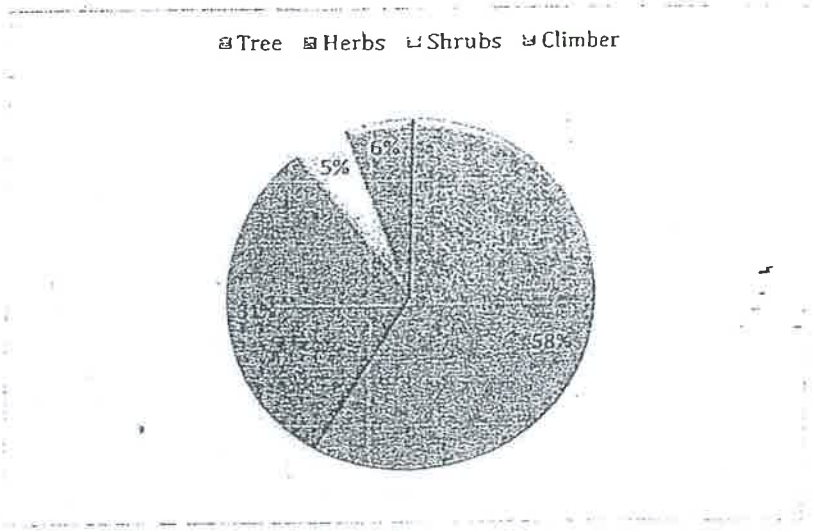

Figure 21: Pie Diagram Showing Distribution of Floral Habits

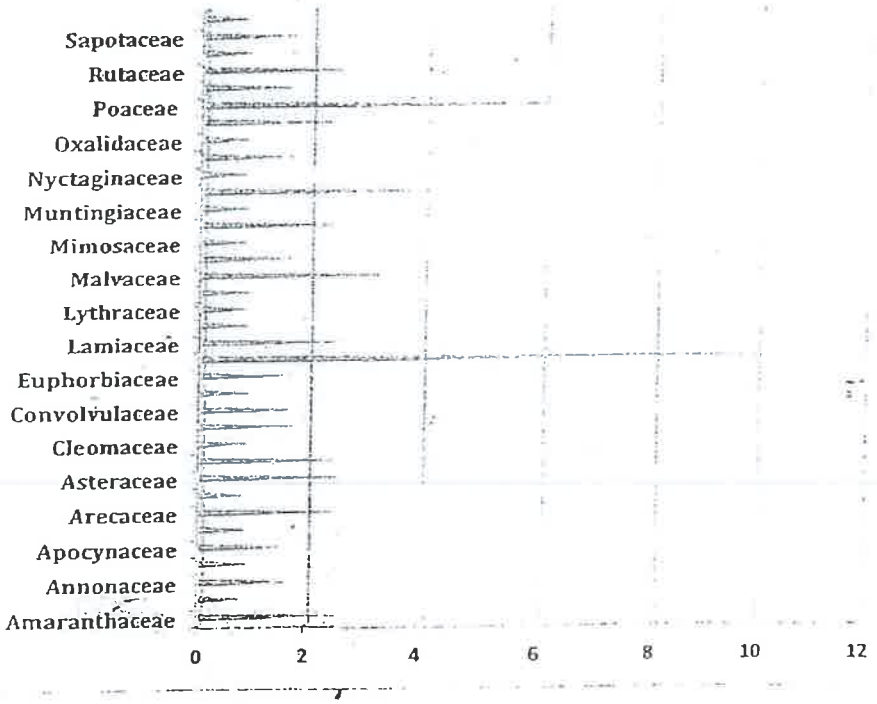

Figure 22: Bar Diagram Showing Family-wise Classification of Floral Diversity

4.8.5 Faunal Diversity

The baseline assessment in the plant area recorded in which 7 birds, 2 reptiles and 9 species were listed in **Table-40** to **42.** A large number of fauna are reported from the buffer area. Sum of 55 faunal species were recorded from the area which belongs to 28 birds, 16 butterflies, 5 mammals, 6 reptiles and amphibians listed in **Table-43** to 46. The faunal diversity of buffer area is shown in bar diagram in **Figure-23.**

Table 40: List of Birds Recorded in Plant Area (core zone)

S. No.	Scientific Name	Common Name	Conservation Status
1.	*Ictinaetus malayensis*	Black Eagle	Accipitridae
2.	*Eudynamys scolopacea*	Koel	Cuculidae
3.	*Pycnonotus jocosus*	Redwhiskered Bulbul	Pycnonotidae
4.	*Alcedo atthis*	Common (Blue) Kingfisher	Alcedinidae
5.	*Halcyon smyrnensis*	White-throated Kingfisher	Halcyonidae
6.	*Merops orientalis*	Green Bee-eater	Meropidae
7.	*Acridotheres ginginianus*	Bank myna	Sturnidae

Table 41: List of Reptiles Reported in Plant Area

S. No.	Scientific Name	English Name	Family	WPA 1972, Schedule
1.	*Calotes versicolor*	Garden lizard	Agamidae	Schedule IV
2.	*Hemidactylus sp*	House lizard	Gekkonidae	Schedule IV

Table 42: List of Butterfly Recorded in Plant Area

S. No.	*Scientific Name*	Common Name	Family
1.	*Acraea terpsicore*	The Tawny Coster	Nymphalidae
2.	*Anaphaeis aurota*	Pioneer White	Pieridae
3.	*Castalius rosimon*	The Common Pierrot	Lycaenidae
4.	*Danais hryšippus*	Plain Tiger	Nymphalidae
5.	*Danais chrysippus*	The Plain Tiger	Danaidae
6.	*Danaus limniace*	The Blue Tiger	Danaidae
7.	*Euchrysops cnejus*	The Gram Blue	Lycaenidae
8.	*Eurema brigitta*	The Common Grass Yellow	Pieridae
9.	*Zizeeria karsandra*	The Dark Grass Blue	Lycaenidae

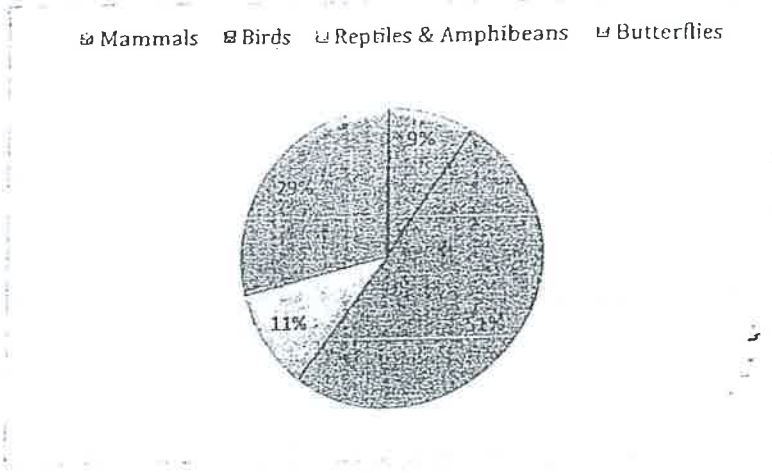

Figure 23: Bar Diagram Showing Faunal Distribution

Table 43: List of Mammals Recorded in Buffer Area

S. No.	Scientific Name	Common Name	Schedule as per WPA, 1972
1.	Felis chaus	Jungle cat	Schedule II
2.	Funambulus palmarum	Three striped palm squirrel	Schedule IV
3.	Herpestes edwadsii	Common Indian Mongoose	-
4.	Hystrix indica	Indian porcupine	Schedule IV
5.	Macaca mulatta	Monkey	Schedule II

Table 44: List of Birds Present in Buffer Area

S. No.	Scientific Name	Common Name	Family
1.	*Acridotheres ginginianus*	Bank myna	Sturnidae
2.	*Alcedo atthis*	Common (Blue) Kingfisher	Alcedinidae
3.	*Anas poecilorhyncha*	Spot-billed Duck	Anatidae
4.	*Anhinga melanogaster*	Oriental Darter	Anhingidae
5.	*Ardea alba*	Great Egret	Ardeidae
6.	*Ardea purpurea*	Purple Heron	Ardeidae
7.	*Ardeola grayii*	Indian Pond Heron	Ardeidae
8.	*Bubulcus ibis*	Cattle Egret	Ardeidae
9.	*Ceryle rudis*	Pied Kingfisher	Cerylidae
10.	*Chrysocolaptes festivus*	Blackbacked woodpecker	Picidae
11.	*Eudynamys scolopacea*	Koel	Cuculidae
12.	*Gallus sonneratii*	Grey Jungle fowl	Phasianidae
13.	*Halcyon smyrnensis*	White-throated Kingfisher	Halcyonidae
14.	*Haliastur indus*	Brahminy Kite	Accipitridae
15.	*Himantopus himantopus*	Black-winged Stilt	Recurvirostridae

16.	*Ictinaetus malayensis*	Black Eagle	Accipitridae
17.	*Merops orientalis*	Green Bee-eater	Meropidae
18.	*Metopidius indicus*	Bronze-winged Jacana	Jacanidae
19.	*Microcarbo niger*	Little Cormorant	Phalacrocoracidae
20.	*Pelecanus onocrotalus*	White Pelican	Pelecanidae
21.	*Pelecanus philippensis*	Spot-billed Pelican	Pelecanidae
22.	*Phalacrocorax fuscicollis*	Indian Cormorant	Phalacrocoracidae
23.	*Porphyrio porphyrio*	Purple Swamphen	Rallidae
24.	*Pycnonotus jocosus*	Redwhiskered Bulbul	Pycnonotidae
25.	*Streptopelia decaocto*	Eurasian collared dove	Columbidae
26.	*Threskiornis melanocephalus*	Black-headed ibis	Threskiornithidae
27.	*Turdoidus striatus*	Jungle Babler	Leiothrichidae
28.	*Vanellus indicus*	Red-wattled Lapwing	Charadriidae

Table 45: List of Butterfly Noted in Buffer Area

S. No.	Scientific Name	Common Name	Family
1.	*Acraea terpsicore*	The Tawny Coster	Nymphalidae
2.	*Anaphaeis aurota*	Pioneer White	Pieridae
3.	*Ariadne merione*	Common castor	Nymphalidae
4.	*Castalius rosimon*	The Common Pierrot	Lycaenidae
5.	*Catopsilia pomona*	Common Emigrant	Pieridae
6.	*Danais chrysippus*	The Plain Tiger	Danaidae
7.	*Danaus limniace*	The Blue Tiger	Danaidae
8.	*Euchrysops cnejus*	The Gram Blue	Lycaenidae
9.	*Euploea core*	Common crow	Nymphalidae
10.	*Eurema brigitta*	The Common Grass Yellow	Pieridae
11.	*Ixias marianne*	White orange tip	Pieridae
12.	*Melanitis leda*	Common evening brown	Nymphalidae
13.	*Papilio demoleus*	Common lime	Papilionidae
14.	*Suastus gremius*	The Indian Palm Bob	Hesperiidae
15.	*Zizeeria karsandra*	The Dark Grass Blue	Lycaenidae
16.	Zizina otis	Pale grass blue	Lycaenidae

Table 46: List of Reptiles and Amphibians Reported in Buffer Area

S. No.	Scientific Name	English Name	Family	WPA 1972, Schedule
1.	*Calotes versicolor*	Garden lizard	Agamidae	Schedule IV
2.	*Duttaphrynus melanostictus*	Common toad	Bufonidae	Not Enlisted
3.	*Hemidactylus sp*	House lizard	Gekkonidae	Schedule IV
4.	*Hoplobatrachus Tigrinus*	Indian bull frog	Dicroglossidae	Schedule IV
5.	*Naja Naja*	Indian Cobra	Elapidae	Schedule II
6.	*Ptyas mucosa*	Rat snakes	Colubridae	Schedule II

4.8.5.1 *Butterflies*

A total of 16 species of butterflies belonging to 6 families were recorded from the study area (shown in **Figure 4.10**). The dominant family recorded was Nymphalidae and Lycaenidae followed by Danaidae, Hesperiidae, Papilionidae and Pieridae.

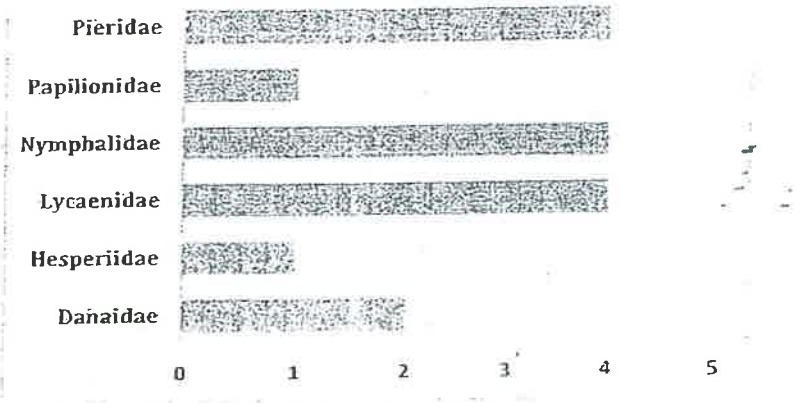

Figure 24: Family-wise Distribution of Butterflies

4.8.5.2 *Avifauna*

A total of 28 species of birds belonging to 22 families were recorded from the study area and birds reported to be present in the study area. All species falls under Schedule IV of Wildlife (Protection) Act 1972 and none are listed. The dominant family recorded was Ardeidae followed by Accipitridae, Pelecanidae and Phalacrocoracidae shown in **Figure 4.11**.

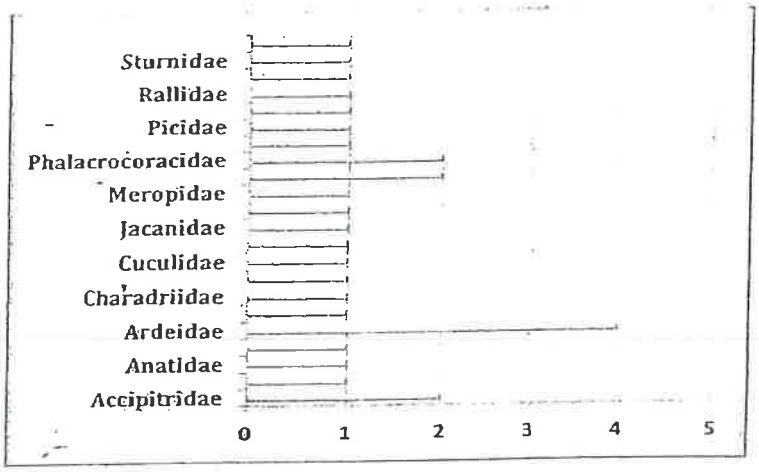

Figure 25: Family-wise Classification of Avifauna

4.8.5.3 *Amphibians and Reptiles*

Two amphibians and four reptile species were recorded from the study area. Among the list 2 species fall under as per Wildlife Protection Act, 1972 in schedule II namely Ptyas mucosa, Naja Naja and remain in Schedule IV except Common toad.

4.8.5.4 *Mammals*

A total of 5 mammals were recorded from the study area. Jungle cat and Monkey fall under Schedule II species. Indian porcupine and Three striped palm squirrel is in Schedule IV.

4.8.6 Aquatic Ecology

Puttenahalli Lake is a 10-hectare water body near Yelahanka, 14 km north of Bangalore. Biodiversity experts have discovered 49 species of birds breeding here. Among those birds are darters, painted storks, black-crowned night herons, purple herons, pond herons, egrets, Asian open bill storks, Eurasian spoonbills, spot-billed pelicans, little grebes, little cormorants, spot-billed ducks, purple moorhens and common sandpipers. Puttenahalli Lake is prominent because lot of birds can be sighted during the breeding season.

Yelahanka Lake, which is near Puttenahalli Lake, covering 292 acres is one of the largest lakes in Bangalore, under the jurisdiction of the Bruhat Bengaluru Mahanagara Palike (BBMP). Home to many birds, as many as 33 species have been recorded there.

The study area has various water bodies. Aquatic weeds, fish and planktonic study carried out in entire study area. Aquatic weed highly dominated in Puttenahalli and Yelahanka Lake. 8 species of aquatic weed reported and it belongs to 6 different families given in Table-47. Typhaceae and Nymphaeaceae is dominated family.

Sum of 8 fish species belong to 4 different families. Among the four families of fish, Cyprinidae (05) is highly dominant followed by Channidae, Nandidae and Heteropneustidae given in Table-48.

Table 47: List of Aquatic Weeds Present in Lakes and Ponds

S. No.	Scientific Name	Family
1.	*Eichhornia crassipes*	Pontederiaceae
2.	*Ipomoea aquatica*	Convolvulaceae
3.	*Nelumbo lutea*	Nelumbonaceae
4.	*Nympheae spp.*	Nymphaeaceae
5.	*Potamogeton spp*	Nymphaeaceae
6.	*Salvinia Molesta*	Salviniaceae
7.	*Typha angusta*	Typhaceae
8.	*Typha latifolia*	Typhaceae

Table 48 List of Fishes Reported in Lakes and Ponds of the Study Area

S. No.	Scientific Name	English Name/	Family
1.	*Catla Catla*	Catla	Cyprinidae
2.	*Hypophthalmichthys molitrix*	Silver carp	Cyprinidae
3.	*Cyprinus carpio*	common carp	Cyprinidae
4.	*Cirrhinus cirrhosus*	Mrigal	Cyprinidae
5.	*Channa marulius*	Murrels	Channidae
6.	*Nandus nandus*	Asian leaffishes	Nandidae
7.	*Amblyph aryngodon mola*	Ray-finned fishes	Cyprinidae
8.	*Heteropneustes fossilis*	Catfishes	Heteropneustidae

4.8.6.1 Planktons

Study Area: Yelahanka lake is situated in Yelahanka town, an extension which is about 15km towards north of Bangalore and covers an area of about 200 acres. The geographic location details of the lake are 13º0.6382 N latitude and 77º35.783 longitude at a mean altitude of 895 m above MSL.

Sample Collection and Analysis

The present investigation was conducted for the period of one week from 1st May 2015 to 7th May 2015. The samples were collected in morning between 7 to 9 am. The water samples were collected from 3 different points of the lake. Water samples were collected by using one liter wide mouth plastic container at each sampling station.

Water quality parameters were analyzed as per methods of APHA (1998). 50 liters of water samples were filtered by using the 125µmesh size plankton net and preserved in 4% formalin. Literature was used for taxonomic position and identification of the plankton.

Species of Protozoa, 03 Species of Copepoda, and 06 Species of Cladocera Zooplankton abundance in Yelahanka lake throughout the study period. Rotifer richness and its biodiversity were found to be maximum in summer in Yelahanka lake. List of rotifera, protozoa, Cladocera, Copepoda are given below:

S. No.	Rotifera
1	*Ascomoypha saltans*
2	*Asplanchna priodota*
3	*Brachionus bidentata*
4	*Brachionus calyciflorus*
5	*Brachionus caudata*
6	*Brachionus plicatilis*
7	*Cephallodella forficula*
8	*Conochilus unicornis*
9	*Colurella obtusa*

10	*Epiphanes senta*
11	*Filinia longiseta*
12	*Gastropus minor*
13	*Gastropus stylifer*
14	*Harringia rousseleti*
15	*Hexarthra mira*
16	*Horella brahmi*
17	*Keratella coachlearis*
18	*Keratella hiemalis*
19	*Keratella quadrata*
20	*Conochilus unicornis*
21	*Colurella obtusa*
22	*Epiphanes senta*
23	*Filinia longiseta*
24	*Gastropus minor*
25	*Gostropus stylifer*
26	*Harringia rousseleti*

	Protozoa
1	*Amoeba proteus*
2	*Centropyxis sp.*
3	*C. arcelloides*
4	*Ceratium hirudinella*
5	*Chlamydomonas minor*
6	*Cyphoderia ampulla*
7	*Difflugia lebes*
8	*Elaeorhanis aculea*
9	*Euglena acus*
10	*Paramecium sp.*
11	*Volvox aureus*

	COPEPODA
1	*Cyclops sp.*
2	*Eucyclops agilis*
3	*Nauplii*

	CLADOCERA
1	*Bosmina longirostris*
2	*Ceriodaphnia laticaudata*
3	*Chydorus Sphaericus*
4	*Daphnia laevis*
5	*Leydigia acanthocercoides*
6	*Moina brachiata*

4.9 SOCIO-ECONOMIC ENVIRONMENT

4.9.1 General

Yelahanka is a suburb of Bangalore in the state of Karnataka originally envisaged as a satellite town of Bangalore city, but now part of the Bruhat Bangalore Mahanagara Palike.

Yelahanka lies to the north of Bengaluru. It was a Municipal council and Taluk (lies below the District level in administrative setup) headquarters prior to formation of BBMP (a metro corporation annexing the original Bangalore area and its suburbs) and now forms a part of greater Bengaluru. A well planned township was developed during early 1980s to the south of the city by Karnataka Housing Board and is identified by several names like 'Yelahanka Upanagara'; 'Yelahanka Satellite Town'; 'Yelahanka New Town' or simply 'Housing Board'. National Highway NH7 passes through Yelahanka and newly constructed NH-7 passes through the north eastern fringes of Yelahanka, acting as a bypass road to avoid the Yelahanka suburb. State Highway 9 (Bangalore - Hindupur) passing in the south of Yelahanka bisects the suburb into Old Town and New Town. Yelahanka business areas are Hospital Main Road and BB road in Yelahanka and in New Town are 16th 'B' Cross and Major Sandeep Unnikrishnan Roads.

Yelahanka has several lakes surrounding it, adjoining: Old Yelahanka, Puttenahalli, Attur and Allalasandra. The lake at Puttenahalli (3 km up the SH 9) has been declared a bird sanctuary. Most of these are either dry or are in bad condition due to emptying of untreated sewerage effluents into them. Yelahanka is a traditional place of weavers. It housed a large number of hand-looms and power looms till 1990s. However, only a handful remains now. The tradition has however been continued by modern textile industries like Co Co International. Yelahanka has the largest milk dairy of Karnataka State, known as 'Mother Diary', a processing unit of the state run Karnataka Milk Federation (KMF).

Yelahanka houses the Rail Wheel Factory (formerly Wheel and Axle Plant) a Production Unit of Indian Railways. It is the largest manufacturer of Railway Wheels and Axles and was until recently, also the proprietary manufacturer of these products in India (save the Durgapur Steel Plant, that produces a small quantity of Railway Wheels).

4.9.2 Approach & Methodology Adopted

Study has been conducted based on the primary as well as Secondary Data: Socio-economic profile has been compiled from census data (2001 & 2011), while primary verification has been carried out by using sample site survey. As the study area is too large so the study has been carried out at district level representing the whole study area for detailed socio-economic analysis.

4.9.3 Concepts & Definition

a. Study Area: The study area, also known as impact area has been defined as the sum total of core area and buffer area with a radius of 10 Kilometers from the periphery of the core area. The study area includes all the land marks both natural and manmade, falling therein.

b. Household: A group of persons who normally live together and take their meals from a common kitchen are called a household. Persons living in a household may be related or unrelated or a mix of both. However, if a group of related or unrelated persons live in a house but do not take their meals from the common kitchen, then they are not part of a common household. Each such person is treated as a separate household. There may be one member households, two member households or multi-member households.

d. Sex Ratio: Sex ratio is the ratio of females to males in a given population. It is expressed as 'number of females per 1000 males'.

e. Literates: All persons aged 7 years and above who can both read and write with understanding in any language are taken as literate. It is not necessary for a person to have received any formal education or passed any minimum educational standard for being treated as literate. People who are blind but can read in Braille are also treated as literates.

f. Literacy Rate: Literacy rate of population is defined as the percentage of literates to the total population aged 7 years and above.

g. Labour Force: The labour force is the number of people employed and unemployed in a geographical entity. The size of the labour force is the sum total of persons employed and unemployed. An unemployed person is defined as a person not employed but actively seeking work. Normally, the labour force of a country consists of everyone of working age (around 14 to 16 years) and below retirement (around 65 years) that are participating workers, that is people actively employed or seeking employment. People not counted under labour force are students, retiredpersons, and stay-at home people, people in prisons, permanently disabled persons and discouraged workers.

h. Work: Work is defined as participation in any economically productive activity with or without compensation, wages or profit. Such participation may be physical and/or mental in nature. Work involves not only actual work but also includes effective supervision and direction of work. The work may be part time, full time, or unpaid work in a farm, family enterprise or in any other economic activity.

i. Worker: All persons engaged in 'work' are defined as workers. Persons who are engaged in cultivation or milk production even solely for domestic consumption are also treated as workers.

j. Main Workers: Those workers who had worked for the major part of the reference period (i.e. 6 months or more in the case of a year) are termed as Main Workers.

k. Marginal Workers: Those workers who did not work for the major part of the reference period (i.e. less than 6 months) are termed as Marginal Workers

l. Work participation rate: The work participation rate is the ratio between the labour force and the overall size of their cohort (national population of the same age range). In the present study the work participation rate is defined as the percentage of total workers (main and marginal) to total population.

4.9.4 Study Area Overview

The following sections present the socio-economic profile of the village falling in the study area (demography, literacy, occupation, etc) based on secondary data available from primary census abstract, census of India, 2001 and 2011, village directory of Karnataka census of India 2011, Administrative Atlas of Karnataka 2011, for detailed socio-economic analysis, tahsil has been taken as the minimum unit. The study area covers Bangalore, District in the state of Karnataka.

4.9.5 Description of the Study Area

The study area covers part of Bangalore & Bangalore rural District in the state of Karnataka. Area and the villages/ wards part of villages and wards located in the 10 Km radius around the project area periphery. There are 50 villages and 23 wards that fall under the study area of the proposed project. Out of these 5 villages come under tahsil Dod Ballapur and 8 villages come under tahsil Devanahalli in Rural Bangalore District, 7 Villages under tahsil Nelamangala, & 5 Villages under tahsil Hosakote in Rural Bangalore District in the state of Karnataka and 3 villages under tahsil Banglore East 22 villages under tahsil Bangalore North in Bangalore District and 23 wards under municipal corporation Bangalore. The District in the state of Karnataka the details are presented in Table-49.

Table 49: Village List

Village	Sub District	District	Village	Sub District	District
Kuduragere	Bangalore North	Bangalore	Ballagere	Nelamangala	Rural Bangalore
Sadenahalli	Bangalore North	Bangalore	Huttanahalli	Nelamangala	Rural Bangalore
Rajanukunte	Bangalore North	Bangalore	Machonaikanahalli	Nelamangala	Rural Bangalore
Dibburu	Bangalore North	Bangalore	Deganahalli	Nelamangala	Rural Bangalore
Koluvarayanahalli	Bangalore North	Bangalore	Srinivasapura	Nelamangala	Rural Bangalore
Seethakempanahalli	Bangalore North	Bangalore	Manchenahalli	Nelamangala	Rural Bangalore
Kalenahalli	Bangalore North	Bangalore	Avalakuppe	Nelamangala	Rural Bangalore
Mathkur	Bangalore North	Bangalore	Sriramanahalli	Dod Ballapur	Rural Bangalore
Muthagada Halli	Bangalore North	Bangalore	Somasettihalli	Dod Ballapur	Rural Bangalore
Lingarajapura	Bangalore North	Bangalore	Srinivasapura	Dod Ballapur	Rural Bangalore
Shivakote	Bangalore North	Bangalore	Nagadenahalli	Dod Ballapur	Rural Bangalore
Hesaraghatta	Bangalore North	Bangalore	Shivapura	Dod Ballapur	Rural Bangalore
Kempapura	Bangalore North	Bangalore	Chikkagollahalli	Devanahalli	Rural Bangalore
Tharabanahalli	Bangalore North	Bangalore	Shanappanahalli	Devanahalli	Rural Bangalore
Meenakunte	Bangalore North	Bangalore	Chikkobanahalli	Devanahalli	Rural Bangalore
Byanahalli	Bangalore North	Bangalore	Venkatapura	Devanahalli	Rural Bangalore
Chikkajala	Bangalore North	Bangalore	Maragondanahalli	Devanahalli	Rural Bangalore
Bilmaranahalli	Bangalore North	Bangalore	Bettenahalli	Devanahalli	Rural Bangalore
Byappanahalli	Bangalore North	Bangalore	Narayanapura	Devanahalli	Rural Bangalore
Chagalahatti	Bangalore North	Bangalore	Somathanahalli	Devanahalli	Rural Bangalore
Guddahalli	Bangalore North	Bangalore	Bagalur	Hosakote	Rural Bangalore

Mittaganahalli	Banglore East	Bangalore	Ramagovindapura	Hosakote	Rural Bangalore
Kadusonnappanahalli	Banglore East	Bangalore	Sarakar Vaddahalli	Hosakote	Rural Bangalore
Nadagowdagollahalli	Banglore East	Bangalore	Agrahara Vaddahalli	Hosakote	Rural Bangalore
Bilmaranahalli	Bangalore North	Bangalore	Muthakadahalli	Hosakote	Rural Bangalore

Ward List

Ward Name	Ward No.	M. Corp	Ward Name	Ward No.	M. Corp
Attur	3	BBMP	Jalahalli	16	BBMP
Yelahanka Satellite	4	BBMP	J.P. Park	17	BBMP
Jakkur	5	BBMP	Radhakrishna Temple	18	BBMP
Thanisandra	6	BBMP	Sanjay Nagar	19	BBMP
Byatarayanapura	7	BBMP	Ganga Nagar	20	BBMP
Kodigehalli	8	BBMP	Hebbal	21	BBMP
Vidyaranyapura	9	BBMP	Nagavara	23	BBMP
Doddabommasandra	10	BBMP	HBR Layout	24	BBMP
Shettyhalli	12	BBMP	Manorayanapalya	33	BBMP
Mallasandra	13	BBMP	Mathikere	36	BBMP
Bagalagunte	14	BBMP	H.M.T.	38	BBMP
T-Dasarahalli	15	BBMP	Chowdeshwari	2	BBMP

4.9.6 Demographic Profile of the Study Area

The proposed Yelahanka Combined Gas Power Plant covers 50 major villages & 23 wards of Bangalore District in the state of Karnataka. A study was under taken with respect to demography, occupational pattern, literacy rate and other important socio-economic indicators of these districts to reveal the socio-economic structure of the entire project area.

4.9.7 Methodology

Door to door socio-economic survey and group discussion of the project-study area was conducted to collect the base line data. Data was collected on various parameters of Quality of life, Income patterns, Land holdings, Amount of land loss due to this project, etc. This detailed information has been used in preparation of the EIA Report.

Group Discussion

During group discussion held with the villagers of Kenchanahalli village, existing socio economic issues and problems which may arise due to Yelahanka Combined Gas Power Plant were discussed in detail. The persons who were present in the discussion are as follows.

- Mr. Raju
- Mr. Nishar Ahamad
- Mr. Keshav
- Mr. Abdul
- Mr. H. Basco

Group discussion held with the villagers of Kenchanahalli village, who have expressed their willingness to accept the project since this would facilitate uninterrupted power supply.

4.9.8 Population

Village Population

The total, population of study area is **62070** the percentages of male & female population are **51.65% & 48.35%** respectively. The average family size is about **4** persons per house. Breakup of the population for male and female is given in following **Table-50** consisting of gender-wise details of population as per census data 2011.

Table 50: Village Population Status of the Study Area

Total House Hold	Total Population	Total Male Population	Total Female Population
13843	57897	29917	27980

(Source: As per Census Data 2011)

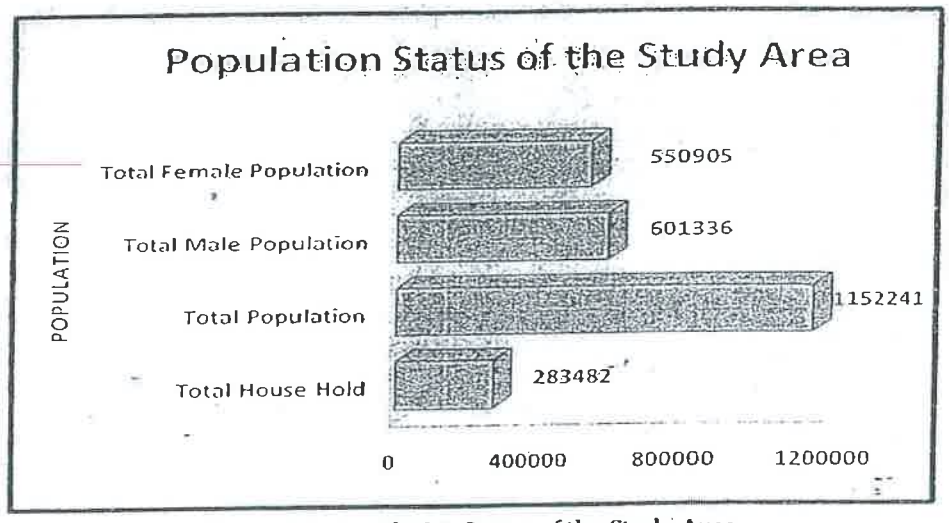

Figure 26: Population Status of the Study Area

Urban Ward Population

There are 23 urban wards that falls under the study area. However the entire ward is covered fully for the study. The total population of these towns as per Census of **2011** is **1094344**. The percentages of male, female population and sex ratio are **52.23%, 47.78%** and **1000** (Males): **915** (females) respectively. There are about **269639** households in the study area. The average family size is about 4 persons per house. Ward viz Population and Sex Ratio is shown in the below Table-51.

Table 51: Ward-wise Population Status of the Study Area

Total House Hold	Total Population	Total Male Population	Total Female Population
269639	1094344	571419	522925

Total Population

	Total House Hold	Total Population	Total Male Population	Total Female Population
Village	13843	57897	29917	27980
Urban Ward	269639	1094344	571419	522925
Total	283482	1152241	601336	550905

4.9.9 Social Structure

The Schedule Caste (SC) population within the study area is 22.33 % of the total population with 49.79% Male and 50.21 % are female. The Schedule Caste (SC) population within the study area is 22.33% of the total population with a sex ratio of 1008 female/1000 males. Schedule Tribe (ST) population in the study area is 4.12% out of a sex ratio of 945female/ 1000 male.

Urban Ward Social Structure

The Schedule Caste (SC) population within the urban wards area is 11.03% of the total population out of which male SC population is 50.84% and female SC population is 49.16%. SC population break-up urban-wards viz is shown in the table: The Schedule Tribe (ST) population in the study area is 2.40% of the total population comprising of 51.87% male and 48.13% females.

Gender wise social structure break-up of village and urban ward wise is shown in the Table-52.

Table 52: Gender Wise Social Structure of the Study Area

	Total SC Population	Total SC Male	Total SC Female	Total ST Population	Total ST Male	Total ST Female
Village	12559	6262	6297	2499	1281	1218
Urban ward	13862	6902	6960	2558	1315	1243
Total	133302	67652	65650	28715	14879	13836

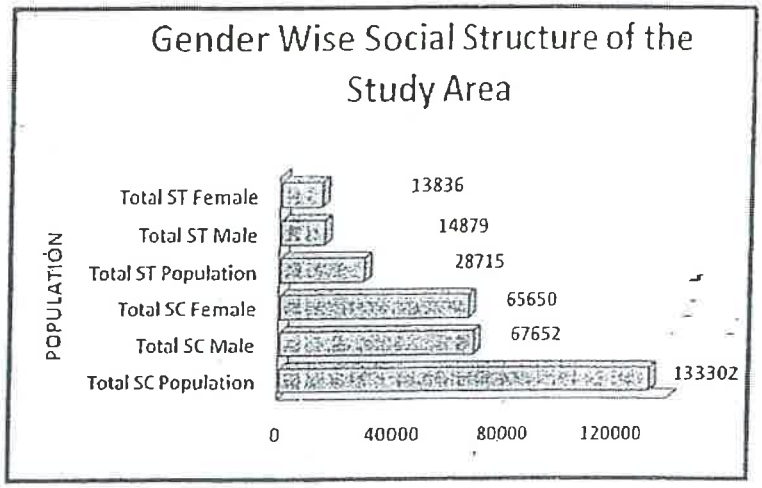

Figure 27 Social Structure of the Study Area

4.9.10 Literacy

Village Literacy

The total number of literate within the study area is 42794 which are 68.94% of total population. Male literacy rate of the study area is 56.44% and female literacy rate is 43.56%.

Urban Ward Literacy

The total number of literates within the urban wards study area is 867598 (79.28%). The percentage of male and female literacy to the total literate population is 54.04% and 45.96%, respectively.

Village/ ward viz literacy break-up is given below in Table-53.

Table 53: Literacy Status of the Study Area

	Total Literate	Total Male Literate	Total Female Literate
Village	39982	22547	17435
Urban ward	867598	468818	398780
Total	907580	491365	416215

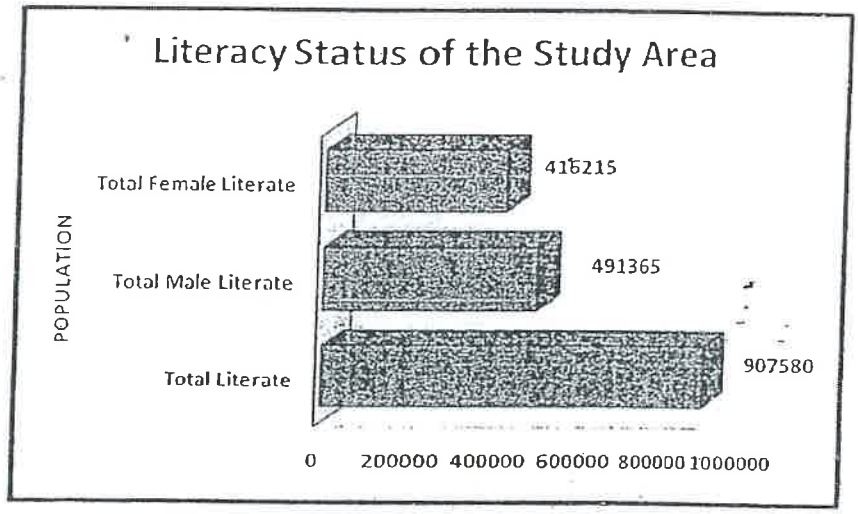

Figure 28: Literacy Status of the Study Area

4.9.11 Occupation Pattern

The occupational structure of the population in the study area has been studied with reference to the total workers and non-workers. Further total workers grouped into two categories main workers and marginal workers. Main workers have been grouped into four categories namely: Cultivators, agricultural labourers, household workers and other workers.

4.9.11.1 Total Workers

Work is defined as participation in any economically productive activity with or without compensation, wage. Such participation may be physical and/ or mental in nature. Work involves not only actual work but also include supervision and direction of work. It even includes part time help or unpaid work on farm, family enterprise or its economic activity. All persons engaged in 'work' as defined above are workers.

The number of total workers in the study area is **483502** which are **41.96%** of total population. Out of which 74.81% is male and only **25.19%** is female. Total workers further divided into main workers and marginal workers.

4.9.11.2 Main Workers

Those workers who had worked for the major part of the reference period (i.e. 6 months or more) are term main workers. Total number of main workers in the study area is **436814** which are **90.34%**of total workers and **37.91 %** of total population.

4.9.11.3 Marginal Workers

The marginal workers are those workers, who are engaged in some work for a period of less than six months, during the reference year prior to the census survey. Total number of marginal workers in study area is 46688 which is approx. 9.66% of the total workers.

4.9.11.4 Cultivators

A person is classified as cultivator if he or she is engaged in cultivation of land own or from government or held from private persons or institutions for payment in money, kind or share. Cultivation work includes effective supervision or direction in cultivation. A person who has given out her/his land to another person or institution(s) for cultivation for money, kind or share of crop and who does not even supervise or direct cultivation process is not treated as cultivator. Similarly, a person working on another person's land for wages in cash or kind or combination of both is not treated as cultivator.

Total cultivators in study area are 8532 out of which 74.64% is male and 25.36% is female.

4.9.11.5 Household Workers

Persons working in others household for wages are treated as household worker .the total workers of this category are about 10052 (2.08% of total workers) in which 73.90% are male and 26.10% are female.

4.9.11.6 Non Workers

The non-workers include those engaged in unpaid household duties, students, retired persons, dependants, beggars etc. The total number of non-workers population is 668739 which are 58.04% of the total population. Out of which 35.83% is male and 64.17% is female.

4.9.11.7 Agricultural Labourers

Persons working on the land of others for wages or share in the yield have been treated as agricultural laborers. The total workers of this category are about 8221 in which 69.35% are male and 30.65% are female.

4.9.11.8 Other Workers

All workers, i.e., those who have been engaged in some economic activity during the last one-year are other workers. The type of workers that come under this category is government servants, municipal employees, teachers, factory workers, plantation workers, those engaged in trading, transport, banking, mining, construction, political or social work, priests, entertainment artist, etc. In effect, all workers except cultivators or agricultural laborers or household industry workers are other workers. The total workers of this category are about 410009 (84.80% of total workers) in which 76.88% are male and 23.12% are female.

Table 54: Occupational Pattern of the Study Area

S. No.	Particulars	Number of Workers in the study area			Proportion
		Total	Male	Female	(%)
1.	Total Workers	483502	361712	121790	33.67
2.	Main Workers	436814	334719	102095	30.50
3.	Marginal Worker	46688	26993	19695	72.96
4.	Cultivators	8532	6368	2164	33.98
5.	Agricultural Labour	8221	5701	2520	44.20
6.	Household Worker	10052	7428	2624	35.33
7.	Other Worker	410009	315222	94787	30.07
8.	Non-workers	668739	239624	429115	179.08
TOTAL		2080100	1302347	777753	59.72

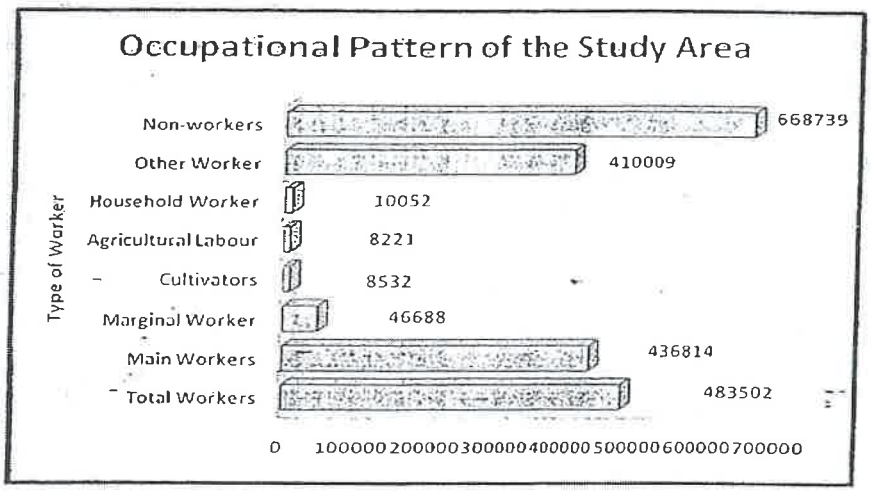

Figure 29: Occupational Pattern of Study Area

4.9.11.9 Infrastructure Facilities

Many of the villages in the study area have primary schools, middle schools and secondary schools. Medical facilities (primary health centre, allopathic & ayurvedic dispensary, maternity and child welfare centre) are good enough in the study area. Water supply in the study area is mainly from taps, well, tube well and hand pumps. Electricity is being supplied for domestic, agriculture,

industrial and public lighting purposes. Electricity and telephone connections are available within the study area.

(a) Education Facilities

Primary schools, middle schools / secondary schools and college are good enough in the study area. The educational facilities within the study area are presented in Table-55 and represented in the form of a bar chart as given in Figure-30.

Table 55: Educational Facilities

S. No.	Educational Facilities	No. of Institution
1.	Primary / Elementary school	75
2.	Middle school	45
3.	Secondary School/Senior Secondary School	12
4.	College	4
TOTAL		136

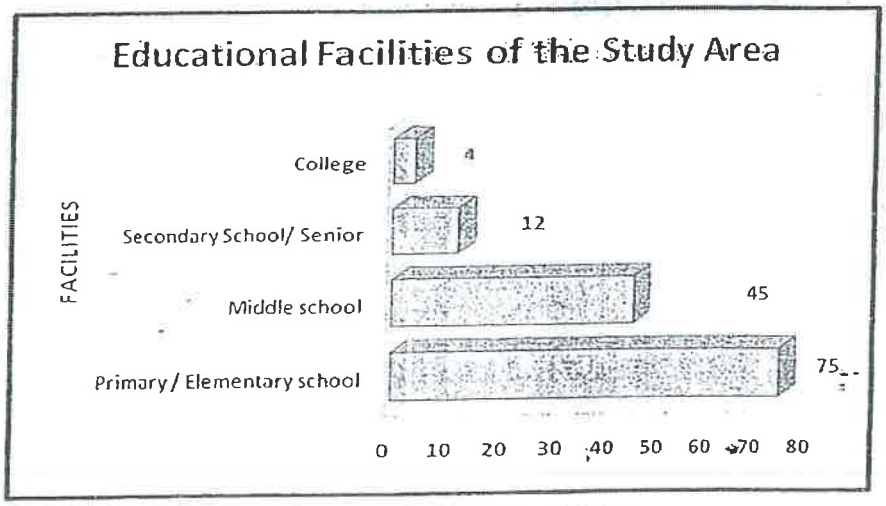

Figure 30: Educational Facilities

(b) Health and Medical Facilities

According to the village directory, census data of 2011, medical facilities (primary health centre, allopathic & homeopathic dispensary, maternity and child welfare centre) are poor in the study area. The status of study area is given in Table-56 and represented in the form of a bar chart as given in Figure-31.

Table 56: Medical Facilities

S. No.	MEDICAL FACILITIES	Number
1.	Allopathic Dispensary	4
2.	Maternity & Child Welfare Centers	10
3.	Primary Health Center	6
4.	Primary Health Sub Center	28
5.	Family Welfare Center	19
6.	Registered Private Medical Practitioners	45
Total Numbers		**112**

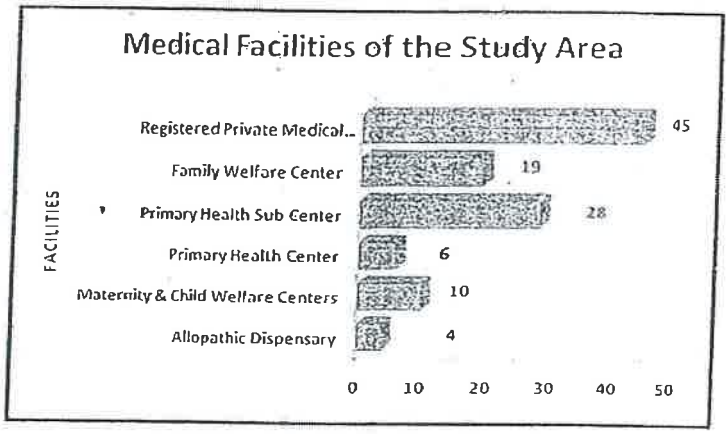

Figure 31: Medical Facilities

(c) Water Facilities

The entire villages in the study area have various sources of drinking water. The number of well, hand pumps and tube well supply in the study area are given in the Table-57 and represented in the form of a bar chart as given in Figure-32.

Table 57: Drinking Water

S. No.	Drinking water facilities	Number
1.	Hand pump	75
2.	Tube well	20
3.	Tap water	150
4.	Well Water	35
TOTAL		280

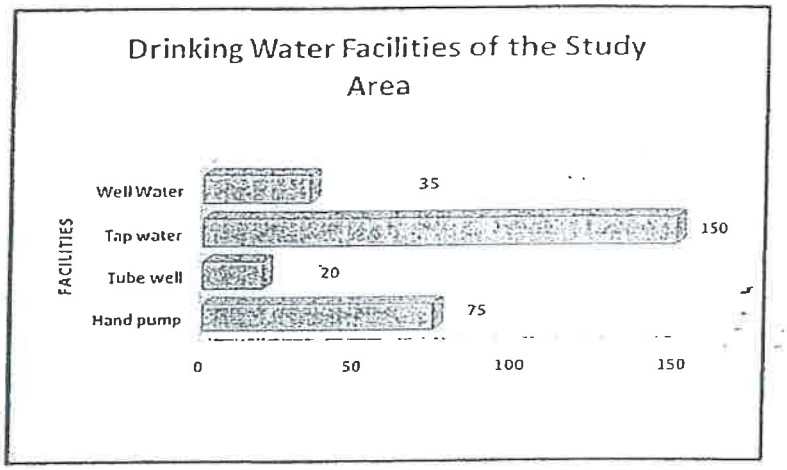

Figure 32: Drinking Water

Crops like paddy, rice and Raagi (millet) were being cultivated at small scale in the area with irrigation from numerous lakes in the area. The villages surrounding Yelahanka, especially Allalasandra, was famous for Guava fruit and grapes. Alas, now the agriculture and farming exists no more due to urbanization and industrialization.

4.9.11.10 Livestock

The livestock predominantly consists of cattle, Cow, Ox, Buffalo, and Goat with miner proportion of, Horses. Cattle provide an important source of livelihood, particularly for the people of the villagers are obliged to keep large herds both for their domestic and agricultural needs as well as to augment their meagre agricultural income. A few heads of cow, ox, buffalo, and goat are a common possession of most rural families.

CHAPTER-5

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CHAPTER-5: IMPACTS & MITIGATION MEASURES

5.1 INTRODUCTION

Prediction of impacts is the most important step of environmental impact assessment. Predictions are superimposed over baseline environmental status to derive ultimate environmental scenario. The impact of the proposed gas based power plant under construction and operation have been considered and discussed in this chapter.

Both beneficial (positive) and adverse (negative) impacts on various components of environment due to proposed power plant are identified, based on the nature of the various activities associated with construction and operation of the gas-based power plants.

5.2 LAND ENVIRONMENT

5.2.1 Sources of Impact

In general, one or more of the following activities impart adverse impact on land environment.

- Handling of solid raw materials, where from fugitive solid may deteriorate the Soil characteristics;
- Handling and disposal of solid wastes, which may deteriorate soil characteristics and change the physical features and drainage, etc.
- Acquisition of land, resulting into change in land use pattern;
- Disposal of liquid wastes on land thereby deteriorating soil quality;
- Disposal of miscellaneous used/damaged materials and garbage may have negative impact on aesthetic value.
- Extraction of landfills material, thereby changing the drainage pattern.

An analysis of the project proposal for the above mentioned causes of impact is as follows:

- Natural gas will be used as fuel for the operating the proposed power project. Use of solid raw material is limited to water treatment chemicals.
- No solid waste will be generated in the proposed power generation activities. Other wastes are limited to used oil, oil sludge from Lamella clarifier, and used containers, which will be disposed through approved vendors.
- The project site is located within premises of existing Yelahanka DG Power Plant, and acquisition of land is not involved.
- Liquid effluents will be pumped to the ETP and treated effluent will be collected in a Guard Pond, from where it will be discharged in the nearby nallah after treating to the norms as prescribed by KSPCB norms, which drains into Yelahanka lake.
- The process does not involve handling of materials resulting into generation of garbage. The municipal solid wastes will be collected in in waste bins and disposed through BBMP facilities.

- The proposed project area is plain land and does not require much filling. The material extracted from construction of the raw Water Reservoir will be utilized as fill material where required.

5.2.2 Impacts

The impacts of the proposed facilities during construction and operation phase are as follows:

- The landfill and excavation activities during construction phase will be limited within area identified for the main plant and raw Water Reservoir. Thus, there is no impact on topography.
- During construction phase some construction waste material will be generated. The civil wastes will be utilized for land fill and the metallic wastes will be disposed as scrap. Thus, it will have no impact on the land environment.
- As natural gas shall be used as main fuel, which will be handled through pipelines, no impact on land environment is envisaged during raw material handling.
- No toxic solid waste will be generated. Sludge from Lamella Clarifier, used oil and used containers will be disposed through CPCB/KSPCB approved vendors. Municipal wastes will be collected in bins and disposed through BBMP facilities. Thus, impact due to disposal of solid wastes is not envisaged.
- As the land is under possession of KPCL and under industrial use, no impact due to change in land use is envisaged.

5.2.3 Mitigation Measures

The proposed mitigation measures are as follows

- During land preparation, the existing drainage pattern of the project area, i.e., gentle slope towards south, shall be maintained.
- Solid wastes in the form of construction debris, defective materials, scraps and packing materials shall be either utilized as land fill material within premises or disposed through approved vendors.
- Hazardous wastes like used oil, oily sludge from Lamella Clarifier and used containers shall be stored within protected area to avoid contamination of land.

5.3 AIR ENVIRONMENT

5.3.1 Construction Phase Impacts

The particulate matter will be the main pollutant due to the excavations, handling and transport of earth and construction material etc. at site. The other pollutants will be NO_x due to the construction activities like operation of construction equipment and traffic movement.

Since the construction activities is a temporary activity and hence the increase in particulate matter and NO_x will be for short duration and its impact will be felt close to the construction site only. Outside the boundary of project activities, the Impacts would be marginal or insignificant.

5.3.2 Compliance with Emission Standards

The proposed Yelahanka CCPP shall utilize natural gas as the fuel for gas turbine, and the waste heat from the gas turbine exhaust will be utilized for steam generation for steam turbine. NG is the cleanest fossil fuel due to negligible sulphur and ash content. On an average, power plant that run on natural gas, emits half of carbon dioxide, less than one third of the nitrogen oxides, one percent of the sulfur oxides, and much lower level of mercury than the plants that burn coal.

The main air pollutants due to burning of fuel are:

- Sulphur Dioxide (SO_2)
- Nitrogen Oxides (NOx)

The combustion of natural gas fuel results in practically no atmospheric emissions of particulate matter. Further, SO_2 levels in flue gas depend upon the sulphur content in the fuel used, which is below 24 ppm in the NG likely to be used. Hence only Nitrogen oxides (NOx) will be the air pollutant in flue gas.

The expected characteristics of emissions from the proposed combined cycle power plant stack are as follows:

a) Oxides of Nitrogen (NOx)	: 25 ppm or 51.3 mg/NM³
b) Sulphur dioxide (SO2)	: Less than 1.5 mg/Nm3 @24 ppm S in NG
c) Particulate matter	: Nil

As per environment norms (emission standards) for gas turbines, NOx emission level should be limited to 50 PPM. It may be seen that, with the use of Dry Low NOx (DLN) burners in the combustors of the gas turbines, the emission of NOx shall be maintained at 25 ppm, which is 50% of the limiting standard.

5.3.3 Air Dispersion Modeling

Since the proposed power plant is gas based and natural gas will be used as fuel for proposed activity, the generation of gaseous pollutants will be less. The suspended particulate matter and SO_2 will not be emitted from CCPP. The main undesirable product of combustion from gas-based power plants is NOx, which is of primary concern as the other pollutants will be traces.

In order to predict the NOx and SO_2 emissions, Aermod Cloud, an interface based on ISCST3-EDM model, was used to predict changes in air quality due to the proposed project. Air Dispersion Mathematical Model was run for the pollutant, oxides of Nitrogen (NOx) and sulphur dioxide (SO_2).The inputs required for the model is:

- Hourly meteorological data
- Source data

- Receptor data
- Programme control parameters

The GLC's were predicted for the scenario, with EMP. The combined impact on ambient air quality at different nearby locations within the study area due to the proposed project based on the various sources of pollution during the study period has been shown in isopleths given in **Figure 5.1** and **Figure 5.2**. Input sources are given in Table- 58, 59 & 60 and output result of the modeling is given in **Table-61**.

Table 58: Volumetric Flow and Efflux Velocity

1	Flue gas volume, m^3/S	599
2	Gas temperature, °C	97
3	Stack ID at Top, m	5.9
4	Stack height, m	45
5	Flue gas volume, Nm3/S	442
6	Flue gas volume, Nm3/hr	1591074
7	Internal area of stack at top, m^2	27.35
8	Efflux velocity, m/s at 97°C	21.9

Table 59: NOx Emission Rate

1	NOx concentration in flue gas, max, ppm	25
2	Mol wt of NO_2	46
3	NOx Concentration in flue gas, max, mg/Nm^3	51.3
4	NOx emission rate, g/s	22.67

Table 60: SO_2 Emission Rate

1	Total sulphur in NG, max, ppm (w/w)	24
2	Fuel consumptio, TPD	1027
3	Fuel consumption, TPH	42.79
4	Fuel consumption, TPS	0.011887
5	Sulphur to GT combustor, g/s	0.285278
6	SO_2 emission rate, g/s	0.570556

Meteorological Data

The hourly micro-meteorological data were recorded near the site at Yelahanka CCPP for three months (March to May, 2015) using a microprocessor based automatic weather monitoring system (WM251). This site-specific hourly met data like wind direction, wind speed, ambient temperature, cloud cover, relative humidity, ceiling height, precipitation, etc. have been used as input for for dispersion modeling.

Result

For the short-term simulations, the concentrations were estimated around various receptors to obtain an optimum description of variations in concentrations over the study area covering 16 directions for the monitoring period. For each time scale, i.e. for 24 hours (short term) the model computes the 50 highest concentrations observed during the period over all measurement points. The first 10 maximum 24 hourly concentrations predicted for NOx and SO_2 are presented in **Table-61.**

Table 61: Maximum 24 Hourly Concentrations Predicted For NOx and SO_2

Averaging period	Rank	Peak concentration, µg/m³		Distance from source, m		Peak date and start hour
		NO_2	SO_2	X-axis	Y-axis	
24-hour	1st	2.41893	0.06074	966.45	-52.99	4/24/2015, 24
24-hour	2nd	2.18049	0.05475	966.45	-52.99	4/19/2015, 24
24-hour	3rd	2.05008	0.05148	966.45	-52.99	4/25/2015, 24
24-hour	4th	2.02230	0.05078	966.45	-52.99	4/27/2015, 24
24-hour	5th	1.95595	0.04911	966.45	-52.99	4/3/2015, 24
24-hour	6th	1.91795	0.04816	966.45	-52.99	4/18/2015, 24
24-hour	7th	1.88403	0.04731	966.45	-52.99	4/9/2015, 24
24-hour	8th	1.72372	0.04328	966.45	-52.99	4/4/2015, 24
24-hour	9th	1.71050	0.04295	966.45	-52.99	4/23/2015, 24
24-hour	10th	1.68819	0.04239	966.45	-52.99	4/8/2015, 24
Period		0.81163	0.02038	966.45	-52.99	

The 24 hours, maximum predicted ground level concentrations (GLCs) for NOx and SO_2 are 2.42 and 0.06 µg/m³, respectively and these were observed in the eastern direction. The maximum mean seasonal GLCs for NOx and SO_2 are 0.81 and 0.02 µg/m³, respectively. These increments are very low and it is concluded that the ambient air quality will remain practically unchanged.

The isopleths of 1st high 24-hour incremental NO_2 and SO_2 incremental concentrations due to emissions from the CCPP are presented in **Figure-33** and **34.**

Resultant Concentrations after Commissioning of the Project

The resultant concentrations of NO_2 and SO_2, after the commissioning of the proposed CCPP, have been predicted by super imposing the predicted incremental values over the maximum baseline concentrations recorded during the study period, irrespective of the date of monitoring. The resultant ground level concentration predicted at the current ambient air quality monitoring stations, is presented in Table-62.

It is seen that there is negligible change in the existing levels, and the resultant GLC's obtained at various locations for the study period are well within the National Ambient Air Quality Standards.

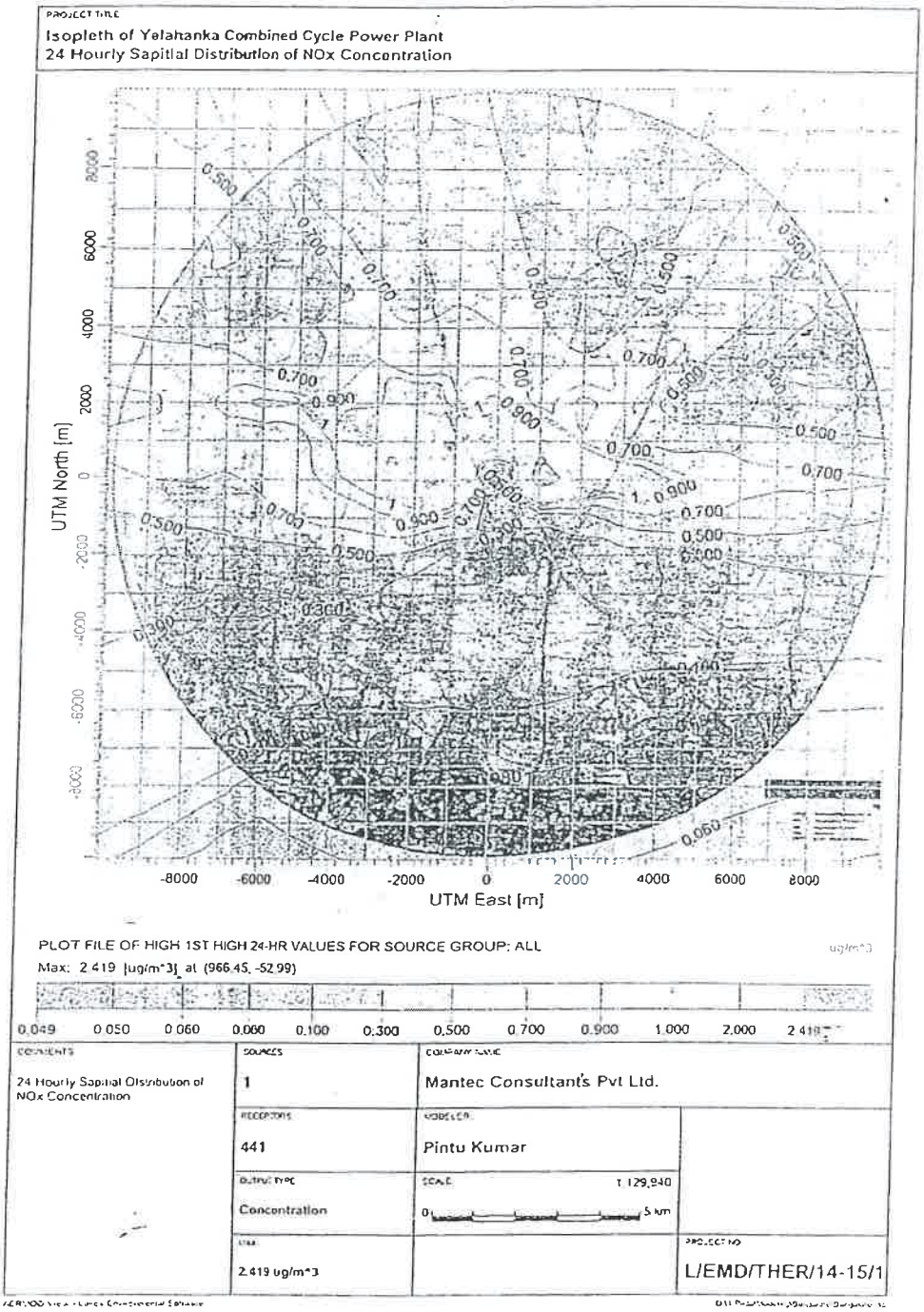

Figure 33: Isopleth of NOx Concentration in 10km Radius from Project Site

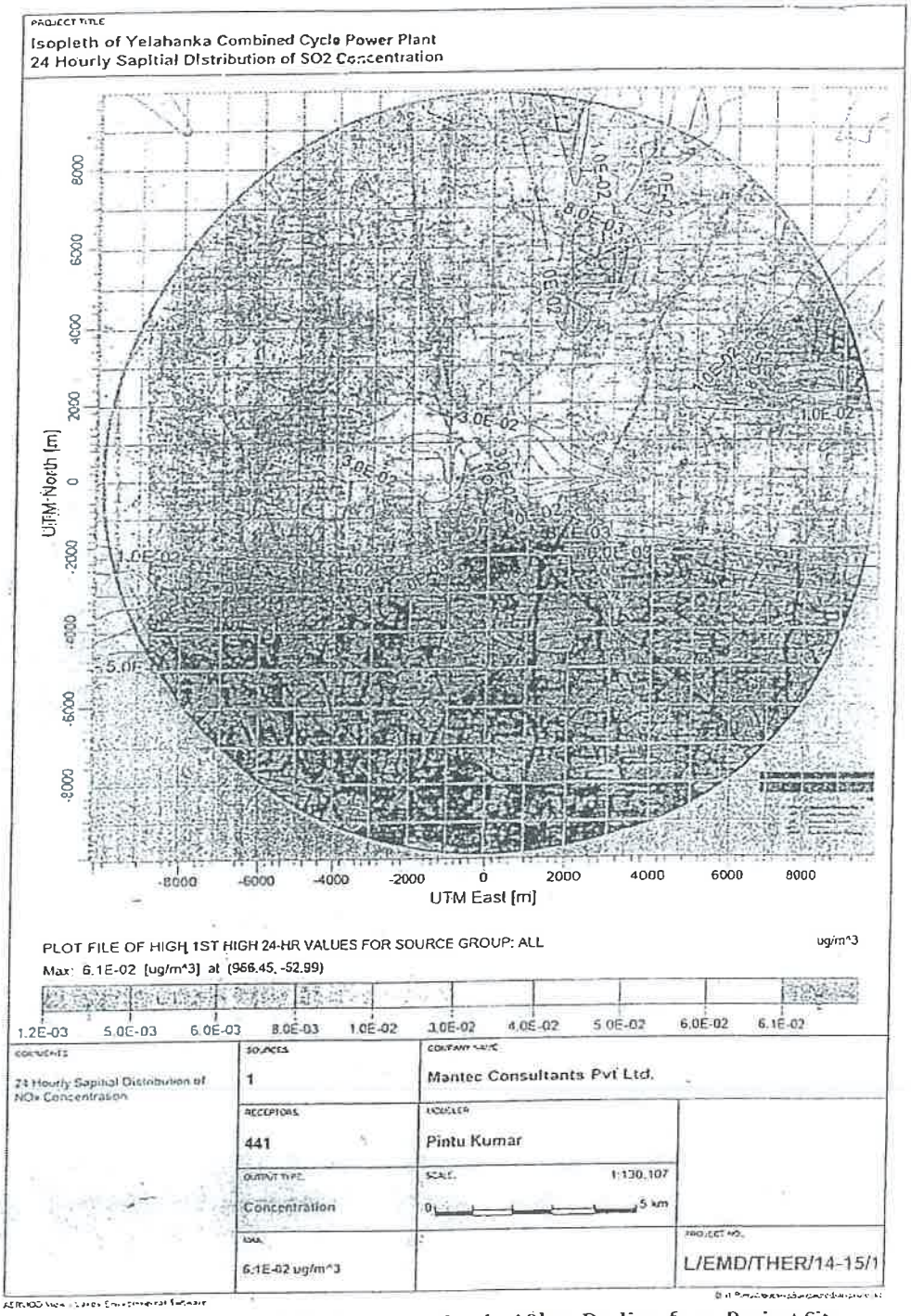

Figure 34: Isopleth of SO_2 Concentration in 10km Radius from Project Site

Table 62: Result Summary of NOx & SO_2 Concentration (ug/m³)

	Maximum 24-Hr Average NOx Concentration, µg/m³			Maximum 24-Hr Average SO_2 Concentration, µg/m³		
Locations	Observed	Incremental	Predicted	Observed	Incremental	Predicted
Anandpur Gate-Project Site	17	0.50	17.5	8.2	0.03	8.23
Jarakabande reserve forest (Vitasagra)	11	0.85	11.85	7	0.025	7.025
Lingarajpuram	18	0.75	18.75	11	0.01	11.01
Hunasamaranahalli	22	0.70	22.7	12	0.01	12.01
Kanchanahalli	15	0.70	15.7	9.2	0.01	9.21
Yelahanka Satellite town	20	0.30	20.3	9.2	0.007	9.225
Marutinagar	16	0.90	16.9	8	0.025	8.025
Laxmipura	20	0.35	20.35	10.2	0.007	10.207

5.3.4 Mitigation Measures

The proposed mitigation measures to be followed during construction and operation of the proposed facilities are as follows:

- Generation of atmospheric dust during construction phase due to movement of vehicles and earthmovers as well as due to filling and leveling shall be controlled through spray of water.
- The afforestation plan shall be aimed to cover all the vacant areas near the boundary walls.
- NOx concentration in the flue gas shall be monitored continuously by on-line monitor.
- Bypass stack shall not be provided.

5.4 WATER ENVIRONMENT

5.4.1 Construction Phase Impacts

The requirement of water for construction purpose will be met through existing ground water facilities of DG Power Plant and IOCL tank farm. No waste water will be generated during construction phase. As the land preparation does not involve major earth work, surface run-off of excavated soil during heavy rains is not envisaged. The construction work force will utilize the existing rest rooms and toilets of DG Plant and IOCL Tank Farm. Therefore, no impact is envisaged during construction phase.

5.4.2 Impact on Water resources

The raw water requirement for operation of the proposed plant is computed as 600 m³/hr or 14400 m³/day. Break-up of water required for various operations is as follows:

a) Make-up to cooling water system : 525 m3/hr.

b) To RO/DM water system : 55 m3/hr.

c) For dilution of effluent in Guard Pond : 20 m3/hr.

Total : 600 m3/hr.

Treated water from RO/DM water system will be utilized for make-up to HRSG, GT inlet air cooling, chemical feed system, service water and HVAC make-up. Effluent from the Guard tank will be utilized for green belt development, Plant washing and make-up to Fire-water system.

Tertiary treated sewage will be used as raw water for operating the proposed plant. Bangalore water Supply and Sewerage Board, vide their letter No. BWSSB/CE(NI & NW)/FA/313 dated 2nd February, 2015, have accorded and allocated 22 MLD tertiary treated water from Jakkur and KHB Colony STPs for the CCPP at Yelahanka. Around 12-15 MLD of tertiary treated water will be supplied initially from jakkur STP and balance will be supplied from the proposed STP of KHB Colony at Puttenhalli. It is propose to entrust the total works of water supply including establishing the tertiary treatment plant with necessary discharge pumps, piping from treatment plant to Yelahanka CCPP raw water reservoir, construction, operation and maintenance of the plant to M/s BWSSB. The tertiary treated water will be utilized as raw water without any pre-treatment.

As the tertiary treatment facilities are being made by BWSSB for exclusive use by the proposed Yelahanka CCPP, impact on water resources and competing users are not foreseen.

5.4.3 Impact on Water Quality

The sources of water pollution are:

- Cooling tower blow down.
- HRSG blow down.
- Effluent from RO and DM water system
- Plants wash down water & miscellaneous drains.
- Sewage from various buildings in the plant.

The characteristics of waste water discharged from various operations those of the final effluent in the Guard Pond are as follows.

Table 63: Characteristics of Wastewater Streams

S.No.	Source of waste water	Qty, KLD	TDS, mg/l
1	Cooling circuit blowdown	4200	2000
2	HRSG blowdown	180	10
3	UF backwash	144	800
4	RO-1 reject	312	3100
5	MBB regen/RO CIP waste	24	7000
6	Dilution water	480	800
	Total into Guard Pond	5340	1879

Based on the total raw water consumed and wastewater collected in the Guard Pond, the TDS content of the wastewater collected in the Guard Pond is computed as follows.

a) Water input to plant, m3/day	:	14400
b) Windage loss in cooling tower @0.2% of Circulation rate	:	1000
c) Net water concentrated & discharged	:	13400
d) wastewater discharge, m3/day	:	5340
e) Concentration (Input: discharge ratio)	:	2.51

The major part of effluent is from blowdown of cooling water from the CW system, RO rejects and UF Backwash. Effluent from regeneration of mixed bed of DM water system is very low, and requires insignificant quantity of acid for neutralization. With these considerations, the characteristics of wastewater in the Guard Pond has been computed by multiplying concentrations of various parameter values in raw water by 2.51, and presented below.

Table 64: Wastewater Characteristics

S. No.	Parameter	Concentration, mg/l, in	
		Raw water	Guard Pond
1	TDS, mg/l, max	800	2008
2	Chloride, mg/l, max	200	502
3	Sulphate, mg/l, max	60	150
4	Calcium hardness as CaCO3, mg/l, max	140	351
5	Magnesium hardness as CaCO3, mg/l, max	94	236
6	Total hardness, as CaCO3, mg/l, max	300	753
7	TKN, mg/l, max	3.4	8.5
8	Total phosphorous, mg/l, max	1	2.5
9	fluoride, mg/l, max	0.39	0.98

The concentrations of other parameters like heavy metals, cyanide, etc. will be well within the detection limits. It is observed that the characteristics of wastewater in the Guard Pond will be well within the specified Standards for Wastewater for Discharge into Inland Surface Waters. It is therefore concluded that discharge of effluents from the Guard Pond in the drain leading to Yelahanka Lake will have no impact on the water quality and aquatic life of the lake.

5.4.4 Mitigation Measures

The following mitigation measures shall be practiced:

- All the trade effluents will be transferred to the Guard Pond, after appropriate treatment, through pipelines.
- Tanks for effluents from DM unit and floor washings will be provided with impermeable lining.
- In cooling water system, a minimum of three cycle of concentration will be practiced.

- Wastage and spillage of water shall be avoided.
- From the Guard Pond, pipelines will be provided for irrigation of afforested areas. Use of raw/process waste for irrigation shall be strictly prohibited.
- Sewage from toilets and washrooms will be treated in septic tanks and disposed in soak pits.
- The final effluent, before discharge, will be diluted by raw water, before discharge into the drain to maintain the TDS concentration at approx 2000 mg/l.

5.5 NOISE ENVIRONMENT

5.5.1 Construction Phase Impacts

The major noise generating sources during the construction phase are construction equipment like, dozer, trucks, scrapers, concrete mixers, cranes, generators, pumps, compressors, rock drills, pneumatic tools, vibrators etc. The operation of these equipment will generate noise ranging between 75 – 90 dB (A). The predicted noise level due to operation of such equipment at a distance of 1.5km from the source is 23.9 dB(A).

The ambient noise level recorded during field studied within distance of 10 km radius from the site ranges between 42-59.2 dB(A). As the ambient noise levels are well within the prescribed noise levels, no increase in the ambient noise levels during construction phase is envisaged.

5.5.2 Operation Phase Impacts

The sources of noise pollution in a power plant are:

- Air inlet & exhaust gas streams
- Steam turbine generator
- Other rotating equipment
- Combustion induced noises
- Flow induced noises
- Steam safety valves
- Cooling Tower ID Fan

All the equipment in the power plant would be designed and operated to have noise level not exceeding 85-90 dB (A) measured at a distance of 1.5 m from the equipment. Generally the manufacturers of the gas turbine generators indicate the following noise level values:

- 85 dB (A) at a distance of 1.5 m from the gas turbines
- 65 dB (A) at a distance of 120 m from the gas turbines

Sound Propagation

Sound propagation from a source to a receiver depends upon the properties of the atmosphere and the presence of any object or barrier in the transmission path. The sound pressure level generated by a noise source decreases with increasing distance mainly due to wave divergence. There is an additional decrease, called excess attenuation, in sound pressure level, with distance from the source due to atmospheric effects or interference with objects in the transmission path.

For a sound source of strength Lw, located above a flat rigid surface, the radiation pattern is approximately hemispherical, and the sound pressure level, Lp, at a distance r from the source is expressed by

$$Lp = Lw - 20 \log r - Ae - 8 \text{ ------} \quad (1)$$

Often, the sound power of a source is not known, but the sound pressure level Lp1 at a distance r1 from the source is known. The sound pressure level Lp2 at a distance r2 from the source can then be calculated from the equation:

$$Lp2 = Lp1 - 20 \log r2/r1 - Ae1,2 \text{ -------} \quad (2)$$

Where Ae1, 2 is the excess attenuation along the path r2-r1 between observers 1 and 2. In environmental noise assessment, Eqn (2) is of more general use since the sound power of a source is seldom known.

Multiple sound sources

In environmental noise problems, generally more than one noise sources are encountered, and the total noise at an observer's location due to all the sources is to be evaluated. Since the sound pressure level is logarithmic, decibel values are not additive. To determine the resultant dB level, it is necessary to convert decibel values to sound pressures, add these pressures, and then reconvert the resultant ratio to the decibel value.

Impact Prediction

On the basis of the above mentioned facts, methodology, observations and assumptions, the resultant noise levels in different directions on the property limits of the complex are computed as follows:

Sl. No.	Location	Noise level, dB(A)	
		Existing	Resultant
1	Northern Boundary	56	56.5
2	Southern Boundary	52	68.8
3	Western Boundary	68	72.4
4	Eastern Boundary	57	68.0

It is, therefore, concluded that the existing noise level in the area will remain unchanged. Thus, no impact on the noise level is foreseen.

5.5.3 Mitigation Measures

- The inlet air and exhaust gas streams would be provided with silencers for noise reduction.
- Adequate measures have been incorporated in the proposed plant for control of noise and vibration from the different equipment. This control of noise within the plants is through the provision of silencers, hoods, and acoustic walls to the noise generating equipment. Suppliers of Steam Turbines, Generator and Compressors shall ensure that the noise levels from these equipment do not exceed desirable noise level of 90 dB(A).
- For mitigation of noise, a proper green belt development program has been formulated, which would further attenuate noise to bring its level down within acceptable levels.

- The control rooms shall be provided with acoustic glass walls to protect the workers from higher noise level. As the operational staff shall remain within the control rooms for most of the time, they will be exposed to the higher noise levels for very short duration. During the visits to the areas of higher noise levels, the operational and maintenance personnel will use earplugs as a safety measure.
- Control of vibration shall be achieved by providing proper foundation and alignment to the vibration generating heavy equipment. Moving parts of equipment and earthmovers shall be properly maintained and lubricated to minimize the generation of noise.

5.6 BIOLOGICAL ENVIRONMENT

5.6.1 Terrestrial Ecology

The impact of proposed plants on vegetation in the study area may occur through following ways:

During Construction Phase

As the project area is devoid of natural forests; the overall impacts on terrestrial ecosystem (e.g. loss of flora and fauna) will be negligible. The site and area around the site will experience some increase in pollution SPM. Deposition of fugitive dust on pubescent leaves of nearby vegetation may lead to temporary reduction of photosynthesis. Such impacts would, however, be confined mostly to the construction phase and would also be regulated and minimized through adoption of control measures such as paving and surface treatment, water sprinkling.

During Operation Phase

There is only one major gaseous pollutant NOx. As DLN burners shall be incorporated to reduce the formation of NOx, long-term incremental ground level concentration of NOx in the study area due to plant operation will be very low. Thus, impact of the emissions on terrestrial ecosystems is likely to be insignificant. The incremental concentration of NOx at the Jarakabande Reserve Forest during March-May has been computed as 11 $\mu g/m^3$. Thus, no significant changes will be there from present circumstances.

5.6.2 Aquatic Ecology

During Construction Phase

The runoff from construction area will be discharged through a catchments pit/-settling pond, thereby reducing suspended solids in stream water runoff and reduction in possibilities of sedimentation at river/water bed. Thus, the impact of construction activities on aquatic ecology of Yelahanka & Puttenahalli Lake is likely to be insignificant.

During Operation Phase

Yelahanka CCPP will not draw any water from any lake or river. Characteristics of wastewater to be discharged into the lake through the drain will be well within the characteristics of wastewater for discharge into inland surface water bodies. Further, as the blow down from the cooling water

system will be taken from the Cooling Tower basin, thermal impact on aquatic ecology is not foreseen. It is, therefore, concluded that the proposed discharge of wastewater into the lake will have no impact on the aquatic ecology of Yelahanka Lake.

5.6.3 Impact on Yelahanka and Puttenahalli Lakes

Puttenahalli Lake is a 10-hectare water body which is to the Western side of the proposed plant and Yelahanka lake is about 120 Hectares and is to the Eastern side of the plant near Yelahanka, 14 km north of Bangalore. These lakes were once outside the Bangalore city and were breeding centers for darters, painted storks, black-crowned night herons, purple herons, pond herons, egrets, Asian open bill storks, Eurasian spoonbills, spot-billed pelicans, little grebes, little cormorants, spot-billed ducks, purple moorhens and common sandpipers.

Due to large scale urbanization and release of untreated urban domestic waste, the bird population visiting these lakes has dwindled and now only local species like night herons, purple herons, pond herons, egrets are seen extensively.

Impact of the project on the above lakes is given below.

- There will be no impact on air environment of lakes as the maximum concentration of NOx is predicted to be 1µg/m² within 1km from the project site. There will be negligible SO2 emission and particulate emission from the project.
- The water after treatment
- The proposed method has less negative impacts on lake water. Only treated water will release in lake.
- The proposed project will not have an effect on soil quality as well sediment quality and it will not generate solid waste.

5.6.4 Mitigation Measures

The following mitigation measures are proposed:

- It shall be ensured that all the pollution control/ environment management systems are commissioned as a part of main plant equipment, before the commencement of the operation of the project;
- For Ecological improvement and attenuation of air pollutants (mainly NO_2) in source receptor pathway and in order to improve the vegetation cover, it is suggested to carry out green belt development and plantation over an area of approx. 4 hectares;
- Routine monitoring of pH of waste water discharged from the Guard Pond.
- Blow down from the cooling water system will be taken from the basin of the cooling tower.
- In consultation with Fisheries Department, every year about 50,000 fish lings of "Dodda Gende" and other local variety will be fed to Puttenahalli and Yelahanka Lakes to maintain a healthy fish population.
- Studies will be conducted regarding the Impact of the Plant on the Fish population in the above lakes once in every two years for a period of 10 years after the commissioning of the

Plant. In the event of any adverse effects due to the establishment of the plant, necessary mitigate measures would be taken

5.7 SOCIO-ECONOMIC ENVIRONMENT

5.7.1 Impacts

The Socio – Economic Impact Assessment is the systematic analysis used during EIA to identify and evaluate the potential socio-economic and cultural impacts of a proposed development on the lives and circumstances of people, their families and their communities. It can identify and distinguish numerous measurable impacts of a proposed development but not every impact may be significant. The population who are impacted either directly or indirectly have a say whether the impacts are significant or not

The proposed plant will be located within premises of the existing DG Power plant of KPCL, and does not require land acquisition or shifting of population. The impacts of the proposed project on the socio-economic environment are as follows.

Demography: The project will generate direct and indirect employment opportunities. Direct employment will be in the form of skilled, semi-skilled and un-skilled work force required for operation of the facilities. The skilled persons will be permanent employees of the project, and semi-skilled and un-skilled work force will be drawn from local population on contract basis. The skilled manpower reuirement is estimated as approx 100 persons. Additionally, the requirement of semi-skilled and unskilled workforce has been estimated as 250 persons. Major part of the semi-skilled workforce and most of the unskilled workforce will be drawn from local population. The permanent employees of the company will stay in the existing colony and nearby township, and commute to the site. Therefore, any impact on demographic profile of the area through influx of job seekers is not foreseen.

Land-use Pattern: The proposed facilities will be located within premises of the existing DG Power Plant, and is under industrial use. Thus, no impact on land use pattern is envisaged. Further, no impact on people from surrounding area through loss of land or shifting of dwelling units is involved.

Transport & Communication: Natural gas and raw water, the main inputs for the proposed project, will be brought to the site through pipeline. Output from the project, electric power, will be transmitted through the existing facilities of KPTCL, existing within premises of the DG plant. Therefore, any impact on transport system due to transport of raw materials and finished products, is not envisaged.

Economy: The proposed project will impart significant positive impact on the economy, employment potential and social structure of the area. In addition to the skilled work-force (100 persons) on permanent rolls of the company, approx. 250 semi-skilled and un-skilled persons will be required, on contract basis, for operation of the plants and facilities. Majority of this work force will be drawn from the local population. Therefore, the proposed project will provide employment opportunities to approx 350 persons from the neighbouring poulation. This is a significant benefit resulting from the proposed project. The proposed facilities will also have positive impact on

regional and national economy. Establishment and operation of the proposed project will contribute significantly to the revenue of the state and central governments in the form of different types of taxes like sales tax on inputs and outputs, income tax of employees, excise duty on the product, service tax, etc.

Social Impacts: On grant of necessary clearances for establishing the proposed project, the company will take up the matter with appropriate authorities, formulate CSR scheme for the areas falling around the proposed project, and implement the same as per MOU with the authorities. The project will provide assured electric power in Bangalore City and the surrounding districts of Karnataka.

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CHAPTER-6: ANALYSIS OF ALTERNATIVES

6.1 ALTERNATIVE LOCATION

6.1.1 Locations considered

KPCL owns &and has been operating a 128 MW DG based power plant located at Yelahanka near Bangalore which runs on fuels such as Diesel/LSHS/LSFO. The plant has not been utilized optimally due to high cost of generation and non-availability of continuous supply of LSHS fuel. The generation from DG plant has stopped since from Aug 2013 on high production cost and its pollution potential. Now, KPCL plans to convert this diesel based power plant to natural gas fired combined cycle power plant to increase the efficiency and to reduce atmospheric Sulphur dioxide & suspended particulate matter emitting from DG sets.

All the required infrastructure facilities like Adm. Building, Guest house, Residential buildings, Green belt development, and compound wall are already exist. Open nala (Raj Kaluve) is passing within the plant boundary and has occupied more area. The area surrounding nala is not being used optimally. The existing nala (Raja Kaluve) can be converted to box type concrete nala and surrounding area can be back filled to develop the green belt.

As the proposed project is for establishing gas fired high efficiency combined cycle power plant in the existing DG based power plant area, which would utilize the land and other infrastructure available at the site, no other site was considered.

6.1.2 Site Selection Criteria

The suitability of the site for locating 1X350±20% MW YCCPP is determined by the following major considerations:

- Availability of adequate space for locating the main plant, transformer yard, switchyard and all the balance of plant facilities required.
- Availability of infrastructure facilities like Adm. Building, Guest house, Residential buildings, Green belt, and compound wall
- Convenience of interconnection with grid for evacuation of the generated power through KPTCL's 220/66/11 KV substation within DG Plant premises.
- Availability of proper road or rail access to the plant site for movement of equipment, construction materials, pipes, chemicals, etc.
- Suitability / feasibility of fuel gas supply.
- Availability of a reliable source of adequate raw-water (treated sewage from BWSSB's STPs) to meet the plant water requirements.
- Suitability of land from topographical and geological considerations.
- Environmental aspects.

6.2 ALTERNATIVE TECHNOLOGIES

6.2.1 Introduction

Gas turbine power plants using Natural Gas as fuel are in operation for a long time. There have been considerable improvements in the design of gas turbine generators resulting in significant enhancement in their reliability, capacity and thermal efficiency. Combined cycle power plants making use of the heat content of the exhaust gas from the gas turbine to raise steam in a heat recovery steam generator and subsequent use of steam in a steam turbine generator have a significantly higher overall cycle efficiency. Power plants have achieved combined cycle efficiency more than 61% on net calorific value basis at ISO condition. The overall efficiency attainable in combined cycle power plants is much higher than the efficiency of the best available fossil fuel fired thermal power plants. Besides, being more efficient compared to the conventional thermal power plants; the combined cycle power plants have the advantage of shorter project implementation duration and a lower auxiliary power consumption of about 2-3 % compared to more than 7-8 % in conventional thermal power plants.

6.2.2 Turbine Rating

Heavy duty gas turbine generators are offered in the market in their standard sizes by reputed manufacturers and a large number of standard sizes up to 400 MW (ISO) rating are available. The cost of gas turbine generator per kW generally reduces as the rating increases. Further, the space requirement for number of small capacity units would be more compared to a lesser number of higher capacity units. The efficiency of large capacity gas turbines is in general higher compared to the smaller capacity gas turbines. In view of this it is preferable to select lesser number of higher capacity gas turbine generators. The capacity of the larger size gas turbine generators presently available with proven operating experience varies between 100 MW and 350 MW amongst different manufacturers. A few gas turbines with still larger capacity are under design and commercial operating feedback is not available at this stage. It is therefore, proposed to implement a single CC power plant to achieve 350±20% MW capacity. The Block would consist of 1 no. of gas turbine (GT) + 1 HRSG + 1 steam turbine (ST) in multi shaft arrangement. The configuration is based on advanced class gas turbine models. Gas turbine and steam turbine would drive separate electric generators.

Following main components are to be accommodated for a combined cycle power plant.

- Gas turbine
- Steam turbine
- HRSG
- Main stack
- CW system comprise of cooling tower and CW pump house
- Water treatment plant
- Fuel gas station
- Workshop & stores
- Emergency Diesel Generator

6.2.3 Selection of GT

In May 2011, both GE and Siemens have launched the next-generation gas turbines, with higher efficiency. GE new machine would achieve a thermal efficiency of 61 %, and Siemens with an efficiency of 60.75 %. During the same period Mitsubishi launched its latest J Series gas turbine, with higher turbine inlet temperature of 1600 °C, i.e. 100 °C higher than its G Series turbines, with gross thermal efficiency greater than 60 per cent at a similar NOx burn to current models. In June 2011, Alstom launched its latest GT26 combined cycle gas turbine with an efficiency of over 61 per cent in combined-cycle operation.

For the proposed CCPP at Yelahanka, modern advanced gas turbines with most fuel efficient electric generating technology is considered in multi shaft to obtain the desired output of 350±20% MW under site conditions. The name of the manufacturers, their combined cycle model number, output under ISO and site conditions with natural gas firing are re given in Table-65.

Table 65: Comparison between Various Makes of Gas Turbine

Sl. No	Manuf. of gas turbine	Gas Turbine Model	Combined Cycle Model	Gross output CC (ISO)	Gross Heat rate CC (ISO)	Net eff. (ISO)	Gross O/P @ site condition	Heat rate CC @ Site Condition
				MW	kcal/kWh	%	MW	kcal/kWh
1	GE	Frame 9E	2x109E	2x193	1655	52	322	1710
2	GE	Frame 9FA	109FA	391	1516	56.7	335.5	1530
3	GE	Frame 9FB	109FB	413	1481	58	370.2	1510
4	Mitsubishi	M701F4	MPCP1	464	1446	59.5	415	1475
5	Mitsubishi	M701G2	MPCP1	498	1450	59.3	440	1482
6	Siemens	(SGT5PAC4000F With SST5-3000)	SSCC5-PAC-4000F 1S	445	1465	58.7	395	1495
7	Alstom	GT26	KA-26-1S	467	1445	59.5	415	1475

6.2.4 Steam Cycle

In a combined cycle power plant the heat in the exhaust gas of the gas turbine is recovered by generating steam in the HRSG. By maximizing the heat recovery and efficient utilization of the steam in steam turbine the overall combined cycle efficiency can be improved. However such an improvement has to be weighed against the economics of heat recovery and overall improvement in the plant efficiency.

The proposed combined cycle power plant would be based on a triple pressure, re-heat steam cycle. The HP steam parameters would be about 135 bar(a) & 567 °C, LP steam parameters would be about 4.7 bar(a) & 279°C, IP & HRH steam parameters would be about 34 bar(a) & 564 °C at the outlet of HRSG.

6.2.5 Environmental Considerations

The primary pollutants emitted by gas turbine engines are NOx, CO and to a lesser extent, unburned hydrocarbons (UHC). Sulfur dioxide, particulate matter (PM) and other hazardous air pollutants are almost absent when natural gas is used as the fuel. Both CO and UHC are the products of incomplete combustion. Given sufficient time and at high enough temperatures, these two pollutants will be further oxidized to carbon dioxide and water.

There are two sources of NOx emissions in the exhaust of a gas turbine. Most of the NOx is generated by the fixation of atmospheric nitrogen in the flame, which is called thermal NOx. Thermal NOx production rates fall sharply as either the combustion temperature decreases, or as the fuel to air ratio decreases. Nitrogen oxides are also generated by the conversion of a fraction of any nitrogen chemically bound in the fuel. Emissions of NOx from fuel bound nitrogen are insignificant when firing natural gas.

Conventional gas turbines are based on diffusion flame combustion in the turbine. In diffusion flame combustion, both fuel and oxidizer are supplied to the reaction zone in an unmixed state. The fuel/air mixing and combustion take place simultaneously in the primary combustion zone. This generates regions of near-stoichiometric fuel/air mixtures where the temperatures are very high. The high flame temperature leads to formation of more NOx.

The lean Pre-mixed Combustion process was developed to reduce the formation of thermal NOx during the combustion process. Lean premixed stationary combustion turbine operate with the air and fuel thoroughly mixed to form a lean mixture before delivery to the combustor. Premixing prevents local "hot spots" within the combustor volume and result into significant reduction in NOx formation.

The Dry Low NOx (DLN) combustor, proposed for YCCPP, is a two-stage premixed combustor designed for use with natural gas. The combustion system includes four major components: fuel injector system, liner, venture, and cap/center body assembly. These components form two stages in the combustor. In the premixed mode, the first stage thoroughly mixes the fuel and air and delivers a uniform, lean, unburned fuel-air mixture to the second stage combustor. This results into significant reduction in NOx formation, and ensures complete combustion of the fuel.

CHAPTER-7: ENVIRONMENTAL MONITORING PROGRAM

7.1 GENERAL

Regular monitoring of environmental parameters is of immense importance to assess the status of environment during project operation. With the knowledge of baseline conditions, the monitoring programme will serve as an indicator of any deterioration in environmental conditions due to operation of the project, to enable taking up suitable mitigatory steps in time to safeguard the environment. Monitoring is also important to evaluate the efficiency of control measures. The objectives of monitoring are to:-

- Verify effectiveness of planning decisions;
- Evaluate effectiveness of operational procedures;
- Confirm statutory and corporate compliance;
- Identify unexpected changes; and
- Energy and resources conservation

7.2 ORGANIZATIONAL SETUP

Success of any environmental management programme depends upon the efficiency of the organizational set up responsible for implementation of the programme. Keeping the utility of monitoring results in the implementation of the environmental management programme, an Environment, Safety & Health (ESH) Cell is proposed to ensure safe and environment friendly operation of the project. The organizational structure of the Cell is shown in Figure-35.

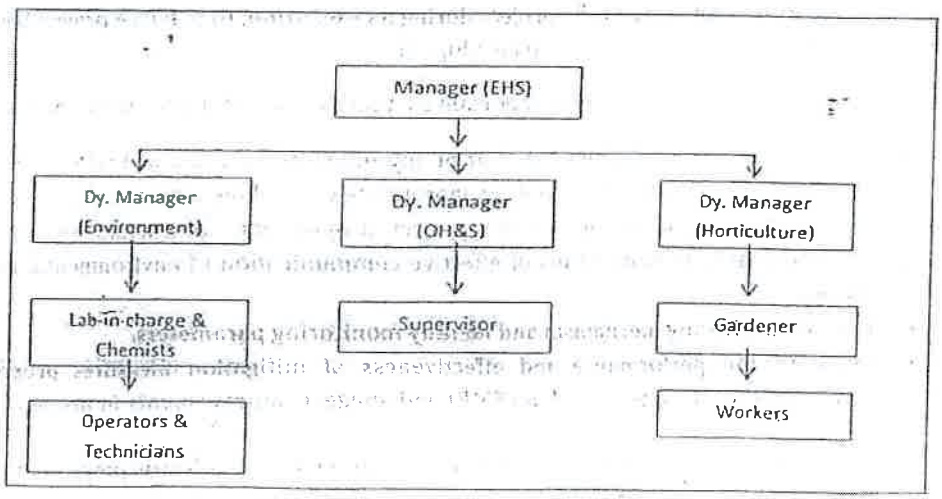

Figure 35: EHS Cell of Organization

7.2.1 Pollution Monitoring and Surveillance System

A well-defined environmental monitoring programme would be instituted with trained and qualified staff who would monitor the ambient air as well as stack gas quality to ensure that the quality of effluents is maintained within the permissible levels. The stacks of the heat recovery steam generators would be provided with suitable ports to monitor the flue gas quality from the stacks. Suitable analyzers will be provided for exhaust gas quality analysis. The quality of the blow down water from the heat recovery steam generator drums and the other water effluents from the plant would be analyzed on a daily basis or as required to ensure that effluents are maintained within the permissible levels.

7.3 ENVIRONMENTAL MONITORING OBJECTIVES

Monitoring will confirm that commitments are being met with. This will take the form of direct measurement and recording of quantitative information, such as quantity and concentrations of discharges, emissions and wastes, for measurement against corporate or statutory standards, consent limits or targets. It will also consist of monitoring of the physical, biological and social environment in the surrounding area. Monitoring may include socio-economic interaction, through local liaison activities or even assessment of complaints.

The preventive approach by management will also require monitoring of process inputs, for example, type and method used, resource consumption, equipment and pollution control performance etc. The key aims of monitoring are, first to ensure that results/ conditions are as per prediction during the planning stage and where they are or not, to pinpoint the cause and implement action to remedy the situation. A second objective is to verify the evaluations made during the planning process, in particular with risk and impact assessments and standard & target setting and to measure operational and process efficiency. Monitoring will also be required to meet compliance with statutory and corporate requirements. Finally, monitoring results provide the basis for auditing. An environmental monitoring plan provides a delivery mechanism to address the adverse environmental impacts of a project during its execution, to enhance project benefits, and to introduce standards of good practice to be adopted.

An environmental monitoring plan is important as it provides useful information and helps to:

- Assist in detecting the development of any unwanted environmental situation, and thus, provides opportunities for adopting appropriate control measures.
- Define the responsibilities of the project proponents, contractors and environmental monitors and provides means of effective communication of environmental issues among them.
- Define monitoring mechanism and identify monitoring parameters.
- Evaluate the performance and effectiveness of mitigation measures proposed in the Environment Management Plan (EMP) and suggest improvements in management plan, if required.
- Evaluate Evaluate specific consumptions of raw materials, electric power and other inputs to ensure their conservation.

From the monitoring point of view, the important parameters are water quality, air quality, noise level, status of flora and fauna, socio-economic status, human health and energy/resources conservation. The suggested monitoring details are outlined in the following sections.

7.4 MONITORING SCHEDULE AND PARAMETERS

7.4.1 Environmental Monitoring

Based on the activities involved in the proposed project, the proposed schedule, frequency and parameters for different environmental components are presented in **Table-66.**

Table 66: Proposed Monitoring Schedule

S. No.	Description of Parameters	Schedule & Duration of Monitoring
1.	**Air Environment**	
a.	Ambient air quality monitoring for SO_2, NO_2 at the following four locations: • Project Site • Yelahanka Satellite Town • Marutinagar • Jarkabande Reserved Forest	24-hour average samples, once in a month.
b.	Monitoring of stack emissions	Routine manual monitoring of GT stack for NOx and SO2 emissions Online (continuous) monitoring of the GT stack for NOx.
2.	**Water Environment**	
a.	Ground water samples from the following locations for all parameters specified under Drinking Water Standards (IS 10500:2012) • Anantpura • Puttanahalli • Kenchenahalli	Once per season (pre-monsoon, post-monsoon and winter seasons)
b.	Surface water samples for comparison with Tolerance Limits for Inland Surface Water, Class 'C' (IS 2296:1986, Drinking water source with conventional treatment followed by disinfection) • Yelahanka Lake • Puttananhalli Lake • Jakkur Lake • Drain near Anantpur gate	Once per season (Pre-monsoon, post-monsoon and winter seasons)

S. No.	Description of Parameters	Schedule & Duration of Monitoring
3.	**Noise Environment**	
a.	Ambient noise monitoring at 3 locations to determine day-time and night-time noise levels. • Yelahanka Satellite Town • Marutinagar • Boundary wall near Wheel & Axle Plant • Boundary wall near Railway Line • Boundary wall near State Highway	Once in 3 months
b.	Work-room noise level at • Turbine Area • Generator Area	Continous
4.	**Land environment** Characterization of soil samples for texture, P_2O_5, fluoride, nitrogen, potassium and organic carbon contents from following locations: • Anantpura Gate • Jarkabande Reserved Forest	Once per season
5.	**Ecology & bio-diversity**	
a.	Inventory of survival and growth rate of trees planted under plantation and green belt development	Once per year
b.	Inventory of endangered/vulnerable flora and fauna species, if any, with respect to their population within 2 km of the project site	Once in 3 years
6.	**Socio-economics**	
a.	Socio-economic condition of local, population, health survey and	Once in 3 years
b.	Traffic status in the area	Once in a year
c.	Monitoring of status of schemes undertaken by the Company under 'Corporate Social Responsibility'	Once in a year
7.	**Resources Conservation**	
a.	Specific consumption (per MW generation) of natural gas, water, and electric power	Once in a month

7.4.2 Occupational Health

The health of the employees who will be working in the unit will be monitored at the time of their placement as well as through general periodical check up and also for respiratory ailments. The health monitoring programme shall include monitoring of

a) Body weight	: Once in a year
b) Blood pressure	: Once in a year
c) Blood sugar	: Once in a year
d) Blood haemoglobin	: Once in a year
e) Chest X-ray	: Once in a year
f) Bone density	: Once in 3 years.
e) Eye & hearing test	: Once in 3 years
f) Liver function test	: Once in 3 years

7.4.3 Laboratory Facilities

In addition to the general laboratory facilities available in the Quality Control Department, the following sampling and analytical equipment will be made available for the proposed environmental monitoring:

- High Volume Air Samplers,
- Multi-gas air samplers,
- Stack sampling train,
- Pitot Tube (Type-s) and Inclined Tube Manometer,
- Selective Ion Electrodes,
- Noise Level Meter with Calibrator,
- Weather Monitoring Station,
- Atomic absorption spectroscope, etc.

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CHAPTER-8: ADDITIONAL STUDIES

8.1 RISK ASSESSMENT

8.1.1 Objective

The objective of carrying out Risk Assessment Study for proposed Yelahanka Combined Cycle Plant project is to study the risk involving hazardous materials and their consequences. In this endeavor, the study objectives are outlined here under.

8.1.1.1 Hazard Identification and Visualization of MCA Scenarios

- To identify major hazards relating to fire, explosion and toxic release due to failure of pipeline/ containment.
- To visualize the Maximum Credible Accident (MCA) scenarios.
- To assess the consequences of these accidents.
- To study past accident information in order to visualize worst accident situations.

8.1.1.2 Analyses of MCA Scenarios

To analyze and quantify primary and secondary effects and damage potential of identified MCA scenarios with recourse to mathematical and analytical models.

8.1.1.3 Consequence Analysis

To study the nature of exposures and consequences of MCA scenarios and characterization of risk levels on-site and off-site population and environment. The scope of work for the study includes the following aspects:

a) Detailed study of engineering information diagrams and layout plans for the plants as well as Chlorine storage facility.
b) Identification of chemical and process hazards.
c) Preliminary identification of hazardous section of the plant and that of storages with resources to Fire-Explosion and Toxicity Index (FETI).
d) Past accident data analysis to identify possible worst accident scenarios.
e) Visualization of Maximum Credible Accident (MCA) scenarios.
f) Analysis of identified MCA scenarios and quantification of primary and secondary effects with recourse to mathematical models pertaining to cases of:
    i. Toxic Dispersions
    ii. Heat Radiations
    iii. Vapour cloud explosion
g) Determination of damage criteria for heat radiation, pressure wave and toxic concentration levels with respect to health criteria, dose-response relations and vulnerability models.
h) Study of on-site and off-site population characteristics.

i) Characterization of risk analysis through study of nature of exposures, pathways and consequences of MCA scenarios and presentation of results in terms of damage distances.

8.1.2 Hazard Identification

8.1.2.1 Introduction

Hazard identification involves knowing how a chemical is likely to behave in process, storage and transport. Identification of hazards in industries is of primary significance in the analysis, quantification and cost effective control of accidents involving chemicals. A classical definition of hazard states that hazard is in fact the characteristics of plant that presents potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident. The type, quantity, location and conditions of release of a toxic or flammable substance have to be identified in order to estimate its damaging effects, the area involved, and the possible precautionary measures required to be taken.In the proposed project hazard identification during storage and transport are relevant.

8.1.2.2 Hazard Potential

The criteria, which could be employed for preliminary evaluation for hazard potential, are:

- Potential for uncontrolled exothermic reactions
- Potential for loss from containment
- Potential for possible ignition sources

Apart from the chemical and process characteristics of the material, the size and layout of the plant and equipment need specific consideration in order to assess the hazard potential. Similarly, natural calamities such as floods, earthquakes etc. cannot be ignored, in the same way as domino or secondary effects of accidents occurring in the surroundings cannot be totally disregarded.

The followingtwo tools have been employed for hazard identification in the study:

- Manufacture, storage and import of Hazardous Chemical Rules, 1989 of Govt. of India (GOI Rules, 1989).
- Relative ranking technique, viz. fire explosion and toxicity index (FETI).

8.1.2.3 Classification of Major Hazardous Substances

Hazardous substances may be classified into three main classes: Flammable substances, unstable substances and Toxic substances. Flammable substances require identification with air for their hazard to be realized. Under certain circumstances the vapours arising from flammable substances when mixed with air may be explosive, especially in confined spaces. However, if present in sufficient quantity such clouds may explode in open air also. Unstable substances are liquids or solids, which may decompose with such violence so as to give rise to blast waves. Finally toxic substances are dangerous and cause substantial damage to life when released into the atmosphere.

The rating for a large number of chemicals based on flammability, reactivity and toxicity have been given in NFPA codes 49 and 325 M:

8.1.2.4 Fire, Explosion and Toxicity Index (FETI) Approach

Amongst the various hazard indices, the Dow chemical Company's Fire and Explosion Index is the most widely used hazard index. This hazard index is commonly known as the Dow's Index or F & EI. It is a number, which indicates damage potential due to the fire, and explosion of a particular unit and comparison is based on numerical value that represents the relative level of significance of each hazard.

FETI is primarily designed for operation involving storage, handling and processing of flammable, combustible and reactive materials, and involves objective evaluation of the realistic fire, explosion, toxicity and reactivity potential of process and/or storage units. It can also be used for analysing pipeline networks, boiler installations and certain elements of power plants. The quantitative methodology relies on the analysis based on historic loss data, the energy potential of the chemical under study and the extent to which loss prevention measures are already applied.

The various factors involved in the calculation of this index are:

- Material factor
- General Process Hazard
- Special Process Hazard

The Material Factor (MF) is a measure of the energy potential of the most hazardous material or mixture of materials present in the unit in sufficient quality actually to present a hazard. The MF is a number in the range from 1 to 40 and is determined using flammability and reactivity properties. The solid cargo proposed to be handled at the terminal has not been classified under hazardous material category. As per the National Fire Protection Association (NFPA) the flammable, toxicity and reactivity ratings for NG are given in Table-67.

Table 67: Ranking of Chemical Hazards of NG as per NFPA Classification

Flammability Hazard (Nf)-4	Are those materials which rapidly or completely vaporize at atmospheric pressure and normal ambient temperature, or which are readily dispersed in air and which will burn readily
Reactivity Hazard (Nr)-0	Are those materials which in themselves are normally stable even under fire exposure conditions, and which are not reactive with water
Health Hazard (Nh)-1	Materials, which on exposure would cause irritation but only minor residual injury, even if no treatment is given

8.1.2.5 *Fire & Explosion Index (FEI)*

The FEI value for each chemical is calculated from material factor, general process hazard and special process hazard values. The degree of hazard potential is identified based on the numerical value of FEI as per the criteria given below:

FEI Range	Degree of Hazard
0 – 65	Light
65 – 95	Moderate
95 & Above	Severe

8.1.2.6 *Toxicity Index (TI)*

The toxicity index is primarily based on the index figures for health hazards established by the NFPA in codes NFPA 704, NFPA 49 and NFPA 325m. The NFPA figures are translated into a toxicity factor in accordance to the following criteria:

NFPA Index Figure	Toxicity
0	0
1	50
2	125
3	250
4	325

In addition, the toxicity factor has to be corrected for the Maximum Allowable Concentration (MAC) value of the toxic substance by adding a penalty, which is assigned according to the following criteria:

MCA, ppm	Penalty
<5	125
5 – 50	75
>50	50

8.1.2.7 *Classification of Hazard Categories*

By comparing the indices FEI and TI, the unit in question is classified into one of the following three categories established for the purpose.

Category	FEI	TI
Light	< 65	<6
Moderate	65-95	6-10
Severe	>95	>10

Certain basic minimum preventive and protective measures are recommended for the three hazard categories.

8.1.2.8 Results of FETI

The various materials handled in the plant and their properties are listed in Table-68. The vulnerable storage and process facilities identified within the complex are, NG, Chlorine as given at Table 8-2 based on GOI rules, 1989. The vulnerability of various units is listed in Table-69.

Table 68: Properties of Materials Employed

Name of Chemicals	Toxicity(TLV)	Flammability	Reactivity
Natural Gas	375 mg/m³	Flammable	NG does not explode or burn.
Sulphuric Acid	1 mg/m³	Non-flammable	Incompatible to organic chlorates, carbides, metals etc.
Hydrated Lime	5 mg/m³ (dust)	Non-combustible	Reacts violently with phosphorous, maleic anhydride, nitro-alkanes.

Table 69: Vulnerable Units of proposed 350 MW Yelahanka CCPP Project

S. No.	Storage & Process Units	Severe or Moderate Hazard Category Based on	
		FEI	TI
1.	NG Pipeline	Yes	No
2.	Chlorine Tonners	Not applicable	Not applicable

8.1.3 Maximum Credible Accident (MCA) Analysis

8.1.3.1 Introduction

Hazardous substances may be released as a result of failures or catastrophe, causing possible damage to the surrounding area. This chapter deals with the question of how the consequences of the released of such substances and the damage to the surrounding area can be determined by means of models.

It is intended to give an insight into how the physical effects resulting from the release of hazardous substances can be calculated by means of models and how vulnerability models can be used to translate the physical effects in terms of injuries and damage to exposed population and environment.

8.1.3.2 *Factors Influencing the Use of Physical Effect Model*

In order to calculate the physical effects of the incidental release of hazardous substances the following steps must be carried out in succession:

- Determine the form in which the hazardous substance occurs- gas condensed to liquid or as a liquid at equilibrium with vapour
- Determine the way in which the release takes place
- Determine the outflow volume (as a function of time) of the gas, vapour/liquid – in the event of liquid outflow determine the evaporation from the pool of liquid formed
- Dispersion of the released gas or the vapour, which has formed into the atmosphere.

In the case of flammable substances, the heat radiation is calculated for the pool fire and in the event of an explosive gas cloud; the peak over pressure resulting from the explosion is calculated.

8.1.3.3 *Visualization of MCA Scenarios*

A Maximum Credible Accident (MCA) can be characterized as an accident with a maximum damage potential, which is believed to be probable.

MCA analysis does not include quantification of the probability of occurrence of an accident. Moreover, since it is not possible to indicate exactly a level of probability that is still believed to be credible, the selection of MCA is somewhat arbitrary. In practice, the selection of accident scenarios representative for a MCA-Analysis is done on the basis of engineering judgment and expertise in the field of risk analysis studies, especially accident analysis.

As an initial step in this study, a selection has been made for the storage units and activities, which are believed to represent the highest level of risk for the surroundings in terms of damage distances. For this selection the following factors have been taken into account.

- Type of compound viz. flammable or toxic.
- Quantity of material present in a unit.
- Storage conditions such as temperature, pressure, etc.

Following steps are employed for visualization of MCA scenarios:

- Chemical inventory analysis
- Analysis of past accidents of similar nature to establish credibility to identified scenarios.
- Short-listing of MCA scenarios.

8.1.3.4 *Chemical Inventory Analysis*

Storage of identified hazardous substances relevant to MCA is limited to chlorine, which will be stored in toners. The minimum quantities of chlorine storage have been screened based on GOI

rules, 1989. The chemical inventory has been short listed and prioritized on the basis of hazard potential assessed by FETI.

8.1.3.5 *Identification of Chemical Release and Accident Scenarios*

The effects of the accidental release of a chlorine or natural gas depend upon a large number of factors viz. type and quantity of released material, meteorological conditions, location and presence or otherwise of an ignition source. The accident scenarios can be divided into the following categories according to the mode of release, physical effects and the resulting damages:

- Flammable gas release
- Toxic gas release

8.1.3.6 *Past Accident Data Analysis*

Analysis of past accidents provides a wealth of information and valuable clues in support of possible modes of occurrence of hazards and their effects and consequences. Extensive coverage of past accident information could be obtained from established computerized data banks and literature databases. A close scrutiny of past accident information reveals the mode of accidents are from storage, transportation and process operations.

8.1.3.7 *Short Listing of MCA Scenarios*

Based on the hazard identification and comparing the nature and occurrence of hazards with that from the past accident information analysis, a final short list of plant storage units have been made. The credible accident scenarios short-listed for all these storage units are:

- Toxic gas release (chlorine gas)
- Vapour cloud explosion (NG release due to pipeline failure)

8.1.3.8 *Atmospheric Stability*

One of the most important characteristics of atmosphere is its stability, which directly influences the ability of atmosphere to disperse pollutants. In most dispersion problem the relevant atmosphere layer is that nearest to the ground, varying in thickness from several hundred feet to a few thousand meters. Variations in both thermal and mechanical turbulence and in wind velocity are greatest in the layer in contact with the surface. Turbulence induced by buoyant forces in the atmosphere is closely related to the vertical temperature structure.

Pasquill has defined six stability classes ranging from 'A' (Extremely unstable) to 'F' (Moderately stable). Surface wind intensity of solar radiation (day time insulation) and nighttime sky cover has been identified as prime factors defining these stability categories. Table-70 indicates the various Pasquill stability categories.

Table 70: Pasquill Stability Classes

Surface wind speed (m/s)	Day Time Insulation			Night-time Insulations	
	Strong	Moderate	Slight	Thin overcast or > 4/8 low clouds	<3/8 cloud
< 2	A	A-B	B	E	F
2 – 3	A-B	C	C	E	F
3 – 5	B	C	C	D	E
5 – 6	C	D	D	D	D
>6	C	D	C	D	D

A – Extremely unstable
B – Moderately unstable
C – Slightly unstable
D – Neutral
E – Slightly stable
F – Moderately stable

When the atmosphere is unstable and wind speeds are moderate or high/gusty, rapid dispersion of pollutants will occur. Under these conditions, air concentrations will be moderate or low and the material will be disposed rapidly. When the atmosphere is stable and wind speed is low dispersion of material will be limited or low.

8.1.3.9 Modes of Failure

The different modes of failures leading to release of toxic or flammable gases, considered for identifying the MCA scenarios and for analysing their consequences, have been described in Table-71.

Table 71: General Mechanism for Loss of Containment

S. No.	Loss of Containment	Probable Cause	Remarks
1.	Flange/Gasket Leaks	✡ Incorrect gasket ✡ Incorrect installation	
2.	Weld failure	✡ Incorrect use of design code ✡ Incorrect use of design material ✡ Incorrect weld procedure	
3.	Pipe overstress causing fracture	✡ Error in stress analysis ✡ Improper pipe material ✡ Inappropriate design code ✡ Extremes temp differentials ✡ Incorrect supports ✡ Lack of inspection during erection etc.	Pipe stress would most likely cause a flange leak unless there exists a combination of cause
4.	Over pressure in the pipe	✡ Incorrect setting of RV of BD pressures.	Careful attention needed for

	causing fracture	✡ Incorrect RV size ✡ Relief valve simmering and hydrating/icing etc.	Hydrocarbons and free water
5.	Failure of pipe due to corrosion or erosion	✡ CO2/H2O corrosion.	
6.	Leaking valve to atmosphere	✡ Gland failure ✡ Packing failure ✡ Sprinkle/plug cork blow out ✡ Operator's failure etc.	
7.	Valve body failure	✡ Catastrophic valve body / bonnet failure etc.	
8.	Instrument/ connection	✡ Bourdon tube failure ✡ Level glass failure ✡ Blow-out of plugged connection ✡ Failure of instrument connection	
9.	Over pressure	✡ Inadequate relief ✡ Fire impingement	

8.1.3.10 Failure Frequency

The prediction of failure frequencies is a difficult task. There are theoretical methods like fault tree or event tree, which can be applied to work out a specific failure scenario. A set of typical failure frequency data is presented in Table 72.

Table 72: Some Typical Failure Frequency Data

Item	Failure frequency (Per million meter per year)
Process pressure vessel failure	3
Pressurized storage vessel failure	1
Full bore vessel connection failure (dia in mm)	
• <= 25 mm	30
• 40 mm	10
• 50 mm	7.5
• 80 mm	5
• 100 mm	4
• >= 150 mm	3
• Full bore process pipeline failure	
• Dia< 50 mm	0.3*

• 50 mm >= Dia<= 150 mm	0.09*
• Dia>= 150 mm	0.03*

8.1.4 Damage / Risk Criteria

8.1.4.1 General

Natural gas is highly inflammable and explosive and its release can cause jet fire as well as explosion. Similarly, chlorine gas is highly toxic to exposure, and the scenario may develop due to leakage valve bodies, corroded pipe-line, snapping of pipe line etc. In case of partial failure of pressurized pipelines, natural gas will be released in the form of jet and will lead to jet fire when in contact with naked flame or hot material. Explosion may also occur due to release of natural gas through leakage. This will cause damage mainly to property.

8.1.4.2 Thermal Radiation

Thermal radiation due to jet flame may cause various degrees of burn on human bodies. Also its effect on inanimate objects like equipment, piping, building and other objects need to be evaluated. The damage effects due to thermal radiation intensity are elaborated in Table-73 & 74.

Table 73: Damage Due To Incident Thermal Radiation Intensity

Incident Thermal Radiation Intensity, KW/m²	Type of Damage
37.5	Can cause heavy damage to process equipment, piping, building etc.
32.0	Maximum flux level for thermally protected tanks.
12.5	Minimum energy required for piloted ignition of wood.
8.00	Maximum heat flux for un-insulated tanks.
4.50	Sufficient to cause pain to personnel if unable to reach cover within 20 sec. (First Degree Burn).
1.60	Will cause no discomfort to long exposure.
0.70	Equivalent to solar radiation.

Table 74: Physiological Effects of Threshold Thermal Doses

Dose Threshold, KJ/m²	Effect
375	3rd Degree Burn
250	2nd Degree Burn
125	1st Degree Burn
65	Threshold of pain, no reddening/blistering of skin

1st Degree Burn: Involve only epidermis, blister may occur; example - sun burn.
2nd Degree Burn: Involve whole of epidermis over the area of burn plus some portion of dermis.
3rd Degree Burn: Involve whole of epidermis & dermis; subcutaneous tissues may also be damaged.

8.1.4.3 *Blast over Pressure*

As mentioned earlier, release of natural gas through leakage may also cause explosion leading to blast over-pressure. Damage effects of explosion overpressure are given in Table-75.

Table 75: Damage Effects Due To Blast Overpressure

Overpressure (Bar)	Damage Type
0.30	Major damage to structure
0.17	Eardrum rupture
0.10	Repairable damage
0.03	Glass breakage
0.01	Cracking of windows

8.1.5 Consequence Analysis

8.1.5.1 *Selected Failure Cases*

The mode adopted for consequence analysis is first to select the probable failure scenarios. The selected failure scenarios are indicated in Table-76.

Table 76: List of Failure Cases

S. No.	Failure Scenarios	Likely Consequences
1.	50 mm holes in natural gas pipelines	Thermal radiation & blast over-pressure due to resulting Jet fire, flash fire and Fire ball

Consequence analysis of selected failure case has been done with software "PHAST" to evaluate and identify possible consequences as well as to incorporate suitable measures in the design, construction and operational phases to prevent and mitigate such failure events.

The following 3 atmospheric conditions have been used for consequence analysis:

- Wind speed: 1.5 m/s, Stability Class: F (Category 1.5/F)
- Wind speed: 5 m/s, Stability Class: D (Category 5D)
- Wind speed: 1.5 m/s, Stability Class: D (Category 1.5/D)

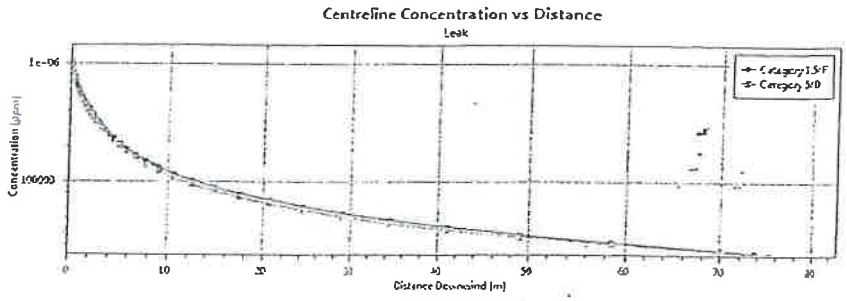
The following consequences have been determined:

- Distance and heights of LFL & UFL Concentrations with respect to location of leakage
- Status and direction of jet fire hazards
- Distances to the specified radiation levels (4, 12.5 and 37.5 kw/m2)
- Hazards and distance to specified radiation levels (4, 12.5 and 37.5 kw/m2)

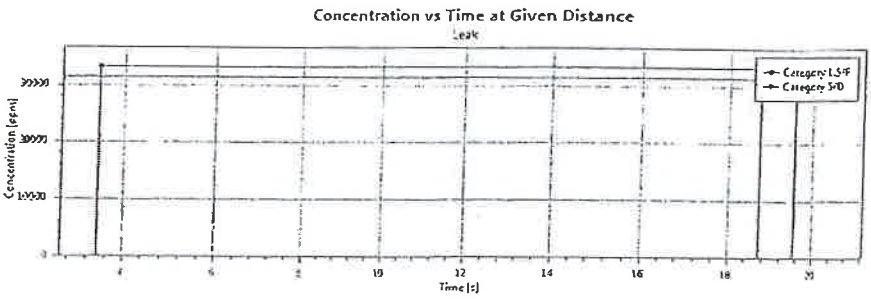
- Flash fire envelopes under different classes
- Effects of and areas affected by early explosion
- Effects of and areas affected by late ignition

The consequence analysis outputs are enclosed as Annexure-2.

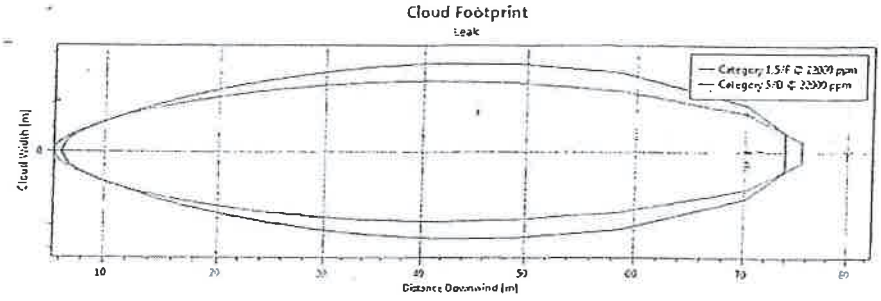
Audit Number	352
Averaging Time	Flammable (18.75 s)
Equipment	Pressure vessel
Material	METHANE
Program	Phast Lite 7.11
Scenario	Leak
Time (Category 1.5/F)	7.09833 s
Time (Category 5/D)	5.18547 s
Weather	Multiple Weather
Workspace	Yelahanka



Audit Number	352
Averaging Time	Flammable (18.75 s)
Dispersion End Time	8.18097E-07 s
Downwind Distance	50 m
Equipment	Pressure vessel
Height of Interest	0 m
Material	METHANE
Offset Distance	0 m
Program	Phast Lite 7.11
Reference Time	EPG (600 s)
Scenario	Leak
Weather	Multiple Weather
Workspace	Yelahanka

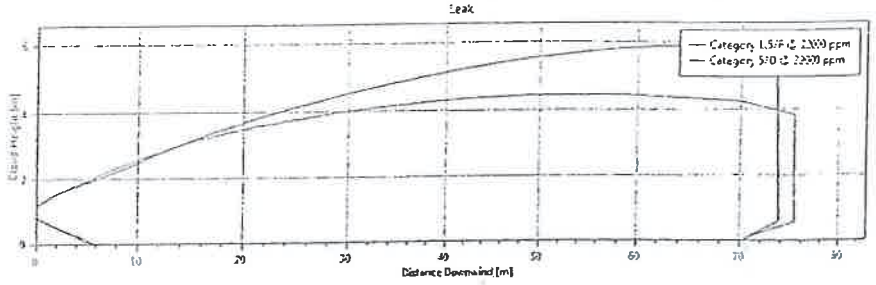


Audit Number	352
Averaging Time	Flammable (18.75 s)
Equipment	Pressure vessel
Height of Interest	0 m
Material	METHANE
Program	Phast Lite 7.11
Scenario	Leak
Time (Category 1.5/F)	7.09833 s
Time (Category 5/D)	5.18547 s
Weather	Multiple Weather
Workspace	Yelahanka



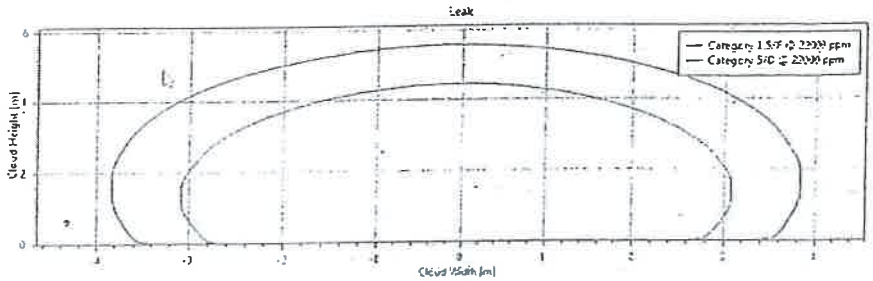
Audit Number	352
Averaging Time	Flammable (18.75 s)
Equipment	Pressure vessel
Material	METHANE
Offset Distance	0 m
Program	Phast Lite 7.11
Scenario	Leak
Time (Category 1.5/F)	7.09838 s
Time (Category 5/D)	5.15547 s
Weather	Multiple Weather
Workspace	Yelahanka

Side View



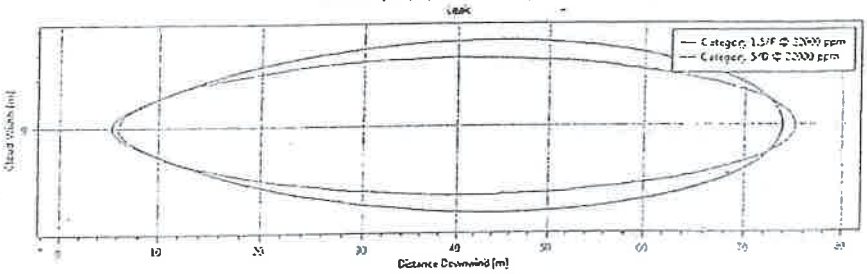
Audit Number	352
Averaging Time	Flammable (18.75 s)
Downwind Distance	58 m
Equipment	Pressure vessel
Material	METHANE
Program	Phast Lite 7.11
Scenario	Leak
Time (Category 1.5/F)	7.09838 s
Time (Category 5/D)	5.15547 s
Weather	Multiple Weather
Workspace	Yelahanka

Cross Section



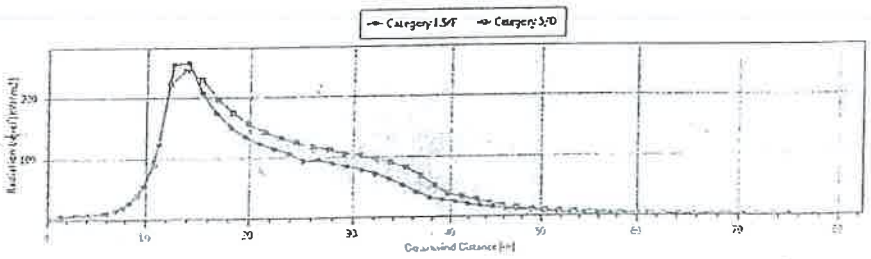
Audit Number	352
Averaging Time	Flammable (18.75 s)
Equipment	Pressure vessel
Height of Interest	0 m
Material	METHANE
Program	Phast Lite 7.11
Scenario	Leak
Weather	Multiple Weather
Workspace	Yelahanka

Maximum Concentration Footprint

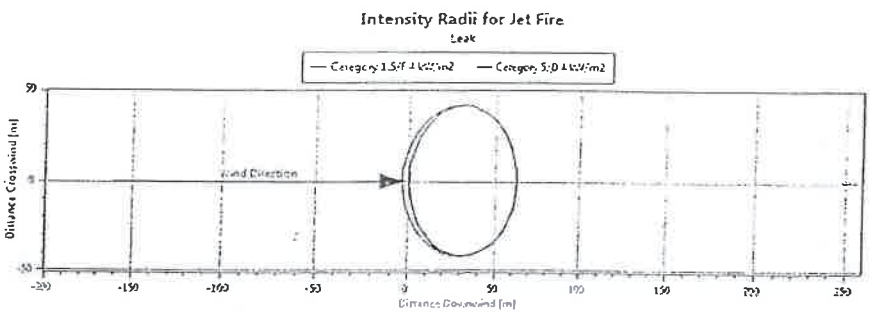


Audit Number	352
Equipment	Pressure vessel
Material	METHANE
Program	Phast Lite 7.11
Scenario	Leak
Workspace	Yelahanka

Radiation vs Distance for Jet Fire



Audit Number 352
Equipment Pressure vessel
Material METHANE
Program Phast Lite 7.11
Scenario Leak
Workspace Yelahanka



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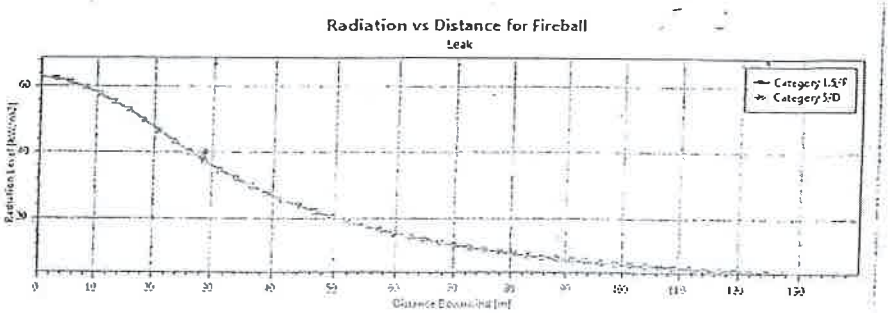
Equipment Pressure vessel
Material METHANE
Program Phast Lite 7.11
Scenario Leak
Workspace Yelahanka



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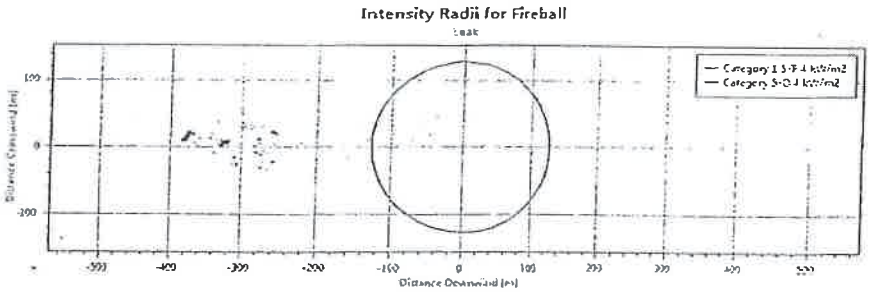
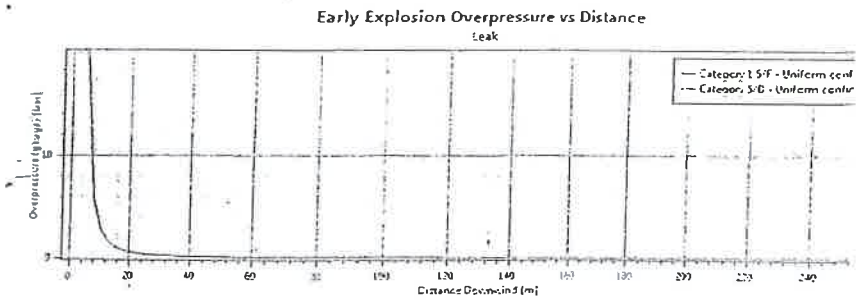
Equipment Pressure vessel
Material METHANE
Program Phast Lite 7.11
Scenario Leak
Workspace Yelahanka

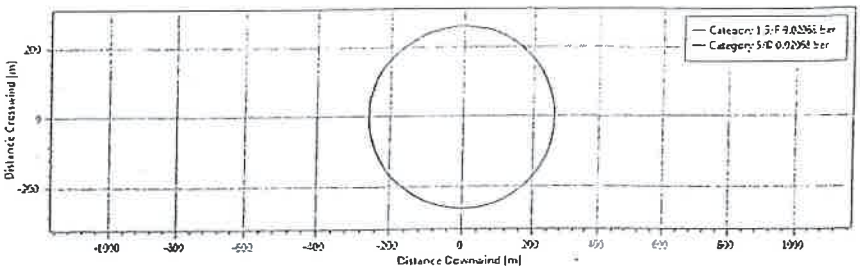


Audit Number 352
Equipment Pressure vessel
Material METHANE
Program Phast Lite 7.11
Scenario Leak
Workspace Yelahanka



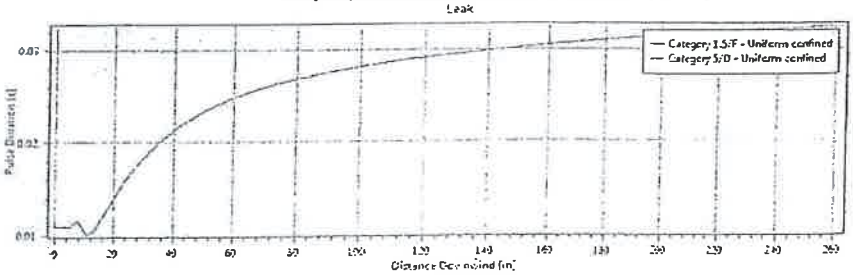
Audit Number	352
Equipment	Pressure vessel
Material	METHANE
Program	Phast Lite 7.11
Scenario	Leak
Workspace	Yelahanka

Early Explosion Overpressure Radii



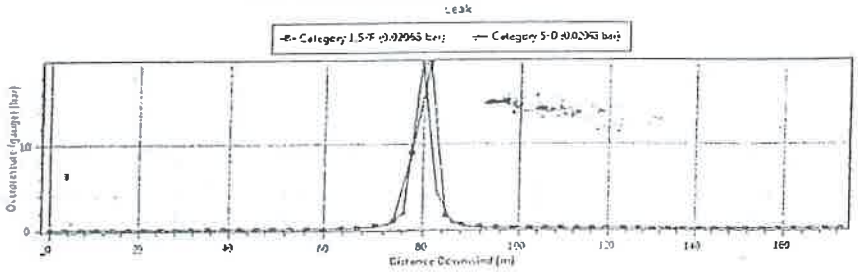
Audit Number	352
Equipment	Pressure vessel
Material	METHANE
Program	Phast Lite 7.11
Scenario	Leak
Workspace	Yelahanka

Early Explosion Pulse Duration vs Distance



Audit Number	352
Equipment	Pressure vessel
Material	METHANE
Program	Phast Lite 7.11
Scenario	Leak
Workspace	Yelahanka

Worst Case Late Explosion Overpressure vs Distance



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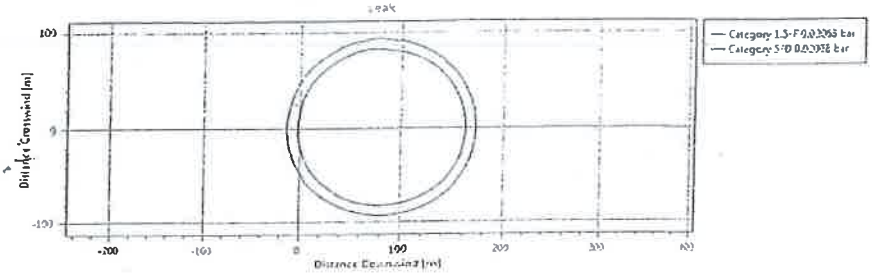
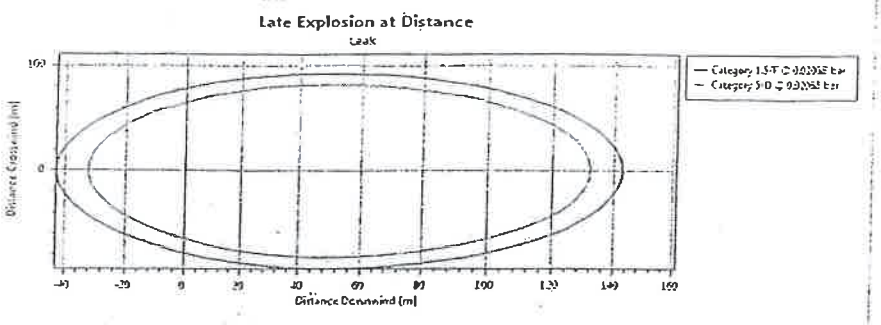
Equipment	Pressure vessel
Material	METHANE
Program	Phast Lite 7.11
Scenario	Leak
Workspace	Yelahanka

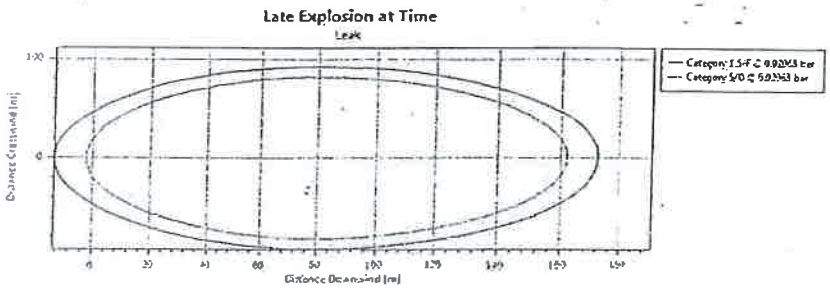
Late Explosion Worst Case Radii



Audit Number 352
Downwind Distance 99 m
Equipment Pressure vessel
Material METHANE
Program Phast Lite 7.11
Scenario Leak
Weather Multiple Weather
Workspace Yelahanka



Audit Number 352
Equipment Pressure vessel
Material METHANE
Program Phast Lite 7.11
Scenario Leak
Time (Category 1.5/F) 6.2418 s
Time (Category 5/D) 5.79103 s
Weather Multiple Weather
Workspace Yelahanka



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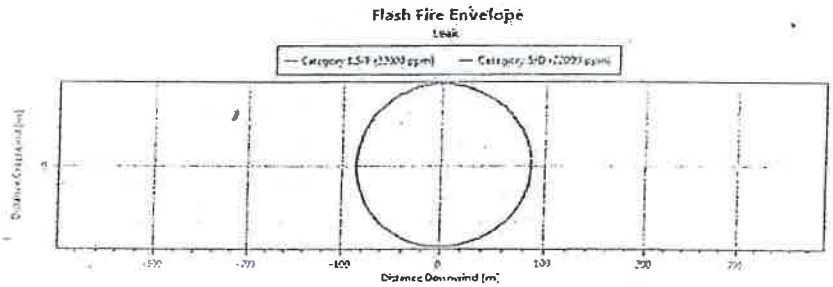
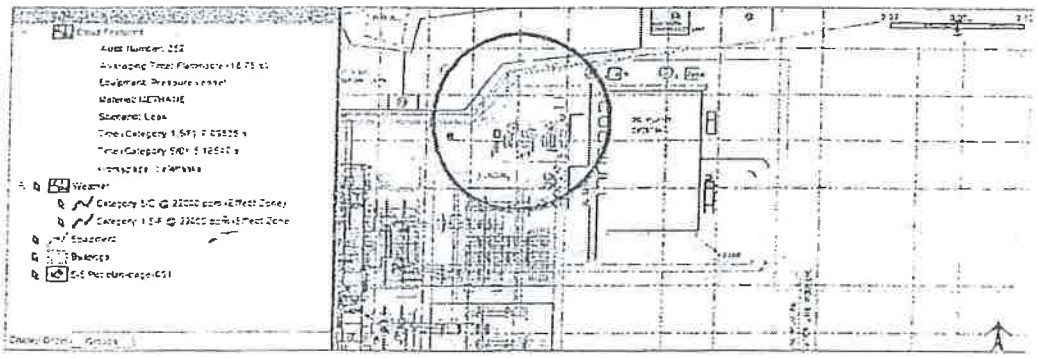
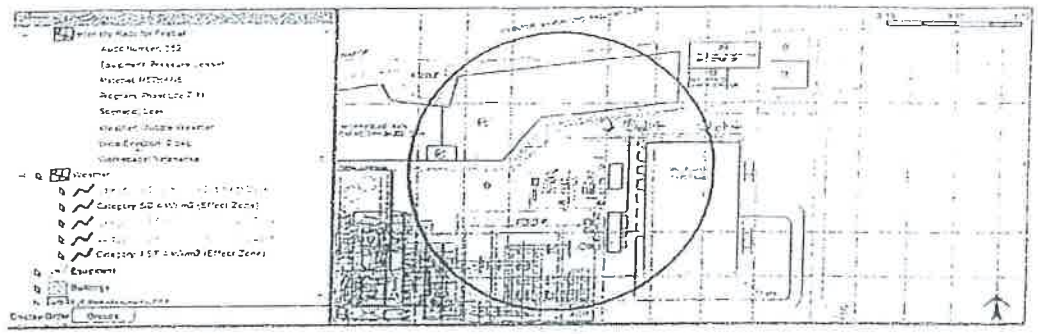
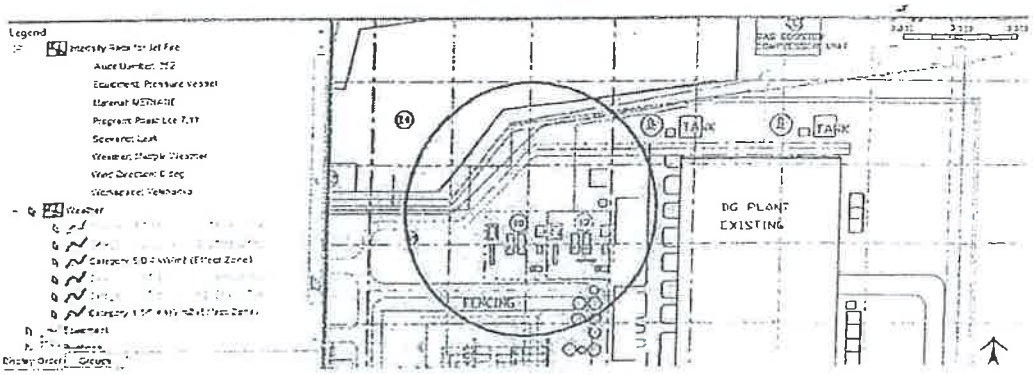
Material METHANE
Program Phast Lite 7.11
Scenario Leak
Workspace Yelahanka





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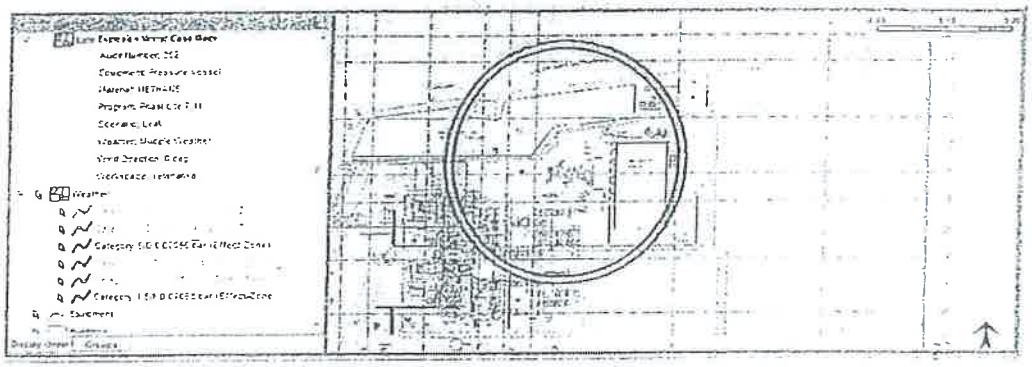
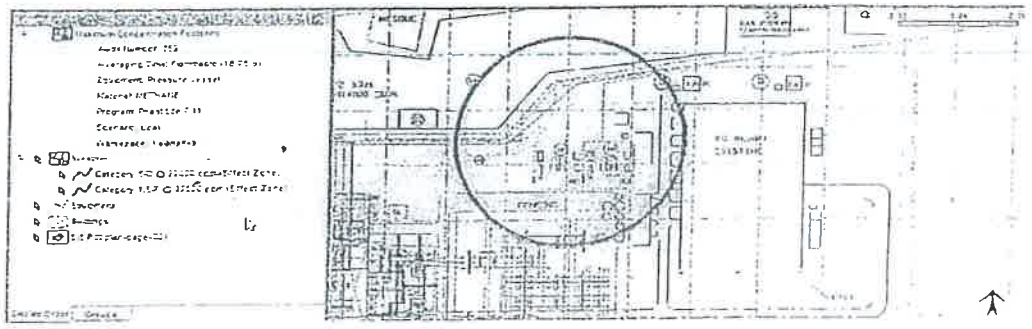




8.2 OCCUPATIONAL SAFETY/HAZARDS

8.2.1 Objective

Large industries in general and power plants in particular where multifarious activities are involved during operation and maintenance, the men, materials and machines are the basic inputs. Along with the boons, the industrialization has brought several problems like occupational health and safety.

The industrial planner, therefore, has to properly plan and take the steps to minimize the impacts of industrialization to ensure appropriate occupational health, safety including fire. All these activities again may be classified under construction, erection, operation and maintenance. During construction as well as operation phase, workers are subjected to various types of occupational hazards. In most of the cases, injuries are results to unsafe working practices, reluctant to use proper protective clothing and personal protective clothing and personal protective appliances, improper house-keeping, improper guarding of machinery, improper working environment, e.g. poor ventilation and lighting, noise etc, and above all lack of awareness of the employees and workers.

Occupational health needs attention in construction, erection, operation and maintenance phases. However, the problems vary in magnitude and variety in the above phases.

Management of occupational safety / hazards involves three stages:

- Identification of potential hazards.
- Quantifying extents of hazards.
- Controlling the hazards.

8.2.2 Identification of Potential Hazards

People at work during construction/operation phase can encounter four basic classes of environmental stresses:

Chemical	: Exposure to fumes, dusts, vapours, liquid etc.
Physical	: Noise, vibration, heat, light, ionizing radiations etc.
Biological	: Insects, mites, yeasts, hormones, bacteria, viruses etc.
Ergonomic	: Man-machine interaction e.g. body position in relation to task on machine.

Out of the above four factors, biological is less common in power industry.

8.2.3 Quantifying Extent of Hazards

Measurement of physical and chemical factors and their duration is related to acceptability and likelihood of injury or disease, if hazard is allowed to continue. Considering exposure of workers to chemicals two broad options may be presented.

- Zero exposure – an ideal approach.
- Permit certain level of exposure.

To achieve zero exposure to all chemicals in work place is not a practical proposition. Safe permissible limits of exposure to gases and fumes have been prescribed by OSHA for various chemicals as TLV, STEL etc.

In the proposed plant, workers may be exposed to fumes of acid or contact of the acid and sodium hydroxide solution, which are used in water treatment. They may also get into contact with exposure to chlorine (used in Water Pre-treatment Plant and Cooling Tower as Biocide) during accidental leakage only.

The ergonomic factor i.e. man machine interrelation is, by far, the most common factor for minor to major injury/accident. Such accidents occur due to:

a). Unsafe Mechanical or Physical Condition of Machine

Unsafe handling of the machine includes following factors:

- Improperly/inadequately guarded machineries particularly moving machineries.
- Defective machinery's (rough, slippery, sharp, and inferior).
- Unsafe dress or apparel (lack of or defective gloves, aprons, shoes, respirators, loose clothing etc.).
- Improper illumination, improper ventilation, noise etc.
- Bad housekeeping.

b) Unsafe Act

Unsafe act is violation of commonly accepted safe procedure, which causes the selected accident. Examples of unsafe acts are:

- Operating without authority, failure to secure or warn.
- Working at unsafe speeds (too slow, too fast, throwing materials etc.)
- Making safety devices inoperative (removing, misadjusting, disconnecting).
- Using unsafe equipment or using equipment unsafely, using hands instead of equipment.
- Taking unsafe position or posture (standing or working under suspended loads, lift with back bent).
- Working on moving equipment e.g. cleaning, adjusting, oiling etc.
- Failure to use proper personal protective equipment etc.

c) Unsafe Person Factors

The "unsafe person factor" is the mental or bodily characteristic, which permits or occasions the selected unsafe acts. Following are the examples of unsafe personal factors:

- Improper attitude (disregard of instructions, failure to understand instructions, nervousness, excitement, etc.).
- Lack of knowledge or skill (unaware of safe practice, unskilled etc.).
- Physical or mental defects (defective eye sight or hearing, epilepsy, fatigue, intoxication, weak heart etc.)

All the above factors cause various types of injuries, disablement or even death. Common accidents during construction phase are:

- Fall from height.
- Struck by falling, moving, sliding objects.
- Caught in machine.
- Fall on same level/slip.
- Contact with electric current, electrocution.
- Cuts.
- Crushed feet or toes.
- Finger crushed by hammer or machine.
- Loss of eyesight due to contact with weld spark or other foreign material.
- Damage due to radiation etc.

Accidents due to ergonomic cause during operational phase are same as those described during for construction phase. However, nature of equipment/machine employed during construction/erection and operation are different.

8.2.4 Hazard Control

After assessment of nature and quantum of occupational hazards arising from physical, environmental and ergonomic causes, the next step shall be to control such hazards.

a) Occupational hazards in operational stage can be controlled by:

- Taking due care in design, layout, procurement of machines, equipment, spare parts.
- Adopting safe working procedure for operation and maintenance and use of proper tools.
- Maintaining safe and comfortable working environment and good housekeeping.
- Ensuring safety awareness among employees by imparting regular training and other safety incentive programmes.
- Avoidance of human errors by proper supervision.
- Personal protection.

b) Occupational hazards during construction phase can also be controlled in the same manner e.g.

- Adopting safe working practices for excavation, construction ofbuildings, foundation of equipment etc.

- Erection of machinery using cranes forlifts of proper capacity using experienced crane operators under supervision of qualified and experienced supervisors. M/s KPCL want to get this job done by experienced consultants and contractors of proven capability.
- Maintaining safe working environment and proper housekeeping.
- Ensuring safety awareness amongst workmen.
- Proper supervision of jobs by experienced engineers and supervisors for avoidance of human errors.
- Use of proper personal protective equipment for different jobs e.g.
  - Hand shields and eye goggles for welding.
  - Safety belts for jobs at height.
  - Use of helmets, safety shoes, etc.
- Adherence to statutory rules and regulations regarding workers' safety, electricity connections, etc.
- Adoption of safety work permit and authorization for various types of work e.g. hot work, cold work, excavation, use of electricity, radiography permit etc. to avoid any unsafe act.

c) **Personal Protection**

This is one of the most important aspects of safety in plants both during construction and operation phases. Personal protective equipment includes protective clothing, shields and respiratory devices. They create a barrier against work place hazards. These protective equipment enable employees to handle hazardous materials and also work in hazardous environment safety for a short duration, if need arises. NIOSH and OSHA have published a list of approved protective equipment and clothing. Some of them, which are required, are given as following:

- Helmets
- Gum boots and safety shoes
- Rubber/Plastic gloves
- Aprons
- Dangry
- Eye goggles
- Face shields
- Ear plugs
- High Temp/Fire Suits
- Safety Belt
- Respiratory equipment like gas masks (chlorine), breathing apparatus, etc.

The above types of personal protective equipment will be kept in sufficient numbers at suitable places. Construction workers shall use suitable personal protective equipment for conducting all work safely.

d) Safety Organization

Management's policy towards maintenance safety is materialized through a well-organized Safety Organization. The safety department shall be headed by a well trained safety officer who will be assisted by 2-3 safety supervisors. The safety officer and safety supervisors shall ensure safety inside the premises. The jobs of safety department are:

- To promote safety awareness among officers and employees by –
  - Imparting regular training.
  - Installing/displaying safety caution boards and safety posters mentioning Do's & Don'ts at different vulnerable locations.
  - Arranging safety& housekeeping competition etc.
- To procure and maintain personal protective equipment in good working condition.
- Help in issuing safety permits for different jobs.

The proposed project will have a safety officer with 2/3 staff who will carry out the above jobs. Training shall be imparted for –

- Safe working and maintenance practices.
- Use of proper tools and tackles.
- Use of personal protective equipment.
- Handling emergency situation.

During construction period the principal contractors shall have a safety officer who will ensure safety of construction workers. He will ensure –

- Use of proper tools & tackles by workers.
- Use of safe and proper working procedure and practices.
- Use of personal protective equipment.
- Proper housekeeping.
- Observance of statutory rules and regulations.
- Proper supervision to avoid human errors.

Safety Officer shall have close liaison with safety officers of principal contractors for maintenance of safety during construction stage.

Finally, it may be said that all efforts shall be made to avoid accidents during construction as well as operation stage as management of KPCL is committed to safety & health of workmen and employees, which is a key word for productivity.

8.2.5 On-site Security & Safety Measures

The site will have necessary security arrangements to prevent entry of unauthorized personnel and proper control of hazardous materials on site. To ensure that the local inhabitants are not exposed to these hazards, the site will be secured by boundary wall and manned at entry points.

There will be a special emphasis on safe handling of material, safety in welding and fabrication activities. All the employees as well as contracted labour will be trained in safety aspects related to their job. All the personnel will be provided with safety appliance such as face shields, helmets safety goggles, safety shoes, hand gloves etc. as per the job requirement.

8.2.6 House Keeping

Better house-keeping can improve the working conditions. The following measures shall be practiced at Power Plant.

- Regular cleaning of shop floors with service water.
- Keeping all de-dusting systems in perfect working conditions to avoid dust accumulation inside and outside the plant.
- Avoid dumping of wastes, damaged equipment and items anywhere inside the plant affecting aesthetics and increasing risk of fire and other hazards.
- Keeping ventilation systems of premises in perfect working condition to avoid ingress of dust inside the pressurized room.
- Keeping air conditioning plants in perfect running conditions for control/ instrumentation rooms.
- Regular moistening of roads by spraying water during construction as well as operation and maintenance to avoid dust generation from vehicle movement.
- Maintaining hygienic conditions in areas like canteens, near drinking water sources and toilets.
- Maintaining green belt along the plant boundaries to suppress noise, fugitive dust and to improve the aesthetics.
- Developing a positive outlook in the employees for improving the working place, both in plant and office or laboratory clean and well maintained.

8.2.7 Safety Awareness among Workers/Employees

All workers/employees will be trained and retrained. The training of personnel of safety and fire departments will be comprehensive and exhaustive and safety-training programme for worker shall be conducted periodically.

a) Safety Training Programme for Employees

Training programmes in safety and accident prevention will be organized at all levels of employees with a view to familiarize them with the general safety rules, safety procedures in various operational activities and to update their knowledge in safety and accident prevention, industrial hygiene and emergency equipment. These training programmes will be conducted periodically in a planned manner to refresh their knowledge.

A suggested list of training courses is given in Table-77 and the names of some of the institutions offering courses on Industrial Safety are furnished in Table-78.

Table 77: Suggested List of Training Courses

1.	Fire Fighting	- General - Extinguishing fire with water using fire hydrant support - Fire extinguishers, their usage and maintenance - Use of fire protective equipment - Fire drill - Do's and Don'ts on fire prevention and control
2.	Industrial Safety	- Modern concept of industrial safety - Human side of industrial safety - Hazard detection and analysis - Control of hazard - Use and maintenance of personnel protective clothing/ equipment
3.	Health & Hygiene	- Industrial hygiene - Training on first aid - Casualty evacuation - Health hazards from heat, noise and suspended particulate matter

Table 78: Institutions Offering Courses on Industrial Safety

Asian Workers Development Institute Sector-6, Rourekela-769 002, Orissa Diploma in Industrial Safety	**Regional Labour Institute** Sarvodaya Nagar Kanpur-208 005 Diploma in Industrial Safety
Atul Products Limited Atul-396 020 Diploma in Industrial Safety	**Centre for Environmental Science and Engineering** Indian Institute of Tech. Powai, Mumbai-400 076 Tel. 5141421 (Extn. 3251)
Central Labour Institute Sion, Mumbai-400 022 Diploma in Industrial Safety	**Garware Institute of Career Education and Development** University of Bombay Vidyanagari, Kalina, Santacruz (East) Mumbai-110,098
Gandhi Labour Institute Ahmedabad-380 052 Diploma in Industrial Safety	**National Environmental Engineering Research Institute** Nehru Marg Nagpur-440 020
Gujarat Safety Council **Institute of Engineers**	**Industrial Safety and Health Association** C/o Dy. Chief Inspector of Factories

(India) Building Race Course Circle Vadodara-390 007 Diploma in Industrial Safety	3694, Shankar Bhavan Adarsh Nagar, Pune-411 037 Diploma in Industrial Safety
Indian Institute of Social Welfare & Business Management Koltaka-700 073 Diploma in Industrial Safety	**Institution of Industrial Safety Professional of India** ¾, BharatiyaBhavan, 17th Road, Khar, Mumbai-400 052 Diploma in Industrial Safety
Regional Labour Institute TTTI Post, Tharamani Madras-600 113 Diploma in Industrial Safety	**Regional Labour Institute** Lake Town, Pattipukur Kolkata-700 089 Diploma in Industrial Safety

b) Training Methodology

Training in industrial safety shall be imparted to all employees. The training shall include the following:

- Preventive measures
- Protective measures
- Corrective measures in case of malfunctions

Training programme will be conducted using audio-visual aids, practical demonstration, etc. to make it more effective and interesting. These programmes will be supplemented with case studies, group discussions, etc. The course material will be selected as per the requirements and need of each level of employees.

c) Mode of Training

- Lectures
- Seminar and workshops
- Mock drills
- Distribution and practice of safety instructions
- Safety quiz contests/competitions for individuals as also for groups.
- Display of the safety posters and safety slogans at convenient and conspicuous places.
- Explanation of instructions (in Hindi and English) about the possible hazards involved in handling of chemicals and methods to deal with such hazards failing which, possible emergency situations are likely to arise.
- Developing safety instructions/booklets or manuals for every job and ensuring practice of these instructions by the workers.
- Making the workers know about the:

- Physical and health hazards arising from the exposure of handling of substances.
- Measures taken to ensure safety and control of physical and health hazards.
- Measures taken by workers to ensure safe handling, loading, unloading, storage and transportation of hazardous substances,
- Use of personal protective equipments
- Signs and symptoms likely to be manifested on exposure of the hazardous substances and to whom to report
- Measures to be taken in case of any spillage or leakage

d) First Aid Training

First aid training programmes will be conducted for all employees with the help of qualified medical and para-medical staff. This programme may be conducted in batches. The programme will include basic first-aid techniques for burn treatment and procedure for artificial respiration. This programme will be repeated periodically to refresh knowledge.

e) Public Awareness Programmes

Public awareness programmes are necessary for taking timely actions by the neighbouring population/inhabitants in the event of major emergencies, which may affect them. The awareness programmes will be conducted in close coordination with civil authorities and local area.

f) Safety Circle

Safety circles are constituted in each area of work in order to fully develop the capabilities of the employees in identification of hazards and improve awareness on occupational health and safety. The circle consists of 5-6 employees from a particular work area. The circle normally meets for about an hour every week.

To create safety awareness, safety films would be shown to workers and leaflets etc. would be distributed. Some precautionary and remedial measures recommended to prevent fires are:

- Compartmentalization of cable galleries, use of proper sealing techniques of cable passages and crevices in all directions would help in localizing and identifying the area of occurrence of fire as well as ensure effective automatic and manual fire fighting operations.
- Safety arrangements for handling the use of hydrogen are to be made.
- Providing fire stops for cable shafts could check spread of fire in horizontal direction.
- Reliable and dependable type of fire detection system with proper zoning and interlocks for alarms are effective protection methods.
- Housekeeping of high standard helps in eliminating the causes of fire.

8.2.8 Accident Reporting

Whenever accidents or dangerous events occur, such incidents will be reported as notified in the sections 88 and 88A of Factories Act 1948, amended from time to time and also as per the schedule 6 of the MSIHC Rules, 1989.

8.2.9 Safety Review Check List

A checklist is one of the very useful tools for hazard identification. A checklist will be used as a final check that nothing has been neglected. For checklist to be effective, it must be used and kept up to date.

8.2.10 Medical Facilities

First few hours after an accident are very important for the injured persons to avoid fatalities. A well-equipped medical centre takes care of all the eventualities during these hours. Well-equipped medical centre can handle emergency resuscitation and treatment to stabilize the patient before transferring to a referral hospital identified for the purpose.

a) First Aid Centre

A list of items to be kept at first aid centre is given below. Medical Officer will review and add/delete the medicines/equipment required specific to the industry based on experience.

List of Items for First Aid Centre

1. Sufficient dressing material
2. Medicines special to the industry as recommended by the doctor.
3. First aid box, emergency box kit
   - Medical grade oxygen cylinders
   - Burn sheets
   - Rescue blankets
   - Oxygen breathing kit
   - Instant glucose
   - Paramedic scissors
   - Bandage scissors
   - Forceps
   - Suction unit
   - Ring cutter
   - Cervical collar (3 sizes)
   - Eye pads
   - Intravenous fluid
   - Flexible bandages
   - Pocket masks/eye-wash bottles
   - Orthopaedic stretcher

- Artificial resuscitators
- Trauma medicines
- Portable respirators
- Ophthalmic solution
- Blood pressure equipment
- Gloves
- Portable lamps/torches

8.2.11 Fire Fighting Arrangement

Protective systems form an integral part of a disaster management planning. Protective system is an important device, which prevents destruction due to failure. Power plant should have various protective systems to meet all the requirements of safety. These are briefly described in subsequent paragraphs.

a) Fire Protection System

A comprehensive fire detection and protection system is envisaged for the complete power station. This system shall generally conform to the recommendation of TAC (India)/ IS: 3034 & NFPA – 850.

Automatic high velocity water spray system for all transformers located in transformer yard and those of rating 10 MVA and above located within the boundary limits of plant, main and unit turbine oil tanks and purifier, lube oil piping (zoned) in turbine area etc. This system shall consist of purifier, lube oil piping (zoned) in turbine area etc. This system shall consist of detectors, deluge valves projector, valves, piping & instrumentation.

Automatic medium velocity spray for cable vaults and cable galleries of main plant, shall be consisting of smoke detectors, linear sensing cable detectors, deluge valves, isolation valves, piping instrumentation, etc.

For protection of control room, equipment room, computer room and other electrical and electronic equipment rooms, suitable "Halon substitutes" such as INERGEN or ARGONITE" system would be opted.

The following protection systems are envisaged:

Hydrant system covers the entire power station including all important auxiliaries and building in the plant area. The system shall be complete with piping, valves, and instrumentation, hoses, nozzles, hose/stations etc.

b) Fire Detection and Alarm System

A computerized analogue, addressable type early warning system shall be provided to cover the complete power plant. Following types of fire detection shall be employed.

- Ionization type smoke detection system
- Photo Electric type smoke detection system
- Combination of both ionisation and photoelectric smoke detection system
- Linear heat sensing cable detector
- Quartzite bulb heat detection system

Portable and mobile extinguishers, such as pressurized water type, carbon-oxide type, foam type, dry chemical powder type, will be located at strategic locations throughout the plant.

Firewater pumps shall be installed in the pump house for hydrant and spray system and the same shall be driven by electric motor and diesel engines as per the regulations of approving (TAC) authority. The firewater storage tank would normally be filled using CW blow down. However, a backup supply to fill this tank from raw water system will be provided. For the above firewater pumping station, automatic pressurization system consisting of jockey pumps and air compressors shall be provided.

Complete Instrumentation and control system for the entire fire detection and protection system shall be provide for safe operation of complete system.

c) Fire Station

A fire station with fire water tender shall be provided.

d) Protective Equipment

List and quantity of the safety equipment proposed is given below.

- Gas Mask
- Canister for gas mask
- Compressed air breathing apparatus
- PVC yellow hand gloves
- PVC white hand gloves
- PVC white gum boots
- Electrical hand gloves
- Asbestos hand gloves
- Asbestos blanket
- PVC apron
- PVC suit with hood (Acid and Alkali proof)
- Aluminated asbestos suit
- Dust respirator
- Face shield of different colour
- Goggles of different types
- Safety belt
- Safety helmet

- Leather hand gloves
- Chargeable hand-set
- Ear muffs and ear plugs
- Smoke exhauster cum blower
- Asbestos suit

List of fire-fighting equipment proposed for the power plant is given below. These will be periodically inspected for their serviceability and adequacy.

- Gum boots
- Red colour jackets
- Hand gloves
- Blankets
- Respiratory equipment/breathing apparatus
- Helmets

8.2.12 Safety & Emergency Plan

Safety of both men and material during construction and operation stages is of concern to industries. The preparedness of an industry for the occurrence of possible disasters is known as emergency plan. The disaster in power plant may occur due to leakage of hazardous chemicals like chlorine, collapse of structures and fire/explosion etc. Keeping in view, the safety requirement during construction, operation and maintenance phase Gasbased Power Plant would formulate safety policy keeping in view the following requirements:

- To allocate sufficient resources to maintain safe and healthy conditions at work.
- To take steps to ensure that all known safety factors are taken into account in the design, construction, operation and maintenance of plants, machinery and equipment.
- To ensure that adequate safety instructions are given to all employees.
- To provide wherever necessary protective equipment, safety appliances and clothing, and to ensure their proper use.
- To inform employees about materials, equipment or processes used in their work, which are known to be potentially hazardous to health or safety.
- To keep all operations and methods of work under regular review for making necessary changes from the point of view of safety in the light of experience and up to date knowledge.
- To provide appropriate instruction, training, retraining and supervision in health and safety, first aid and to ensure that adequate awareness is given to these matters.
- To ensure proper implementation of fire prevention and an appropriate fire fighting service together with training facilities for personnel involved in this service.
- To ensure that professional advice is made available wherever potentially hazardous situations exist or might arise.
- To organize collection, analysis and presentation of data on accident, sickness and incident involving personal injury or cause of sickness with a view to taking corrective, remedial and preventive action.

- To promote through the established machinery, joint consultation in health and safety matters to ensue effective participation by all employees.
- To publish/notify regulations, instructions and notices in the common language of employees.
- To prepare separate safety rules for each type of occupation/process involved in a power station.
- To ensure regular safety inspection by a competent person at suitable intervals of all buildings, equipment, work places and operations.

8.3 DISASTER MANAGEMENT PLAN

8.3.1 General

Disaster is an undesirable happening of such magnitude and nature, which can adversely affect man, material and environment. Risk assessment forms an integral part of "Disaster Management". Any major or a number of minor failures could lead to an accident taking a heavy toll of human life and affecting the production target considerably.

Disaster management has assumed significant role due to modern complex nature of chemical & petrochemical operations. Disasters are major accidents, which cause wide spread disruption of human and commercial activities. Disaster can be defined as a sudden occurrence of such magnitude as to affect normal pattern of life in the plant and/or vicinity causing extensive damage to life and property. Normally, the community absorbs common accidents, but disasters are major accidents and community cannot absorb within its own resources. Most of the disasters, natural or technological (man-made) have sudden onset and give very short notice or no time to prevent the occurrence.

Disaster is major emergency in works, which has the potential to cause serious injury or loss of life, both inside and outside the works. It would normally require the assistance of outside emergency services to handle it effectively. Although the emergency may be caused by a number of different factors, e.g. plant failure, human error, earthquake, vehicle crash or sabotage, it will normally manifest itself in three basic forms: fire, explosion or toxic release.

It is therefore, necessary to ensure safety and reliability of any new plant, through a systematic study of industrial installations based on mathematical modeling to identify possible failures and prevent their occurrence before the disasters.

8.3.2 Purpose and Scope of DMP

In carrying out the preliminary Risk Analysis, the stress is given to Maximum Credible Accident (MCA) analysis and the resulting DMP include the following:

Recommended elements of emergency planning like organization, communication, coordination, procedure, etc. are given below:

- On-Site Emergency Plan

- Off-site Emergency Plan
- Safety Review Check Plan
- Accident Reporting

8.3.3 Causes for Disaster

Disastrous incident could be a local one causing damage to plant, equipment and material only or additionally affecting the persons working in the plant/industry or if more serious, affect the neighbouring environment including human population. The first two categories can be termed as "On-site Emergency" and the last one as an "Off-site Emergency". There are number of factors that can be considered as causes for disastrous situation or emergencies. The three main causes are given in subsequent paragraphs.

A good process technology has to be engineered equally well following accepted standards in design, if the hazards are to be minimized. Improper sizing of plant and equipment, inadequate schemes, faulty choice of material of construction may lead to unsafe conditions. There are national standards available for such designs, but many a times, looking to the increased capital costs of the plants, designers in consultation with the owners cut the corners and the results are evident. Risk evaluation, Hazard analysis (HAZAN) and Hazard & operability (HAZOP) studies are modern tools, which should be emphasized and if necessary were made mandatory while engineering a project. The facilities in respect of the above requirements in developing countries are far from adequate. Even the quality of engineering needs improvement.

8.3.4 Disaster Control Philosophy

The principal strategy of Disaster Management Plan of proposed 350MW Yelahanka CCPP is prevention of the identified major hazards. And since these hazards can occur only in the event of loss of containment, one of the key objectives of technology selection, project engineering, construction, commissioning and operation is Total and Consistent Quality assurance. It is committed to this philosophy right from the conceptual stage of proposed 350MW Yelahanka CCPP. The second control strategy adopted for potential emergencies is minimization of operation inventories of hazardous substances both in process plants as well as in storage limits of viability of continuous operation.

And another control measure that will be adopted is early detection of any accidental leak and activation of as well structured, resourced and rehearsed Off -Site Emergency Plan to intercept the incident with speed and ensure safety to employees, operating plants, public and environment as a matter of priority.

8.3.5 Disaster Control Plan

8.3.5.1 Design Stage Considerations

From the analysis of the vulnerable zones the following actions are recommended for consideration during design stage:

a) Natural Gas

- All structures near the corridor of Natural Gas pipeline should be protected against the heat radiation damages.
- Weeds, long grass, deciduous shrubs and trees and any combustible material should be removed from these areas.
- Electrical equipments should only be installed in a safe area away from the gas station and pipe corridor.
- Lighting should be provided.
- Adequate fire fighting arrangements should be provided.
- Human movement near the gas station should be minimal & controlled.

b) Chlorine Storage

- Chlorine installations should be sited at a sufficient distance (25 m minimum) from public roads or main railway lines to reduce the risk of damage to the chlorine installation in the event of an accident. Protective barriers should be installed wherever necessary.
- The chlorine unloading area should be on reasonably level ground with adequate surrounding space providing good access from different directions.
- Adequate lighting covering all escape routes should be provided and the provision of emergency lighting is advisable.
- Automatic gas leak detectors must also be provided.
- The chlorine pipeline in the area should be properly routed so as to minimize the risk of damage from collision by the tanker, other vehicle or mobile equipment.
- All chlorine storages should be installed in a bund, which is impervious to liquid chlorine. The bund should be capable of taking the contents of the largest single storage with adequate free board and a sump. Sump should not be connected to a drain. It may be connected to an alkali scrubber to provided neutralization in an event of emergency. Provision should included for removal if rain water over bund wall, not via drain or through valves in the bund.
- As the leaks of liquid chlorine are potentially more dangerous than leaks of gaseous chlorine, the system needs to be so designed that sources of leakage of liquid are reduced to a minimum. A major contribution to this will be the avoidance of joints, which are continuously exposed to liquid chlorine. If it is unavoidable then in case of failure of liquid outlet from the tonner, it should be rotated by 180 deg. so that any leakage will only be gas.
- In an event of toxic release from the tonner all the people within 550 m of the prevailing wind direction should be advised to run perpendicular to the wind direction.
- Adequate means must be provided for evacuation of the critical segment of the population to a safer place.

- Maintenance personnel should equip with protective equipments to minimize the risk of exposure in case of an accident.

8.3.5.2 *Equipment Plan*

Availability and easy access to the required equipment and facilities are of paramount importance during an emergency situation. Equipment plan needs arrangement of sufficient and proper appliances needed to combat any disaster after careful study of requirements including alarm and communication system as well as provision of vehicles for communication and relief measures.

Efficient and adequate measures shall be provided within the premises combat any emergency. Efficient fixed fire fighting arrangement as well as portable fire fighting and safety appliances shall be made available to take care of emergency condition.

Fire Fighting Equipment and Facilities

The existing plants of IPGCL are having well managed fixed and portable fire fighting systems. Proposed facility shall also have Fire Water Storage Tanks, Pumps, Hydrants, Water Spray Systems, CO_2/inert gas extinguishing systems and fire detection system etc.

Fire Hydrant and Monitors, Sprinkler System

All fire prone and hazardous areas shall be provided with fire hydrants & monitors as per rules & guidelines. Automatic sprinkler system shall be provided for transformer bays and cable galleries connected with quartzoid bulbs and deluge valves. Water scrubbing arrangement shall also be provided for areas where chlorine will be handled e.g. chlorine tonner storage area etc. Hose boxes shall be provided at different places as per rules.

CO_2/ Inert Gas Extinguishing System

A fixed CO_2 /Inert Gas Extinguishing System with automatic and manual release will be provided for battery/UPS room, gas turbine enclosures, control room etc. The CO_2/inert gas shall be supplied from cylinder batteries located adjacent to the area likely to be affected.

Portable Fire Fighting Apparatus

Fire Extinguishers of suitable type e.g. CO_2 and DCP extinguishers shall be provided in the plants and shall be distributed in vulnerable areas. The extinguishers shall be checked/inspected at regular intervals for replenishment.

Fire Services Personnel

Fire service shall be manned by CISF Fire Personnel. Fire services department shall have adequate number of safety equipment for use during emergency. The list of safety appliances is as follows:

- Gas Mask

- Canisters
- Alkali Suit
- Asbestos Suit
- Fire Proximity Suit
- BA Set
- Electric Gloves (for 15000 volts)
- Hydraulic Tool
- Telephone
- Emergency Ladder, etc.

Safety and Personal Protective Appliances

Safety and personal protective appliances shall be provided in adequate numbers and shall be distributed in different sections according to requirement. A list of such appliances available in the plant is given in the **Table-79.**

Table 79: List of Proposed Safety Equipment

S.No.	Equipment	Nos.
Gas Mask		
01.	Carbon Monoxide	Adequate Nos.
02.	*Chlorine*	- do -
Breathing Apparatus		
01.	Compressed Air.	- do -
02.	Air line respirator	- do -
Others		
01.	Pneupac Resuscitator	- do -
02.	Combustible gas indicator/explosimeter	- do -
03.	Gas Detector (Dragger Pump)	- do -
04.	Safety Belts	- do -
05.	Alkali/Acid Suit	- do -
06.	Asbestos Suit	- do -
07.	Hand Gloves etc.	- do -
08.	Gum Boots	- do -
09.	Safety Shoes	- do -
10.	Eye Goggles	- do -

Emergency Control Centre

An emergency control centre shall be provided at a safe place from where Chief Emergency Co-ordinator shall function for ON-SITE emergency. The Emergency Control Centre (ECC) shall be provided with adequate personal protective equipment, alarm and communication network (Siren, local as well as P&T Telephone, Public Address system etc.), route map, fire hydrant and monitor layout, windrose chart, copy of detailed Disaster Management Plan (where names, telephone

numbers of the response team members and their responsibilities are clearly written as well as names and telephone numbers of key personnel from outside agencies in Mutual Aid Scheme and district authorities, Fire Station, State Hospitals and doctors are provided), first aid kit, material safety data sheets of chemicals etc. The Disaster Management Manual shall also contain map of the factory & surrounding areas, evacuation routes, fire hydrant network and other important information.

Assembly Point

Assembly points shall be set up near to the likely hazardous event sites where pre-designated persons from the disaster response team should assemble and meet the Site Incident controller. This may be regarded as Site Incident Control Room where Incident Controller will receive instruction and furnish information to the Chief Emergency CO-ordinator. The site incident control room shall be provided with efficient communication system, adequate personal protective equipment, copy of Disaster Management Manual etc.

Emergency Shelter

Emergency shelter places shall be chosen sufficiently away from likely affected site. Employees who are not in the emergency management team shall be asked to take shelter. The place is chosen such that the employees taking shelter are not affected by fire, explosion and release of toxic gases. More than one emergency shelter shall be designated so that proper shelter point can be chosen depending on wind direction and other factors.

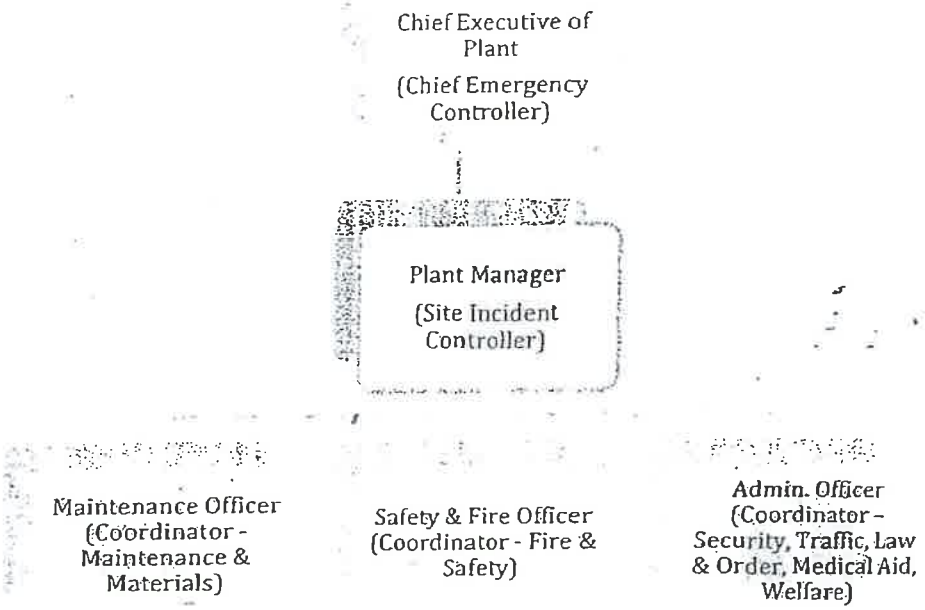
Wind Socks

Windsocks shall be provided on the top of tall buildings to indicate the wind direction.

8.3.5.3 Organizational Plan

The Organization Plan is a systematic list of persons in the emergency management team and their functions before, during and after emergency. The disaster management organisation shall be capable of quick response at any time of the day or night to meet the emergency condition, both for ON-SITE as well as OFF-SITE. The plan given a detailed chain of command, area of responsibility of each personnel involved in the plan, the information flow pattern to be followed and co-ordination activities required to tackle the emergency.

The Disaster Management Organisation and functions proposed for an emergency situation is as follows:



During emergency personnel and facilities from existing plants shall be also be summoned for combating disaster. It can be seen from Disaster Management Organization that Chief Emergency Coordinator shall take charge of the whole situation and shall guide the various coordinators to contain and control the incident. Various activities are to be carried out by pre-designated key personnel (Coordinators) and their team in quickest possible time.

The names, residential addresses and telephone numbers of key personnel shall be clearly written in Disaster Management Manual as well as widely circulated in ECC, different control rooms. It is to be noted that first few minutes after start of the incident is most vital in prevention of its escalation.

8.3.5.4 Action / Response Plan

The action plan for tackling emergency includes the following:

- Actions to be taken in pre-emergency period.
- Action during emergency/disaster.
- Actions to be taken in post disaster period.

Pre-emergency Actions

The proposed preventive and pre-emptive measures are as follows:

- Ensure implementation of Disaster Planning.

- Ensure that all drafted for emergency undergo regular training and are prepared for tackling emergency/disaster.
- Ensure that Mock Drills are performed under simulated emergency condition at regular intervals to assess the strength and weaknesses of the response team/plan.
- Ensure awareness among employees through regular training.
- Ensure good liaison with all agencies and industries in the neighbourhood for getting help if situation arises.
- Ensure adequate stock of safety, personal protective appliances in good working condition.
- Ensure awareness amongst public in the neighbouring areas.

8.3.6 Disaster Management Plan

8.3.6.1 General

It will be seen from Risk Analysis of the proposed project that major emergency situation can arise mainly from release of chlorine and fire. The situation can be grave or minor depending on the scenario occurring causing the release of chlorine. Care should be taken for other release incidents of flammable/explosive material, which may pose threat to life, employees, and property of the organisation. A list of emergency response functions that are identified for large-scale release of chlorine is given as follows:

- Alarm, warning and signaling
- Communication
- Operations
- Fire and Safety,
- Toxic Gas Spreading Protection
- Emergency Shelter
- Medical Services
- Transport services for handling injured persons and evacuation
- Welfare activities

8.3.6.2 Resource Planning

Resource Planning needs to be done so that the functions mentioned above can be operated smoothly. Regular Mock drill and training are essential for proper and timely response.

Since the large-scale release scenario can affect seriously the employees within the complex as well as the public, creation of awareness is must. The public should also be taught the actions to be taken to save themselves.

8.3.6.3 Medical Services

The doctors in the nearby hospitals should be trained for treatment of personnel affected by chlorine gas leakage. Necessary apparatus and drugs should also be available in first aid post and in State Hospitals and also other Nursing Homes nearby. Manager (HR-Welfare) should have good

liaison with authorities of nearby hospitals and Nursing Homes as well as doctors outside so that help may be available when required.

8.3.6.4 Transport and Communication

Ambulance Van shall be available under the command of Chief Engineer inside the factory as well as in the Hospitals. However, in case of disaster all the vehicles in transport department will also be used. In case of necessity vehicles from outside shall be requisitioned.

8.3.6.5 Safety Appliances

As already mentioned Gas Masks, BA Set and Respirators, Fire Suits etc. are available in the plants. However, they will be checked at regular intervals and kept in good working order.

8.3.6.6 Operational Functions

- Detection of leakage and isolation from the source to prevent the leakage is the most important activity in the beginning. It may also be necessary to isolate the line or equipment by closing the isolation valves. The functional requirement may be one or more operators to close the valve manually in an area with high toxic concentration and possibility of expose to thermal radiation on the body. The personnel should wear gas masks, breathing apparatus, fire suits etc. The operating personnel should be fully drilled in proper and safe use of the safety appliances.
- Plant or section of the plant shall be shut down.
- Operator/Shift-in-charge should inform immediately to Fire & Safety Department as well as Plant Manager and General Manager who in turn will assess the situation.
- Emergency is to be declared and other actions are to be taken by them.
- Since chlorine is readily soluble in water, water scrubber should be immediately started on hearing chlorine leak detector alarm. If the leakage is inside chlorine tonner storage room closing of isolation valve shall be tried. For outdoor release or if the scrubber fails to work closing of isolation valve shall be tried at first with all precautionary measures. A water curtain may be prepared at downwind direction by the fire services to decrease the concentration of in air and its dispersion.
- Rescue of the personnel affected and evacuation of other employees to emergency shelter room may be needed. Emergency shelter shall be located at a safe place at up wind direction.
- Medical help may be necessary to the affected personnel. Coordinator (medical aid) and Transport Coordinator shall take proper care under guidance of Site Incident Controller.

8.3.6.7 Off-site Emergency

It has been mentioned that OFF-SITE Emergency can only happen in case of leakage of chlorine only when people present in nearby vicinity and passing on the roads may feel throat irritation. The preparatory actions are as follows:

a) Preparation of Disaster Management Organisation by District Administrations, after assessment of disaster potential in consultation with KPCL.

b) Preparation of Disaster Management Manual which would include

- Potential hazards & likely effects
- Actions to be taken by different key personnel in the team.
- Names and telephone number of key personnel e.g. police station/officer, designated hospitals, fire brigade, YelahankaCCPP plant in-charge etc. shall be written.
- First aid procedure etc.

c) Meeting of the key personnel at regular intervals.
d) Mock Drill.
e) Creation of awareness.

CHAPTER-9

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CHAPTER-9: PROJECT BENEFITS

9.1 BENEFITS OF COMBINED CYCLE POWER PLANT

Fuel Efficiency

In conventional power plants turbines have a fuel conversion efficiency of 33%, which means *two thirds* of the fuel burned to drive the turbine off. The turbines in combined cycle power plant have a fuel conversion efficiency up to 60%, which means they burn about half amount of fuel as a conventional plant to generate same amount of electricity.

Plant Efficiency

The efficiency of the combined cycle plant is better or higher than the turbine cycle or steam cycle plant. The efficiency of combined cycle power plant will be of the order of about 45 to 50%.

Low Capital Cost

The capital cost for building a combined cycle unit is two thirds the capital cost of a comparable coal plant.

Stability

The combined cycle power plant is more suitable for rapid start and shutdown than the steam power plant. Therefore these plants accept load variations quickly and help in maintaining the stability in the electrical grid.

Water Requirement

The cooling water requirement of the combined cycle plant is much lower than the normal steam turbine power plant having same capacity output. In these types of plants almost 2/3rd of the power is generated by the gas turbine plant which requires very little or no cooling water. Conventional cooling water system (once through) or recycle system is adopted. In case of lack of sufficient water at the site, dry cooling system can also be provided for cooling. Less water requirement for combine cycle plants is also major advantage while selecting the site of the plant.

Commercial Availability

Combined cycle units are commercially available from suppliers anywhere in the world. They are easily manufactured, shipped and transported.

Abundant Fuel Sources

The turbines used in combined cycle plants are fuelled with natural gas, which is more versatile than a coal or oil and can be used in 90% of energy publications. To meet the energy demand now a

day's plants are not only using natural gas but also using other alternatives like bio gas derived from agriculture.

Self Sustaining Feature

The combined system offers self-sustained feature. For example if the plant is shut down due to any fault or maintenance, no start up power supply can be required to start the unit. Gas turbine offers to start the plant and supply power to plant auxiliary loads. Therefore combined cycle plants have advantage of self sustaining feature.

Power Output

Combined cycle plants have the advantage of high ratio of power output to the area occupied. Therefore for designing a combined cycle plant space requirement is not a concern.

Maintenance

Maintenance duration (down time) for combined cycle power plant is significantly low. This improves the plant availability feature.

Reduced Emission and Fuel Consumption

Combined cycle plants use less fuel per kWh and produce fewer emissions than conventional thermal power plants, thereby reducing the environmental damage caused by electricity production. Comparable with coal fired power plant burning of natural gas in CCPT is much cleaner.

NG is the cleanest burning fossil fuel due to negligible sulphur and ash content. On an average, power plant that run on natural gas, emits half of carbon dioxide, less than one third of the nitrogen oxides, one percent of the sulfur oxides, and much lower level of mercury than the plants that burn coal.

Use of Sewage Treated Water

Sewage treated water from the Jakkur STP located near the project site will be used for the plant activities thereby conserving the sparse fresh water resources.

Transmission

Power generation near load center shall reduce the Transmission losses and improve the power availability factor and reduces the dependability on private power producers or power transmission from other sources.

Potential Applications

The potential for combined cycle plant is with industries as well as to nearby places in Bangalore that requires electricity and heat or stem.

Environmental Benefits

The combustion of NG as fuel will result in virtually no atmospheric emissions of sulphur dioxide or small particulate matter.

Dry Low Nox (DLN) burners in the combustors of the gas turbines will be used to reduce the level of NOx emission for the proposed CCPP to 25 PPM which is well within the desirable and permissible limits.

All the equipment in the power plant would be designed to have a total noise level not exceeding 85 dB (A).

It is propose to develop a green belt of suitable species for width 5-10 mtr all along the project boundary and also in vacant spaces within the plant area of approximately 10 acres (40468.73 Sq.m) to minimize the noise pollution from the plant.

Corporate Responsibility

This proposed project will provide employment opportunities for local residents.

Education, medical, electricity, drinking water, sanitation facilities and other necessary facilities will be provided by the proponent to the nearby area people.

CHAPTER-10

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CHAPTER-10: ENVIRONMENTAL MANAGEMENT PLAN

10.1 ENVIRONMENT MANAGEMENT SYSTEM

10.1.1 Environment Management at KPCL

KPCL's power generation blueprint has a clear-cut policy on environment management. Building in green-mapping concepts such as sustainable development, which creates the framework for improving the quality of life, sustainable development goes hand-in-hand with environment protection'. KPCL has a comprehensive action plan in place that enables environment management, pollution monitoring and the implementation of specific environment projects. All KPCL projects have the assurance of a comprehensive Environmental Impact Study to evaluate the impact of the project on the environment. It also prepares an Environmental Management Plan complying with all the conditions stipulated by KSPCB/MOEF.

Although KPCL does not have a certified environmental management syatem at the corporate level, its 1720 MW Raichur Thermal Power Station, located in Raichur district, is accredited with ISO 14001-2004 certification for its environment protection measures. The following innovative and new measures to aid the process of environment control, have been put in place at the Raichur Power Station:

- A unique Ayurvedic greenhouse has been developed at Kadra Project.
- Fish fingerlings in power generation reservoirs to maintain aqua-balance.
- Eco-friendly control measures adopted such as controlled blasting.
- Construction of colonies with least destruction to ecology.
- Installation of Electro Static Precipitators in Thermal Plants.
- Measures across the board to minimize pollution.
- Fuel supply agreement with collieries to ensure high grade coal supplies.
- Monitoring measures for ash minimization, ash emission control, ash utilization and ash disposal.
- Recycling of water from ash ponds for alternative use.
- Modernization of sewerage treatment plant.
- Continuous monitoring of air quality in work environments & environment management measures.

10.1.2 EMS at Yelahanka CCPP

Organizations of all kinds are increasingly concerned with achieving and demonstrating sound environmental performance by controlling the impacts of their activities, products and services on the environment, consistent with their environmental policy and objectives. They do so in the context of increasingly stringent legislation, the development of economic policies and other measures that foster environmental protection, and increased concern expressed by interested parties about environmental matters and sustainable development.

The EMS offers a structured way to incorporate environmental considerations into day-to-day operations; and promotes continual improvement of the environment and human health. It monitors and checks the environmental performance, integrates and implements the environmental management and its performance with and along the routine operations of the organization's long and short term planning and takes positive steps in case of any deviation with a view to ensure better and enhanced performance. Continual improvement is an integral part of any environmental management system. In view of these facts, Karnataka Power Corporation Limited proposes to implement and maintain an environmental management system (EMS) the proposed Yelahanka Combined Cycle Power Plant, in accordance with the International Standard ISO 14001:2004, and to undertake environmental "reviews" or "audits" to assess its environmental performance.

The Environmental Management System will be based on the methodology known as Plan-Do-Check-Act (PDCA). PDCA can be briefly described as follows:

Plan:	Establish the objectives and processes necessary to deliver results in accordance with the organization's environmental policy.
Do:	Implement the processes.
Check:	Monitor and measure processes against environmental policy, objectives, targets, legal and other requirements, and report the results.
Act:	Take actions to continually improve performance of the environmental management system.

In order to develop the EMS, the company shall identify the impacts, plan and set targets to reduce the negative impacts, implement steps to achieve the targets effectively and efficiently, evaluate the results of implementations, take steps to bridge the gaps between planned and achieved objectives, and continually improve the environmental performance. The important components of the proposed EMS are as follows.

- Environmental policy
- Documentation
- Impact identification
- Environmental objectives and targets
- Consultation
- Operational and Emergency Procedures
- Training on environmental aspects
- Reviews, audits and compliance monitoring
- Continual Improvement

10.2 WATER ENVIRONMENT

10.2.1 Water Consumption

Total make-up water requirement for operation of the proposed project is 600 m3/hr or 14400 m3/day, which will be met from tertiary treated sewage supplied by Bangalore Water Supply and Sewerage Board from its from Sewage Treatment Plants at Jakkur and Puttenhalli. The requirement of fresh water for different uses is as follows:

a) Make-up to Cooling Water System	: 525 m3/hr
b) Make-up to BFW, DMCW & Chemical feed	: 15 m3/hr
e) HVAC make-up and service water	: 20 m3/hr
f) Losses in RO and DM water system	: 20 m3/hr
g) Dilution of wastewater to reduce its TDS	: 20 m3/hr
Total	: 600 m3/hr or 14400 m3/day

The tertiary treated water from the raw water Reservoir will be used directly, without any pre-treatment, for make-up to Cooling water system and for dilution of waste water in the Guard Pond. However, for make-up to BFW (Condenser Hot Well), DMCW and Chemical feed systems, de-mineralized water is required. For HVAC Make-up and service water system, RO treated water is required. To meet these requirements, a RODM Plant, comprising UF, RO1, RO2 and MB, is proposed. Output from RO1 will be used to meet requirements of HVAC Make-up and service water system, whereas output from MB will be used for BFW make-up, DMCW make-up and Chemical feed.

10.2.2 Waste-water Generation

The wastewater generated from various operations is as follows.

Cooling water blow down	: 175 m³/hr
Wastewater (back-wash) from UF	: 6 m³/hr
Reject water from RO1	: 13 m³/hr
Reject & regeneration waste from RO2 & MB	: 1 m³/hr
HRSG blow down	: 7.5 m³/hr
Total wastewater	: 202.5 m³/hr
Dilution water	: 20 m³/h
Total to Guard Pond	: 222.5 m³/hr or 5340 m³/day

10.2.3 Cooling Tower Blow-down

Considering the quality of raw water, it is propose to maintain COC of three (3) for the cooling water system. As the blow down water will be drawn from the Cold water basin of the Cooling Tower, its temperature will be ambient, and it will be led to the guard pond along with other

influents to the guard pond which includes the effluents from the neutralizing pit, RO plant reject, clear water from the outlet of the oil-water separator and HRSG blow down. Water collected in the guard pond will be treated for pH correction and also diluted if required with water drawn from the tertiary water storage tank - to the standards as stipulated by Pollution Control Board. The water collected in the guard pond will be partly used for plant cleaning, gardening, firefighting etc. Remaining water is pumped (after 24 hours detention period) to nala after necessary treatment (as per the norms of pollution control board).

10.2.4 HRSG Blow-down

The main pollutant in HRSG blow down is pH and temperature of water. Suspended solids would be negligible. The pH would be in the range of 9.5 to 10.3 and the temperature of blow down water will be brought down by water spray from the ACW system. Hence the boiler blow down does not require any further treatment to achieve the limit. Also by operating with proper chemistry in the condensate and feed water systems, copper and iron are not present in significant quantities in the blow downstream. The blow down would have very less quantity of dissolved solids and hence it is proposed to lead to the guard pond through plant drains.

10.2.5 DM Plant & Water Treatment Plant Effluent

Effluents from pretreatment plant and filtration plant will be sent to sludge pit wherein sludge shall settle down at bottom and water shall be recovered. Sludge will be disposed from bottom portion of sludge pit at regular intervals and will be used for land filling. Over flow water from sludge pit will be lead to the neutralizing pit.

The effluents from the regeneration of cation resin units in water treatment plant (DM plant) are generally acidic in nature and from anion resin units are alkaline in nature. The combined waste water from DM plant would be neutralized in a neutralizing pit. The neutralized effluent is expected to have suspended solids less than 5 ppm and pH in the range of 6.5 to 8.5. This will be lead to guard pond. The neutralized effluent is expected to have suspended solids of less than 5 PPM and pH in the range of 6.5 to 8.5.

10.2.6 Plant Wash-down Water & Miscellaneous Drains

The areas of plant wash water are:

- HRSG area
- Transformer yard area
- GT and ST area.
- Leakages from pumps & bearing cooling, oil burners

The oily waste from the above areas mainly comprise of floor wash, leakages from bearings cooling system, leakage from pumps, hydraulic couplings, oil leakage from burners etc, mainly consists of suspended solids, oil and grease. An underground retention pit is provided to collect waste water from these areas. From the retention pit the waste water is transferred to lamella clarifier located in the ETP area for removal of suspended solids and oil. Separated oil is collected in the storage tank. The treated water from lamella clarifier shall be finally sent to guard pond.

Lamella clarifier output will be conforming to following standards.

- Oil & grease : 10mg/l, max
- Suspended solids : 100 mg/l, max

10.2.7 Sewage from Various Buildings in Plant

Sewage from various buildings in the power plant area will be conveyed through separate drains to septic tanks. The effluent from septic tanks will be disposed of in the soil by providing dispersion trenches. There will be no ground pollution because of leaching. Sludge shall have to be removed and disposed of as landfill. Network of sewage pipelines of HDPE construction would be provided to carry sewage from the building toilets and other drains to a septic tank. Outflow from septic tank is led to soak pit. Treated water may be utilized for gardening. Water containing oil would be passed through oil separator unit before leading into guard pond.

10.2.8 Drainage

The storm water drainage from the plant area is envisaged to be achieved by gravity through open brick masonry / RCC drains, which will finally dispose into the nearby natural drain or may be integrated with the existing drains. Catch drains shall be provided to convey respective buildings drainage in to main drains.

10.3 AIR ENVIRONMENT

10.3.1 Control Measures

The proposed plant shall utilize natural gas as fuel for gas turbine, and the waste heat from the gas turbine exhaust gas will be utilized for steam generation (in HRSG boilers) followed by power generation in steam turbine. Natural gas (NG) is the cleanest burning fossil fuel due to negligible sulphur and ash content. On an average, power plant that run on natural gas, emits half of carbon dioxide, less than one third of the nitrogen oxides, one percent of the sulfur oxides, and much lower level of mercury than the plants that burn coal. As a result, the combustion of NG results in virtually no atmospheric emissions of sulphur dioxide or small particulate matter. Hence, Nitrogen oxide (NOx) is the only air pollutant in the flue gas. As per environment norms, NOx emission level should be limited to 50 PPM (as per the environmental protection rules 1986). For control of NOx in the flue gas, Dry Low NOx (DLN) burners in the combustors of the gas turbines will be used to reduce the level of NOx emission. The guarantee value of NOx for the proposed CCPP is 25 PPM. Further, to facilitate adequate dispersion of pollutant in the atmosphere and to avoid local dispersion, the exhaust gases from HRSG will be discharged through a stack height of about 45mtr above the ground level. Automatic On – line stack monitoring instrument will be provided for monitoring of NOx emission.

The expected emissions and its characteristics from the proposed combined cycle power plant stack are:

	Pollutant	Flue gas emission characteristics
1	Oxides of Nitrogen(NOx)	25 ppmvd@15%O2 at GT Exhaust
2	Sulphur dioxide (SO2)	Less tha 2 mg/Nm3 @24 ppm 'S' in NG
3	Particulate matter	Nil

10.3.2 Low NOx Technology for NOx Control

The primary pollutants emitted by gas turbine engines are NOx, CO and to a lesser extent, unburned hydrocarbons (UHC). Sulfur dioxide, particulate matter (PM) and other hazardous air pollutants are almost absent when natural gas is used as the fuel. Both CO and UHC are the products of incomplete combustion. Given sufficient time and at high enough temperatures, these two pollutants will be further oxidized to carbon dioxide and water.

There are two sources of NOx emissions in the exhaust of a gas turbine. Most of the NOx is generated by the fixation of atmospheric nitrogen in the flame, which is called thermal NOx. Thermal NOx production rates fall sharply as either the combustion temperature decreases, or as the fuel to air ratio decreases. Nitrogen oxides are also generated by the conversion of a fraction of any nitrogen chemically bound in the fuel. Emissions of NOx from fuel bound nitrogen are insignificant when firing natural gas.

The combustion process in a gas turbine can be classified as diffusion flame combustion or lean-premix staged combustion. In diffusion flame combustion, both fuel and oxidizer are supplied to the reaction zone in an unmixed state. The fuel/air mixing and combustion take place simultaneously in the primary combustion zone. This generates regions of near-stoichiometric fuel/air mixtures where the temperatures are very high. Diffusion flame combustion was practiced at the beginning of gas turbine development, when emphasis was placed on maximizing combustion efficiency while minimizing the emission of unburned hydrocarbons and CO. However, the high flame temperature leads to formation of more NOx. The lean Pre-mixed Combustion process was developed to reduce the formation of thermal NOx during the combustion process.

Lean premixed stationary combustion turbine means any stationary combustion turbine designed to operate at base load with the air and fuel thoroughly mixed to form a lean mixture before delivery to the combustor. Mixing may occur before or in the combustion chamber. Premixing prevents local "hot spots" within the combustor volume that can lead to significant NOx formation. In LPM systems, atmospheric nitrogen (from the combustion air) acts as a diluent, as fuel is mixed with air upstream of the combustor at deliberately fuel-lean conditions. The fuel to air ratio typically approaches one-half of the ideal stoichiometric level, meaning that approximately twice as much air is supplied as is actually needed to burn the fuel. This excess air is a key to limiting NOx formation, as very lean conditions cannot produce the high temperatures that create thermal NOx.

The GE Dry Low NOx (DLN-1) combustor is a two-stage premixed combustor designed for use with natural gas and capable of operation on liquid fuel. The combustion system includes four major components: fuel injector system, liner, venture, and cap/center body assembly. These components form two stages in the combustor. In the premixed mode, the first stage thoroughly mixes the fuel

and air and delivers a uniform, lean, unburned fuel-air mixture to the second stage. The DLN-1 system operates in four distinct modes; illustrated in Figure-37:

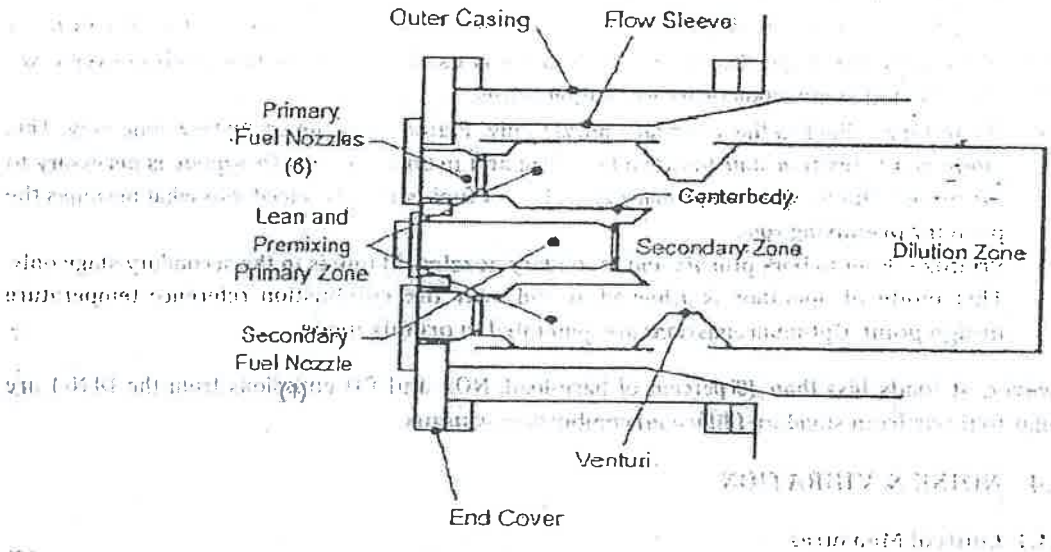


Figure 36: Dry Low NOx Combustor

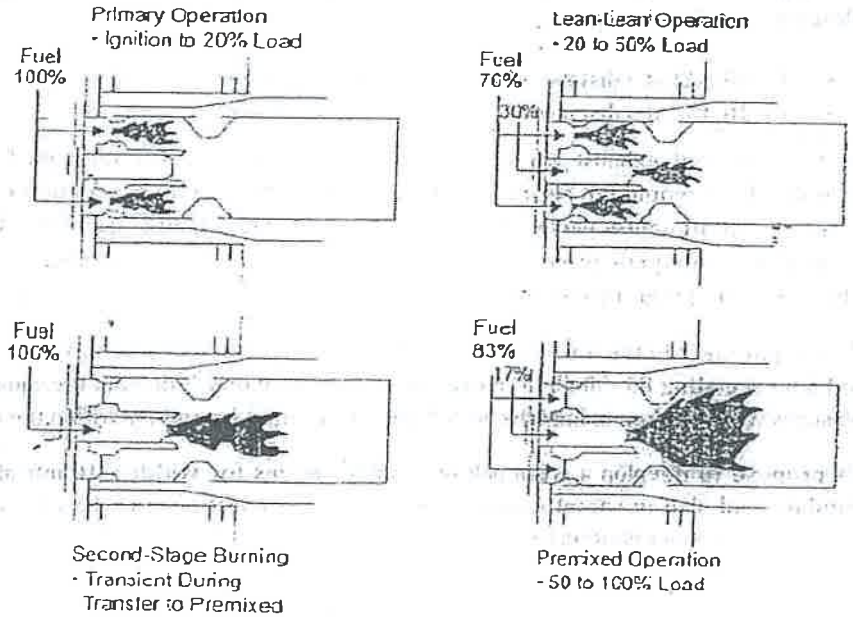


Figure 37: Fuel-staged Dry Low NOx Operating Modes

Modes of Operation for the DLN-1 system are as follows:

- Primary – Fuel to the primary nozzles only. Flame is in the primary stage only. This mode of operation is used to ignite, accelerate, and operate the machine over low- to mid-loads, up to a preselected combustion reference temperature.
- Lean-Lean – Fuel to both the primary and secondary nozzles. Flame is in both the primary and secondary stages. This mode of operation is used for intermediate loads between two pre-selected combustion reference temperatures.
- Secondary – Fuel to the secondary nozzle only. Flame is in the secondary zone only. This mode is a transition state between lean-lean and premix modes. This mode is necessary to extinguish the flame in the primary zone, before fuel is reintroduced into what becomes the primary premixing zone.
- Premix – Fuel to both primary and secondary nozzles. Flame is in the secondary stage only. This mode of operation is achieved at and near the combustion reference temperature design point. Optimum emissions are generated in premix mode.

However, at loads less than 20 percent of base-load, NOx and CO emissions from the DLN-1 are similar to those from standard (diffusion) combustion systems.

10.4 NOISE & VIBRATION

10.4.1 Control Measures

All the equipment in the power plant would be designed to have a total noise level not exceeding 85 dB (A). Generally the manufacturers of the gas turbine generators indicate the following noise level values:

- 85 dB (A) at a distance of 1.5 m from the gas turbines
- 65 dB (A) at a distance of 120 m from the gas turbines

The inlet air and exhaust gas streams would be provided with silencers for noise reduction. Generally there would not be any operators near the gas turbine generator on a continuous basis. However, maintenance personnel working local to gas turbine generator building would be provided with adequate protection against noise. The steam turbine generator would be housed in a closed building thereby reducing the transmission of noise to the outside environment.

All the equipment in the waste heat recovery power plant will be designed / operated to have noise level not exceeding 85 -90 db (A) measured at a distance of 1.5 m from the equipment. Also, all the measures will be taken to limit the noise levels at the plant boundary within the stipulated limits.

It is propose to develop a green belt of suitable species for width 5-10 mtr all along the project boundary and also in vacant spaces within the plant area of approx. 10 acres (40468.73 Sq.m) to minimize the noise pollution from the plant.

14.	*Madhuca latifolia*	Mahua (Hippe)
15.	*Millingtonia hortensis*	Indian Cork Tree (Birate mara)
16.	*Parkia biglandulosa*	Badminton ball tree
17.	*Pithecellobium dulce*	Madras thorn (Bettada Hunise)
18.	*Pongamia pinneta*	Pongamia (Honge)
19.	*Spondias pinnata*	Amate Kai
20.	*Syzygium cumini*	Jamun (Sanna Nerale Mara)

Figure 38: Green Belt Development Plan

10.5.3 Action Plan with Budget Allocation for Plantation

The proposed green belt development plan will be complete as per action plan illustrated in Table-81.

Table 81: Action Plan With Budgetary For Plantation

Year	No. of plant	Area (ha)	Capital Cost (INR)	Recurring cost (INR)
1st Year	3200	2	50,000.00	15,000.00
2nd Year	3200	2	50,000.00	15,000.00
3rd Year	3200	2	50,000.00	15,000.00
4th Year	3200	2	50,000.00	15,000.00
5th Year	1600	1	20,000.00	10,000.00
Total	**14400**	**9**	**2,20,000.00**	**70,000.00**

10.5 BIOLOGICAL ENVIRONMENT

10.5.1 Green-belt Development

Scientific data is available to show that 1 ha tropical dense forest has the capability to sequester 0.3 tonnes of CO_2 per day. The plant will emit CO_2 to the tune of 15,781 tonnes/day. This means 500 sq. km. multi-tired forest for total sequestration of the gas. Hence, large scale plantations are required to minimize the carbon foot print of the plant as well as to act as a dust trap. Different types of plantation have been suggested to cater to this general need and the specific need assigned to each.

10.5.2 Block Plantation

With a view to compensate impact of project and sustainable energy production, 9ha plantation with species qualifying habitat will be taken up inside the plant area (approx. 4 ha), government waste lands, forest land and in vacant places like lake banks as proposed in the management plan, as plantations will commence after EC.

Nursery raised seedlings in polypots@1600 seedlings per ha will be planted in previously excavated and treated pits. Nine months to one and half year old seedlings will be used depending on growth characters. Pits will be dug of 45 cm. cube in June and September when soil is still moist and allowed to wither. To each pit a basketful of farm yard manure/compost and 30 gm basal dose of NPK will be added before planting to improve soil texture and nutrient status. Half moon trenches will be made on uphill side of sloping land or saucer made in flat land to conserve moisture.

Mulching will be done after first soil working/weeding in 1m radius to improve soil moisture and minimize weed growth. Plantation will be watered as and when required. As a preventive against termite, 20 gm of neem cake will be added around each plant. Plantation will be kept properly weeded; fire may protect and will be stone-wall fenced against cattle for 5 years till rise above browsable height. The choice of species will be as follows in Table-80:

Table 80: Species Adaptable To the Site and Recommended

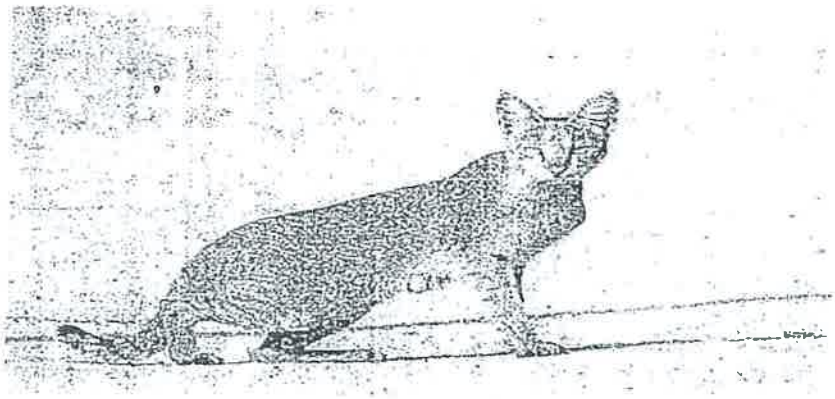
S. No.	Scientific Name	Common Name
1.	*Azadirachta indica*	Neem (Bhevu)
2.	*Bombax ceiba*	Red Silk Cotton (Buruga)
3.	*Butea monosperma*	Flame of the forest (Muthuga)
4.	*Cochlospermum gossypium*	White Silk Cotton (Kaduburuga)
5.	*Dendrocalamus strictus*	Bamboo
6.	*Erythrina indica/verigata*	Indian Coral Tree (Harivana)
7.	*Erythrina suberosa*	Erythrina (Mullu muruku)
8.	*Eugenia jambolana*	Jamun (Dodda Nerale)
9.	*Ficus benghalensis*	Banyan (Goni Mara)
10.	*Ficus recemosa*	Ficus (Aathi hannu)
11.	*Ficus religiosa*	Peepul (Aarali Mara)
12.	*Firmiana colorata*	Scarlet-Sterculia
13.	*Gliricidia sepium*	Gliricidia

10.5.4 Conservation cum Management Plan

A large number of fauna are reported from the buffer area. Sum of 55 faunal species were recorded from the area which belongs to 28 birds, 16 butterflies, 5 mammals, 6 reptiles and amphibians listed in Table X to Y. Among all the recorded species, four species fall under schedule II and rest of the belong either schedule IV or not listed. In the view of sustainable and eco-friendly power generation, conservation cum management plan is prepared for schedule II species (Felis chaus, Macaca mulatta, Naja Naja and Ptyas mucosa).

10.5.4.1 Description of Scheduled-II Species and Their Threats

1) Jungle Cat (*Felis chaus*)



Scientific Classification

Kingdom	: Animalia
Phylum	: Chordata
Class	: Mammalia
Order	: Carnivora
Family	: Felidae
Genus	: Felis
Species	: *F. chaus*
Binomial name	: *Felis chaus* Schreber, 1777

Habit

Jungle cats primarily prey on animals that weigh less than 1 kg and commonly consume rodents, lizards, snakes, frogs, birds, hare, fish, insects, livestock, and even fruit during the winter. Rodents are its primary prey item, however, which provides up to 70% of its daily energy intake. Although they specialize on small prey, jungle cats have been known to kill wild pigs (Sus scrofa) and chital fawns (Axis axis).

Except for breeding season, jungle cats live solitary lives. They are most active at night, but are not

strictly nocturnal. They are more often seen at dusk and travel approximately 5 to 6 km per night. They typically rest in dense cover during the day but often sunbathe on cold winter days. Unlike most cat species, jungle cats have an affinity for water and are proficient swimmers that will dive into water to catch fish with their mouths.

Jungle cat mating season is marked by the shrieks and fighting of male cats. Vocalization rates of males and females increases prior to copulation. Intense mew calls are used by both genders to attract potential mates. They also scent mark territorial boundaries, which may help them find and locate potential mates. Male and female jungle cats may have multiple different mates throughout their lives.

Habitat

Jungle cats prefer habitats near water with dense vegetative cover but can be found in a variety of habitats including deserts (where they are found near oases or along riverbeds), grasslands, shrubby woodlands and dry deciduous forests, as well as cleared areas in moist forests. They are commonly found in tall grass, thick brush, riverside swamps, and reed beds. They also adapt well to cultivated land and can be found in many different types of agriculture and forest plantations. Jungle cats are known to occur at elevations of up to 2500 m, but are more common in lowlands.

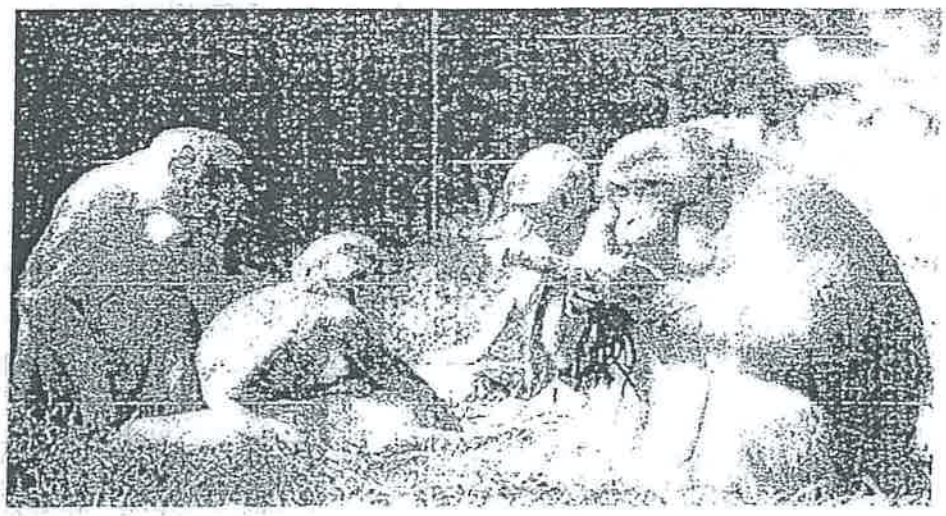
Conservation Status

Habitat destruction and persecution by humans are the main threats to jungle cats. As the human population increases, more land is cultivated and jungle cats' natural habitat is converted to farmland. Although they are very adaptable, these altered environments do not support the same density of cats. In addition, farmers often hunt and poison jungle cats for attacking and killing poultry and are also poached for their fur. Although laws have been implemented to protect them, illegal trade still continues in many countries. For example, over the last decade more than 3,000 jungle cat skins have been seized across the globe. Currently, jungle cats are considered as a species of "least concern" by the IUCN. Hence as per Indian Wildlife conservation act 1972 Jungle Cat considered as Schedule II species.

Threats:-

- Human–Cat conflict
- Competition with other predators
- Loss of Habitat
- Loss of prey
- Poaching
- Illegal trade
- Fires

2)Rhesus Macaque *(Macaca mulatta)*



Scientific Classification

Kingdom	: Animalia
Phylum	: Chordata
Class	: Mammalia
Order	: Primates
Family	: Cercopithecidae
Genus	: *Macaca*
Species	: *M. mulatta*
Binomial name	: *Macaca mulatta* (Zimmermann, 1780)

Habit

The dietary habits of rhesus monkeys can vary greatly depending upon where they live. Macaca mulatta is omnivorous, and often eat roots, herbs, fruits, insects, crops, and small animals. The diet can also vary with the season. For example, rhesus that live in the mountain forests of northern Pakistan feed primarily on clovers during the summer, but during winter when snow covers the ground they are forced to switch to foods with lower nutritional values and higher fiber contents, such as pine needles and oak leaves. These monkeys seem to choose their environments carefully with respect to food resources. Even when they are forced to switch to lower quality food sources during the winter months they do not exhibit higher mortality rates, although they may lose a considerable percentage of their body weight.

Rhesus monkeys are highly active and very loud. They enjoy being in water and are good swimmers. They live in groups of up to two hundred individuals. When a group's size reaches 80 to 100 members, a subgroup of females may split off to form a new group. Populations generally consist of a few unrelated males and many closely related females. Sometimes small groups form that consist

of only males. Males usually leave the group in which they were born shortly after they reach sexual maturity. Offspring born to a mother and son, or to siblings, are very rare. Both males and females in a group show a preference for high ranking members of the opposite sex.

Although rhesus monkeys live in groups, they are not territorial. Each group of individuals usually has its own sleeping space, but the territories of neighboring groups may overlap considerably. Confrontations between groups are rare. Usually when groups meet, the weaker group will avoid the stronger group. Any confrontations that arise are because of an uncertainty concerning strength and dominance.

Although rhesus monkeys show mate preferences, in general they are highly promiscuous. As they live in multi-male, multifemale groups, there are ample opportunities for individuals to copulate with multiple partners.

Habitat

Macaca mulatta lives in a wide range of habitats, and shows a great deal of adaptability. Some populations live in flatlands, while others, in northern India and Pakistan, live in the Himalayas at elevations up to 3,000 m. These primates are able to aclimate to a variety of climatic extremes, from the hot, dry temperatures found in deserts, to cold winter temperatures which fall to well below the freezing point.

In addition to living in the wilderness, some populations of M. mulatta have become accustomed to living alongside humans. Occasionally, small groups can be found living in the densely populated urban areas of northern India. Groups of rhesus monkeys that become used to living in areas occupied by people usually search out other human-populated areas if people attempt to relocate them away from civilization.

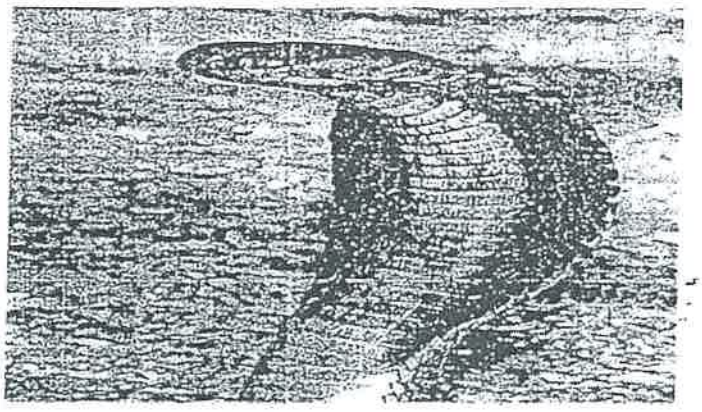
Conservation Status

This species is listed on CITES Appendix II. It is also listed in Schedule II in Schedule I, Part I in the Indian Wildlife (Protection) Act (amended up to 2002) and as per IUCN it falls under Least Concern.

Threats

- Human-Assamese macaque interaction (Crop-raiding and its consequences).
- Loss of Habitat
- Effect of human feeding on the road mortality of Rhesus Macaques
- Hunting
- Encroachment
- Fires

3) Cobra (*Naja naja*)



Scientific Classification

Kingdom	: Animalia
Phylum	: Chordata
Class	: Reptilia
Order	: Squamata
Family	: *Elapidae*
Genus	: *Naja*
Species	: *N. naja*
Binomial name	: *Naja naja* (Linnaeus, 1758)

Habit

The Indian cobra feeds on rodents, lizards and frogs. It bites quickly, and then waits while its venom damages the nervous system of the prey, paralyzing and often killing it. Like all snakes, N. naja swallows its prey whole..This species sometimes enters buildings in search of rodent prey. When threatened, the Indian-Cobra will assume its characteristic posture. It will raise the front one third of its body and elongate its long, flexible neck ribs and loose skin to form its distinctive hood, on which are resembled eyes.

The Indian Cobra reproduces sexually by the joining of male and female gametes and produces eggs. Most snakes do not pay much attention to their eggs, but this is not the case with the Indian Cobra. The eggs, usually 12 to 20, are laid in a hollow tree, or in the earth, and the female will guard them throughout the incubation period, only leaving to feed. The young snakes will then hatch after approximately 50 days. Immediately freeing itself from the egg, a hatchling is capable of rearing up, spreading its hood and striking.

Habitat

This species inhabits a wide range of habitats throughout its geographical range. It can be found in

dense or open forests, plains, agricultural lands (rice paddy fields, wheat crops), rocky terrain, wetlands, and it can even be found in heavily populated urban areas such as villages and city outskirts, ranging from sea-level to 2,000 metres (6,600 ft) in altitude. This species is absent from true desert regions. The Indian cobra is often found in the vicinity of water. Preferred hiding locations are holes in embankments, tree hollows, termite mounds, rock piles and small mammal dens.

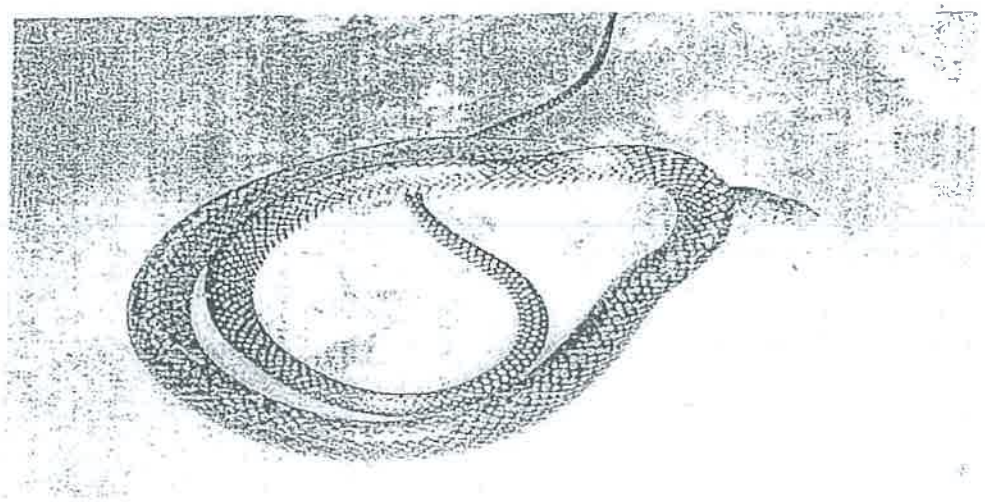
Conservation Status

Although the Indian Cobra is under Schedule II species as per Indian Wildlife Conservation Act. It is listed under the CITES treaty because it closely resembles other species that are threatened and in need of protection.

Threats

- Asian cobras are exploited for leatherware, meat and gall bladders for consumption and snake-wine with perceived tonic medicinal effects, stuffed tourist trinkets, venom and antivenin for medical use, pets, and scientific specimens.
- Targeted collection of Naja spp. and other large snakes (Ptyas spp., Elaphe spp., Python spp., Xenopeltis unicolor) for subsistence consumption and domestic and international trade of leather, meat (food with perceived medicinal benefits) or live specimens, mainly to East Asian food markets but also for local consumption.
- Wanton killing by humans out of fear and accidentally by cars ('roadkills').
- Environmental degradation including drainage of wetlands, development of residential and industrial estates, excessive pesticide usage, organic pollution, and uncontrolled grass/forest fires.

4) Rat Snake (Ptyas mucosa)



Scientific Classification

Kingdom	: Animalia
Phylum	: Chordata
Class	: Reptilia
Order	: Squamata
Family	: *Colubridae*
Genus	: Ptyas
Species	: *P. mucosa*
Binomial name	: *Ptyas mucosa (Linnaeus, 1758)*

Habit

Rat Snake, though harmless to humans, are fast-moving, excitable snakes. In captivity individuals remain highly territorial and may continue to defend their turf aggressively, attempting to startle or strike at passing objects. Dhamans are diurnal and semiarboreal. They inhabit forest floors, wetlands, rice paddies, farmland, and suburban areas where they prey upon small reptiles, amphibians, birds, and mammals. Adults, unusually for a colubrid, prefer to subdue their prey by sitting on it rather than by constricting, using body weight to weaken prey.

Very long body with dark color patterns on the whole dorsal surface are its general identification features. Apart from these it can be identified precisely by checking posterior body reticulated with black color net like markings. Traditionally people differentiate between Cobra and Rat Snake by accepting Rat Snake to be a snake having head broader than neck or neck thinner than mid body.

Dhamans mate in late spring and early summer, though in tropical areas reproduction may take place year round. Males establish boundaries of territory using a ritualised test of strength in which they intertwine their bodies. The behaviour is sometime misread by observers as a 'mating dance' between opposite-sex individuals. Females produce 6-15 eggs per clutch several weeks after mating.

Adult members of this species emit a growling sound and inflate their necks when threatened. This adaptation may represent mimicry of the king cobra or Indian cobra which overlaps this species in range. The resemblance often backfires in human settlements, though, as the harmless animal is then mistaken for a venomous snake and killed.

Habitat:

Remain hidden in dark and silent places like rat holes, termite mounds, wood caves, under rocks or any narrow and dark place. Distributed in variety of forests including rainforest, scrub lands, semi-desert, dry, moist and mixed deciduous forests, grasslands, mangroves, wetlands etc. Lives in almost all kinds of habitat due to its tendency to survive in tough conditions; this includes urban areas, dense & open forest, hills & plains, agricultural lands etc. Prefers wet surroundings during summer (shows semi aquatic behavior few times), while dry during monsoon.

Conservation status

Rat snakes are under Schedule II species as per Indian Wildlife Conservation Act.

Threats:

Threats includes killing due to misidentification with venomous species like King Cobra, other Cobra species. This is one the most intentionally threatened snake in its range due to its prone activity in and around humans and large size. In many parts of its range it is exploited for skin and edible use. Snake charmers use this species in snake charming because of its large size and harmless to display nature

10.5.4.2 Wildlife Management Plan

Wildlife management consists of habitat evaluation and assessment, periodic vegetation and animal status monitoring, identification of habitat factors favorable to growth and which act against the population. Welfare factors are promoted, decimating factors are arrested and limiting factors mitigated so that habitat carrying capacity is optimized and populations attain the saturation point intrinsic to the species. Participation and support of local public is enlisted to make the conservation plan work and outcome becomes sustainable.

The state needs growth and a vibrant economy. However, protection of nature and environment and development of economy are not alternatives, not mutually exclusive. Both have to proceed hand in hand so that natural ecosystems are maintained or better restored for uninterrupted flow of goods and services, on which human survival is dependent. Every entrepreneur need to be sensitive of the ecological impact of setting an industry and forge a connection with natural objects and dependent societies. This will make the development sustainable and bring lasting cheer in the society. M/s Karnataka power corporation Limited (KPCL) is expected to usher in green development initiatives in this locality as an agent of change to fulfill their corporate responsibility. Conscious of the above and in consonance with the statutory requirement, this conservation plan is made to mitigate the impact on flora & fauna.

Objects of management

The important objects of management are:-

i) To maintain the existing wildlife habitats in optimal state of productivity by alleviating the impairing forces.
ii) To restore degrading habitats and nurture biodiversity for scheduled species.
iii) To protect the resident fauna and long ranging mammals and migratory birds through mass awareness and timely damage control measures.
iv)To provide alternatives of livelihood to consumptive use of biomass for auto-resuscitation of habitats and elicit public support to maximize above objectives.

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Suggested interventions

Scientific data is available to show that 1 ha tropical dense forest has the capability to sequester 0.3 tonnes of CO_2 per day. The plant will emit 15,781 tonnes of CO_2 per day. This means 500 sq. km. multi-tired forest for total sequestration of the gas. Hence, large scale plantations are required to minimize the carbon foot print of the plant as well as to act as a dust trap. Different types of plantation have been suggested to cater to this general need and the specific need assigned to each.

Plantation

With a view to compensate impact of project, 3 ha plantation with species qualifying habitat will be taken up in government waste lands, forest land and in vacant places like lake banks as proposed in the management plan, as plantations will commence after EC.

Nursery raised seedlings in polypots@ 1000 seedlings per ha will be planted in previously excavated and treated pits. Nine months to one and half year old seedlings will be used depending on growth characters. Pits will be dug of 45 cm. cube in June to September when soil is still moist and allowed to wither. To each pit a basketful of farm yard manure/compost and 30 gm basal dose of NPK will be added before planting to improve soil texture and nutrient status. Half moon trenches will be made on uphill side of sloping land or saucer made in flat land to conserve moisture.

Mulching will be done after first soil working/weeding in 1m radius to improve soil moisture and minimize weed growth. Plantation will be watered as and when required. As a preventive against termite, 20 gm of neem cake will be added around each plant.

The food and cover plants are to be intimately mixed in plantation. With the protection afforded, if any qualifier species regenerates from stool, it will not be sacrificed. Area available for such block plantation is in hill slopes and uplands near villages.

Ground flora improvement

Ground flora will be improved with plantation of grass, bushes and shrubs. For uniform growth of grass and to prevent seeds being washed away, grass seed pellets will be sown at regular interval of 1x1.5m for which 6700 pellets will be needed per ha. Pellets can be made by mixing powdered clay and farm yard manure in 6:1 ratio to which grass seeds will be added @ 5 kg/ha. Native grass, bushes as like *Lataina camara* and shrubs will be cultivated.

Promote Plantation

With a view to reduce dependence on the natural forests for biomass, alternate resources need to be building up. 500 seedlings will be distributed first five years to villagers.

Biodiversity monitoring

With a view to closely observe and analyze if there is any change in biodiversity either positive or negative, a baseline study need to be carried out in first year. Changes in species and abundance of

both plants and animals will be studied. This will be done through permanent trend transects selected by stratified random sampling procedure.

Awareness promotion:

The success of any conservation plan of this magnitude is entirely hinged on the active support and whole hearted co-operation of all stakeholders with the members of public playing a major role. For this purpose, meetings and seminars will be organized from village to village on regular basis to carry the people along with implementation. Functions like Van Mahotsav, Wildlife Week, World Forestry Day, and World Environment Day will be organised in a befitting manner to which village heads, members of PR system at GP level, local leaders, members of NGO may be invited. The discussion may evolve around habitat loss, human-wildlife conflict, fire damage control and how best the vegetation can be revamped etc. Members of public will be encouraged to speak. Student community may also be sensitized on various conservation issues. Awareness promotion program will be carry out first five years.

Human wildlife conflict

Training will be provide to workers and strictly guided don't hurt any wildlife. If any Human wildlife conflict will be happen then immediately inform the wildlife officers. Except this any poaching or killing activities will be that also intimate the near forest range office.

Table 82: Financial Forecast

S. No.	Description	Capital cost	Recurring cost
1.	Block plantation	75000.00	15000
2.	Ground flora improvement	25000.00	10000
2.	Biodiversity study	100000.00	-
3.	Awareness promotion	30000.00	120000.00*
	Total	230000.00	145000.00

*- for five years

10.5.4.3 Conclusion

Ecology and biodiversity study is carried out around the 10 km of the project location. Flora and fauna recorded in the study area are crosschecked with listed Scheduled species of Wildlife Conservation Act, 1972 & amendments. The present study has schedule II Species and schedule IV Species. The conservation plan covers Scheduled species management plan, in which plantation, awareness, prevention and other necessary steps are committed.

Proposed wildlife management plan will be a milestone of eco-restoration cause. Plantation of tree, grass and herbs has various purposes as for example fruit bearing plant will fascinate herbivorous, herbs and grass will allow shelter and food to ground fauna. The studied schedule species will be safe and survive in good condition in the prospectus of management plan. It will give more chances to herbivorous while providing carnivorous with food and shelter.

10.6 CORPORATE SOCIAL RESPONSIBILITY

10.6.1 Objective

Yelahanka Combined Gas Power Plant in aligning its CSR endeavors has upgraded its CSR policy which states "commitment to operate in an economically, socially and environmentally sustainable manner while pursuing the core interest of stakeholders" and implementing CSR activities in the project mode with specified time frames and periodic milestones. The policy, therefore, extends intend of the CSR initiatives beyond philanthropic activities to address the wider social and environmental concerns which would enhance the company's overall contribution to society.

10.6.2 Area Identification

To start with, the CSR activities will focus towards all its stake-holders, in the area adjoining the Units of Yelahanka Combined Gas Power Plant. This will include nearby urban villages. Prepare CSR policy and ensure its efficient delivery to the beneficiary. These villages/ part of villages are located in the 10km radius around the project area periphery.

10.6.3 Survey & Observations

As per the survey conducted during month of May 2015, the observation made as follows:

1. The survey was conducted keeping in mind that the need of the people is addressed properly and company's expenditure will be made in line to meet the requirement of people.
2. Though primary school facility is available in the villages but the facilities i.e. seating, electricity, sanitation is not found.
3. No medical facility is seen in these urban villages (Kachanahalli, Chokkanahalli, Venkatapura).
4. No basic facility for pregnant women i.e. vaccination, nutrition, health checkup, availability of female nurses/Asha workers etc are found. Neither any facility are observed for mother & new born.
5. Literacy (till class V) in the area is very poor and women are no exception to it.
6. However, there are number of government plans & schemes in place, but people are found to be almost unaware of these schemes.

10.6.4 Activities

Education

- Construction/Renovation/Modernization of school/college infrastructure
- Providing Computer and other teaching aids including sports equipment
- Skill upgradation and literacy enhancement programmes
- Scholarships to under-privileged/disadvantaged children for primary/secondary/ professional education.

Health

- Providing Mobile Medicare Units/Ambulances and other hospital equipment
- Construction/Renovation of Old Age Homes/Hostels;
- Medical facilities to mentally or physically Challenged persons and Health Check-ups.
- Up gradation of existing facilities in the government hospital

Electrification through Solar Power

- Installation of Solar Cookers/Solar Lamp in rural areas.
- Solar Electrification of remote villages not connected to power grid.

Women Empowerment

- Supporting and facilitating professional/skill development programmes by providing infrastructure and training aids including sewing/ embroidery/ knitting machines etc.
- Training Programmes for effective empowerment and self-reliance.
- Other gender development initiatives.

Drinking Water & Sanitation Facility

- Potable Water facilities in schools/colleges/hospitals/rural/urban areas.
- Up gradation/Renovation of Sanitation facilities in schools/colleges/hospitals/rural areas.
- Rain Water Harvesting.
- Construction of Tube-Wells, Bore-Wells, Hand-Pumps, Over-Head Tanks in remote areas.

Skill Development

- Training Program i.e computer training, machine handling.

Environment Protection

- Development of Environment benign products like paper bags etc.
- Waste Management in schools/ colleges/hospitals/ rural and urban areas

Upliftment of underprivileged

- Support various initiatives/programmes for the physically and mentally challenged persons and destitute children.
- Social Welfare measures such as provision of health services, construction of old age home etc. for the ageing population.

General Program

- Legal awareness program shall be organized time to time which will cover various Pradhan Mantry Yojana, government schemes, aadhar card registration, Yoga program etc.
- The scope will not be only limited to legal awareness but also social issues i.e. dowry, education, respect to women and elder etc shall be covered. Awareness about various

diseases and illness (HIV, TB etc.) along with sporadic diseases i.e. Swine Flu etc. will also be spread among the people.

Budget

- M/S Yelahanka Combined Gas Power Plant. Will allocate statutorily permissible at least 5% of the total cost of the project.

Table 83: Budgetary Allocation of CSR

S.No.	Activities	Item	Numbers	Cost per Item, INR	Total Cost	Investment in 5 Years
1	Drinking Water	Hand Pumps	20	15000/-	300000/- One time	300000
2	Sanitation	Community Toilets	50	15000/-	750000/- One time	750000
3	Health & Medical	Mobile Health Van & Health Camps	Twice Per month	50000/-	100000/-per month	6000000
		Distribution of Free Dietary Supplements	Twice Per month	100000/-	200000/-per month	12000000
		Up gradation of existing facilities in the government hospital	Once in a year	10000000/-	10000000/- per year	50000000/-
4	Education	Distribution of Stationary	Once in a Session	100000/-	200000/- per year	1000000
		Infrastructure Development	30 Toilets	15000/-	450000/- One time	450000
		Scholarship	per student per month (for 1000 students)	300/-	300000/-per month	18000000
5	Skill Development	Training Program i.e computer training, machine handling	15 days camp on half yearly basis	100000/-	200000/- per year	1000000
6	Local Area Development	Plantation along the road	One time plantations followed by watering twice a day	Plantation : 5000000/- INR	5000000/- One Time	5000000
				Watering : 2000/- INR per day	60000/-per month	3600000
		Development of a Children Park	One time investment on park development + maintenance	500000000/- Capital cost	500000000/- One Time	500000000
				20000/- per month	20000/- per month	1200000

					maintenance		
7	Women Empowerment	Legal Awareness Program	Once per month		50000/-	50000/- per month	300000
		Provision of Nutrition Camp	Once in a month		50000/-	50000/- per month	300000
		Professional/skill development programmes (sewing/embroidery. beautician course.	Sewing	100 Machine	8000/- per machine	800000/- One time	800000
			Embroidery	100 Frame	200/- per frame including material	20000/- One time	20000
			Beautician course	7 days course. Once in a month	100000/- INR One time investment;	100000/- INR One time investment;	100000
					10000/- recurring cost per month	10000/- recurring cost per month	600000
8	General Program	Social Awareness Program	Once per month	5000/- per visit	5000/- per month	30000	General Program
9	Upliftment of underprivileged	Construction of old age home	One time Capital Investment	10000000/-	10000000/- One time	10000000	Upliftment o underprivileg
10	Promotion of Renewable Energy	Solar Lamp	One time distribution of 1000 lamps	5000/-	5000000/ One time	5000000	Promotion o Renewable Energy
		Solar Cooker	One time distribution of 1000 cooker	4000/-	4000000/- One time	4000000	Solar Cooker
		Solar Power Street Light	One time installation of 5000 lights	20000/-	100000000/- One time.	100000000	Solar Power Street Light
	Expenditure on Miscellaneous Expenses in implementation of CSR Activities						45000000
							696400000/-
						Say	69.70 Crores

CHAPTER-11

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CHAPTER-11: DISCLOSURE OF CONSULTANTS

11.1 DISCLOSURE OF CONSULTANTS ENGAGED

Name of the Project: Yelahanka Combined Cycle Power Project of M/s KPCL at Yelahanka Tehsil of District Bangalore in Karnataka

Nature of consultant/ consultancy organization	Name and address of the Consultant/expert	Approvals, if any from (NABL/DGMS/IBM/ NRBPT/MOEF/CPCB/others etc)*, give reference
EIA/ EMP Organization	Mantec Consultants Pvt. Ltd, Noida.	Accredited by NABET for Sector 04 (Thermal Power Plant Projects) vide meeting dated May, 09, 2014.
FAE-AP	Mr. S. B. Sinha Assoc. FAE: Nirjhar Raturi	NABET meeting dt. 09-05-2014
FAE-WP	Mr. S. B. Sinha Assoc. FAE: Muzaffar Ahmad	NABET meeting dt. 09-05-2014
FAE-SHW	Mr. S. B. Sinha Ass. FAE: Mr. Sumit Verma	NABET meeting dt. 09-05-2014
FAE-EB	Dr. Vivek N. Singh Assoc. FAE: Mr. Gaja Nand Mallick	NABET meeting dt. 09-05-2014
FAE-SE	Mr. Anil Kumar	NABET meeting dt. 09-05-2014
FAE-LU	Mr. Deepak Srivastava Assoc. FAE: Mr. Manoj K. Singh	NABET meeting dt. 09-05-2014
FAE-AQ	Mr. S. B. Sinha Assoc. FAE: Nirjhar Raturi	NABET meeting dt. 09-05-2014
FAE-RH	Mr. Pintoo Kumar	
FAE-NV	Mr. A. S. Brara	NABET meeting dt. 09-05-2014
FAE-GEO	Mr. B. M. Sinha	NABET meeting dt. 09-05-2014
FAE-HG	Mr. R. K. Khanna	NABET meeting dt. 09-05-2014
FAE-SC	Dr. Vivek K. Singh	NABET meeting dt. 09-05-2014
Environmental Monitoring & analysis	Mantec Environmental Laboratory of Mantec Consultants Pvt. Ltd., D-36, Sector-6, Noida (U.P.)	In-house testing laboratory accredited by NABL and recognized by CPCB.

I hereby accept all the liabilities and obligations associated with the working and results of the above organizations submitted herein with the report.

Signature: 15.2014

Name of Project Proponent: Chief Engineer (EIA&TA)
Karnataka Power Corporation Ltd
"Sudarshan Complex"
No. 22/23, Seshadri Road
BANGALORE-560 009

Seal of the Project Proponent

APPENDIX

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QUESTIONNAIRE FOR ENVIRONMENTAL APPRAISAL
(THERMAL POWER SECTOR PROJECTS)

I. General Information

A.	Name of the Project	:	Yelahanka Combined Cycle Power Plant
	1. Existing project/proposed project/ expansion project/modernization project	:	New project
	2. If Existing/expansion/modernization project, whether environmental clearance has been obtained	:	The generation from DG plant has stopped since from Aug 2013 and abandoned.
B.	Generation Capacity (MW)	:	1 x 350±20% MW
C.	Location		
	1. Village	:	Puttenahalli&Kenchenahalli
	2. Tehsil	:	Yelahanka
	3. District	:	Bengaluru
	4. State	:	Karnataka
D.	Geographical location		
	1. Latitude	:	13°06'50" to 13°07'08"
	2. Longitude	:	77°34'49" to 77°35'08"
	3. Elevation above mean sea level (metres)	:	908 metres
	4. Total Area envisaged for setting up of the project (Ha.)	:	26.4 ha. (after accounting for the existing facilities which will not be disturbed)
	5. Nature of terrain (hilly, valley, plains, Coastal plains etc.)	:	Plain land sloping towards south-east.
	6. Nature of Soil (sandy, clayey, silty, loam, etc.	:	Brownish red clay with silt, sand & gravel (up to 0.5 m) followed by sandy silt (up to 5 m).
	7. Permeability (cm/sec)	:	Will be available after geotechnical studies (under progress).
E.	Alternate sites considered	:	As the proposal is for implementing a new Gas based combined cycle power plant with in the existing vacant area in the DG plant area, abandoning the existing DG plant. No other site was considered.
F.	Reasons for selecting the proposed site on comparative evaluation on environmental consideration	:	Not applicable.

II. Current land usage of the proposed project site Area (in hectares)

A.	Notified Industrial Area/Estate	:	41.3
B.	Agricultural		
	1. Irrigated	:	Nil
	2. Unirrigated	:	Nil

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C.	Homestead	:	Nil
D.	Forest	:	Nil
E.	Grazing	:	Nil
F.	Fallow	:	Nil
G.	Mangroves	:	Nil
H.	Marshes	:	Nil
I.	Others (Please specify)	:	Nil
	Total	:	41.3

III. Is the proposed site located in a low-lying area?

Yes [ ] No [-X]

If yes,

A.	Level before filling (above MSL, in. metres)	:	Not applicable
B.	Level after filling (above MSL in metres)	:	Not applicable
	Quantity of fill material required (in cum.)	:	Not applicable
	Source of fill material	:	Not applicable
C.	Does the project involve land preparation/reclamation?	:	Not applicable

IV. Please indicate area earmarked for each of the following (in ha.)

A.	Plant Facilities	:	7.00
B.	Ash Disposal	:	Not applicable
C.	Storage (Fuel)	:	Not applicable
D.	Storage (Water)	:	2.30
E.	Storage (Hazardous Waste)	:	Not applicable
F.	Storage (Hazardous Chemicals)	:	Not applicable
G.	Storage (Others)	:	Not applicable
H.	Approach Road(s)	:	1.00 (existing)
I.	Township	:	1.62 (existing)
J.	Green Belt	:	16.04 (existing & proposed)
K.	Others (220kv switchyard of KPTCL: 5.91,Guest House, Buildings & Playgrounds: 0.6;nalla: 3.20, Abandoned DG Plant:3.63)	:	13.34
	Total	:	41.30

V. Proximity to sea/water bodies

	Sea	Other Water bodies like River/creek/lake etc.(Please specify)
Distance of site* boundary (in m)	Not applicable	Yelahanka Lake, 0.2 km, east Puttenahalli Lake: 0.5 km, east
Distance of plant facilities (in m)	Not applicable	Yelahanka Lake, 0.5 km, south-west Puttenahalli Lake: 0.6 km, south-west

* *From highest flood line/high tide line*

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VI. Whether any of the following exist within 7 km. of the periphery of the project site. If so, please indicate aerial distance and the name of the eco-system as given under the Table.

S. No		Name	Area falling within 7 km periphery of project (ha.)	Aerial Distance, km
1	National Park/Wildlife Sanctuary	None		
2	Tiger Reserve/Elephant Reserve/Turtle Nesting ground	None		
3	Core Zone of Biosphere Reserve	None		
4	Habitat for migratory birds	None		
5	Lakes/Reservoir/Dams	Puttenhally Lake Yelahanka Lake Allalasandra Lake Jakkur Lake Attur Lake	100% 100% 100% 100% 100%	0.7 km, W 0.3 km, E 2.6 km, S 3.8 km, SE 2.6 km, W
6	Stream/Rivers	None		
7	Estuary/Sea	None		
8	Mangroves	None		
9	Mountains/Hills			
10	Notified Archaeological sites	None within 7 km		
11	Any other Archaeological sites -	None within 7 km		
12	Industries/Thermal Power Plants	Rail Wheel Factory Federal-Mogul Goetz India Pvt. Ltd. Many other industries in Yelahanka and Bangalore	100% 100%	0.5 km 1.5 km
13	Defence Installation	BSF Campus	100%	2.5 km, NE
14	Airports	YelahankaAirforce Station	100%	2.7 km, NE

If located within limits of municipal bodies, please confirm: Located within limits of Bruhat Bangalore MahanagarPalika.

From National/ State Highways and railway lines, distance of 0.5 km should be maintained: The project area is located between Bangalore – DoodaballapurHindupur Road (SH-9) and Railway line, within 100 m distances.

If located in the landing funnel of the airport, clearance from Airports Authority of India should be obtained: The project site is 2.7 km to the west of YelahankaAirforce Station. However, the site does not fall in the landing funnel as orientation of the runway is North-South.

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VII. Description of the flora/vegetation within 7 km under following headings.

A.	Agricultural crops	:	Paddy, Millet, etc.
B.	Commercial crops	:	Grapes, Clove, etc.
C.	Plantation	:	Mango, Tamarind, Jack fruit, Guava,
D.	Natural Vegetation/Forest Type	:	South Indian Thorn Scrub&South Indian Dry Deciduous type forests
E.	Grass Lands	:	The Bamboo type forests andThe Evergreen Shola type
F.	Endangered species	:	Not reported
G.	Endemic species	:	Not reported
H.	Others (Please Specify)	:	NA

VIII. Description of fauna (non-domesticated) within 7 km under the following headings

A.	Total listing of faunal elements	:	Pl. refer to Tables 4-31 to 4-34.
B.	Endemic fauna species	:	Not identified during field visit
C.	Endangered species	:	No schedule I specie reported. However, many Schedule II & IV species reported in the study area.
D.	Migratory species	:	Reported in the lakes.
E.	Route of migratory species of birds & mammals	:	The site does not fall in the route of migratory birds.
F.	Details of aquatic fauna (if applicable)	:	Pl. refer to Section 4.8.6.

IX. Meteorological Parameters

A.	Seasonal Data (continuous monitoring for full pre-monsoon season of 2015)		
	1. Temperature (in °C)	:	Maximum : 39 Minimum : 17 Mean : 29.0
	2. Rainfall (mm)	:	Maximum : 287 Minimum : 0 Mean : 53
	3. Mean value of humidity (%)	:	65
	4. Inversion occurrence	:	Not recorded
	5. Seasonal windrose pattern (16 points on compass scale)	:	Please refer to figure 4.4.

B. Hourly Mean Meteorological data (continuous monitoring for full pre-monsoon season of 2014)

Hour	Low/Medium Cloud amount (in OCTAS)	Wind Speed in (Km/h)	Predominant wind direction	Ambient air temperature (in deg K)	Realtive humidity, %	Mixing depth (in m) (CPCB data)
1	2.3	1.5	W	26.1	42.1	400
2	2.3	1.5	SW	27.3	39.0	400
3	2.3	1.7	W	29.0	35.0	400
4	2.3	1.8	SW	30.7	31.3	400
5	2.5	1.7	SW	32.1	28.0	750

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	6	2.4	1.4	SSW	33.2	25.1	750
	7	2.3	1.5	S	34.0	23.1	900
	8	2.4	1.7	S	34.6	21.7	750
	9	2.2	1.7	S	35.1	20.6	900
	10	2.6	1.7	SSW	35.5	20.3	900
	11	2.6	1.9	SSW	35.5	20.1	900
	12	2.3	1.7	S	35.3	20.7	900
	13	2.3	1.5	S	34.5	21.9	900
	14	2.3	1.4	W	33.6	22.8	900
	15	2.2	1.7	SSW	32.8	24.3	900
	16	2.4	1.6	SSW	32.1	25.5	900
	17	2.6	1.5	SSW	31.2	27.4	900
	18	2.5	1.4	SW	30.4	29.0	900
	19	2.8	1.5	SW	29.6	31.1	750
	20	2.4	1.6	SW	28.8	33.8	400
	21	2.3	1.6	WSW	27.9	35.9	400
	22	2.5	1.8	WSW	27.2	38.0	400
	23	2.6	1.7	WSW	26.6	40.1	400
	24	2.5	1.8	W	26.1	42.0	400

X. Ambient Air Quality Data

[Frequency of Monitoring should be as per guidelines of CPCB and monitoring should cover one full season (excluding monsoon)]

A.	Season and period for which monitoring has been carried out	:	Season: Pre-monsoon season of 2015 Period: March to May, 2015 No. of monitoring locations:8
B.	Frequency of sampling	:	2 days/week/location
C.	Number of samples collected at each side	:	12 (Daily monitoring results are presented in Tables 4- 12 to 4-19.
D.	24 hourly concentrations (in µg/m3)	:	

Pollutant(s)	Maximum	Minimum	Mean	98%
PM_{10}	78 to 91	68 to 78	68 to 82	78 to 89
$PM_{2.5}$	42 to 51	34 to 44	38 to 47	42 to 51
SO_2	7 to 12	ND to 6.4	5 to 9	7 to 12
NO_x	11 to 22	9 to 12	10 to 17	11 to 22
CO	730 to 1100	430 to 730	730 to 903	731 to 1077

E.	Specific air pollution issues in the project area	:	

XI. Water Requirements (cum/day)

Purpose		Avg. Demand	Peak Demand	Source	Type Treated / untreated/Fresh /Recycled	Remarks
A.	Project					
	1. Process	Nil	Nil			

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	2. Cooling water	12,600	12,600	BWSSB STP	Untreated	
	3. DM water	360	360	BWSSB STP	Treated	
	4. Dust suppression	Nil	Nil	-		
	5. Drinking	100	100	Ground water	Untreated	
	6. Green Belt	480	480	Guard Pond	Treated effluent	
	7. Fire Service	240	240	Guard Pond	Treated effluent	
	8. Plant washing	240	240	Guard Pond	Treated effluent	
	9. Service water	480	480	BWSSB STP	Treated (RO-1)	
	10. Treatment losses	480	480	BWSSB STP	Untreated	
	11. Dilution water	480	480	BWSSB STP	Untreated	
B.	Township					
	1. Green Belt	NA	NA			
	2. Drinking	NA	NA			
	3. Others (pl. specify)	NA	NA			
C.	Total (Treated sewage)	14,440	14,440			
	Total (wastewater)	960	960			
	Total (ground water)	100	100			

XII. Source of Raw Water Supply

S.N	Source		Cu.m./hr	Cu.m./day
1	Sea	:	Nil	Nil
2	River	:	Nil	Nil
3	Groundwater	:	4-4.5	100
4	Tertiary treated sewage water from STP of BWSSB at Jakur	:	600	14,400

XIII. Lean Season flow in case of surface water source (cusecs/cumecs): Not applicable

XIV. Groundwater

A.	Recharge Rate	:	3290 hectare metre in Bangalore
B.	Withdrawal rate	:	3 times of recharge
C.	Ground water level (metres)		
	1. Pre-monsoon	:	49 mbgl
	2. Post-monsoon	:	35 mbgl

XV. Competing Users of the Water Source : Not applicable, the tertiary treatment facilities are being established BWSSB for the proposed project.

Sl. No.	Usage	Present Consumption (cu.m/day)	Addition Proposed as per local plan (cu.m./day)	Total (cu.m./day)
1	Irrigation			
2	Industry			
3	Drinking			
4	Others (Please specify)			

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Total			

XVI. Physico chemical analysis of Raw Water at intake point

Please refer to table 3-XX.

XVII. Physico chemical analysis of treated water to be used in project/township.

No treatment required for cooling water system. However, for make up to the BFW and the DMCW and the HVAC systems, RO and MB plant is proposed.

XVIII. Waste Water Management

A.	Description of waste water treatment plan with flow chart		
	1. Coal storage	:	Not applicable
	2. Other than coal storage	:	Blowdown from CW system and the HRSG will be sent directly to the Guard Pond. Wastewater from RODM Plant will be collected in the neutralization Pit, neutralized, and sent to the Guard Pond. Plant washings will be treated in Lamella Clarifier for removal of oil and suspended solids, followed by discharge into Guard Pond. Dilution water (raw water) will be added in the Guard Pond to maintain TDS level at approx. 200 mg/l. Part of wastewater will be utilized for washing, plantation and fire-water make-up, and balance discharged into nearby drain.

B.	Composition/characteristics of discharge stream(s) before and after treatment		
	Sl. No. / Item	Characteristics: Before treatment	After treatment
	1.		
	2.		
	3.		
	4.		
	5.		
	6.		

C.	Daily discharge (cu.m./day) from different sources		
	1. Cooling	:	4200
	2. Processing	:	180
	3. D.M. Plant effluent	:	480
	4. Domestic	:	-
	5. Others (Dilution water)	:	480
	6. Total	:	5340
D.	Quantity of water recycled		
	In %	:	18%
	In cu.m/day	:	960
E.	Details of recycling mechanism	:	Wastewater from the Guard Pond shall be utilized for plantation, Plant washing

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			and Fire-water make-up.	
F.	Mode of final discharge/disposal of treated effluent			
	S.N.	Mode	Length (in m.)	Quantity(in cu.m/day)
	1	Open Channel	500	4,380
	2.	Pipeline		
	3.	Others (Please specify)		
				4,380
G.	Point of final discharge:			
	S.N.	Final Point		Quantity (in cu.m/day)
	1.	Green belt within the plant/township		480 (shown under recycle)
	2.	Agricultural land		Nil
	3.	Fallow Land		Nil
	4.	Forest Land		Nil
	5.	River/Stream		Nil
	6.	Lake (Yelahanka lake)		4,380
	7.	Estuary		Nil
	8.	Sea		Nil
		Total		4,380
I.	Lean season flow rate in case of discharge in a river/stream (cusecs/cumecs)	:	Not applicable	
	1. Human use	:		
	2. Irrigation	:		
	3. Industry	:		
	4. Others (pl. specify)	:		
K.	Analysis of river water 100 metres upstream of discharge point and 100 metresdownstream of discharge point (except in rainy/monsoon season) along with detailsof aquatic life	:	Analysis report of Yelahanka lake water is given in Table-4-24(SW-1).	
L.	What is the predicted impact on water quality of the receiving body due todischarge? (Briefly state the prediction tool adopted)	:	Characteristics of the wastewater will be within specified limits for discharge of effluents into Inland Surface water Bodies. However, slight increase in TDS and nutrients is foreseen.	

XIX. Quantity of fly ash/residue produced per day (tonnes)

			Dry	Wet
A.	Flu Ash	:	Not applicable	
B.	Bottom Ash	:	Not applicable	
C.	Others, pl. specify	:	Not applicable	
	Total	:	Not applicable	

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XX. Solid Waste Management

A.	Details of solid waste		:	
	S.N.	Source	Quantity (TPM)	Form
	1.	Raw water treatment plant	Not applicable	Not applicable
	2.	ETP (oily sludge)	Approx 0.1	Sludge
	3.	Process	Not applicable	Not applicable
	4.	Oil & Chemical containers	Approx 0.2	Solid, metallic
	5.	Spent oil	Approx 0.5	Viscous liquid
	6.	Domestic wastes	Approx 1.0	Solid
B.	If waste(s) contain any hazardous/toxic substance/radioactive materials or heavymetals, provide data and proposed precautionary measures.		:	ETP sludge, spent oil and containers are hazardous wastes.
C.	What are the possibilities of recovery and recycling of wastes?		:	Not applicable
D.	Possible users of Solid Waste (s).		:	Not applicable

XXI. Method of disposal of solid waste (s)

	Method		Qty(TPM)
A.	Landfill	:	Nil
B.	Incineration	:	Nil
C.	Recovery	:	Nil
D.	Downstream Users	:	0.7 (Spent oil and containers)

XXII. Please indicate the methods used for handling ash

A.	Collection	:	Not applicable
B.	Transport	:	Not applicable
C.	Disposal	:	Not applicable

XXIII. Utilisation of ash (tonnes per day)

A.	Proposed use		
	1. Bricks	:	Not applicable
	2. Cement	:	Not applicable
	3. Road construction	:	Not applicable
	4. Landfill	:	Not applicable
	5. Soil amendment	:	Not applicable
	6. Others (Pl. specifiy)	:	Not applicable
B.	In case of landfill		
	1. Is solid amenable for landfill?	:	Not applicable
	2. Dimensions of landfill	:	Not applicable
	3. Life of landfill (Years)	:	Not applicable
	4. Proposed precautionary and mitigation measures along with design features	:	Not applicable
C.	Indicate the phased programme for	:	Not applicable

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	utilisation of fly ash. (Number of years for fullutilization, area etc.)		

XXIV. Noise Pollution Control and Management

A.	Source	:	Air inlet & exhaust gas streams, Steam turbine generator, Gas turbine, Combustion induced noise, flow induced noise, Sateam safety valves, Cooling tower fans, etc.
B.	Level at source (dB)	:	85 to 90 db(A) at 1.5 m from source
C.	Level at Project boundary (dB)	:	56-69 dB(A)
D.	Abatement measures (give source-wise details)	:	Manufacturers of machines will guarantee that the noise level at 1.5 m from source does not exceed 90 dB(A).

XXV. Fuel Requirements

A.	Details of Fuel used					
	Fuel	Daily Consumption (TPD)		Calorific value (Kcals/kg)	% Ash	% Sulphur
		Existing	Proposed			
1	Gas	Nil	1027	11577	Nil	<0.0024
2	Naphtha	-	-	-	-	-
3	HSD	-	-	-	-	-
4	Fuel Oil	-	-	-	-	-
5	Coal	-	-	-	-	-
6	Lignite	-	-	-	-	-
7	Other (Pl. specify)	-	-	-	-	-

B.	Source of fuel (Distance in km)		
	1. Port	:	Not applicable
	2. Mine	:	Not applicable
	3. Refinery	:	Not applicable
	4. Storage depot/terminal	:	GAIL's Tap-off Point (SV-38) at Hebbal Flyover Junction on Ring Road, route survey by GAIL is under process.
C.	Mode of Transportation of fuel to site		
	1. Trucks (numbers/day)	:	Not applicable
	2. Pipeline(length in km.)	:	10-15 km
	3. Railway Wagons (numbers/day)	:	Not applicable

XXVI. Coal handling and dust suppression

Give details of dust suppression/collection equipment for reducing pollution from coal fines and other fugitive emissions from coal handling

A.	Wagon tippling	:	Not applicable
B.	Conveyer transfer points	:	Not applicable
C.	Storage	:	Not applicable
D.	Crushing mills	:	Not applicable

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E.	Bunker filling	:	Not applicable
F.	Other (pl. specify)	:	Not applicable

XXVII. Emissions and Stack details

A. Flue gas characteristics

	Pollutant	Source of Emission	Emission rate, kg/hr	Concentration in flue gas, (mg/Nm³)
1	SPM	Not applicable	Nil	absent
2	RPM	Not applicable	Nil	absent
3	SO_2	HRSG stack	2.05	51
4	NOx	HRSG stack	81.6	<1.5

B. Size distribution of SPM at the top of the stack

Size range		% by weight
< 1 Micron	:	Not applicable
1-10 Micron	:	Not applicable
10-20 Micron	:	Not applicable
> 20 Micron	:	Not applicable

C. Stack emission details
- Frequency of stack emission monitoring as per CPCB guidelines
- Emission rate for each pollutant (kg/hr)

Sl. No.	Stack Attached to	Stack Height (m)	Stack Internal diameter (m)	Temp. of exhaust gases (deg-K)	Exit Velocity (m/sec)	SPM	SO2	NOX	Heat emission rate (kcal/hour)
1	HRSG	45	5.9	370	21.9	Nil	2.05	81.6	12.89 x 10^6
2									
3									
4									
5									

D.	Equipment used for stack monitoring	:	On-line NOx monitor for realtime monitoring of NOx concentration.

XXVIII. Predicted impact on air quality (as per CPCB Guidelines for conducting the air quality modelling):

Results of dispersion modelling of expected stack emissions demonstrate that the maximum 24-hr average incremental concentrations of NOx and SO2 will be 2.42 and 0.06 µg/m3, which are insignificant, and will have practically no impact on existing ambient air quality.

XXIX. Storage of chemicals (inflammable/explosive/hazardous/toxic substances)

Not applicable

Sl. No.	Name	Number of Storages	Capacity (TPD)	Physical and Chemical Composition	Consumption (in TPD)	Maximum Quantity of storage at any point of time	Source of Supply	Means of transportation

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XXX. Occupational Health and Industrial Hygiene

A.	What are the major occupational health and safety hazards anticipated? (Explain briefly)	:	Exposure to fire, explosion and thermal radiation due to handling of flammable gas and high pressure steam.
B.	What provisions have been made/ propose to be made to conform to health/safety requirements. (Explain briefly)	:	Proper precautionary measures shall be taken for the workers, engaged and shall be examined regularly for various relevant diseases.
C.	Details of personal protective equipment provided/to be provided to the workers	:	Helmets, safety shoes, face shields, nose masks, ear plugs, etc.
D.	Details of proposed measures for control of fugitive emission/odour nuisance from different sources,	:	Not applicable
E.	Details of fire protection and safety measures envisaged to take care of fire and explosion hazards	:	Elaborate fire detection and fighting system would be provided as per the requirement of TAC

XXXI. Green Belt Plan

A.	Total area of project / township (in ha.)	:	26.4 ha. available for plant location
B.	Area already afforested (for existing projects), in ha	:	4
C.	Area proposed to be afforested (in ha.)	:	9 (including strengthening of area already afforested)
D.	Plant species proposed		
	1. Indigenous	:	Chapter 10, Green Belt Development
	2. Exotic	:	Chapter 10, Green Belt Development
E.	Width of green belt (minimum, in metres)		
	1. Along plant boundary	:	5 to 50
	2. Roads and avenues within the plant	:	3
	3. Ash Dike	:	Not applicable
	4. Township	:	Existing, will be strengthened
	5. Other-ornamental, garden spaces, Commercial plantations etc.	:	5
F.	Trees planted & proposed		
	1. Planted and survival rate	:	Approx. 4 ha. is under plantation
	2. Proposed	:	9 (including strengthening of existing)
	3. List of species planted	:	Chapter 10, Green Belt Development

XXXII. Construction Phase

A.	Estimated duration of construction in months	:	31

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B.	Number of persons to be employed forconstruction, ➢ Peak ➢ Average	: :	 1550 700
C.	What provision has been made for the sewage treatment for the constructionworkers?	:	Since the project is in close proximity with the city, no settlement inside the project premises is envisaged.The existing washrooms and a few temporary toilets will be provided for use during working hours and the sewage will be treated by providing septic tanks followed by soak pits.
D.	How the fuel (kerosene/wood, etc.) requirement of labour force will be met toavoid cutting of trees from the adjoining areas	:	Cooking will not be permitted. Canteen facilities will be provided. Additionally, local restaurants outside the plant premises are also available.
E.	Proposed Health care Measures with emphasis on protection from endemicdiseases.	:	Drinking water will be provided to resist any water borne disease.
F.	Educational and other social welfare measures proposed	:	Not proposed as residential accommodation for workforce is not proposed.

XXXIII. Human Settlement

	Aerial distance from the periphery of the site		
	Upto 500m from periphery	500m to 3000 m from the periphery	3000m to 7000m from the periphery
Population	36602	100115	338496
Number of Houses	9506	25188	82758
Present Occupational Pattern	46.08	12.27	42.12

XXXIV. Rehabilitation & Resettlement Plan (Wherever applicable)

A.	Village(s) affected by the project: **Not applicable**			
Sl	Village (Tribal/Others)	Population	Occupation	Average Income per annum
1				
2				
3				
4				
B.	Population to be displaced: **Not applicable**			
	Name of Village	Population		
Sl		Land oustees only	Homestead Oustees	Land and

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			only	Homestead oustees
1				
2				
3				
4				

C.	Salient features of Rehabilitation Plan for oustees: Not applicable		
1	Site where the people are proposed to be resettled	:	
2	Facilities proposed at the resettlement site	:	
3	Compensation package	:	
4	Agency/Authority responsible for their resettlement	:	

XXXV. Pollution Control Aspects

A.	Details of Pollution Control Systems		
Sl.	Control system for	Existing	Proposed to be installed
1	Air	Not applicable	Dry Low NOx Burners
2	Water	Not applicable	Neutralizing pits, Guard ponds, Settling tanks, oil separators, Effluent treatment plant
3.	Noise	Not applicable	Acoustic hood, silencers for noise generating equipment
4	Solid Waste	Not applicable	Disposal through approved agencies.

B. Efficiency of each pollution control equipment/system installed for the existingunits Not applicable

Sl.	Name of the System/ Equipment	Design Efficiency %	Present Working efficiency %
1			
2			
3			

XXXVI. Expenditure on Environmental Measures

A.	Capital cost of the project (as proposed to approved by the fundingagency/ financial institutions (Rs. Lakhs)	:	1571 Crore
B.	Cost of environmental protection measures (Rs. Lakhs)	:	

Sl		Recurring Cost per annum	Capital Cost
1	Air Pollution Control	20	200
2	Water Pollution Control	30	300

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3	Noise Pollution Control	1	10
4	Environment Monitoring and Management	2	20
5	Reclamation borrow/mined area		
6	Occupational Health	1	10
7	Green Belt	10	100
8	Others (Pl.Specify)	2	10

C.	Details of organizational set up/cell for environmental management and monitoring	:	A separate environmental group will be established to implement environmental management plan including environmental monitoring.
D.	Details of community welfare/peripheral development programmesenvisaged/being undertaken by the project proponent	:	Details described in Chapter 10, Corporate Social Responsibility.

XXXVII. Public Hearing details

A.	Date of advertisement	:	Not applicable
B.	Newspapers in which the advertisement appeared(with copies)	:	Not applicable
C.	Date of Hearing	:	Not applicable
D.	Panel present	:	Not applicable
E.	List of public present along with address andoccupation	:	Not applicable
F.	Summary/details of public hearing repor	:	Not applicable

Sl	Issues raised	Recommendation of panel	Response of Project Proponents
1	Not applicable		
2	Not applicable		

The data and information given in this Performa are true to the best of my knowledge and belief.

Date : 23-07-2015

Place : Bengaluru

Signature :

Name : Mr. N Shankar,
Chief Engineer (EI & TA)

Address : Karnataka Power Corporation Limited,
22/23, Sudharshan Complex,
Sheshadri Road,Bengaluru –'560009

Seal of the Organization : Chief Engineer (EI&TA)
Karnataka Power Corporation Ltd
"Sudarshan Complex"
No. 22/23, Seshadri Road
BANGALORE-560 001

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ANNEXURE

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ANNEXURE-I

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By Speed Post

No. SEIAA 20 IND 2014
STATE LEVEL EXPERT APPRAISAL COMMITTEE, (SEAC)
KARNATAKA

Department of Ecology and Environment
M.S. Building, Bangalore: 560 001.
Dated: 19th January 2015.

To

The Chief Engineer (EI & TA),
M/s. Karnataka Power Corporation Ltd.,
22/23, Sudharshan Complex, Sheshadri Road,
Bengaluru-560 009

Sir,

Sub: Proposal for establishment of 1X350MW Gas based Yelahanka Combined Cycle Power Plant at Sy. Nos. 44(P), 45, 46, 47/1-2, 48, 56/1 to 9, 57, 58, 59, 60/1-2, 61, 62/1-2, 63, 64, 65, 66/1-2, 67 of Puttenahalli village, 24, 25, 26-P, 28P of Kenchanahalli village, Yelahanka, Bengaluru District of M/s. Karnataka Power Corporation Ltd. - ToRs - Regarding.

* * * *

Please refer to your letter No. CE(EI&TA)/ENV/YEL/833 dated 20.12.2014 along with Form-1 and proposed ToRs as per the EIA Notification, 2006.

2. The proposal is for establishment of 1X350MW gas based combined cycle power plant at Sy. Nos. 44(P), 45, 46, 47/1-2, 48, 56/1 to 9, 57, 58, 59, 60/1-2, 61, 62/1-2, 63, 64, 65, 66/1-2, 67 of Puttenahalli village, 24, 25, 26-P, 28P of Kenchanahalli village, Yelahanka, Bengaluru District.

3. The State Expert Appraisal Committee, Karnataka has considered the project during its meeting held on 13th and 14th January 2015. Based on the consideration of the documents submitted and the presentation made by you and the Environment Consultant, the Committee categorized the said proposal as B1 and has decided to prescribe the following Terms of Reference (ToRs) for preparing draft EIA report for the above mentioned project:

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1. Executive Summary of the project giving a prima facie idea of the objectives of the proposal, use of resources, justification, etc. in addition, it should provide a compilation of EIA report, EMP and the post-project monitoring plan in brief.
2. Conformity of the site with the prescribed guidelines in terms of distance of 500 m from HFL of the river, highways and railway lines should also be shown.
3. All the coordinates of the plant site to be shown on toposheet.
4. The study area should cover an area of 10 km radius around the proposed plant site.
5. Land requirement for the project to be optimized. Item wise break up of land requirement and its availability to be furnished. The norms prescribed by Central Electricity Authority (CEA) should be kept in view. The issue related to land acquisition and R & R should be clearly discussed in EIA report.
6. Location of intake and outfall points (with coordinates) should be given. These locations should be selected based on modeling studies. Details of modeling and the results obtained there from should be furnished. Details of desalination plant, if any, and disposal of sludge.
7. Topography of the area should be given clearly indicating whether the site requires any filling. If so, details of filling, quantity of fill material required, its source, transportation etc. should be given.
8. Impact on drainage of the area and the surroundings.
9. Information regarding surface hydrology, water regime and impact of the same, if any due to the project.
10. Surface water quality of nearby river (60 m upstream and downstream) and other surface drains at eight locations must be ascertained.
11. One season site-specific meteorological data shall be provided.
12. Action plan to follow National Ambient Air Quality Emission Standards issued by the Ministry vide G.S.R. No. 826(E) dated 16th November, 2009 should be included.
13. Ambient air quality at 8 locations within the study area of 10 km aerial coverage from project site.
14. One complete season AAQ data (except monsoon) to be given along with the dates of monitoring. The parameters to be covered shall include SPM, RPM, SO2, NOx, Hg and Ozone (ground level). The location of the monitoring stations should be so decided so as to take into consideration the pre-dominant downwind direction, population zone and sensitive receptors including reserved forests. There should be at least one monitoring station in the upwind direction. There should be at least one monitoring station in the predominant downwind direction at a location where maximum ground level concentration is likely to occur.
15. Impact of the project on the AAQ of the area. Details of the model used and the input data used for modeling should also be provided. The air quality contours may be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any. The wind roses should also be shown on this map.

16. Quantity of fuel required, its source and transportation. Details of gas supply agreement / commitment to be provided.
17. Examine the feasibility of zero discharge. In case of any proposed discharge, its quantity, quality and point of discharge, users downstream etc. should be provided. The effluent shall be treated and reused to meet the service and greenbelt development water requirement.
18. Details of greenbelt i.e. land with not less than 1500 trees per ha giving details of species, width of plantation, planning schedule etc.
19. Detailed R&R plan/compensation package in consonance with the National / State R&R Policy for the project affected people including that due to fuel transportation system / pipeline and their ROW, if any, shall be prepared taking into account the socio economic status of the area, homestead oustees, land oustees, landless labourers.
20. Details of flora and fauna duly authenticated should be provided. In case of any scheduled fauna, conservation plan should be provided.
21. Details regarding infrastructure facilities such as sanitation, fuel, restroom, medical facilities, safety during construction phase etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase.
22. Measures of socio economic influence to the local community proposed to be provided by the project proponent. As far as possible, quantitative dimensions to be given.
23. Environmental Management Plan to mitigate the adverse impacts due to the project along with item wise cost of its implementation.
24. Risk assessment including fire and explosion issues due to storage and use of fuel should be carried out. It should take into account the maximum inventory of storage at site at any point in time. The risk contours should be plotted on the plant layout map clearly showing which of the proposed activities would be affected in case of an accident taking place. Based on the same, proposed safeguard measures should be provided. Measures to guard against fire hazards should also be provided.
25. Any litigation pending against the project and /or any direction /order passed by any Court of Law against the project, if so, details thereof.
26. Details of water balance (water intake, use, wastewater generation) taking into account reuse and re-circulation of effluents. Additional water conservation measures, if any, proposed for the project.
27. Land use of study area should include data about the residential/institutional/nearest village/ township/ locality/ housing society, etc., based on the satellite imagery.
28. If ecologically sensitive attributes fall within a 10 km radius of the project boundary, proponent shall describe the sensitivity (distance, area and significance) and propose the additional points based on significance for review and acceptance by the State Expert Appraisal Committee (SEAC). A map

marking the location of such areas (existing or proposed) duly authenticated by the Chief Wildlife Warden. Ecological sensitive attributes include:

- National Parks.
- Wildlife Sanctuaries Game Reserve.
- Tiger Reserve/Elephant Reserve.
- Breeding Grounds.
- Habitat for migratory birds.
- Areas with threatened (rare, vulnerable, endangered) flora/fauna.
- Wetlands.
- Zoological Gardens.
- Reserved Forests/ Protected Forests.
- Any other closed/protected area under the Wild Life (Protection) Act, 1972, any other area locally applicable.

32. If the plant location falls in a valley, studies on specific issues connected to the management of natural resources.
33. Impact on drainage of the area and the surroundings.
34. Details of rainwater harvesting and its proposed usage in the plant.
35. Action plan for the green belt development Details of greenbelt giving details of species, width of plantation, planning schedule, etc.
36. Green belt shall be developed in atleast 33 % of plant area as per the CPCB guidelines in consultation with the DFO.
37. Proposed measures for occupational safety and health of the workers.
38. Details of alternative sources of energy such as photovoltaic cells use in the plant for various applications.
39. Details on improved technologies.
40. Appropriate monitoring network has to be designed and proposed for regulatory compliance and to assess the residual impacts, if any.
41. Detailed compensation package for the people affected by the project shall be prepared, considering the socio-economic status of the area, homestead oustees, land oustees, and landless labourers.
42. Proposed post-project monitoring programme to ensure compliance to the approved Management Plan including administrative and technical organizational structure.
43. Details of alternative sites for the proposed project.
44. Disaster Management Plan.
45. Source of water for the project and necessary clearance.
46. The EIA studies should also take into account another power plant proposed (if any) in the same village.

47. At least 5 % of the total cost of the project should be earmarked towards the corporate social responsibility and item-wise details along with time bound action plan should be included. Socio-economic development activities need to be elaborated upon.

Additional Corporate Environmental Responsibility:-

(i) (a) Does the company have a well laid down Environment Polity approved by its Board of Directors? If so, it may be detailed in the EIA report.

(b) Does the Environment Policy prescribe for standard operation process/procedures to bring into focus any infringement/deviation/violation of the environmental or forest norms/conditions? If so, it may be detailed in the EIA.

(ii) What is the hierarchical system or Administrative order of the company to deal with environmental issues and for ensuring compliance with the Environmental Clearance conditions details of this system may be given.

(iii) Does the company have a system of reporting of non-compliances/violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism should be detailed in the EIA report.

PLEASE NOTE:

1. The project proponent shall submit an undertaking as a part of the EIA report, owning the contents (information and data) of the EIA report in view of the O. M. No. J-11013/41/2006-IA-II(I) dated: 05.10.2011 issued by MoEF, GoI and

2. The project proponent shall submit the filled up information in the enclosed Format "Declaration by experts contributing to the EIA" thus forming it the first page of their EIA report. Otherwise, it will be at the project proponent's risk.

Additional ToRs:

1. Study of source of water and impact on the competitive users of the treated sewage of BWSSB.
2. Mode of disposal of the DM water reject and its impact.
3. Impact on the Puttenahalli and Yelahanka lakes.
4. Monitoring Methane and Carbon Monoxide along with PM_{10}, $PM_{2.5}$ NO_2 and SO_2
5. Impact of cumulative noise pollution due to the railway station, wheel and axel plant and the proposed activity and mitigation measures thereon.

6. Impact on the Temperature and Humidity levels of the surrounding area due to the proposed activity.
7. Risk assessment and disaster management plan within the plant and in the Surroundings of up to 500 m.

The ToRs prescribed by the State Expert Appraisal Committee, Karnataka should be considered for the preparation of EIA / EMP report for the above mentioned project in addition to all the relevant information as per the Generic Structure of EIA given in Appendix III and IIIA in the EIA Notification, 2006.

The consultants involved in the preparation of EIA/EMP report after accreditation with Quality Council of India/National Accreditation Board of Education and Training (QCI/NABET) would need to include a certificate in this regard in the EIA/EMP reports prepared by them and the data provided by other Organization(s)/Laboratories including their status of approvals etc. In this regard Office Memorandum No. F. No. J-11013/77/2004-IA.II(I) dated 30th June, 2011 available on the MoEF, GoI website http://www.moef.nic.in may please be referred.

The project is exempted from the applicability of public consultation in accordance with Para 7(i)(III)(i)(b) of the Notification No. S.O 1533(E) dated 14th September 2006 as the proposed activity is located within a notified industrial area.

Yours faithfully

For Secretary,
State Expert Appraisal Committee
(SEAC)

Copy to:-

1. The Secretary, Department of Ecology and Environment, Govt. of Karnataka, Bangalore
2. Chairman, Karnataka State Pollution Control Board, Parisar Bhavan, 4th & 5th Floor, Church street, Bangalore -560 001
3. Guard File.

ANNEXURE-II

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Yelahanka

Yelahanka

Yelahanka\Pressure vessel\Leak

Base Case

CASE Name: Data

Path: Yelahanka\Pressure vessel\Leak

User-Defined Data

Scenario

Direction

[Outdoor release direction Horizontal]

Hole

Orifice diameter 50 mm

Use specified discharge coefficient? No

Release location

[Elevation 1 m]

Material

Material

[Material characteristics Flammable only]

[Material to track METHANE]

Phase

[Phase to be released Vapour]

Discharge parameters

Droplet breakup mechanism

[Droplet break-up mechanism - instantaneous Use flashing correlation]

[Droplet break-up mechanism - continuous Do not force correlation]

Model settings

[Atmospheric expansion method Closest to initial conditions]

[Is flashing allowed to the orifice? No flashing in the orifice]

Dispersion

Dispersion scope

[Specify user-defined averaging time No]

Bund, building and terrain: Default Terrain

Dispersing surface

[Surface over which the dispersion occurs Land]

[Surface roughness length User-defined]

[User-defined length 183.156 mm]

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Bund, building and terrain: No Bund
Bund properties
[Bund height 0 m]
[Bund area (internal) 0 m2]
[Bund failure modeling Bund cannot fail]

Surface for pools
[Type of surface for pools Concrete]

Bund, building and terrain
Building definition
[Specify a release building No]

Toxic parameters
Exposure time data
[Set averaging time equal to exposure time Use a fixed averaging time]

Indoor toxic calculations
[Specify the downwind building type Unselected]

Toxic contours
[Number of toxic levels 4]
[Dose levels(1) 130000]
[Dose levels(2) 1.3E+06]
[Dose levels(3) 1.3E+07]
[Dose levels(4) 1.3E+08]
[Probit levels(1) 2]
[Probit levels(2) 3]
[Probit levels(3) 4]
[Probit levels(4) 10]
[Lethality levels(1) 0.001 fraction]
[Lethality levels(2) 0.01 fraction]
[Lethality levels(3) 0.1 fraction]
[Lethality levels(4) 0.99 fraction]

Explosion parameters
Ignition:
[Supply late ignition location No ignition location]

Vapour liquid method
[Use of explosion mass modification factor Early and late explosions]
[Explosion mass modification factor 3]

Fireball
Calculation method
[Fireball model Recommended]

Parameters

[Mass modification factor 3]

Radiation levels
[Number of input radiation levels 3]
[Intensity levels(1) 4 kW/m2]
[Intensity levels(2) 12.5 kW/m2]
[Intensity levels(3) 37.5 kW/m2]

Result types to calculate
[Calculate probit No]
[Calculate dose No]
[Calculate lethality No]

Jet fire
Cone model data
[Horizontal options Use standard method]
[Correlation Recommended]

Jet fire method
[Jet fire method Cone model]

Parameters
[Rate modification factor

Radiation levels
[Number of input radiation levels 3]
[Intensity levels(1) 4 kW/m2]
[Intensity levels(2) 12.5 kW/m2]
[Intensity levels(3) 37.5 kW/m2]

Result types to calculate
[Calculate probit No]
[Calculate dose No]
[Calculate lethality No]

Surface emissive power
[Calculation method for surface emissive power Calculate SEP]

Path: Yelahanka\Pressure vessel\Leak

DISCHARGE DATA for Weather: \Weather Folder\Category 1.5/F

Wind Speed	1.50 m/s
Wind Speed at Height (Calculated)	0.46 m/s
Pasquill Stability:	F

USER-DEFINED QUANTITIES

Material	METHANE
Scenario	Leak

Inventory	196.00	kg
Fixed Duration	n/a	s
Stagnation data (data at upstream end for long pipe):		
- Pressure	41.01	bar
- Temperature	35.00	degC
- Fluid State	Pressurized gas	

CALCULATED QUANTITIES

Mass Flow of Air (Vent from Vapor Space only)	n/a	
Mass Flowrate	12.1748	kg/s
Release Duration	16.10	s
Orifice or pipe exit data (before atmospheric expansion):		
- Pressure	22.12	bar
- Temperature	-9.25	degC
- Vena Contracta Velocity (exit velocity for pipe releases)	414.83	m/s
- Discharge Coefficient	0.87	
Final data (after atmospheric expansion):		
- Temperature	-40.36	degC
- Liquid Mass Fraction	0.00	fraction
- Droplet Diameter	0E+000	um
- Expanded Radius	0.10	m
- Velocity	500.00	m/s

DISCHARGE DATA for Weather: Weather Folder\Category 5/D

Wind Speed:	5.00	m/s
Wind Speed at Height (Calculated)	3.21	m/s
Pasquill Stability:	D	

USER-DEFINED QUANTITIES

Material	METHANE	
Scenario	Leak	
Inventory	196.00	kg
Fixed Duration	n/a	s
Stagnation data (data at upstream end for long pipe):		
- Pressure	41.01	bar
- Temperature	35.00	degC
- Fluid State	Pressurized gas	

CALCULATED QUANTITIES

Mass Flow of Air (Vent from Vapor Space only)	n/a	
Mass Flowrate	12.1748	kg/s
Release Duration	16.10	s
Orifice or pipe exit data (before atmospheric expansion):		
- Pressure	22.12	bar
- Temperature	-9.25	degC
- Vena Contracta Velocity (exit velocity for pipe releases)	414.83	m/s
- Discharge Coefficient	0.87	
Final data (after atmospheric expansion):		
- Temperature	-40.36	degC

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- Liquid Mass Fraction	0.00	fraction
- Droplet Diameter	0E+000	um
- Expanded Radius	0.10	m
- Velocity	500.00	m/s

DISCHARGE DATA for Weather: Weather Folder\Category 1.5/D

Wind Speed:	1.50	m/s
Wind Speed at Height (Calculated)	0.96	m/s
Pasquill Stability:	D	

USER-DEFINED QUANTITIES

Material	METHANE
Scenario	Leak
Inventory	196.00 kg
Fixed Duration	n/a s

Stagnation data (data at upstream end for long pipe):

- Pressure	1.01	bar
- Temperature	35.00	degC
- Fluid State	Pressurized gas	

CALCULATED QUANTITIES

Mass Flow of Air (Vent from Vapor Space only)	n/a	
Mass Flowrate	12.1748	kg/s
Release Duration	16.10	s

Orifice or pipe exit data (before atmospheric expansion):

- Pressure	22.12	bar
- Temperature	-9.25	degC
- Vena Contracta Velocity (exit velocity for pipe releases)	414.83	m/s
- Discharge Coefficient	0.87	

Final data (after atmospheric expansion):

- Temperature	-40.36	degC
- Liquid Mass Fraction	0.00	fraction
- Droplet Diameter	0E+000	um
- Expanded Radius	0.10	m
- Velocity	500.00	m/s

Consequence Results

Distance to Concentration Results

Path: Yelahanka\Pressure vessel\Leak

The height for user defined concentrations is the user defined height 0 m
All toxic results are reported at the toxic effect height 0 m
All flammable results are reported at the cloud centreline height

Concentration(ppm)	Averaging Time		Distance (m)		
			Category 1.5/F	Category 5/D	Category 1.5/D
UFL (165000)	18.75	s	6.93446	6.51328	6.93039
LFL (44000)	18.75	s	38.4146	35.6221	36.6191
LFL Frac (22000)	18.75	s	86.5507	85.5027	82.937

Concentration(ppm)	Averaging Time		Heights (m) for above distances		
			Category 1.5/F	Category 5/D	Category 1.5/D
UFL (165000)	18.75	s	1.00186	1.00152	1.00184
LFL (44000)	18.75	s	0.79028	0.72194	0.654329
LFL Frac (22000)	18.75	s	3.95835	3.31698	2.96127

Jet Fire Hazard

Path: Yelahanka\Pressure vessel\Leak

Jet fire method used: Cone model - Recommended

	Category 1.5/F	Category 5/D	Category 1.5/D
Jet Fire Status	Truncated	Truncated	Truncated
Flame Direction	Horizontal	Horizontal	Horizontal

Radiation Effects: Jet Fire Ellipse

Path: Yelahanka\Pressure vessel\Leak

This table gives the distances to the specified radiation levels for each jet fire listed in the above hazard table

			Distance (m)		
			Category 1.5/F	Category 5/D	Category 1.5/D
Radiation Level	4	kW/m2	62.3999	62.3499	62.3999
Radiation Level	12.5	kW/m2	47.7144	49.6695	47.7144
Radiation Level	37.5	kW/m2	36.949	40.276	36.949

Fireball Hazard

Path: Yelahanka\Pressure vessel\Leak

	Category 1.5/F	Category 5/D	Category 1.5/D
Fireball Flame Status	Hazard	Hazard	Hazard

Radiation Effects: Fireball Ellipse

Path: Yelahanka\Pressure vessel\Leak

			Distance (m)		
			Category 1.5/F	Category 5/D	Category 1.5/D
Radiation Level	37.5	kW/m2	127.269	127.269	127.269
Radiation Level	12.5	kW/m2	68.2781	68.2781	68.2781
Radiation Level	4.73	kW/m2	28.5099	28.5099	28.5099

Flash Fire Envelope

Path: Yelahanka\Pressure vessel\Leak

All flammable results are reported at the cloud centreline height

			Distance (m)		
			Category 1.5/F	Category 5/D	Category 1.5/D
Furthest Extent	22000	ppm	86.5507	85.5027	82.937
Furthest Extent	44000	ppm	38.4146	35.6221	36.6191

			Heights (m) for above distances		
			Category 1.5/F	Category 5/D	Category 1.5/D
Furthest Extent	22000	ppm	3.95835	2.31598	2.96127
Furthest Extent	44000	ppm	0.79028	0.72194	0.654329

Explosion Effects: Early Explosion

Path: Yelahanka\Pressure vessel\Leak

Early Explosions are assumed to be centered at the release location
Explosion Model Used : ME

			Category 1.5/F	Category 5/D	Category 1.5/D
Supplied Flammable Mass			196	196	196

			Distance (m) at Overpressure Levels		
			Category 1.5/F	Category 5/D	Category 1.5/D
Overpressure	0.02068	bar	260.878	260.878	260.878
Overpressure	0.1379	bar	50.7035	50.7035	50.7035
Overpressure	0.2068	bar	38.0155	38.0155	38.0155

			Used Mass (kg) at Overpressure Levels		
			Category 1.5/F	Category 5/D	Category 1.5/D
Overpressure	0.02068	bar	196	196	196
Overpressure	0.1379	bar	Not Reachable	Not Reachable	Not Reachable
Overpressure	0.2068	bar	Not Reachable	Not Reachable	Not Reachable

Explosion Effects: Late Ignition

Path: Yelahanka\Pressure vessel\Leak

Explosion Model Used : Multi-Energy: Uniform confined
Explosion Location Criterion: Cloud front (LFL fraction)
All distances are measured from the Source
All flammable results are reported at the cloud centreline height

			Maximum Distance (m) at Overpressure Level		
			Category 1.5/F	Category 5/D	Category 1.5/D
Overpressure	0.02068	bar	172.767	162.237	166.341
Overpressure	0.1379	bar	98.0299	95.9832	96.781
Overpressure	0.2068	bar	93.5181	91.9836	92.5818

		Supplementary Data at 0.02068 bar		
		Category 1.5/F	Category 5/D	Category 1.5/D
Supplied Flammable Mass	kg	8.81296	6.13955	7.10559
Used Flammable Mass	kg	8.81296	6.13955	7.10559
Overpressure Radius	m	92.767	82.2366	86.3415
Distance to:				
- Ignition Source	m	80	80	80
- Cloud Front/Centre	m	80	80	80
- Explosion Centre	m	80	80	80

		Supplementary Data at 0.1379 bar		
		Category 1.5/F	Category 5/D	Category 1.5/D
Supplied Flammable Mass	kg	8.81296	6.13955	7.10559
Used Flammable Mass	kg	8.81296	6.13955	7.10559
Overpressure Radius	m	18.0299	15.9832	16.781
Distance to:				
- Ignition Source	m	80	80	80
- Cloud Front/Centre	m	80	80	80
- Explosion Centre	m	80	80	80

		Supplementary Data at 0.2068 bar		
		Category 1.5/F	Category 5/D	Category 1.5/D
Supplied Flammable Mass	kg	8.81296	6.13955	7.10559
Used Flammable Mass	kg	8.81296	6.13955	7.10559
Overpressure Radius	m	13.5181	11.9836	12.5818
Distance to:				
- Ignition Source	m	80	80	80
- Cloud Front/Centre	m	80	80	80
- Explosion Centre	m	80	80	80

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Weather Conditions

Path: Yelahanka\Pressure vessel\Leak

		Category 1.5/F	Category 5/D	Category 1.5/D
Wind Speed	m/s	1.5	5	1.5
Pasquill Stability		F	D	D
Atmospheric Temperature	degC	9.85	9.85	9.85
Surface Temperature	degC	9.85	9.85	9.85
Relative Humidity	fraction	0.7	0.7	0.7

ANNEXURE-III

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APPENDIX – 2

ANALYSIS OF NATURAL GAS/RLNG (TYPICAL)

Sl. No.	Component Name	Formula	Concentration	Molar fraction % (GAIL DATA)	Volume %
1.	Nitrogen	N2	0.01 – 1.0	0.02612	0.71
2.	Methane	C1	75 - 90	91.97691	95.49
3.	Carbon Dioxide	CO2	2 - 5	0.02743	0.01
4.	Ethane	C2	6 - 8	6.75148	2.45
5.	Propane	C3	2 - 5	0.96059	0.9
6.	I.Butane	C4	1 - 3	0.09063	0.33
7.	I.Pentane	IC5	0.5 – 1.0	0.02093	0.05
8	Carbon Monoxide	(CO)	< 10 PPM Vol.	NA	
9.	Hydrogen sulphide	H2S	< 24 PPM WT.	< 10 PPM Vol.	
10.	Total Sulphur content	S		< 24 PPM WT.	

Average Cal .Value (Kcal/Scm) : 9880

Gross Cal. Value (kcal / Scm) : 9880

Net Cal. Value (kcal / kg) : 11577.00

Average Gas Density : 0.7 Kg/M3

Temperature at Terminal Point : 25°C- 30° C

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ANNEXURE-IV

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www.bwssb.org

Phone No :- 080-22945116

APPENDIX-11

ಬೆಂಗಳೂರು ನೀರು ಸರಬರಾಜು ಮತ್ತು ಒಳಚರಂಡಿ ಮಂಡಳಿ

BANGALORE WATER SUPPLY AND SEWERAGE BOARD

Office of the Chief Engineer (NI &NW), 7th Floor,
Cauvery Bhavan, K.G. Road, Bangalore 560 009

No. BWSSB/ CE (NI & NW) /TA / 323 /2014-15 DT: ~~/01/2015~~ 02/02/2015

To

Chief Engineer (Civil) / Bidadi,
No. 116/2, Trade Centre,
2nd Floor, Race Course Road,
Bengaluru- 560001.

Sir,

Sub: Supply of 22 MLD tertiary treated water to 2X350 MW Gas Based Combined Cycle Power Plant at Yelahanka- Reg: Issue of allotment letter.

Ref: No. CE(C)/Bidadi (YDG)/CCPP/RWS/302 dt: 23.01.2015

****

With reference to the above subject, as per the request made vide letter cited under reference, you are hereby accorded and allocated to utilize 22 MLD Tertiary Treated Water from Jakkur & KHB Colony STP's for 350 MW CCP plant at Yelahanka.

Now, around 12-15 MLD of tertiary treated water will be supplied initially from Jakkur STP and balance 10-12 MLD will be supplied from the proposed TTP of KHB Colony, Puttenahalli. However, the BWSSB will take up the above work under D.C Works of KPTCL.

Thanking you

Yours faithfully

31/1/15

Chief Engineer (NI &NW),
7th Floor, Cauvery Bhavan,
K.G. Road, Bangalore 560 009

Office of the CE(C)/Bidadi
No: 431 02/2/15
O/C | SE(C) | CE(C)/Bidadi

31/1/15

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ಕರ್ನಾಟಕ ಕೈಗಾರಿಕಾ ಪ್ರದೇಶಾಭಿವೃದ್ಧಿ ಮಂಡಳಿ
ಬೆಂಗಳೂರು 560 001.

The Karnataka Industrial Areas Development Board

BANGALORE - 560 001.

ನಂ. ಐಎಡಿಬಿ No. IADB/ AE/ 801 /2014-15 ದಿನಾಂಕ/Date 20-11-2014

ಸ್ವಾಧೀನ ಪತ್ರ / POSSESSION CERTIFICATE

ನಿವೇಶನ ಸಂಖ್ಯೆ/The Possession of Plot No.: Sy. No. 44 (Part).

ಅಳತೆಯ / measuring 2 Acres - 6 Guntas in Puttenahalli Village

ಕೈಗಾರಿಕಾ ಪ್ರದೇಶದ/Industrial Area Yelahanka

ಹೋಬಳಿ / Hobli Bengaluru North ತಾಲ್ಲೂಕು ಜಮೀನನ್ನು / Taluk, has been handed over to

M/s. Karnataka Power Corporation Limited,

Bengaluru. ರವರಿಗೆ ಹಸ್ತಾಂತರಿಸಲಾಗಿದೆ.

ಗಡಿ ಗುರುತು/Boundaries :

ಉತ್ತರಕ್ಕೆ ಗಡಿ / Bounded on North : As per sketch Enclosed

ದಕ್ಷಿಣಕ್ಕೆ ಗಡಿ " " South :

ಪೂರ್ವಕ್ಕೆ ಗಡಿ " " East :

ಪಶ್ಚಿಮಕ್ಕೆ ಗಡಿ " " West :

ನಿವೇಶನದ ಸುತ್ತಳತೆ/Dimensions of the Plot :

ಉತ್ತರಕ್ಕೆ " " North :

ದಕ್ಷಿಣಕ್ಕೆ " " South : As per sketch Enclosed

ಪೂರ್ವಕ್ಕೆ " " East :

ಪಶ್ಚಿಮಕ್ಕೆ " " West :

ಈ ನಿವೇಶನವನ್ನು ನಾನೇ ಖುದ್ದಾಗಿ ಅಳತೆ ಮಾಡಿರುತ್ತೇನೆ. ಮೇಲೆ ಹೇಳಿರುವ ಅಳತೆ ಹಾಗೂ ಗಡಿ ಗುರುತು ಸರಿಯಾಗಿರಬಹುದೆಂದು ಈ ಮೂಲಕ ಪ್ರಮಾಣೀಕರಿಸುತ್ತೇನೆ.

Certified that the plot is actually measured by me and the dimensions and boundaries stated above are as per actuals on the land.

ಸಹಾಯಕ ಇಂಜಿನಿಯರ್ / ಸರ್ವೇಯರ್
Assistant Engineer / Junior Engineer / Surveyor
ZONAL OFFICE,
BANGALORE

ನಿವೇಶನವನ್ನು ನಾನು ಮೇಲ್ಕಂಡ ದಿನಾಂಕದಲ್ಲಿ ಸ್ವಾಧೀನಕ್ಕೆ ತೆಗೆದುಕೊಂಡಿರುತ್ತೇನೆ.

TAKEN POSSESSION of Plot No. Sy. No. 44 (Part) of Puttenahalli Village as noted above on this day the 20th November 2014

ಹೊಂದಿದವರ ಸಹಿ ಮತ್ತು ಮೊಹರು
Signature of the Allottee with seal

20/11/14
Assistant Executive Engineer (Civil)
DG Plant, K.P.C.L.
Yelahanka

467

The Karnataka Industrial Areas Development Board

BANGALORE-560 002

No. IAOB/ / /

Date 5/3/1986.

POSSESSION CERTIFICATE

THE POSSESSION of Sy. No 26/P & 28/P of Kenchenahally Village measuring 5-33 & 2-16-08-09 guntas respectively in Industrial Area Yelahanka North Taluk, Hobli Bangalore has been handed over to M/s Karnataka Electricity Board, Bangalore.

Boundaries :

Bounded on North :

" South :

" East :

" West :

Dimensions of the Plot :

North : Separate Sketch enclosed.

South :

East :

West :

Certified that the Plot is actually measured by me and the dimensions and boundaries stated above are as per actuals on the land.

Assistant Engineer / Junior Engineer / Surveyor

Countersigned

Deputy Development Officer
K.I.A.D. Board

Countersigned

Development Officer
K.I.A.D. Board

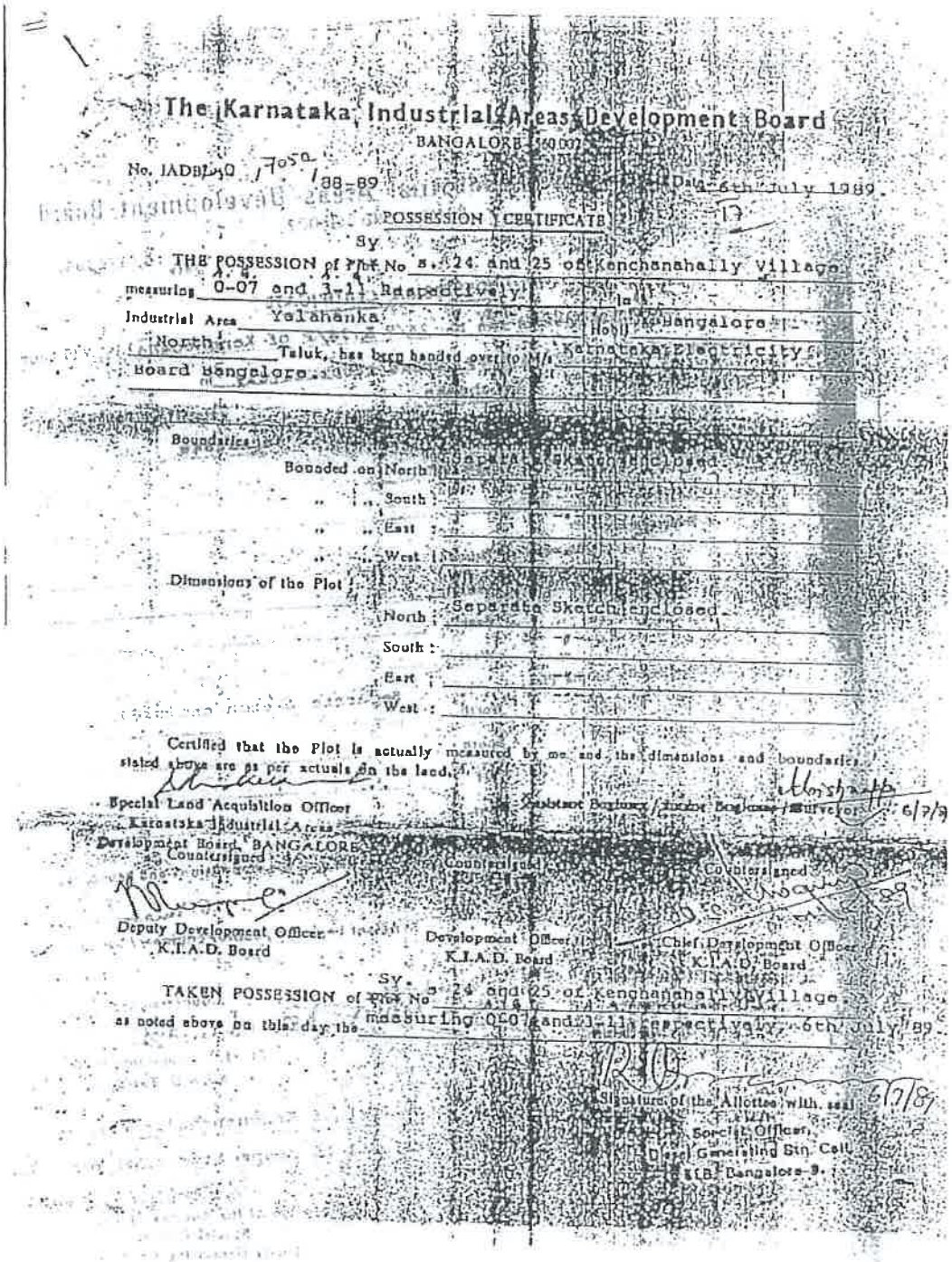
Countersigned

Chief Development Officer
K.I.A.D. Board

TAKEN POSSESSION of Sy. No 26/P & 28/P of Kenchenahally Village as noted above on this day the measuring 5-33 & 2-16 respectively, 5th March 86.

Signature of the Allottee with seal
Special Officer,
Diesel Generating Stn. Coll.
K.E.B, Bangalore-9.

468



The Karnataka Industrial Areas Development Board

BANGALORE

No. IADB/LAO /7050 /88-89 Dated 6th July 1989

POSSESSION CERTIFICATE

By

THE POSSESSION of Plot No s. 24 and 25 of Kenchanahally Village measuring 0-07 and 3-11 Respectively in Industrial Area Yelahanka Hobli Bangalore North Taluk, has been handed over to M/s. Karnataka Electricity Board Bangalore.

Boundaries:

Bounded on North : Separate Sketch Land Used

" South :

" East :

" West :

Dimensions of the Plot :

North : Separate Sketch Land Used

South :

East :

West :

Certified that the Plot is actually measured by me and the dimensions and boundaries stated above are as per actuals on the land.

Special Land Acquisition Officer
Karnataka Industrial Areas
Development Board, BANGALORE

Assistant Engineer / Junior Engineer / Surveyor 6/7/89

Countersigned

Deputy Development Officer
K.I.A.D. Board

Countersigned

Development Officer
K.I.A.D. Board

Countersigned

Chief Development Officer
K.I.A.D. Board

By

TAKEN POSSESSION of Plot No s. 24 and 25 of Kenchanahally Village as noted above on this day the measuring 0-07 and 3-11 respectively 6th July 89

Signature of the Allottee with seal

Special Officer,
Diesel Generating Stn. Cell
KSEB, Bangalore-9.

469

The Karnataka Industrial Areas Development Board

BANGALORE-560 002

No. IADB/ / / Date 5/3/1986.

POSSESSION CERTIFICATE

THE POSSESSION of Plot No Sy. 44/P, 45, & 48 of Puttenahally Village measuring 30-30 10-23 11-21 =52-34 respectively in 0-13 pk 0-15pk 0-02pk-0-30pk Industrial Area Yalahanka Hobli Bangalore North Taluk, has been handed over to M/s Karnataka Electricity Board, Bangalore.

Boundaries:

Bounded on North :

" " South :

" " East :

" " West :

Dimensions of the Plot : Separate sketch enclosed.

North :

South :

East :

West :

Certified that the Plot is actually measured by me and the dimensions and boundaries stated above are as per actuals on the land.

~~Assistant Engineer / Junior Engineer / Surveyor~~

Countersigned
Deputy Development Officer
K.I.A.D. Board

Countersigned
Development Officer
K.I.A.D. Board

Countersigned
Chief Development Officer
K.I.A.D. Board

TAKEN POSSESSION of Plot No Sy. 44, 45 & 48 of Puttenahally, measuring 30-30 10-23 11-21 respectively 0-13pk 0-15pk 0-02pk as noted above on this day the 5th March 1986.

Signature of the Allottee with seal
Special Officer,
Diesel Generating Sta. Cell,
K.E.B. Bangalore-9.

470

The Karnataka Industrial Areas Development Board

BANGALORE-560 002.

No. IAD9/LAO / 570 / 88-89. 16/88

Date: 24 th December '88.

POSSESSION CERTIFICATE

THE POSSESSION of Plot No's: 47/1,2.56/1to9.57,58,59.60/1,2. of Puttenahally, v
20-38 61,62/1,2.63,64,65.66/1,2, and 67
measuring 0-27 P.K in Puttenahally, Village.
Industrial Area 26-11 Puttenahally Hobli Yelahanka
Bangalore North Taluk, has been handed over to M/s. KARNATAKA ELECTRICITY BOARD, BANGALORE.

Boundaries: (existing)
Bounded on North:
" " South:
" " East:
" " West:

Dimensions of the Plot: (as per sketch enclosed separately)
North:
South:
East:
West:

Certified that the Plot is actually measured by me and the dimensions and boundaries stated above are as per actuals on the land.

Special Land Acquisition Officer
Karnataka Industrial Areas
Development Board
BANGALORE.

Countersigned

Deputy Development Officer
K.I.A.D. Board
Survey

Assistant Engineer/Junior Engineer/Surveyor

Countersigned

Development Officer
K.I.A.D. Board

Countersigned

Chief Development Officer
K.I.A.D. Board

TAKEN POSSESSION of Plot No's: 47/1,2.56/1 to 9.57,58,59.60/1,2,61,6
62/2,63,64,65,66/1,2 and 67.
as noted above on this day the measuring: 20-38
00-27 P.K
26-11
24th December'88.

Signature of the Attorney with seal
Diesel Generating Stn. Cell,
KEB, Bangalore-3.

30/1/8

Copy

Special Officer,
Diesel Generating Stn. Cell,
KEB, Bangalore-3.

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(17)

The Karnataka Industrial Areas Development Board

BANGALORE-560 002

No. IAOE/ LAO / 217 90-91 Date 2.07.1990

POSSESSION CERTIFICATE

THE POSSESSION of Plot/Site Survey No. 46

measuring 8 Acres 18 Guntas in Puttenahalli Village

Sarjapur Road Yelahanka Hobli Bangalore

North Taluk, has been handed over to M/s Karnataka Electricity

Board, Bangalore.

Boundaries :

Bounded on North : Sy.No. 44 and 45

" " South : Sy.No. 61 and 66

" " East : Sy.No. 47 and XX 48

" " West : Bangalore - Doddaballapura Road.

Dimensions of the Plot :

North :

South :

East : Sketch enclosed

West :

Certified that the Plot is actually measured by me and the dimensions and boundaries given above are as per actuals on the land

Assistant Engineer / Junior Engineer / Surveyor 2/7/90

Countersigned

Assistant Development Officer
K.I.A.D. Board

Countersigned

Development Officer
K.I.A.D. Board

Countersigned

Chief Development Officer
K.I.A.D. Board

TAKEN POSSESSION of Plot/Site Sy.no. 46

as noted above on this day the 2nd July '90.

Signature of the Allottee with seal

Chief Engineer Electricity (Projects)
Karnataka Electricity Board
Cauvery Bhavan, Bangalore-9

472

ಕರ್ನಾಟಕ ಸರ್ಕಾರ
ಆರೋಗ್ಯ ಮತ್ತು ಕುಟುಂಬ ಕಲ್ಯಾಣ ಸೇವೆಗಳ ನಿರ್ದೇಶನಾಲಯ

ಆನಂದ ರಾವ್ ವೃತ್ತ, ಬೆಂಗಳೂರು-೫೬೦೦೦೯

ಸಂಖ್ಯೆ:ಹೆಬ್ಇಕ್ಯೂ(ಹೆಜ್): 174:2014-15 ದಿನಾಂಕ:31:02:2015

ನಿರಾಪೇಕ್ಷಣಾ ಪ್ರಮಾಣ ಪತ್ರ

ವಿಷಯ:- ಯಲಹಂಕ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ೩೫೦ ಮೆಗಾವ್ಯಾಟ್ ಬಯೋಗ್ಯಾಸ್ ಪವರ್ ಪ್ಲಾಂಟ್ ಪ್ರಾರಂಭಿಸಲು ನಿರಾಪೇಕ್ಷಣಾ ಪತ್ರ ನೀಡುವ ಕುರಿತು.

ಉಲ್ಲೇಖ:-1. ತಮ್ಮ ಕಛೇರಿ ಪತ್ರ ಸಂಖ್ಯೆ:ಸಿಇ(ಜಿಎಸ್ಡಬ್ಲ್ಯೂ)ಯಲಹಂಕ ಸಸಿಪಿಪ /ಸಿಎಲೆಎಸ್/662/ದಿನಾಂಕ:11.12/11/2014

2. ಆರೋಗ್ಯ ಮತ್ತು ಕು ಕ ಅಧಿಕಾರಿಗಳು ಬೆಂಗಳೂರು ನಗರ ಇವರು ಭೇಟಿ ನೀಡಿ ನೀಡಿರುವ ವರದಿಯ ಮೇರೆಗೆ

--*-*-*

ಮೇಲ್ಕಂಡ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ಹಾಗೂ ಉಲ್ಲೇಖಿತ ಪತ್ರದಲ್ಲಿ ಯಲಹಂಕಾ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ೩೫೦ ಮೆಗಾವ್ಯಾಟ್ ಬಯೋಗ್ಯಾಸ್ ಪವರ್ ಪ್ಲಾಂಟ್‌ನ್ನು ಅಳವಡಿಸಿ ಪ್ರಾರಂಭಿಸಲು ನಿರಾಪೇಕ್ಷಣಾ ಪ್ರಮಾಣ ಪತ್ರ ನೀಡಲು ಕೋರಲಾಗಿದೆ.

ಸದರಿ ಪ್ರದೇಶಕ್ಕೆ ಸಂಬಂಧಪಟ್ಟ ಆರೋಗ್ಯ ಮತ್ತು ಕು ಕ ಅಧಿಕಾರಿಗಳು ಬೆಂಗಳೂರು ನಗರ ಇವರು ಭೇಟಿ ನೀಡಿ ನೀಡಿರುವ ವರದಿಯಂತೆ.

ಬೆಂಗಳೂರು ಉತ್ತರ ತಾಲ್ಲೂಕು, ಯಲಹಂಕ ಸಮೀಪದ ಲಕ್ಷ್ಮಿಪುರ ಹೆದ್ದಾರಿ ಯಲಹಂಕ – ದೊಡ್ಡಬಳ್ಳಾಪುರ ರಸ್ತೆಯ ಸುಮಾರು ಯಲಹಂಕದಿಂದ 2-3 ಕಿ.ಮೀ. ದೂರದಲ್ಲಿ ಕೆ.ಪಿ.ಸಿ.ಎಲ್ ಕಛೇರಿಯ ಅಧಿನದಲ್ಲಿರುವ ಡಿ.ಜಿ. ಪ್ಲ್ಯಾಂಟ್ ನ ಆವರಣದಲ್ಲಿ ಹೊಸದಾಗಿ 350 ಮೆಗಾವ್ಯಾಟ್ ಬಯೋಗ್ಯಾಸ್ ಪವರ್ ಪ್ಲಾಂಟ್ ಪ್ರಾರಂಭಿಸಲು ಗುರುತಿಸಲಾಗಿದ್ದ ಪ್ರದೇಶದ ಚಕ್ಕುಬಂದಿಯು ಈ ಕೆಳಕಂಡಂತೆ ಇರುತ್ತದೆ.

ಪೂರ್ವಕ್ಕೆ :- ಬೆಂಗಳೂರು ದೊಡ್ಡಬಳ್ಳಾಪುರ ರಾಜ್ಯ ಹೆದ್ದಾರಿ
ಪಶ್ಚಿಮಕ್ಕೆ :- ಡಿ.ಜಿ.ಪ್ಲಾಂಟ್ ಪ್ರಾರಂಭಮಾಡುವ ಸ್ಥಳವನ್ನು ಒಳಗೊಂಡಂತೆ ಕಂಪೌಂಡ್ ಗೋಡೆ
ಉತ್ತರಕ್ಕೆ :- ಖಾಸಗಿ ಅಪಾರ್ಟಮೆಂಟ್
ದಕ್ಷಿಣಕ್ಕೆ :- ಸದರಿ ಸಂಸ್ಥೆಯವರ ಹಾಲಿ ಡಿ.ಜಿ.ಪ್ಲಾಂಟ್

ಸದರಿ ಚಕ್ಕುಬಂದಿಯ ಪ್ರಕಾರ ಹಾಲಿ ಪರಿವೀಕ್ಷಣೆ ಮಾಡಿದ ದಿನದಂದು ಯಾವುದೇ ವಸತಿ ಪ್ರದೇಶಗಳು ಬಂದಿರುವುದಿಲ್ಲ. ಹಾಗೂ ಹಾಲಿ ಕೆ.ಪಿ.ಸಿ.ಎಲ್ ಕಛೇರಿಯ ಅಧಿನದಲ್ಲಿರುವ ಕೆ.ಪಿ.ಸಿ.ಎಲ್ ಆಡಳಿತ ಕಛೇರಿ ಹಾಗೂ ಡಿ.ಜಿ. ಪ್ಲ್ಯಾಂಟ್ ನಲ್ಲಿ ಕಾರ್ಯನಿರ್ವಹಿಸುತ್ತಿರುವ ಸಿಬ್ಬಂದಿ ವರ್ಗದವರು ಆರೋಗ್ಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ಅವಶ್ಯ ಮುನ್ನೆಚ್ಚರಿಕೆ ವಹಿಸಿದ್ದಲ್ಲಿ ಸಾರ್ವಜನಿಕರಿಗೆ ಮತ್ತು ಸಿಬ್ಬಂದಿ ವರ್ಗದವರಿಗೆ ಆರೋಗ್ಯಕ್ಕೆ ಯಾವುದೇ ರೀತಿಯ ಧಕ್ಕೆಯಾಗುವ ಸಂಭವನೀಯತೆಯಿರುವುದಿಲ್ಲ.

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ಈ ಹಿನ್ನೆಲೆಯಲ್ಲಿ ಯಲಹಂಕಾ ಸಮೀಪದಲ್ಲಿ ೩೨೦ ಮೆಗಾವ್ಯಾಟ್ ಬಯೋಗ್ಯಾಸ್ ಪವರ್ ಪ್ಲಾಂಟ್‌ನ್ನು ಅಳವಡಿಸಿ ಪ್ರಾರಂಭಿಸಲು ಇತರೆ ಇಲ್ಲಾಖೆಗಳಿಂದ ಅವಶ್ಯವಿರುವ ನಿರಾಪೇಕ್ಷಣಾ ಪ್ರಮಾಣ ಪತ್ರವನ್ನು ಪಡೆಯಲು ಷರತ್ತಿಗೊಳಪಟ್ಟು, ಈ ಇಲಾಖೆಯಿಂದ ನಿರಾಪೇಕ್ಷಣಾ ಪ್ರಮಾಣ ಪತ್ರವನ್ನು ನೀಡಲಾಗಿದೆ.

ನಿರ್ದೇಶಕರು
ಆರೋಗ್ಯ ಮತ್ತು ಕ.ಕ.ಸೇವಗಳ ನಿರ್ದೇಶನಾಲಯ
ಬೆಂಗಳೂರು.

1) ಪ್ರತಿಯನ್ನು ಮುಖ್ಯ ಅಭಿಯಂತರರು (ಇಪ&ಟಎ) ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತ ಶೇಷಾದ್ರಿ ರಸ್ತೆ ಬೆಂಗಳೂರು ಇವರಿಗೆ ಸಲ್ಲಿಸಿದೆ.
2) ಪ್ರತಿಯನ್ನು ಮುಖ್ಯ ಅಭಿಯಂತರರು (ಜೆಎಸ್‌ಡಬ್ಲು) ಸುದರ್ಶನ ಕಾರಪ್ಪಕ್ಕ ಎರಡನೆ ಮಹಡಿ ಶೇಷಾದ್ರಿ ರಸ್ತೆ ಬೆಂಗಳೂರು ಇವರಿಗೆ ಸಲ್ಲಿಸಿದೆ.
3) ಕಛೇರಿ ಪ್ರತಿ.

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ಕರ್ನಾಟಕ ಸರ್ಕಾರ
(ಮೀನುಗಾರಿಕೆ ಇಲಾಖೆ)

ಸಂಖ್ಯೆ: ಮೀನಿ/17/ಆರ್.ಎಸ್.ಹೆಚ್/2014-15

ಮೀನುಗಾರಿಕೆ ನಿರ್ದೇಶನಾಲಯ,
3ನೇ ಮಹಡಿ, ಪೋಡಿಯಂ ಬ್ಲಾಕ್,
ವಿಶ್ವೇಶ್ವರಯ್ಯ ಕೇಂದ್ರ, ಡಾ:ಅಂಬೇಡ್ಕರ್ ವೀಧಿ,
ಬೆಂಗಳೂರು-1, ದಿನಾಂಕ: -05-2015

ಇವರಿಗೆ:
The Chief Engineer (EI&TA)
Karnataka Powe Corporation Ltd.
"Sudarshan Complex" 2nd, Floor
No.22/23, Sheshadri Road,
Bangalore-560009

ಮಾನ್ಯರೆ,

ವಿಷಯ:ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ (ನಿ), ರವರು ಯಲಹಂಕ ಇಲ್ಲಿ 350 ಮೆವ್ಯಾ ಅನಿಲ ಆಧಾರಿತ ವಿದ್ಯುತ್ ಸ್ಥಾವರ ಸ್ಥಾಪಿಸಲು ಇಲಾಖೆಯಿಂದ ನಿರಾಕ್ಷೇಪಣಾ ಪತ್ರ ನೀಡುವ ಬಗ್ಗೆ.

ಉಲ್ಲೇಖ: ಮುಖ್ಯ ಇಂಜನೀಯರ್ (E.I& T.A) K.P.C.L ರವರ ಪತ್ರದ ಸಂಖ್ಯೆ:CE (GSW)/YELAHANKA/CCPP/CLS/661.dated:11/11/2014.

*****

ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ (ನಿ), ರವರು ಯಲಹಂಕ ಇಲ್ಲಿ 350 ಮೆವ್ಯಾ ಅನಿಲ ಆಧಾರಿತ ವಿದ್ಯುತ್ ಸ್ಥಾವರವನ್ನು ಈ ಕೆಳಕಂಡ ಷರತ್ತುಗಳಿಗೆ ಒಳಪಟ್ಟು ಸ್ಥಾಪಿಸಲು ಮೀನುಗಾರಿಕೆ ಇಲಾಖೆಯ ನಿರಾಕ್ಷೇಪಣೆ ಇರುವುದಿಲ್ಲವೆಂದು ತಿಳಿಸಲಾಗಿದೆ.

1. ಸ್ಥಾವರದ ಮೆಶಿನರಿಯ ಕೂಲಿಂಗ್‌ನಿಂದ ಬರುವ ನೀರನ್ನು ಸ್ಥಳೀಯ ಕೆರೆಗಳಿಗೆ ಬಿಡುವುದರಿಂದ ಕೆರೆಯ ಮತ್ಸ್ಯಸಂಪತ್ತನ್ನು ವೃದ್ಧಿಸಲು ಇಲಾಖೆಯು ಸೂಚಿಸುವ ಸ್ಥಳೀಯ ಮತ್ತು ದೊಡ್ಡಗೆಂಡ ಜಾತಿಯ 50,000 ಮೀನುಮರಿಗಳನ್ನು ಪತ್ತಿರುಬ ಪುಟ್ಟೇನ ಹಳ್ಳಿ ಯಲಹಂಕ ಕೆರೆಗಳಿಗೆ ಮೀನುಗಾರಿಕೆ ಇಲಾಖೆಯಿಂದ ಪ್ರತಿ ವರ್ಷ ವಿರೀದಿಸಿ ದಾಸ್ತಾನು ಮಾಡುವುದು.

2. ಸ್ಥಾವರ ನಿರ್ಮಾಣದ ಸಮಯದಲ್ಲಿ ಹಾಗೂ ತದನಂತರ ನಿರ್ಮಾಣದ ಪಾಸ್ಟ್ ನಿರ್ವಹಣೆಯ ಸಮಯದಲ್ಲಿ ಯಾವುದೇ ತ್ಯಾಜ್ಯಗಳನ್ನು ಹೊಳೆ/ಕಾಲುವೆಗೆ ಹಾಗೂ ಸಮೀಪದ ಕೆರೆ, ಜಲಾಶಯಗಳಿಗೆ ಹಾಕದೆ ಬೇರೆಡೆಗೆ ದೂರ ಸಾಗಿಸುವುದು.

3. ಮುಂದಿನ ದಿನಗಳಲ್ಲಿ ಸಮೀಪದ ಕೆರೆಗಳಲ್ಲಿ ಮೀನುಗಾರಿಕೆ ಅಭಿವೃದ್ಧಿಗೆ ಯಾವುದೇ ಅಡಚಣೆ ಮಾಡಬಾರದು.

4. ಕಂಪನಿಯ EIA ಮತ್ತು EMP ವರದಿಯಲ್ಲಿ ಅಳವಡಿಸಿಕೊಂಡಿರುವ ಮೀನುಗಾರಿಕೆಗೆ ಸಂಬಂಧಿಸಿದ ಎಲ್ಲಾ ನಿಬಂಧನೆಗಳನ್ನು ಖಚಿತವಾಗಿ ಪಾಲಿಸತಕ್ಕದ್ದು.

Office of the CE(EI & TA)
KPC Ltd., Bangalore-560 009
Inv. No.: 486
Date: 6.6.15

OM	EE	SE	CE

KMG

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5. ಮೀನುಗಾರಿಕೆ ಇಲಾಖೆಯ ಅಧಿಕಾರಿಗಳು ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ಫಲಕದ ಒಳಗೆ ಪ್ರವೇಶಿಸಿ ಮೇಲ್ವಿಚಾರಣೆಸಿದ ನಿಬಂಧನೆಗಳನ್ನು ಪಾಲಿಸಿರುವ ಬಗ್ಗೆ ಪರಿಶೀಲಿಸುವ ಅಧಿಕಾರವನ್ನು ಹೊಂದಿರುತ್ತಾರೆ.

6. ಮೀನುಗಾರಿಕೆ ಹಿತದೃಷ್ಟಿಯಿಂದ ಮೀನುಗಾರಿಕೆ ಇಲಾಖೆಯು ಮುಂದೆ ವಿಧಿಸುವ ಯಾವುದೇ ಹೆಚ್ಚಿನ ಷರತ್ತು ಮತ್ತು ನಿಬಂಧನೆಗಳನ್ನು ವಿಧಿಸಿದ್ದಲ್ಲಿ ಅದಕ್ಕೆ ಬದ್ಧರಾಗಿರತಕ್ಕದ್ದು.

7. ಸ್ಥಾವರ ಸ್ಥಾಪಿಸಿದ ದಿನಾಂಕ 10 ವರ್ಷಗಳ ಅವಧಿಯವರೆಗೆ ಪ್ರತಿ 2 ವರ್ಷಕೊಮ್ಮೆ ಮೀನು ಸಂಕುಲದ ಮೇಲೆ ಉಂಟಾಗಿರುವ ಪರಿಣಾಮದ ಬಗ್ಗೆ ಅಧ್ಯಯನ ಸಮಿತಿ ವರದಿಯನ್ನು ಮೀನುಗಾರಿಕೆ ಇಲಾಖೆಗೆ ಸಲ್ಲಿಸುವುದು ಹಾಗೂ ಪರಿಣಾಮ ಬೀರಿದಲ್ಲಿ ಅದನ್ನು ಸರಿಪಡಿಸುವುದು.

8. ಈ ಮೇಲ್ಕಾಣಿಸಿದ ಯಾವುದೇ ಷರತ್ತು ಮತ್ತು ನಿಬಂಧನೆಗಳನ್ನು ಉಲ್ಲಂಘಿಸಿದ್ದಲ್ಲಿ ತಮಗೆ ನೀಡಿರುವ ನಿರಾಕ್ಷೇಪಣಾ ಪತ್ರವನ್ನು ರದ್ದುಗೊಳಿಸುವ ಅಧಿಕಾರವನ್ನು ಮೀನುಗಾರಿಕೆ ಇಲಾಖೆ ಕಾಯ್ದಿರಿಸಿ ಕೊಂಡಿರುತ್ತದೆ.

ತಮ್ಮ ನಂಬುಗೆಯ

ಮೀನುಗಾರಿಕೆ ನಿರ್ದೇಶಕರು

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भारतीय विमानपत्तन प्राधिकरण
AIRPORTS AUTHORITY OF INDIA

No. AAI/KIA/ATM/NOC/488-92 Date: 5/5/2015

Narendra Kumar

22/23 Sudharshan Complex KPCL Seshadri Road
Blore09

NO Objection Certificate for Height Clearance

This NOC is issued by Airports Authority of India (AAI) in pursuance of responsibility conferred by and as per the provisions of Govt. of India (Ministry of Civil Aviation) order SO84 (E) dated 14th Jan, 2010 for Safe and Regular Aircraft Operations.

1. References:

NOCID	JAKK/SOUTH/B/032615/107133
Applicant Letter	26/03/2015
AAI Reference.	BL-139/2015

2. NOC Details for Height Clearance:

Applicant Name	Narendra Kumar
Type of Structure	Chimney.
Site Address	Yelhanka DG Plant Karnataka Power Corporation Ltd ,SN Halli Post Yelhanka Bangalore 560064
Site Cordinates	13 7 4.281N -77 34 54.16E
Site Elevation AMSL in Mtrs -	900.0 Mtrs Nine Zero Zero Decimal Zero Meters AMSL.
Permissible height above Ground Level in Mtrs	60.0 Mtrs Six Zero Decimal Zero Meters AGL.
Permissible Top Elevation AMSL in Mtrs	960.0 Mtrs Nine Six Zero Decimal Zero Meters AMSL.

3. This NOC is subject to the terms and conditions as given below:

a. The site-elevation and site coordinates provided by the applicant are taken for calculation of the permissible top elevation for the proposed structure. If,however, at any stage it is established that the actual data is different from the one, provided by the applicant, this NOC will be invalid.

b. The issue of the 'NOC' is further subject to the provisions of Section 9-A of the Indian Aircraft Act, 1934 and those of any notifications issued there under from time to time including the Aircraft(Demolition of Obstruction caused by buildings and trees etc.) Rules,1994.

c. No radio/TV Antenna, lighting arresters, staircase, Mumtee, Overhead water tank and attachments of fixtures of any kind shall project above the Permissible Top Elevation 960.0 Mtrs, indicated in para 2.

d. The use of oil fired or electric fired furnace is mandatory, within 8 KM of the Aerodrome Reference Point.

e. The certificate is valid for a period of 7 years from the date of its issue. If the building/structure/Chimney is not constructed & completed within the period, the applicant will be required to obtain a fresh 'NOC' from the Designated Officer of Airports Authority of India. The date of completion of Building/Structure/Chimney should be intimated to this office of AAI. Request for revalidation of NOC will not be entertained after the expiry of its validity period.

f. No light or a combination of lights which by reason of its intensity, configuration or colour may cause confusion with the aeronautical ground lights of the Airport shall be installed at the site at any time, during or after the construction of the building.

g. The applicant will not complain/claim compensation against aircraft noise, vibrations, damages etc. caused by aircraft operations at or in the vicinity of the airport.
h. Day markings & night lighting with secondary power supply shall be provided as per the guidelines specified in chapter 6 and appendix 6 of Civil Aviation Requirement Series 'B' Part I Section 4, available on DGCA India website: www.dgca.nic.in
i. The applicant is responsible to obtain all other statutory clearances from the concerned authorities including the approval of building plans as this NOC for height is for the purpose of 'to ensure the safe and regular aircraft operations' and shall not be used as document for any other purpose/claim whatsoever, including ownership of land etc.
j. This NOC has been issued w.r.t. the Civil Airports as notified in S0 84(E). Applicant needs to seek separate NOC from Defence, if the site lies within jurisdiction of Defence Airport.
This certificate is issued for "HEIGHT CLEARANCE ONLY" with the approval of Competent Authority for Permissible Top Elevation 960.0: Mtrs.
M.MUTHU GENERAL MANAGER (ATM) Airports Authority Of India
Copy to :
1. The Executive Director(ATM), AAI, Rajiv Gandhi Bhavan, Safdarjung Airport, New Delhi-110003
2. GM(NOC)/Airport Director(Bundle).
3. Guard File
4. Regional Executive Director(Southern Region),AAI,Chennai Airport,Chennai-600027. 5. Member Secretary,BIAAPA,Devanahalli/Commissioner,BBMP,Bangalore.
6. Director Operations,BIAL. 7. The Director I/C, Govt.Flying Training School, Jakkur Aerodrome,Yelahanka Post,Bangalore-64.

ANNEXURE-V

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APPENDIX – 5

KARNATAKA STATE POLLUTION BOARD NORMS FOR WATER POLLUTION

The treated effluent shall conform to the standards given below:

Sl. No.	Characteristics	Tolerance Limits
1	Colour & Odour	See note (1) below
2.	Suspended Solids, mg/l. Max.	100
3.	Particle size of Suspended Solids	Shall pass 850 micron IS Sleeve
4.	pH Value	6.5 to 8.5
5.	Temperature	Shall not exceed 5°C above the receiving water temperature
6.	Oil and Grease, mg/l. Max.	10
7.	Total Residual Chlorine, mg/l. Max.	1.0
8.	Ammonical Nitrogen (N) mg/l, Max.	50
9.	Total Kjeldhal Nitrogen (as N), mg/l Max.	100
10.	Free Ammonia (as NH_3), mg/l, Max.	5.0
11.	Bio-chemical Oxygen Demand, mg/l (5 days at 20°C) Max.	30
12.	Chemical Oxygen Demand, mg/l. Max.	250
13.	Arsenic (as AS), mg/l. Max	0.2
14.	Mercury (as Hg), mg/l. Max.	0.01
15.	Lead (as Pb), mg/l. Max.	0.1
16.	Cadmium (as Cd), mg/l. Max.	2.0
17.	Hexavalent Chromium (as Cr+6.), mg/l. Max.	0.1
18.	Total Chromium (as Cr), mg/l. Max.	0.2
19.	Copper (as Cu), mg/l. Max.	1.0

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20.	Zinc (as Zn), mg/l. Max.	1.0
21.	Selenium (as Se), mg/l. Max.	0.05
22.	Nickel (as Ni), mg/l. Max.	3.0
23.	Cyanide (as CN), mg/l. Max.	0.2
24.	Flouride (as F), mg/l. Max.	2.0
25.	Sulphide (as S), mg/l. Max.	2.0
26.	Phenolic Compounds (as C6 H5 OH), mg/l. Max.	1.0
27.	Radioactive Materials:	
	a) Alpha emitters micro curie / mg/l. Max.	10^{-8}
	b) Beta emitters micro curie / mg/l. Max.	10^{-7}
28.	Bio – assay test	90% survival of fish after 96 hours in 100% effluent
29.	Manganese (as Mn), mg/l. Max.	2
30.	Iron (as Fe), mg/l	1.0
31.	Vanadium (as V), mg/l	0.2
32.	Nitrate Nitrogen, mg/l	10
33.	Dissolved phosphates (as P) mg/l, Max.	5.0

Note:1 All efforts shall be made to remove colour and unpleasant odour as far as practicable.

The domestic effluent from the plant shall be treated to the standards given below:

Sl. No.	Characteristics	Tolerance Limits
1.	Total Suspended Solids, mg/l. Max.	30
2.	Biochemical Oxygen Demand for 5 days at 20°C, mg/l Max.	20

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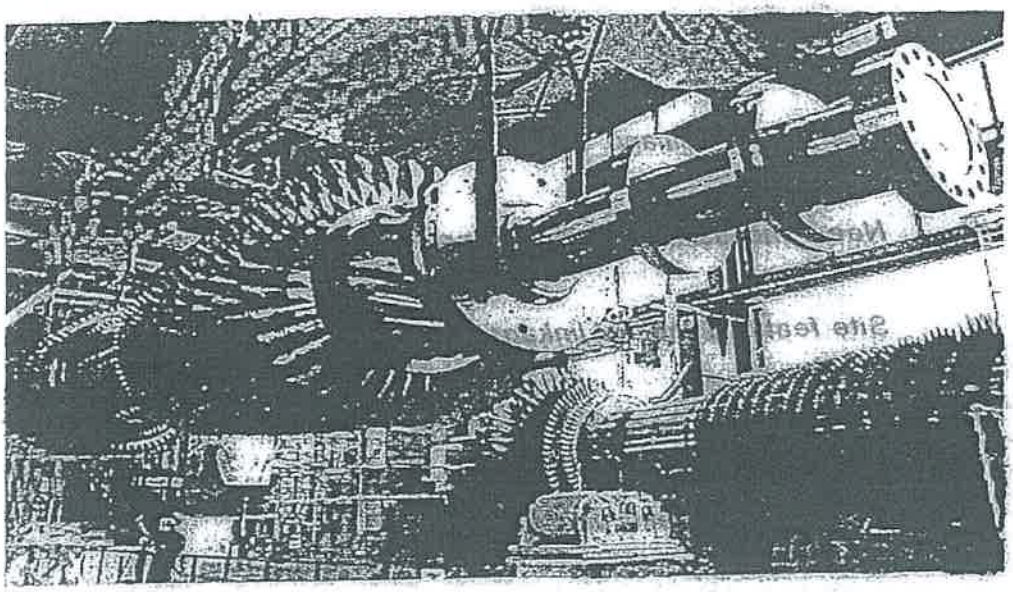
Annexure-R8

Karnataka Power Corporation Limited

DETAILED PROJECT REPORT



1X350 ± 20% MW
Yelahanka Combined Cycle Power Plant (YCCPP)

Chief Engineer (GSW)
Karnataka Power Corporation Limited
DG Plant, Post: Singanayakana Halli
QB Road, Yelahanka
Bangalore-560 064

March – 2015
Bangalore

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CHAPTER - 1

INTRODUCTION

Karnataka Power Corporation Ltd. (KPCL) is a state owned public limited company and is in the business of generation of electric power. KPCL has a total installed capacity of about 6500 MW consisting of Hydro-Electric Stations, Thermal Power Plants (TPP), Windmills and Solar PV Plants.

During early 90's power generation in Karnataka was mostly hydro based. Due to implementation of thermal, solar, wind and renewable energy power projects, present Karnataka power generation system has changed. Presently Karnataka has installed capacity of 14017 MW consisting of Hydro 3652 MW, Thermal 4378MW (Coal, Diesel) Solar 14 MW, Wind 2182 MW, Renewable Energy 1872MW (Mini hydro, Biomass) Power stations executed and operated by SEB's /IPP's including Central Govt. share of 1919 MW.

The state has several plans for power generation from Hydel, Thermal, Gas, Solar, Wind and other renewable energy sources. The Hydel power generation capacity is subject to the vagaries of monsoon, leading to a situation of additional crippling power cuts on the industries during periods of low rainfall. The power generation from solar, wind and other renewable energy sources is dependent on the weather condition leading to lot of variation in generation and hence may not meet the continuous power demand of state.

In order, to build-up a reliable, stable and effective power generation system, the integrated operation of both hydro and thermal power stations is considered necessary, with thermal/gas stations operating as base load stations and hydro, solar, wind power stations meeting the supplemental and peak power requirements.

The electric power grid for the Southern Region (SR) of India comprises the states of Karnataka, Andhra Pradesh, Tamil Nadu, Kerala and Union Territory of Pondicherry. With the rapid industrialization, successful rural electrification and large-scale use of electricity for the irrigation purpose, the demand for electricity has registered a significant growth and steep increase in the Southern Region particularly in Karnataka State. Also, it is expected that the on-going liberalization of the country's economic policy would accelerate the industrial growth, which would further increase the demand for power. Although several new power projects have been identified with a view to bridge the gap between the demand and availability, only a few could be taken up for implementation due to financial, environmental and other constraints. This would result in large short fall in the availability of both power (717 MW) and energy (6098MU) as of 2013-2014. The present demand for electrical power continues to grow and will continue to outstrip the available and planned generation capacity leading to chronic shortage of available power and energy in the future years.

Karnataka has been a power starved state over the years and has been experiencing frequent power cuts and load shedding even as of date. In order to overcome the

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prevailing and expected power and energy shortages in the future years, it is necessary to augment power generation capacity in the state of Karnataka.

KPCL owns & operate 128 MW DG based power plant located at Yelahanka near Bangalore which run on fuels such as Diesel/LSHS/LSFO. The plant has not been utilized optimally due to high cost of generation, non-availability of continuous supply of LSHS fuel. The generation from DG plant has stopped since from Aug 2013.

Hence, KPCL plans to convert this diesel based power plant to natural gas fired combined cycle power plant to increase the efficiency and to reduce atmospheric sulphure dioxide & suspended particulate matter emitting from DG sets.

Considering the proximity to the GAIL pipeline network, conversion of this plant to gas, assumes importance for better efficiency and will help existing industry cluster to get continuous supply of power and also enable for industrial growth in Bangalore city. In view of this , KPCL proposes to augment the power generating capacity by installing a 1x350±20% MW capacity gas based Combined Cycle Power Plant at Yelahanka .

During Sept 2013, KPCL appointed Tractebel Engineering Private Limited as consultant for preparation of detail feasibility report covering various options for the conversion of Yelahanka DG plant to gas fired power station. The consultant has submitted the report recommending the implementation of 1x350±20% MW gas based Combined Cycle Power Plant in 1st stage and expanding later of similar capacity depending on the financial viability and availability of gas.

In this regard, KPCL approached Government of Karnataka for the implementation of 1x350±20% MW capacity gas based combined cycle power plant. GOK vide its order No. EN 28 PPC 2014 dated 27.07.2014 has accorded approval for establishing first block of gas based Combined Cycle Power Plant of 350±20% MW capacity at Yelahanka with RLNG as the fuel.

For the implementation of the project, KPCL have prepared the detailed project report (DPR) (based on the feasibility report submitted by the consultant and collecting other data) for the implementation of the 1x350±20%MW capacity gas based Combined Cycle Power Plant at Yelahanka by dismantling the required structures/system of the existing DG plant.

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CHAPTER - II

EXECUTIVE SUMMARY

1. Purpose:

The detailed project report is prepared for the implementation of 1x 350±20%MW capacity gas based Combined Cycle Power project located at north of Bangalore along Bangalore - Doodaballapur Hindupur road situated at Yelahanka about 18 Kms from Bangalore and 25 kms from Bangalore International Airport.

This report highlights the details of the selected site, availability of fuel and water, evacuation of power, systems/structures of existing DG plant to be dismantled, features of the main plant equipment including raw and cooling water system, electrical systems, environmental aspects, estimates of project cost, schedule for project implementation and organization structure for construction, operation and maintenance.

2. Scope:

The scope of this detailed project report covers the following:

a. Review of the planned generation capacity and energy requirements of Karnataka state and establish the need for augmentation of the installed generation capacity.
b. Selection of power generating unit sizes for the proposed 1x350±20% MW capacity gas fired combined cycle power plant.
c. Preparation of plant layout considering the future expansion and identifying the systems/structures of the existing DG plant to be dismantled.
d. Details of the major aspects of the proposed plant, general design philosophy and salient technical specifications of the following major equipment / systems for the proposed 1x350±20% MW unit CCPP installation.
   (i) Gas turbine generators and auxiliary systems
   (ii) Heat recovery steam generators and auxiliary system
   (iii) Steam turbine generators and auxiliary systems
   (iv) Water systems
   (v) Fuel gas system
   (vi) Other mechanical balance of plant systems.
   (vii) Instrumentation and control systems.
   (viii) Electrical systems
   (ix) Civil engineering features
e. Environmental aspects.
f. Preparation of project implementation schedule.
g. Project cost estimates and cost of generation

3. Need for the project:

It can be seen from the actual power supply position during the year 2013-14, Bangalore, Southern Region and the country experienced high to moderate shortages both in terms of energy and peaking availability.

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The total energy requirement in the country was 10, 02,257 MU's and the availability was 959829 MU's and the peak demand requirement was 135918 MW against the availability of 129815 MW. As such the deficit in terms of energy and peak demand is around 4.2% and 4.5% respectively. All the regions in the country namely Northern, Western, Southern Eastern and Northern Eastern regions continued to experience energy as well as peak power shortage of varying magnitude on an overall basis. As per the CEA's LGBR 14-15 report, the energy shortage varied from 1.0% in the Western region to 6.8% in the Southern region during the year 2013-14.

The total energy demand of the Southern region and Karnataka was 277245 MU and 64150 MU against the availability of 258444 MU and 58052 MU respectively. The peak load demand of Southern region and Karnataka was 39015 MW and 9940 MW against the availability of 36018MW and 9223 MW. The total deficit in terms of energy was around 6.78 % in the Southern region, and 9.5% in Karnataka. In terms of peak demand, the deficit is around 7.68 % in the Southern region, 7.21 % in Karnataka.

Keeping in view of heavy shortages in the Southern region and in Karnataka, and the industrial development in Karnataka, especially in Bangalore and around Yelahanka, this capacity addition is needed for reducing the gap between the availability and requirement.

Moreover proposed generation by KPCL own plant will give more stability, as it is continuously available. Power from traders / exchanges can be unstable despite of short/medium /long term contracts, as availability is not guaranteed due to transmission corridor constraints. Hence for the grid stability, own generation is recommended.

The Yelahanka DG plant has stopped generation from August 2013, due to local agitation by public, non-compliance of the pollution norms as stipulated by the Pollution Control Board and high cost of generation. As this plant is situated in the heart of the city, and continued burning of LSHS would violate the pollution norms. Hence conversion of this plant to higher capacity and burning clean fuel ie. natural gas is the immediate requirement to meet the strict pollution norms as well as to meet the huge demand keeping in view the developments taking place in and around Yelahanka.

Based on the details of load forecast and assessment of generation capacity duly taking into account the planned additions to the grid and the assistance from the plants in the Central sector, the State of Karnataka has a deficit of 717MW in peak power for the year 2013-14 and deficit in energy availability is about 6098MU's. In spite of the expected additions in the generating capacities in Karnataka , the deficit in peak power and energy availability in the year 2014-15 is expected to be 2635MW (24.5%) and 10003(14.4%)MU's.

Bangalore does not have a power plant nearby, though load the center is at Bangalore. Coal based power plant is not possible near Bangalore due to distance from coal mine and from environmental point of view. At present power is transmitted to Bangalore from a

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distance of more than 300 kms resulting in heavy transmission losses. In order to overcome expected power and energy deficits, it is proposed to install a Natural Gas/RLNG fired combined cycle power plant at North of Bangalore along Bangalore – Doodaballapur Hindupur road situated at Yelahanka about 18 Kms from Bangalore and 25 kms from Bangalore International Airport with a capacity of 350±20%MW.

Gas supply to the proposed site at Yelahanka may take about 15-18 months from issue of LOA and expected to synchronize with the commissioning of the plant. This project is being taken up based on gas as fuel to avoid pollution and also use treated sewage water, which is an added advantage and therefore this project is entitled to the benefits available under Climatic Change Mitigation/ Clean Development Mechanism projects.

4. Land:

About 120 acres of land is available within the premises of Yelahanka Diesel Power Plant. Out of which 14 Acres 24 Guntas is handed over to KPTCL for establishing 220 KV switch yard and 18 Acres is reserved for Forest/Water body. Remaining land is used for establishing the power plant as below:

Description	Area in Acres	
	Acres	Guntas
A. Allocated to KPTCL for 220/66/11 KV substation	14	24
B. Existing infrastructure	31	05
i. Administrative blocks	01	
ii. Guest house and Play ground		20
iii. Residential building	04	
iv. Overhead tank	01	
v. DG Plant	15	25
vi. IOCL Storage tanks	4	40
vii. Railway lines	4	
C. Existing plantation /Vacant land	56	11
D. Forest land/water body to be handed over to KPCL	18	
Total land(A+B+C+D)	**120**	

Total area available within the premises of diesel power plant complex is about 120 acres. By best engineering practices the proposed combined cycle power plant can be accommodated by dismantling the required existing structures/systems of the DG plant. None of the existing facilities can be used for the proposed combined cycle power plant, as the existing facilities were meant for smaller capacity unit size plant and do not match the requirement of the proposed CCPP.

All the required infrastructure facilities like Adm. Building, Guest house, Residential buildings, Green belt development, and compound wall are already exist. Open nala (Raj Kaluve) is passing within the plant boundary and has occupied more area. The area surrounding nala is not being used optimally. The existing nala (Raja Kaluve) can be converted to box type concrete nala and surrounding area can be back filled to develop the green belt.

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5. Site characteristics:

The ground inside the plant boundary is practically level and is sloping towards South East. Topographical survey of the entire available land has to be done during the detailed engineering. The final grade level shall be decided considering main power house floor level during detail engineering stage. Suitable drain has to be provided all around the plant to divert rain water flowing from other areas as well as plant area considering the existing nala/natural drain inside the plant premises.

Top layer (0.5mtr) of soil is brownish red clay with silt sand and gravel followed by sandy silt (up to 5mtr) and pink yellowish grey sand up to 20mtr depth and detailed soil investigations (SBC) shall be available after geotechnical investigation studies (under progress). Based on the available data, for heavier loads raft foundations or bored cast in situ piles with sufficient penetration into hard laterite bed with N value more than 50 can be adopted. M25/ M30 grade of concrete for all foundations can be considered. Footing foundation can be adopted for all the remaining system/structure's foundations.

6. Access to site:

The site is located at north of Bangalore along Bangalore – Doodaballapur Hindupur high way and is situated at Yelahanka about 18 Kms from Bangalore and 25 kms from Bangalore International Airport. Nearest railway station to site is Yelahanka and Bangalore city junction, which are 2 Km and 20 Km away respectively. The Yelahanka site is approachable through motorable road connecting major state highways and rail as stated above.

7. Main plant equipment:

The main plant equipment consists of Gas Turbine Generator (GTG) and auxiliaries, Heat Recovery Steam Generator (HRSG) and auxiliaries including main stack, Steam Turbine Generator (STG) and auxiliaries, and gas forwarding station including gas booster station. The possible configuration of the main equipment shall be one block of 1GT+1HRSG+1ST in multiple shaft configurations with separate electrical generator for GT and ST to achieve 350±20% MW.

The Combined Cycle Power Plant (CCPP) with GTG of advanced technology is the most fuel-efficient form of electric power generation. The heat in the exhaust of gas turbine is recovered by generating steam in the HRSG. By maximizing the heat recovery and efficient utilization of the steam in steam turbine the overall combined cycle efficiency can be improved.

8. Fuel:

Natural Gas (NG) is the main fuel for the proposed power plant. Natural gas analysis is as shown in Appendix # 2. M/s GAIL have already completed the execution of gas pipe line work from Dabhol to Bangalore and have terminal point at Bidadi. Further M/s GAIL have executed the gas pipe line all around Bangalore along ring road to meet the domestic and industrial gas requirement of Bangalore. Now it is proposed to take a tap off from the

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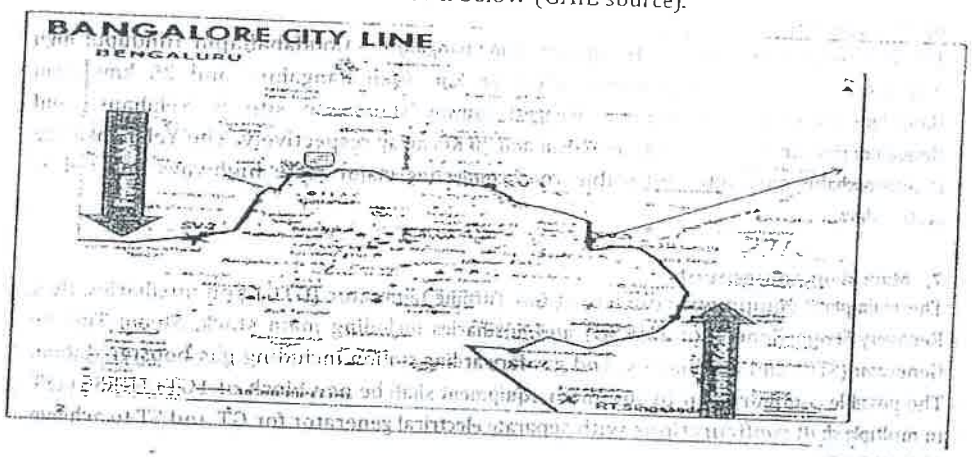
terminal point SV3B near Kuvempu circle on outer ring road. M/s GAIL have made preliminary route survey from tap off location at SV3B/Hebbal flyover junction to KPCL, Yelahanka site.

M/s KPCL has approached M/s GAIL in this regard and have agreed to supply the required gas to proposed Yelahanka site at a pressure of 17-19 KSC. Hence it is propose to install gas booster station at proposed site location in order to meet gas pressure requirement of the gas turbine. About 1.4 MMSCMD of gas is required for the 1st stage of 350±20%MW and considering the future expansion the total gas requirement shall be 3.0 MMSCMD. A fuel gas station with metering arrangements is proposed to be installed in the plant premises. Gas supply to proposed site at Yelahanka may take about 15-18 months from the date of issue of LOA and expected to synchronize with the commissioning of the plant.

Meeting was held with M/s GAIL to discuss the gas supply arrangements for the proposed plant and necessary modification in existing GT agreement. The final source of fuel will be selected based on economics and other relevant aspects during the implementation stage of the power project. MOM is enclosed in Appendix #9.

Existing gas pipeline route has been shown below (GAIL source).



9. Water requirement and source of water supply:

The total water requirement for the 1x350±20% MW capacity CCPP at Yelahanka is about 14.4 MLD (600 M^3/Hr.) for 1st stage. Considering the future expansion, the total water requirement shall be around 29 MLD for 700 MW CCPP. The water requirement for the proposed plant is met by the tertiary treated sewage water from BWSSB treatment plant Jakkur /Puttenehalli, which is around 4-6 Km away from the plant site.

In this regard M/s KPCL has already initiated discussion with M/s BWSSB and have deposited the amount required for the initial route survey and other feasibilities. In this regard M/s. KPCL have to enter into an agreement / MOU with details of quantity of water requirement, and location etc. Details such as feasibility of pipe routing, cost, execution period etc. (presently 18-20 months from the date of LOA /Agreement /MOM are required for execution of the piping and water supply) are to be negotiated with M/s BWSSB before entering into agreement /MOU.

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10. Power evacuation:

M/s. KPTCL have established 220/66/11 kV substation with 2x150MVA, 220/66/11 kV transformers within the plant premises. The substation has a provision of 5 bays (4 I/C feeders and 1 B/C). 220 kV bus bars system is having a current carrying capacity of 2500 amps with 3" Aluminum tube which is sufficient to carry 700MW plus load. Substation charging is under progress by erecting required transmission lines.

The details of present infrastructure available and future proposals by M/s. KPTCL for power evacuation to meet the growing power requirement and to establish power corridor at north Bangalore are stated as below.

- M/s. PGCIL have established a 400/220kV substation at Singanayakanahalli near Yelahanka which is around 5 to 6 kms. from DG plant.
- Construction of 220-220kV Multi-circuit line for a route length of 11 kms from the Nelamangala-D.B.Pura DC line to the existing 400/220kV Singahayakanahalli (S.N.halli) substation, Yelahanka, Bangalore.
- Construction of 220-220kV Multi-circuit line for a route length of 10 kms from existing 400/220kV Singanayakanahalli station to the existing 220/66/11kV KPTCL substation.
- Construction of 220-66kV Multi-circuit line for a route length of 5.73kms partly on multi-circuit multi-voltage towers and partly on DC towers in the existing 66kV DG Plant-Peenya 3&4 corridor. Work is under progress.
- Construction of 220-220kV Multi-circuit line for a route length of 5 kms from the GB halli limits to 220kV Hebbal tap point in the 220kV Nelamangala-Hoody-Peenya corridor. Work is under progress.
- Construction of 66kV DC lines with Drake ACSR conductor from 220/66/11kV Yelahanka sub station to link to the nearby DG Plant-Peenya 1, 2, 3&4 and Doddaballapura 1&2 lines. Work is under progress.

It is proposed to evacuate the generated power from the nearest Yelahanka 220/66/11kV substation of KPTCL established within the plant premises. The generated power shall be evacuated at 220 kV voltage level. The proposed 1x350±20% MW CCPP switch yard is around 500 Mtr away from the KPTCL substation. In this regard M/s KPCL have initiated discussions with M/s KPTCL to provide the power evacuation scheme and MOM is enclosed as Appendix #10. The design/erection of necessary power evacuation lines would be done by M/s KPTCL.

11. Plant layout:

Plant lay out for the proposed YCCP is planned considering the future expansion and identifying the required structures/ systems to be dismantled by optimizing the available land and infrastructure.

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12.Environmental aspects:

The Natural Gas/RLNG is the cleanest burning fossil fuel. The combustion of this fuel results in virtually no atmospheric emissions of sulphur dioxide and negligible particulate matter. The quality of effluents (gaseous fuel vents and liquid condensate) would meet Karnataka State Pollution Control Board (KSPCB) guidelines. It is propose to discharge the small quantity of effluents from the entire power plant to existing nala passing within the plant boundary after treating it to the required levels of KSPCB norms.

The proposed plant shall largely cater to the power demands of Bangalore city with a population of more than 10 million. The vehicle population in Bangalore is around 5 million. The pollution level in the city is in the threshold limits and power plants based on coal or liquid fuel are likely deteriorate the pollution levels. Hence it is proposed to go for gas based Combined Cycle Power Plant so as to produce power from a clean source of fuel and may not harm the environmental pollution levels.

Presently natural gas to Bangalore has to be drawn from longer distances (Dabhol/Middle east/Eastern countries), which may increase the cost of power generation. However in the interest of maintaining the environment clean, it is necessary to use clean fuel like gas to produce power in the highly populated city like Bangalore. M/s GAIL have already completed the gas pipe line from Dabhol to Bangalore and shall boost usage of gas as fuel(replacement to liquid fuels) for transportation , domestic and power generation needs, which is environmental friendly.

The latest technology gas turbines are used in CCPP, which are more fuel efficient (59-60%). Dry Low Nox (DLN) burners are used in the combustors to reduce the NOX emission. The latest technology machines will be costlier which may increase cost of the project, leading to increase in cost of generation. The above factors may have impact on the cost of generation but with less environmental impact, which is the order of requirement for a growing city like Bangalore. In order to reduce the project cost, M/s KPCL may explore the possibility of availing the carbon credit so that project becomes more viable.

13.Project cost and tariff:

Total capital cost including the interest during construction for the proposed 1x350+20% MW project is estimated to be Rs:1571.2 Crores and cost per MW of installed capacity works out to Rs:4.246 Crores. Project cost estimate and Tariff calculation are shown in Appendix # 6 & 7

The cost of generation for the proposed 1x350±20% MW MW unit at station bus bar, after allowing for auxiliary power works out to:

- Rs:7.72/kwh at 80% PLF and Rs7.61/kwh at 85% PLF in the first year of full commercial operation with gas price of 15.25 $/MMBTU (MDP price).
- Rs:5.90/kwh at 80% PLF and Rs:5.80/kwh at 85% PLF in the first year of full commercial operation with gas price of 10.77 $/MMBTU(Spot price).

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14. Project schedule:

It is proposed to execute project through a lump sum turnkey EPC contract. To make the project execution cost low, some activities shall be completed before zero date. Considering the expected deliveries of major equipment, tentative schedule of fuel availability, estimated time duration for design, engineering and construction, commissioning and trial operation of the plant in CCPP mode can be achieved within 30 months from the zero date. By effectively coordinating the design, supply, erection and commissioning activities, the project can be implemented within 28 months.

However during contract negotiation stage with EPC vendors, this can be further negotiated and can be reduced. Zero date has been considered as the date of issue of Letter of Award (LOA) to EPC works. Project implementation schedule is attached as Exhibit No.15

15. Project status / progress made:

Government of Karnataka vide its order No. EN 28 PPC 2014 dated 27.07.2014 has authorised Karnataka Power Corporation Ltd for establishing first block of 1x350±20% MW capacity gas based combined cycle power plant by dismantling the required structures/systems of the existing DG plant at Yelahanka. Copy of the same is attached as Appendix-8.

To ensure timely completion of the proposed project, the following actions are initiated by KPCL.

- KPCL has permitted M/s KPTCL for the erection of 220/66 KV transmission towers for charging the KPTCL 220 /66/11 Kv substation and same shall be used for the evacuation of the generated power from the proppsed 1x350±20% MW CCPP. MOM is enclosed as Appendix#10.
- M/s KPCL has initiated discussion with BBMP for the development of existing nala to optimise the available land.
- For the speedy implementation of the project KPCL have proposed to entrust the EPC works of 350±20% MW CCPP to M/s BHEL on MOU basis. GOK has exempted KPCL from KTPP act for awarding the EPC works to M/s BHEL.
- KPCL has issued LOI to M/s BHEL for the implementation of 1x350±20% MW gas based CCPP on EPC basis.
- M/s KPCL has assigned the works of EI studies to a consultant for getting the clearances from KSPCB. SEAC, Karnataka has issued the TOR.
- KPCL has initiated discussion with M/s GAIL for gas supply arrangements and for the modification of existing GT agreement. MOM is enclosed as Appendix#9.
- KPCL has made discussion with M/s BWSSB for supply of tertiary treated water and have deposited the amount required for the preliminary study works. Water allotment letter issued by M/s BWSSB is enclosed as Appendix#11.
- Actions are initiated for getting all the statuary clearances.
- KPCL/IOCL has initiated the dismantling work of required systems /structures.

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CHAPTER – III

NEED AND JUSTIFICATION FOR THE PROJECT

1. Installed capacity and planned generation capacity in Karnataka :

Karnataka has been experiencing of power shortage because of the growing demand for power due to rapid economic growth. The state government has taken up various projects in the public and private sector to add capacity. Recognizing the crucial role of power in achieving economic progress, Karnataka was one of the first Indian state to initiate reforms in power sector.

The core issue in power supply in Karnataka is the status of demand & supply to ensure that there is no shortage in supply in the State. The State of Karnataka has been facing power shortage as it is a progressive state and there is ever growing demand for power. The state government has been planning through various means for capacity addition for adding more power to the grid to meet the growing demand.

Apart from augmenting its generation, the state has been importing power from central power-generating stations, from neighboring states, and also through energy exchanges for minimizing power shortages. In addition, the state government is taking steps for conservation of energy through demand side management programs. In cases where it is highly difficult to bridge the supply-demand gap, load shedding is imposed.

Southern region grid compresses the states of Andhra Pradesh, Karnataka, Kerala, Tamilnadu and Pondicherry. The grid map of Karnataka State and Bangalore is enclosed in Exhibit –2 & 3.

Based on the data available with CEA, the total installed generation capacity in Karnataka State, as on 2013-2014 is 14017 MW. The installed generating capacity of the existing power stations, projects under execution, projects under planning as well as Karnataka's share from central sector projects for the period 2013 to 2017 as per the data available are shown as below.

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2. Karnataka - Installed capacity and energy generation:

Source		2009-10	2010-11	2011-12	2012-13	2013-14
Public Sector(KPCL)						
a) Hydel	MW	3637	3652	3652	3652	3652
b) Wind energy	MW	4.555	4.555	4.555	4.555	4.555
c) Thermal	MW	1970	2220	2240	2720	2720
d) Diesel plants	MW	108	108	108	108	108
e) Solar PV plant	MW	6	6	9	14	14
Total		5725.5	5990.5	6013.5	6498.5	6498.5
Private Sector						
f) IPP Thermal	MW	109	709	709	1550	1550
g) Mini Hydel	MW	572	656	656	701	701
h) Wind energy	MW	1513	1670	1976	2177	2177
i) Co-generation & Biomass	MW	766	744	1001	1171	1171
Total	MW	2960	3779	4342	5599	5599
Central Generating Station	MW		1596	1700	1836	1919
Total installed capacity	MW	8686	11366	12056	13934	14017
Electricity Generation						
k) Hydel (KPCL)	MU	12249	10543	13989	10022	12825.5
l) Thermal(KPCL)	MU	13263	10434	12813	12723	15827.7
m) Diesel (KPCL)	MU	494	490		189	23.87
n) Wind (KPCL)	MU	13	16	13	13	13.67
o) Solar PV plant	MU	3	7	8	23	17.82
p) Private sector	MU	5546	8984	16903	16914	17059
Total		31566	30474	43726	39884	45767.5
Electricity imports						
i) Central projects	MU	10974	11041	11575	11619	7452
ii) Other States	MU	35	5757	1627	5870	7374
Total	MU	11009	16798	13202	17489	14826
Total Electricity supply	MU	42575	47272	56928	57373	60593.5

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3. **Karnataka - share of power generation capacity from CGS (in MW):**

SLNo	Source	Allocation to Karnataka share
1	Ramagundam Stage I & II (Units 1 to 6)	423
2	Ramagundam Stage III (Unit 7)	106
3	MAPS	33
4	NLC TPS II Stage I	130
5	NLC TPS II Stage II	176
6	NLC TPS I (Expansion)	108
7	Kaiga (1&2)	121
8	Kaiga 3rd & 4th Unit	132
9	Simhadri Unit	212
10	Talcher Stage II	388
11	Vallur I & II	89
	Total	**1919**

4. **Listofprojects under implementation by KPCL in Karnataka:**

Sl. No	Project	MW rating planned	Expected year of availability and MW			
			2015-2016	2016-2017	2017-2018	2018-2019
I.	Hydro Plants					
	a. Munirabad	10	-	10	-	-
	b.Nagjhari ,RM &U of NPH ,U-6	15	15	-	-	-
II.	Thermal Plants					
	a. Yermaras thermal Power Station	2x800	800	800	-	-
	b. KPCL-Bellary TPS	1X700	700	-	-	-
III	Gas based					
	a. Bidadi CCPP 1st Stage	1x700	-	-	-	700
	b. Yelahanka CCPP	1x350	-	-	350	-
IV	Solar/Wind/renewable Energy					
	a. Solar PV plant at Belakanwadi	10MW		10		
	Total expected capacity in MW	3385	1500	835	350	700

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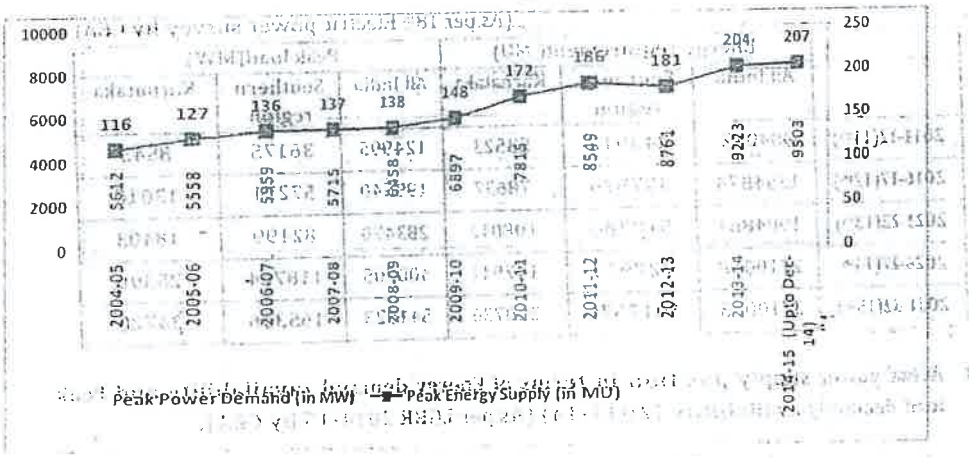
5. List of Projects Planned by KPCL:

Sl.No	Project	MW rating planned
1.	Hydro Plants a. Ghatababha Hydro station	20
	b. Shivansamudra Seasonal Scheme	a. 2x100 b. 1x45
	c. Gundia Hydel Project	2x200
II.	Thermal Plants a. Godhna TPS Chhattisgarh(Pit head)	2x800
	b. Edlapur TPS	1x800
III	Gas based a. Bidadi 2nd Stage	1x700
	b. Tadadi Gas based Project	3x700
IV	Solar /Wind /Renewable Source a. Chadrpura Dist. Haveri	5
	b. Kaginele Dist. Haveri	5
V	**Total expected capacity in MW**	5875

6. Demand for electrical power and energy:

Karnataka - trends in peak power demand and peak energy supply



It may be observed from the above graph that both the peak demand and peak energy supply per day are showing increasing trends since 2007-08. The peak demand met during 2013-14 was 9223 MW, and in 2014-15 it was 9503MW which indicates an increase of 3.04%. The anticipated peak demand during 2014-15 is likely to be around 9600 MW.

The demand for electrical energy has been steadily increasing at the rate of 6-8 % in the State of Karnataka due to rapid industrialization and urbanization.

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The peak power demand and the expected energy requirement as projected in the Eighteenth Electric Power Survey of India for the period 2012-2013 to 2016-2017(12th Five year plan) is shown in table.

(As per 18th Electric power survey by CEA)

	Energy requirement (MU)			Peak load(MW)		
	All India	Southern region	Karnataka	All India	Southern region	Karnataka
2012-13	1007694	266433	58513	143967	39850	9742
2013-14	1084610	286820	63001	156208	43623	10473
2014-15	1167731	308767	67833	169491	47752	11258
2015-16	1257589	332392	73036	183902	52273	12102
2016-17	1354874	357826	78637	199540	57221	13010

7. **Long term forecast of Electrical energy and Peak load requirement at end of future five year plans at Power station bus bar (utilities):**

The long term demand of electrical energy requirement, and to meet the energy demand corresponding generating installed capacity at the power station bus bar at the end of 12th, 13th, 14th, 15th five year plan for all India, Southern region, all states of southern region are projected as indicated in the table below

(As per 18th Electric power survey By CEA)

	Energy requirement(MU)			Peak load(MW)		
	All India	Southern region	Karnataka	All India	Southern region	Karnataka
2011-12(11th)	904012	243912	53523	124995	36175	8545
2016-17(12th)	1354874	357826	78637	199540	57221	13010
2021-22(13th)	1904861	510786	108012	283470	82199	18403
2026-27(14th)	2710058	727913	147941	400705	118784	25396
2031-32(15th)	3710083	1017576	200736	541823	165386	34720

8. **Actual power supply position in terms of Energy demand /availability and Peak load demand/ availability (2013-14) (As per LGBR 2014-15 by CEA):**

	Energy requirement (MU)			Peak load(MW)		
	Demand	Availability	Shortage /excess	Demand	Availability	Shortage /excess
All India	1002257	959829	(-)4.2%	135918	129815	(-)4.49%
Southern region	277245	258444	(-)6.8%	39015	36018	(-)7.68%
Karnataka	64150	58052	(-)9.5%	9940	9223	(-)7.21%

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9. Anticipated power position in terms of Energy demand /availability and Peak load demand/ availability (2014-15) (As per LGBR 2014-15 by CEA):

	Energy requirement (MU)			Peak load MW		
	Demand	Availability	Shortage /excess	Demand	Availability	Shortage /excess
All India	1048672	995157	(-)5.1%	147815	144788	(-)2.0%
Southern region	298180	260366	(-)12.7%	41677	32423	(-)22.2%
Karnataka	69596	59593	(-)4.4%	10772	8137	(-)24.5%

10. Availability of power:

The Power Survey of India recognizes that while computing the available peak power from the installed capacity, the following factors are considered:

- Planned outage due to maintenance
- Forced outage
- Spinning reserve
- Auxiliary power consumption
- Other factors relevant to the aspect of peak power availability
- Availability of power from renewable energy

11. Need for the power project:

It can be seen, from the actual power supply position during the year 2013-14 and the anticipated power supply position during 2014-15, Karnataka, Southern Region and the Country experienced and expected to experience high to moderate shortages both in terms of energy and peaking availability.

12. Long term forecast of Electrical energy and Peak load requirement at end of future five year plans at power station bus bar (utilities):

(As per LGBR 2014-15 by CEA and 18th EPS)

State	Electrical energy requirement (MU)				Peak electric load (MW)			
	12th	13th	14th	15th	12th	13th	14th	15th
	2016-17	2021-22	2026-27	2031-32	2016-17	2021-22	2026-27	2031-32
Andhra Pradesh	129767	191912	284776	412903	22445	33194	51601	74818
Karnataka	78637	108012	147941	200736	13010	18408	25396	34720
Kerala	26584	34691	46049	61125	4669	6093	8150	10903
Tamilnadu	119251	171718	244703	337491	20816	29975	43044	59127
Pudduchery	3586	4452	4444	5271	630	782	787	940
Southern Region	357826	510786	727913	1017526	57221	82199	118764	165336
All India	1354874	1904861	2710058	3710083	199540	283470	400705	541823

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As per long term projection of CEA, the energy requirement of Southern Region by 2016-17 will be 357826 MU's from 286820 MU's during 2013-14 and peak demand will be 57221 MW by 2016-17 from 4323 MW during 2013-14. Similarly the energy requirement of Karnataka by 2016-17 will be 78637MU's from 63001 during 2013-14 and peak load demand will be 13010 MW by 2016-17 from 10473 MW. To meet this huge growth in power demand, large capacity needs to be added to the system.

13. Bangalore city energy consumption:

According to the BESCOM data, the peak demand of Bangalore city was 1134 MW during 2003-04 which rose to around 2002 MW by 2010-11 and is expected to grow @ 5.71% and 5.74% during 12th and 13th plan respectively from the base year 2010-11 in spite of 8.46% actual growth from 2003-04 to 2010-11. As the result of the study of pattern of utilization of various categories, the peak electric load will be 2805 MW and 3717 MW by the end of 12th (2016-17) and 13th (2021-22) plan respectively.

The total electricity consumption of the Bangalore city during the year 2010-11 was 10299 MUs and is expected to increase to 14465 MU and 18972 MU during the year 2016-17 and 2021-22 respectively with the compounded growth rate of 5.82 & 5.71% from the base year 2010-11

Considering above, the proposed power project of about 1x350±20% MW capacity which is expected to be commissioned during 13th Plan period is fully justified from the demand supply consideration. Considering the shortage in total energy and peak load requirement of Karnataka State and Bangalore in particular the proposed power project near Bangalore is justified.

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CHAPTER - IV

SITE FEATURES AND FUEL LINKAGE

1. Project location:

The proposed site is located in the revenue limits of Kenchenahalli/Puttenehalli village, Yelahanka taluk, of North Bangalore in Karnataka State. Exhibit #1 shows the location of proposed project site in Bangalore.

2. Discussion of site features:

The suitability of the site for locating 1X350±20% MW is determined by the following major considerations:

- Availability of space for locating the main plant, transformer yard, switchyard and all the balance of plant facilities required.
- Availability of adequate space for construction activities.
- Availability of proper road or rail access to the plant site for movement of equipment, construction materials, pipes, chemicals, etc.
- Suitability / feasibility of fuel gas supply.
- Availability of a reliable source of raw water adequate to meet the plant water requirements.
- Suitability of land from topographical and geological considerations.
- Convenience of interconnection with grid for evacuation of the power generated.
- Environmental impact.

The above mentioned requirements with respect to the proposed site are discussed in the following paragraphs.

3. Site location:

Yelahanka DG plant is located at North of Bangalore along Bangalore – Doodaballapur Hindupur road situated at Yelahanka about 18 Kms from Bangalore and 25 kms from Bangalore International Airport and is 2 to 3 kms from Yelahanka Railway Station and 25 Km from the Bangalore city railway junction. The site is easily approachable through Doodaballapur Bengaluru state highway. The Yelahanka site is approachable through motorable road connecting major state highways and rail.

4. Land:

About 129 acres of land is available within the premises of Yelahanka diesel power plant. Out of which 14 Acres 24 guntas is handed over to KPTCL for establishing 220kV switchyard. The available land is sufficient for establishing gas based combined cycle power plant of 1X350±20% MW capacity in 1st stage and similar capacity plant in 2nd stage.

In the present project location, the available infrastructure/facilities of the existing DG plant like power house building with all equipments /system, switch yard, all the BOP's

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like oil handling system, fire station, work shop, store building and IOCL infrastructure for receiving, storage and oil handling system required for DG plant are not suitable for the proposed CCPP. Hence some of the systems/structures are to be dismantled in order to implement the 1st stage gas based CCPP and all systems/structures are to be dismantled for implementation of the 2nd stage CCPP of similar capacity.

5. Fuel:

M/s GAIL has already completed the execution of gas pipe line work from Dabhol to Bangalore and has a terminal point at Bidadi. Further M/s GAIL has executed the gas pipe line all around Bangalore along ring road to meet the domestic and industrial gas requirement of Bangalore. M/s KPCL has approached M/s GAIL regarding the Gas Transport Agreement (GTA) and for the Gas Supply Agreement (GSA). M/s GAIL has agreed to supply the required gas to the proposed Yelahanka CCPP. M/s KPCL shall finalize source of fuel and suppliers on the basis of techno economic feasibility and other aspects during the implementation of the power project.

6. Water:

The total water requirement for the 1x350±20% MW capacity CCPP at Yelahanka is about 14.4 MLD (600 M^3/Hr.). Considering the future expansion, the total water requirement shall be around 29 MLD for 700 MW CCPP.

A huge volume of sewage generated in Bangalore City is being treated by BWSSB at various places in Bangalore. 64 MLD capacity secondary treatment plant is established by BWSSB at Hebbal. Presently treatment plant is working to its full capacity and the treated water is not utilized and is let out to natural nala. 10 MLD sewage treatment plants are established by BWSSB at Allasandra near Yelahanka DG plant and at Jakkur near Jakkur lake. The Allasandra water treatment plant is approximately 2 to 4 Kms and Jakkur water treatment plant is approximately 6 to 8 kms. respectively from the Yelahanka DG plant.

BWSSB is proposing to enhance the capacity of Jakkur treatment plant by establishing 15 MLD new tertiary treatment plant with latest technology to meet the water quality and quantity requirement of proposed Yelahanka CCPP. BWSSB have made pipe line rout survey from Jakkur plant to proposed Yelahanka CCPP site and length of pipeline would be around 6-8 kms. The water quality parameters as agreed by BWSSB are enclosed as Appendix # 3.

It is propose to entrust the total works of water supply including establishing the tertiary treatment plant with necessary discharge pumps, piping from treatment plant to Yelahanka CCPP raw water reservoir, construction, operation and maintenance of the plant to M/s BWSSB, who are presently carrying out water supply works in Bangalore. In this regard M/s. KPCL have to enter into an agreement / MOU with details of quality and quantity of water requirement, and location etc. Details such as feasibility of pipe routing, cost, execution period etc. (presently 15-18 months from the date of LOA /Agreement /MOM are required for execution of the piping and water supply) are to be negotiated with M/s BWSSB before entering into agreement /MOU. KPCL have initiated the discussion with M/s BWSSB regarding the supply of required quantity/quality of tertiary treated water to

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the proposed CCPP, and M/s KPCL has deposited the amount for pipe routing feasibility studies and for preliminary activities.

7. Power evacuation:

Generated power shall be evacuated at 220 kV voltage level. The nearest 220/66/11 kV KPTCL substation established at plant premises shall be used for the evacuation of generated power from the proposed CCPP.

The charging of 220KV substation is under progress by erecting new 220 KV double circuit transmission lines. KPTCL is also dismantling the existing 66/11 kV transmission lines connected to existing KPCL switchyard and are establishing the new 66/11 KV DC lines from Yelahanka 220KV substation to meet the existing power requirement north Bangalore and infrastructure around Yelahanka. The distance between the switchyard of proposed CCPP and KPTCL switchyard for power evacuation is less than 500 Mtrs.

8. Meteorological data:

Temperature	Annual mean of daily maximum 37 °C
	Annual mean of daily minimum 11.5 °C
	Design Ambient air Temperature 28.0 °C
Relative Humidity	79 % @ 830 Hrs And 52% @ 1730Hrs
Annual Total Rainfall	970 mm
Design Wind Velocity	33 m/s (as per IS 875)

The information about the site and the meteorological data has been furnished in Appendix #1.

9. Topographical aspects and site grading:

The ground level in the main plant area varies from RL906 M to RL 894 M above the mean sea level and is slopping towards South East. The ground level of power house and switch yard area in the proposed plot plan, varies from RL 901M to RL 897 M and for the BOPs like CW system, Cooling tower , RODM plant etc. varies from RL 904M to RL 902 M.

It is propose to locate the raw water reservoir at eastern part of the plant where the ground level is around RL 898-896 M. By observing the site grade level, the finished ground level (FGL) of the plant can be fixed at around RL 900 M. The exact FGL of the plant can be finalized during the detailed engineering considering the natural slope for rain water /road drains/plant drains and the level of existing storm water drain (nala) and cost of excavation/filling required and after topographical survey of the proposed plot plan area.

10. Fuel availability and linkage:

The fuel for the proposed combined cycle power plant at Yelahanka will be Natural Gas/RLNG (NG). No secondary fuel will be used as a standby or as an emergency fuel. The

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gas turbine for this power plant will be designed for gaseous fuel operation with Natural Gas/RLNG as the fuel. No supplementary firing in the HRSG is envisaged.

The Natural Gas/RLNG is the cleanest burning fossil fuel. It reduces CO_2 & SOx emissions by 60% & 80 % respectively compared to coal. Further, there is no ash or sludge disposal associated with gas. The combustion of this fuel results in virtually no atmospheric emissions of sulphur dioxide and negligible particulate matter. The quality of effluents (gaseous fuel vents and liquid condensate) would meet Karnataka State Pollution Control Board (KSPCB) and MOEF guidelines.

The requirement of land and water for gas based combined cycle power plant is reduced by 1/6th and 1/3rd compared with coal based power plant of similar capacity. Similarly the requirement of construction and operation staff and implementation period is also less compared with coal based power plant of similar capacity.

With the Karnataka /Central Government initiative in making gas available to Bangalore at competitive gas price, make the proposed project more feasible.

Availability of gas at project site would coincide with the completion of construction of the power plant. The estimated annual gas requirement for CCPP with 100 % gas fuel firing, with 85% PLF and base load operation of the gas turbines will be around 0.35 Million Tonnes per Annum (MTA) for the 1st stage of 350±20% MW CCPP and will be around 0.7 Million Tonnes per Annum considering the second stage of similar capacity.

A separate metering station, conditioning skid and gas booster station shall be set up in the plant premises.

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CHAPTER -V

SELECTION OF POWER GENERATING UNITS

1. Introduction:

Gas turbine power plants using Natural Gas as fuel are in operation for a long time. There have been considerable improvements in the design of gas turbine generators resulting in significant enhancement in their reliability, capacity and thermal efficiency. The gas turbine generators are primarily classified as Aeroderivative machines and Heavy duty machines. The Aeroderivative machines are being manufactured up to ratings of about 43 MW (ISO conditions). Similarly, the heavy duty gas turbine generators are being manufactured up to ratings of about 334 MW (ISO conditions). Gas turbine designs with still higher rated outputs are under development. Combined cycle power plants making use of the heat content of the exhaust gas from the gas turbine to raise steam in a heat recovery steam generator and subsequent use of steam in a steam turbine generator have a significantly higher overall cycle efficiency. Power plants have achieved combined cycle efficiency more than 61% on net calorific value basis at ISO condition. The overall efficiency attainable in combined cycle power plants is much higher than the efficiency of the best available fossil fuel fired thermal power plants. Besides, being, more efficient compared to the conventional thermal power plants; the combined cycle power plants have the advantage of shorter project implementation duration and a lower auxiliary power consumption of about 2-3 % compared to more than 7-8 % in conventional thermal power plants.

2. Load factor, Availability & Capacity utilisation factor:

The proposed power plant at Yelahanka would be operated as a base load station at plant load factor of about 85%. In order to achieve expected high plant load factor of about 85%, availability of the generating sets shall be well above 90%. Availability of the combined cycle power plant with large capacity heavy-duty gas turbine has been developed to be in the range of 90 to 99%.

3. Plant ISO output:

For the design site ambient conditions, the combined cycle plant net output considering derating factor with Natural Gas/RLNG as fuel will be about 15-17% less with reference to the published output at ISO condition for the standard combined cycle configuration. The derating factor would vary marginally between the manufacturers due to differences in gas turbine design. Based on the above factors, the configurations of the combined cycle power plant including the number of gas turbines and steam turbines have to be selected.

4. Types of gas turbines and ratings:

Gas Turbines are basically classified as Aeroderivative machines and Heavy duty machines. For the proposed 350±20% MW combined cycle power plant at Yelabanka, considering the capacity of the plant, aeroderivative machines are not considered for the proposed power plant.

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5. **Heavy duty gas turbine rating:**

Heavy duty gas turbine generators are offered in the market in their standard sizes by reputed manufacturers and a large number of standard sizes up to 400 MW (ISO) rating are available. Some manufacturers have developed gas turbines with ISO ratings up to 400 MW but these are under execution stage and are yet to enter commercial operation as on date. The cost of gas turbine generator per kW generally reduces as the rating increases. Further, the space requirement for number of small capacity units would be more compared to a lesser number of higher capacity units. The efficiency of large capacity gas turbines is in general higher compared to the smaller capacity gas turbines. In view of this it is preferable to select lesser number of higher capacity gas turbine generators. The capacity of the larger size gas turbine generators presently available with proven operating experience varies between 100 MW and 350 MW amongst different manufacturers. A few gas turbines with still larger capacity are under design and commercial operating feedback is not available at this stage.

For the proposed 350±20% MW CCPP at Yelahanka, the details and the capacity of the combined cycle plants at ISO conditions as published in the GT world 2001-2002 of various manufacturers are listed out.

6. **Combined cycle power plant configurations of leading manufactures:**

(At ISO conditions)

Sl. No.	Manufacturer	Model No.	Number of GTGs /STGs	Output of each GTG	Output of each STG	Plant out put (MW)	Heat Rate (kcal/ kWh)	Plant Effn. %
1	MHI	MPCP2 (M701DA)	1 x 2/ 1	142.1	142.4	426.6	1667	51.6
2	MHI	MPCP1 (M701F4)	1 x 1/ 1	307.2	157.8	464.5	1446	59.5
3	MHI	MPCP1 (M701G2)	1 x 1/ 1	325.7	172.3	498	1450	59.3
4	Alstom	KA-26-1S (GT26)	1 x 1/ 1	326	141	467	1445	59.5
5	GE	9E	2x2/2	126	67	386	1655	52
5	GE	9FA(109FA)	1 x 1/ 1	256	135	391	1516	56.7
6	GE	9FB(109FB)	1 x 1/ 1	279	134	413	1481	58
7	Siemens	SSGC5-PAC-4000F 1S (SGT5-PAC4000F With SST5-3000)	1 x 1/1	307	138	445	1465	58.7

The heavy-duty machines are further classified as single shaft machines and multi-shaft machines. In single shaft configuration, gas turbine and steam turbine are coupled to the generator in a tandem arrangement to run on the same shaft. However, in multi-shaft configuration the gas turbine generators and the steam generators are on different shafts. The single shaft machines requires more space along the shaft for accommodating

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condenser, steam turbine, generator, gas turbine, HRSG and stack in one train. In the single shaft configuration both the prime movers i.e. GT & ST drives a single generator of about 350 MW. This large size generator of about 350 MW would necessitate import of the three phase transformer, or alternately if the transformer are sourced indigenously would call for installation of three numbers of single phase transformers in each train for power evacuation when compared to three numbers of three phase transformers (one each for GTG & STG) in case of a multi shaft machines. Hence, the single shaft option would result in more space requirement for transformers in case the transformers are sourced in India. The down time for maintenance of the generator in case of generator rotor removal for any investigation / repair in case of single shaft configuration is longer. This is because the entire generator assembly has to be skidded out of place so that the rotor could be withdrawn parallel to GTG / STG centre line. There are no single shaft configuration machines presently installed or operating in India though there are number of installations outside India. Hence, operating experience on single shaft machines in India is not available.

However, from the above table the net plant efficiency for various models in the options are found to be around 51.6% – 59.5 %, with advanced technology gas turbines. The plant efficiency and heat rates have a major impact on the cost of electricity. Capital cost is expected to be higher for higher capacity machines. Considering the limitation of availability, land, single GT configuration to achieve the required power output is considered for the proposed CCPP. In view of the availability of 220 KV KPTCL switch yard, it is proposed to evacuate the power at 220 KV which requires less space compare to 400 KV switch yard. In view of lower plant efficiency, larger area requirement and higher spares inventory, the option of more than 1 GTG is not considered for the proposed CCPP.

Configuration of 1 GTG, 1 HRSG and 1 STG in multi-shaft configuration in one block is considered for the purpose of cost estimate and other details to be presented in the DPR. However, it is recommended that the exact configuration and output could be decided during the project procurement stage by evaluating the capital cost, operating cost etc.

7. Latest development in the Gas Turbines:

Leading gas turbine manufactures, Alstom, GE Energy, MHI and Siemens have launched their latest packages.

In May 2011, both GE and Siemens have launched the next-generation gas turbines, with higher efficiency. GE new machine would achieve a thermal efficiency of 61 %, and Siemens with an efficiency of 60.75 %. During the same period Mitsubishi launched its latest J Series gas turbine, with higher turbine inlet temperature of 1600 °C, ie 100 °C higher than its G Series turbines, with gross thermal efficiency greater than 60 per cent at a similar NOx burn to current models. In June 2011, Alstom launched its latest GT26 combined cycle gas turbine with an efficiency of over 61 per cent in combined-cycle operation.

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a. **GE Flex Efficiency 50:**

During May 2011 GE launched the Flex Efficiency 50 .The machine is rated at 510 MW and claims a thermal efficiency in combined-cycle mode greater than 61 per cent with operational flexibility. And with this machine, a plant can ramp up at a rate of 51 MW per minute, twice the normal, while maintaining emissions limits of 50 ppm NOx and can go from hot start to full rated power in 28 minutes. 9FB's with Flex Efficiency technology is scheduled to enter commercial operation in 2015.

b. **Siemens : H Class:**

Siemens' H Class gas turbine is designed to achieve 60 per cent efficiency at a capacity of 600 MW in combined-cycle operation. HRSG is designed and built by Siemens with the steam temperature of 600 °C, an increase of 35 °C. Steam pressure is 180 bar, an increase of 35 per cent over the F class's 130 bar, while steam mass flow is 100 kg/s, an increase of 30 per cent over 77 kg/s achieved by the F Class. The heating surface is increased by 45 per cent. In the long-term, Siemens targets 2015 for operating a 600 MW 50 Hz H Class combined-cycle gas turbine at an efficiency of 61.5 per cent.

c. **Alstom - GT26:**

Alstom new launch gas turbine GT26 has a base load efficiency of 61 per cent, with best all-round efficiency over the entire load range. GT26 low load operation capability allows more than 500 MW with much reduced minimum load point of about 100 MW to provide fast responding stand by and significantly reduced fuel consumption during such low load periods. GT26 ramp up rate is 350 MW in 15 minutes from low load. Testing of the full, upgraded GT26 package started in March 2011 and likely to start the commercial generation during 2014-15.

d. **Mitsubishi - J Series:**

Mitsubishi Heavy Industries (MHI) has achieved the world's highest gas turbine inlet temperature of 1600 °C, with its J Series gas turbine. The new turbine can withstand a temperature of 100 degrees higher compare to the G series GT. The J Series gas turbine has achieved a rated power output of about 320 MW (ISO basis) and 460 MW in combined-cycle power generation with gross thermal efficiency exceeding 60 per cent, but is aiming to achieve 61 per cent. J Series features improved 3D engineering of compressor blades, steam-cooling of stationary combustor components and advanced thermal barrier coatings.

8. **Selection of GT:**

For the proposed CCPP at Yelahanka, modern advanced gas turbines with most fuel efficient electric generating technology is considered in multi shaft to obtain the desired output of 350±20% MW under site conditions.

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The name of the manufacturers, their combined cycle model number, output under ISO and site conditions with natural gas firing are as below.

SL No	Manuf. of gas turbine	Gas Turbine Model	Combined Cycle Model	Gross output CC (ISO)	Gross Heat rate CC (ISO)	Net eff (ISO)	Gross O/P @ site condition	Heat rate CC @ Site Condition
				MW	kcal/kWh	%	MW	kcal/kWh
1	GE	Frame 9E	2x109E (1x1)	2x193	1655	52	322	1710
2	GE	Frame 9FA	109FA	391	1516	56.7	335.5	1530
3	GE	Frame 9FB	109FB	413	1481	58	370.2	1510
4	Mitsubishi	M701F4	MPCP1	464	1446	59.5	415	1475
5	Mitsubishi	M701G2	MPCP1	498	1450	59.3	440	1482
6	Siemens	(SGT5PAC4000F With SST5-3000)	SSCC5-PAC-4000F 1S	445	1465	58.7	395	1495
7	Alstom	GT26	KA-26-1S	467	1445	59.5	415	1475

9. Steam cycle:

In a combined cycle power plant the heat in the exhaust gas of the gas turbine is recovered by generating steam in the HRSG. By maximising the heat recovery and efficient utilisation of the steam in steam turbine the overall combined cycle efficiency can be improved. However such an improvement has to be weighed against the economics of heat recovery and overall improvement in the plant efficiency.

The proposed combined cycle power plant would be based on a triple pressure, re-heat steam cycle. The HP steam parameters would be about 135 bar(a) & 567 ^{0}C, LP steam parameters would be about 4.7 bar(a) & 279^0 C, IP & HRH steam parameters would be about 34 bar(a) & 564 ^{0}C at the outlet of HRSG.

10. GT inlet air evaporative coolers:

The Gas turbine generators would be provided with evaporative type coolers for enhancing the power output of the plant during summer months when the relative humidity is lower and the ambient dry bulb temperature is higher. Evaporative cooling at GT inlet option can be considered depending on the ambient condition (relative humidity during the summer season). GT inlet evaporative coolers are not considered for the proposed CCPP.

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CHAPTER - VI

MECHANICAL SYSTEMS AND PLANT LAYOUT

1. General:

The proposed combined cycle power plant at Yelahanka would comprise gas turbine generator (GTG) having an approximate site output of 237 MW, heat recovery steam generators (HRSG) and steam turbine generator (STG) having a rating of about 133 MW. A typical combined cycle power plant scheme is shown in Exhibit - 16.

Heat recovery steam generator in triple pressure reheat feed water heating steam cycle would recover the heat content of the exhaust gas from the gas turbine. The steam generated would then be expanded in a condensing type, reheat steam turbine, driving an electric generator. Operation of the plant on simple cycle mode is not envisaged and hence no bypass stack has been considered.

COMBINED CYCLE POWER PLANT:

2. Gas Turbine Generator (GTG):

The gas turbine generator would essentially comprise the following:

a. Gas turbine section
b. Compressor section
c. Combustion system
d. Fuel system
e. Lubricating and hydraulic system
f. Inlet and exhaust systems
g. Fire protection system
h. Cooling system
i. Starting system
j. Generator and auxiliary module

The gas turbine would consist of a multistage compressor and turbine. The compressor would be of axial flow with 18 stages with modulating guide vanes. Inter stage air extractions are used for cooling and sealing air for turbine nozzles; wheel spaces and bearings, and for surge control during start up.

The turbine section has three stages of nozzles (stationary blades) with air cooling provided to all three stages. The first stage and second stage nozzles are cooled by a combination of film cooling (gas path surface), impingement cooling, and convection cooling in the vane and side wall regions. The third stage is cooled by convection.

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3. Combustion system :

The gas turbine units would have combustors with Natural Gas/RLNG firing capability. These combustors chambers are arranged around the periphery of the compressor discharge casing. The major components of combustion system are Dry Low Nox (DLN) Combustor, Combustion liners, Transition pieces, Spark plugs, Cross fire tubes, Flame detectors etc.

The combustion of air and fuel mixture takes place in the combustors and the hot combustion gases would be expanded in the gas turbine which would drive the generator and the axial flow air compressor, which would provide the combustion air. The compressor would be provided with inlet vane control system for regulating the airflow and to improve the part load efficiency of the GTG. The gas turbine units would drive the generator directly at 3000 rpm.

4. Fuel system:

The fuel system modulates the gas fuel flow to the turbine. Fuel gas system requires that the gas be supplied to the fuel control system at the proper pressure and temperature to maintain proper gas flow and required temperature to maintain the hydrocarbon super heat. The major components of fuel gas system are stop/speed ratio control valves, vent valves, fuel manifold and nozzles, consolidated fuel gas conditioning system, fuel gas filters, heater, etc.

5. Lubricating and Hydraulic system:

This system is mounted on a separate base frame, which would house the mechanical, and the control elements required for the gas turbine operation. The major components located in the accessory compartment are the lubrication oil system complete with lube oil pumps, lube oil reservoir, lube oil coolers, and accessory gear for driving the main lube oil pump and hydraulic system.

6. Inlet and exhaust systems:

The gas turbine performance and reliability are the function of the quality and cleanliness of the air entering the turbine .Therefore for most efficient operation , it is necessary to treat the ambient air entering the turbine and filter out the contaminants . The function of the air inlet system is to maintain the quality of air under various temperature, humidity and contamination conditions etc.

The inlet air system would consist of a filter house with-self-cleaning pulse jet type single stage static air filters, ducting and silencer. The system would draw atmospheric air into the gas turbine compressor unit. Air intake silencer would be provided to suppress the noise in the intake air system. To further increase the output of the gas turbine generator, the inlet air temperature to the gas turbine compressor unit has to be reduced. This can be achieved by installing an inlet air cooling system. Considering the temperature data as furnished in Appendix #1, the option of using the inlet air cooling system would be restricted to summer months. Hence, evaporative cooling system at gas turbine inlet is not being considered for this project.

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7. **Exhaust system:**

The exhaust system would allow the exhaust gas to escape through the HRSG. After exiting from the last stage of turbine, the exhaust gas enters the diffuser section in which portion of the dynamic pressure is recovered and the gas flows axially in to the exhaust system. The exhaust system would comprise of exhaust diffuser silencer, dampers and ducting, expansion joints etc.

The height of the HRSG stack would be about 45mtr above the ground level which is considered adequate as Natural Gas/RLNG contain negligible sulphur which is the minimum requirement as per CEA/MOEF norms. The gas turbine units would have an enclosure around the base frame for reducing the noise level to acceptable limits. A fire detection and carbon dioxide protection system would be provided to protect the gas turbine and its auxiliaries against fire hazard.

8. **Cooling system:**

Cooling system basically comprises of lube oil cooling with heat exchangers. Cooling water is supplied with proper flow and pressure, temperature and with monitoring system.

9. **Starting System:**

The static start system uses load commutating inverter (LCI) as the starting means for the gas turbine. The generator will be turning via a low speed turning gear, prior to LCI starting. With signals from turbine control, the LCI will accelerate or decelerate the generator to self-sustaining speed required for purging, light off, water wash etc.

The turning gear assembly is located on the collector end of the generator and is used for slow speed operation, (6RPM), cooling, standby turning and rotor break away during start-up. Motorized disconnect switch is provided to disconnect the static starter device during the normal generator operation.

10. **Heat Recovery Steam Generator (HRSG):**

The HRSG would be of triple pressure, reheat natural circulation, and feed water heating, unfired, horizontal gas flow type each with a self-supporting stack of BHEL design of Module of Steam Generator (MSG). The HRSG is provided with super heater, re heater, evaporator and economiser for HP, IP and LP circuits. Steam and water flow is counter current in all the heat transfer section to maximise the effectiveness of the HRSG.

HRSG would be complete with inlet ducts, super heater section, re heater section, attemperators, evaporators, steam drums, economiser and feed water heater, interconnecting piping, valves, thermal insulation and lagging. HRSG casing(ducting) , exhaust ducts, dampers, expansion joints, platforms and ladders with HRSG main chimney. Feed water and steam sampling arrangements as required would be provided. A condensate preheater to recover the thermal energy of the hot gas to the maximum extent will be provided apart from the superheater, evaporator and economiser sections. Steam temperature control would be achieved with spray water attemperation for both main steam and reheat steam.

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The exhaust gas is directed through the GT exhaust duct to the HRSG for operation in the combined cycle mode. Solid /serrated spiral finned tubes of suitable fin parameters are used for all heat transfer surfaces considering the usage of cleaner fuel in the gas turbine.

11. HRSG main chimney:

HRSG chimney shall be of self-supported, straight cylindrical type chimney shall be designed as per IS 6533. Chimney shell shall be made of MS (as per IS 2062), cage ladder and platforms to approach aviation lamps and sampling ports are to be envisaged. Thermal insulation is to be provided throughout the length of chimney.

12. Recommended feed water limits in HRSG

Sl.no.	Parameters	Values
1	PH at 25° C(Copper alloy pre-boiler system)	8.8 to 9.3
2	PH at 25° C(Copper -free pre-boiler system)	9.0 to 9.6
3	Conductivity at 25° C in micro Siemens/cm	<0.2
4	Silica as SiO_2 , ppm	<0.02
5	Dissolved oxygen, ppm	0.002 to 0.01
6	Iron, ppm	0.02
7	Copper , ppm	<0.003
8	Hydrazine residual, ppm	0.01-0.02
9	Total organic carbon, ppm	<200
10	Total hardness, ppm	nil

13. Recommended boiler water limits in HRSG:

Sl.no.	Parameters	HP	IP	LP
1	PH at 25° C	9.1 to 9.4	9.1 to9.8	9.1 to9.8
2	Conductivity in micro Siemens/cm	<20	<50	<50
3	Phosphate residual as PO4, ppm	1 to 3	5 to 10	5 to 10
4	Silica as SiO2,ppm	<0.4	< 7.5	< 7.5

14. Steam purity /parameters at HP outlet:

Sl.no.	Parameters	Values
1	Conductivity in micro Siemens/cm	< 0.2
2	Silica as SiO2, ppm	< 0.02

15. Steam Turbine Generator (STG):

The Turbine is off condensing type, tandem compound with separate HP/IP and LP cylinders. The combined HP/IP cylinder is of reverse flow design with high pressure and intermediate pressure blading. LP cylinder is of double flow type. The turbine is basically engineered on reaction principle with throttle governing to drive alternating current full capacity turbo generator. The readily designed HP & LP modules are combined and sized to required power output, steam parameters and cycle configuration to give the most economical turbine set.

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The STG shall be fitted with valves & actuators, turbine governing system, turbine monitoring system, closed circuit oil supply system for bearings, high pressure control oil system.

The salient features of turbine are;

- Reaction blades with high stages efficiency
- State of the art low-pressure blading under high efficiency
- Flexibility of operation with quick start-ups and loadings
- Wide range of frequency for continuous operation
- Balancing of rotors at rated speed and over-speeding
- Sophisticated control and monitoring equipment

Steam is generated at three (3) pressure levels, namely high pressure (HP), intermediate pressure (IP) and low pressure (LP) in the HRSG.

While HP steam is admitted to the steam turbine through a set of emergency stop and control valves, IP and LP steam would be injected into the steam turbine at an appropriate stage through the injection control valves. The turbine control would be of electro - hydraulic type with hydro-mechanical system as a backup. The STG would be complete with lube oil and control oil system, jacking oil system, governing system, protection system and gland sealing steam system.

Intermediate pressure (IP) and low pressure (LP) bypass systems of 100% HRSG capacity for dumping the HP, IP and LP steam to the condenser during start up and turbine trip conditions would be provided.

16. Condensing equipment and Auxiliaries:

The steam turbine would be provided with a two pass divided water box, surface type condenser fixed to the turbine exhaust for condensing the exhaust steam from the steam turbine supported on the springs. The condenser will be suitably designed to use tertiary treated sewage water for condenser cooling. The condenser would have 90-10 Cu-Ni tubes in the condensing zone and stainless steel tubes in the air cooling zone with carbon steel tube sheets. Two (one working and one standby) mechanical vacuum pumps would be provided for evacuation of air from the condenser. Two condensate extraction pumps (CEP) (one working and one standby) of vertical canister type would be provided to pump condensate from the condenser hot well to the deaerator through condensate preheater of the HRSG with the assistance of three nos (3x50%) Condensate Preheater Recirculation (CPHRC) pumps.

17. Feed Water System:

A constant pressure deaerator has been proposed for feed water heating and deaeration of the HRSG feed water. The deaerator would be located on a separate structure over the

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feed water pump close to the HRSG. The deaerator is provided to remove the dissolved corrosive gases from the feed water. The oxygen is reduced to 5cc/1000 litres and carbon di oxide is reduced to untraceable limits. Access to the deaerator floor will be through a platform of the HRSG.

Dearator is a direct contact type heater and is located between LP Heaters and Boiler feed pump in a regenerative cycle. The deaerator feed water heater would be a direct contact type or spray type of deaerator arrangement. The feed water storage tank would have an adequate storage capacity of about six minutes under 100% maximum continuous operation of the HRSG. The deaerator would be located at a suitable elevation to provide the required net positive suction head for the feed water pumps.

The feed water system delivers feed water contained in the feed water storage tank to HRSG. Two 100% capacity combined HP/IP boiler feed water pump and two 100% capacity combined LP boiler feed water pump delivers the feed water through the HP and IP economisers to their respective HP and LP steam drums. Feed water is tapped from the intermediate pressure economiser outlet for the use as the heat source in the fuel gas performance heater located near gas turbine. No separate IP pump is provided but an inter-stage tap off to the IP circuit is provided from the HP feed water pumps. The feed water flow to the HRSG would be regulated through feed water control valves (feed control station).

18. Chemical Dosing System:

a. Feed water system:

To maintain the quality of the feed water, chemicals are dosed in the LP and HP side of the feed water cycle as well in the ECW system.

LP dosing consists of three dosing systems i.e. Hydrazine, Ammonia, and NaOH dosing system. The residual oxygen present in the feed water is detrimental to feed water equipments. In order to control the same, continuous dosing of hydrazine is done at the deaerator out let. Boiler feed water/condensate water should have requisite PH in order to protect the system from corrosion. In order to control the same, dosing of dilute solution of Ammonia is done at the CEP discharge header. Sodium Hydroxide (NaOH) dosing system is provided to dose NaOH solution in equipment cooling water lines (DMCW) to increase PH up to 9.5. Each system would be complete with solution preparation-cum-feed tanks, agitators / mixers, metering pumps, piping, valves and fittings.

b. Circulating Water System:

The circulating water has impurities that induce the scale formation on the condenser tubes, increase corrosion. To prevent this, CW treatment is carried out. The CW treatment system mainly consists of scale inhibitor/corrosion inhibitor dosing system and biocide dosing system. Considering the alkalinity of the raw water (20-30PPM) H2SO4 dosing is proposed.

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It is propose to have ozone treatment for the cooling water to prevent growth of biological substances. The ozone system consists of oxygen generating plant, ozone generator, ozone dosing system.

c. Waste water treatment:

Waste water generated from the plant is treated as below:

- CW Blow is transferred to the guard pond
- HRSG blow down is transferred to the guard pond.
- Reject water generated from the RODM plant neutralizing pit shall be transferred to guard pond.
- Oily waste generated from HRSG, transformer yard, GT/ST area shall be treated in the lamella clarifier and treated water shall be transferred to the guard pond.

The treated water from guard pond shall be used for gardening, cleaning and remaining shall be left to nala after dilution.

19. Details of combined cycle power plant :

Sl. No.	Equipment	Units	Parameters
1	Number of GTG	Nos	1
2	ISO output with Natural gas/RLNG firing	MW	279
3	GTG output at site condition (28°C)	MW	237
4	Number of HRSG	Nos.	1
5	Number of STG	No.	1
6	STG Output (28°C) at generator terminals with cooling water temperature of 28°C	MW	133.225
7	Combined cycle output at 28 °C	MW	370.20
8	Total auxiliary consumption at 100% MCR condition	MW	12.86
9	Combined cycle heat rate with Natural gas/RLNG firing and LHV basis, 100% base load and 0% make-up	kcal/kWh	1470
10	Natural gas/RLNG consumption at 100% base load	t/h	46.316

20. HRSG Steam parameters :

Sl.No	Details		HP	IP	LP
a)	Steam generation	T/h	294.4	297	339
b)	Pressure	Bar(a)	135	34	4.65
c)	Temperature	°C	567	564	275.9

21. STG Throttle steam parameters:

Sl.No	Details		HP	IP+HRH	LP
a)	Flow	t/h	294.4	297	315.42
b)	Pressure	Bar(a)	129.6	33.09	4.74
c)	Temperature	°C	565	563.7	279.3

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AUXILIARY SYSTEMS:

22. Fuel Gas System:

Natural gas/RLNG would be the fuel for the proposed power plant. Gas from the gas grid will be supplied from tap-off provision at GAIL's SV Station SV-3B/ Hebbal flyover junction located on outer ring road to KPCL, Yelahanka site boundary limits at a pressure of 17-18 kg/ cm2(g) through pipe line from M/s GAIL. Due to lying of pipe line in congested city area limits, it may not possible to supply the gas at higher gas pressure. The gas turbine would require the Natural gas/RLNG at a pressure of about 35 kg/cm2 (g) to 40 kg/cm2 (g) near the GT inlet. Hence, gas booster station with two gas centrifugal compressors (1working and 1 stand by) with all accessories is proposed for this project.

The gas being supplied would be metered at the site with a separate metering arrangement. Further filtration and conditioning of the gas would be carried out. The scheme of fuel gas system is shown in Exhibit # 8.

23. Water systems:

The proposed scheme of water system for the plant is shown in Exhibit # 9. Water is required for condenser cooling, cooling of various auxiliaries of gas turbine generators (GTGs), steam turbine generators (STGs), etc. Major consumptive requirements are demineralised water for HRSG feed water make-up, make-up to the CW system, service and potable water system. The water system consists of various sub-systems listed below and discussed in the subsequent paragraphs of this chapter:

a. Raw water supply system
b. Cooling water (CW) system
c. Auxiliary cooling water (ACW) system
d. CW make up water system
e. Reverse Osmosis (RO) and Demineralized (DM) plant
f. Service and potable water system
g. Fire protection system
h. CW treatment plant
i. Chemical laboratory equipment
j. Ozone generation plant for CW system
k. Effluent disposal system

24. Raw water supply system:

The water to the power plant will be sourced from the tertiary treated sewage water from nearby BWSSB treatment plants. BWSSB has established 10 MLD capacity tertiary treatment plants at Jakkur and Allasandra near Yelahanka and is proposing to increase the capacity of the Jakkur treatment plant to meet the 1st stage requirement of Yelahanka CCPP. BWSSB has carried out the feasibility study and preliminary works required for the supply of tertiary treated water to the proposed Yelahanka CCPP. In this regard KPCL have deposited the amount required for the proposed works.

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It is propose to entrust the total works of water supply including establishing the tertiary treatment plant with necessary discharge pumps, piping from treatment plant to Yelahanka CCPP raw water reservoir, construction, operation and maintenance of the plant to M/s BWSSB.

M/s BWSSB have agreed to supply the required quantity tertiary treated water to proposed Yelahanka CCPP from Jakkur treatment plant. The analysis of tertiary treated water to be supplied by BWSSB is shown in Appendix #3. In order to avoid further treatment at Yelahanka Plant; it is propose to get the tertiary treated water with required quality to be directly used for industrial use /non-potable purpose. (With TDS around 600-800).

The total raw water requirement of the plant is around 14400 M^3/day (approximately 600 M^3/h). Tertiary treated water drawn from the sewage treatment plant will be stored in the tertiary water storage tank of 114000M^3 capacity, which will be sufficient to cater around six (6) days of raw water requirement of the plant. The tank will also have an adequate reserve and dead storage to cater to the requirements of the fire protection system.

The raw water pump house located adjacent to the tertiary water storage tank will be of jack well type. In order to remove organic /micro organism, the raw water will be subjected to chlorination for prevention/ control of growth of algae. The chlorination dosing system equipment and the MCC will be housed separately in a common building adjacent to the raw water pump house.

The raw water pump house will house the CW make up pumps, RO plant supply pumps and the fire water pumps.

25.Plant raw water requirement:

SL.No	Item	Quantity M^3/Day
1	**CW System**	
	a. Evaporation and drift loss in cooling tower	8400(350 M^3/hr)
	b. Blowdown from CW system	4200(175 M^3/hr) with 3 COC
2	**Total Make up for CW System**	**12600(525 M^3/hr)**
3	RO and DM plant (Including service water and potable water requirement)	1320(55 M^3/hr)
4	Dilution required for ETP	480(20 M^3/hr)
5	**Total (approximate) Raw water requirement per day**	**14400 (600 M^3/hr)**

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26. Cooling water system:

An open type closed cycle cooling system with one no. Induced Draft Cooling Tower (IDCT) is proposed, considering limited availability of water at the site. Cold water from cooling tower will be pumped to condenser and hot water from condenser shall be returned to cooling tower for cooling. Cycles of concentration (COC) is considered to be three (3).The circulating water quantity required for cooling of the condenser and GTG & STG auxiliaries is estimated to be about 18200 M^3/h and 2000 M^3/h respectively.

27.Selection of type of cooling tower:

A comparative study has been carried out between Natural Draft Cooling Towers (NDCT) & Induced Draft Cooling Towers as presented below.

NDCT does not require fans and thus no power consumption but are more capital intensive. The height of the tower is relatively higher than IDCT. The maintenance requirements are much less as compared to IDCT as there are no moving parts. On the other hand IDCTs are relatively less capital intensive, the height of the tower is less as compare to NDCT but consume power for operation of the fans for entire life of the plant. IDCT is better suited for clear water applications. IDCTs can achieve lower approach temperature (better performance). Considering the site specific conditions such as ambient air conditions, quality of water to be handled, land availability, plant layout requirements, etc. the selection has to be made based on Techno-economic analysis.

28.Details of Techno –Economic analysis of IDCT:

Sl.no	Description	Mechanical Draft Cooling Tower	Natural Draft Cooling Tower
1	Layout	Lower foot print area required	Higher foot print area required
2	Capital Cost	Base	Relatively Higher
3	Construction Period	Base (Less than 18 Months)	Longer Construction (Min 30 Months)
4	Fan Power Consumption	Auxiliary Power consumption on account of fans to be considered	No fans envisaged
5	Operation Flexibility	Possible with multicellular construction	Fixed
6	Tower performance	Is adjustable by changing the blade angle	Fixed

KPCL needs to obtain aviation clearance for the power plant; the tallest structure in the plant can be of only 45 m height. Since, the height of NDCT would be more than 70 m, NDCT may not be viable. Based on the above study, IDCT is the preferred choice for the power project.

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An open type closed cycle cooling system using tertiary treated water with one no. Induced Draft Cooling Tower (IDCT) is proposed. The system essentially consists of circulating water pumps, cooling tower and CW make-up system. CW pumps supply the cooling water requirement of the condenser and to secondary circuit of plate heat exchanger of STG & GTG auxiliaries. The condenser inlet and outlet piping, and the cooling tower inlet pipes will be of carbon steel. For the purpose of isolation and control, motor-operated butterfly valves are proposed on the CW pump discharge lines, condenser inlet and outlet pipes as well as on the cooling tower inlet (risers). Rubber expansion joints would be provided on the pump discharge lines and condenser inlet and outlet lines to take care of misalignment and expansion of these pipelines as well as to facilitate dismantling of the butterfly valves.

29. CW Pumps and Pump Area:

The CW system shall broadly comprise of

- 3 X 50% vertical wet pit type CW pumps
- One no. of EOT crane
- One no. of electric hoist for handling bar screens and stop gates
- One no. RE Joint and one no. of BF valve at each discharge of CW pumps
- IDCT
- COLTACS

The cycle of concentration in the CW system depends on the quality of raw water. Considering the quality of tertiary treated water COC can be fixed in the range of 3-4. The blow down from CW system for maintaining proper concentration in the cooling system shall be led to guard pond. Make up for the closed cycle CW system shall be supplied by 2 x 100% CW make up pumps installed in raw water pump house.

The exact value of pump capacity/ head would be decided during the detailed engineering stage. The pumps proposed are of vertical turbine type, non pull out and mixed flow type and will be located in a wet pit. The CW pumps will be located in an enclosure.

The CW system will also be subjected to chlorination for control / prevention of growth of algae and to chemical treatment for control of circulating water chemistry. Both the chemical dosing and chlorination systems will be housed separately in a room adjoining the CW pumps area. The MCC will also be housed in a room.

30. CW Piping:

From the CW pumps, the cooling water to the condenser is proposed to be conveyed by a cold water steel conduit of suitable diameter up to the STG building. From this conduit, steel pipes would convey the cooling water through the condenser. Similarly, outlet pipes would convey the hot water from the condenser up to a hot water steel conduit outside the STG building. This conduit would be laid up to the cooling tower area from where steel pipes (risers) would be provided to carry the hot water to the cooling tower.

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31.Cooling Tower:

Induced draught cooling tower, one (1) no. of 22000 M^3/hr capacity, will cool the hot water from the STG condenser and ACW heat exchangers. The exact values of hot and cold water temperature will be decided based on the design of the steam turbine condenser, which will be optimised along with the CW system during detailed engineering stage. The cooling tower would be of RCC construction with an RCC basin and PVC film type fills. From the cooling tower basins, the re cooled water would flow by gravity through a channel up to the common CW fore bay and sump ahead of the CW pump house.

Cooling tower details are as below:

- The design wet bulb temperature -26.5 °C.
- The approach temp -5.5°C
- The cooling range -9°C
- Design cold water temp -32°C
- Type of fills -Film fills
- Basin Storage Capacity -Minimum six (6) minutes of design capacity

32.Condenser on load tube cleaning system (COLTS):

The condenser on load tube cleaning system (COLTS) is provided to prevent the formation of scales in condenser tubes with cleaning balls transported through the condenser tubes by cooling water flow. After traversing through tubes, the balls are separated from the cooling water by the strainer section installed at the condenser out let and then reinjected into CW system through recirculation pump. The COLTS system mainly shall consists of Ball separator, Ball recirculation Skid, Monitering system.

33. Auxiliary Cooling Water (ACW) System:

Auxiliary cooling water (ACW) system is used for cooling DMCW from the steam and gas turbine auxiliaries using the tertiary treated water through plate heat exchangers.

This system supplies cooling water requirements to all the auxiliaries of GTG & STG. A closed loop ACW system using passivated DM water is proposed with three 3 x 50% ACW pumps (2 w + 1s). Hot water from the auxiliaries will in turn be cooled in the plate type ACW heat exchangers. 3 x 50 % plate type heat exchangers are provided. On the secondary side of the heat exchangers, the cooling water would be provided by tapping off from the main (STG condenser) CW system using three 3 x 50% capacity ACW (2 w + 1s). The hot water from these heat exchangers is let to the hot water conduit of the main CW system and returns to the cooling tower. Self-cleaning strainers are provided in the ACW system with auto back washing arrangement of the choked filter while the pumps are in operation.

34.CW Blowdown:

Due to evaporation and drift losses in the cooling tower, certain quantity of circulating water is continuously lost. Due to this loss, the concentration of the solids (dissolved and suspended) increases. To maintain the concentration of the solids certain quantity of water

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is removed from the system and this is termed as blowdown from cooling tower. To make-up the losses due to evaporation, drift and blowdown, water will be added to the system. The ratio of the make-up quantity to the blowdown quantity is called the cycle of concentration. Evaporation and drift is dependent on the cooling range and little control is possible on the loss of water. Thus quality of make-up water will decide quantity the blowdown and the cycle of concentration to be adopted and shall govern the make-up water quantity.

Though adopting a high concentration ratio will result in reduced blowdown of water quantity and hence quantities of make-up water, it may be noted that no appreciable advantage is gained by adopting a very high concentration ratio. In fact, it would not be possible to operate the system at very high COC. This is because water circulated at very high COC could have an adverse impact on the metallurgy of the equipment involved in the CW system. The outlet effluent discharged has a higher TDS with higher COC. In order to limit the TDS of the outlet effluent additional tertiary water is required for dilution to bring the TDS within the permissible limits. Considering the above factors optimisation of COC in the range of 3-4 is essential. This would at the same time help to limit the requirement of makeup quantity and reduce the blowdown water quantity.

To prevent scaling arising due to the operation of CW system, chemical dosing system with scale inhibitor / dispersant is envisaged. In order to prevent /minimise growth of algae in the CW system, biocide dosing system is proposed instead of chlorination system. The chemicals dosed will possess anti-corrosive, anti-scalant and dispersing properties. The blowdown water from the CW system will be led to a guard pond, treated along with the other effluents collected in the guard pond.

35. CW makeup system:

The raw water from the tertiary water storage tank will be used as make-up for the circulating water system. Motorised butterfly valves with isolation valves will be provided along the CW make-up line for controlling the flow of make- up water. The make-up water will flow by gravity from the storage tank to the CW sump.

36. RO and DM (UF-RO1-RO2-MB) Plant:

The RO and DM plants will provide demineralised water (DM) to meet the feed cycle makeup requirements of HRSG and the makeup requirement of GT inlet air evaporative coolers of the plant. The DM plant capacity has been sized considering 3 % of HRSG MCR capacity as makeup requirement along with the makeup requirement for GT inlet air cooling. The DM plant will comprise of mixed bed units.

RO DM system mainly consists of

- Pressurized Ultra- Filtration System (UF)
- Reverse Osmosis System (RO1)
- Reverse Osmosis System (RO2)

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- Degreaser system
- Mixed bed system
- Membrane cleaning and Protection system
- Waste disposal system
- Electrical ,Controls and Instrumentation

a. Pressurized Ultra- Filtration System (UF):

The chlorinated tertiary treated water from raw water storage tank is pumped to RO –DM plant through RO plant supply pumps(1w+1s) and is passed through 500 micron strainers and then fed into pressurized UF system and UF permeate is collected in UF permeate tank. The strainers are back washed /flushed periodically with UF back wash Pumps (1w+1s) based on increase in the differential pressure across the screen and the waste is collected in a proposed neutralizing pit.

b. Reverse Osmosis System (RO1):

The Ultra filter water from UF permeate is supplied to RO stage 1 system though RO-1 feed pumps. The RO system consists of cartridge filter, high pressure feed pumps (1w+1s). These pumps will pump the filtered water under high pressure through RO membranes. Acid and scale inhibiting chemicals will be dosed to the filtered water for protection of RO membranes. RO membrane and RO vessels mounted on a single skid.

c. Reverse Osmosis System (RO2):

RO1 permeate is collected in RO-1 permeate tank. The RO -1 permeate from the permeate tank is sent to RO-2 through RO-2 feed pumps (1w+1s) for further treatment. RO-1 brine is disposed off to guard pond while RO -2 reject is routed to inlet of RO-1. A portion of RO-1 permeate is utilized for service water purpose (20 M^3/hr).

d. Degreaser system:

RO-2 permeate is further passed though degasser tower for reducing the dissolved CO2 and stored in degasser water storage tank from where it is admitted to Mixed Bed system to get the desired water quality. The permeate water from the degasser tower prior to being let to the storage tanks will be subjected to pH correction by the caustic dosing system provided for the purpose. MB regeneration waste is routed to neutralizing pit.

e. Mixed bed system:

The mixed bed unit will be designed to produce demineralized water required for HRSG feed water make-up and GT inlet air cooler makeup. The plant is designed for a feed water make-up at 3 % HRSG MCR along with the makeup requirement for GT inlet air cooling. The plant will consist of two (2) streams of mixed bed units, each of 50 % capacity. Each stream will be designed for a productive run of 16hrs in a day and the units will be brought out-of-service for regeneration/ maintenance. Each stream will be designed for a flow rate of 25.5 M^3/hr and will be designed for a productive output of 312 M^3/Day. The treated output (DM water) will have a conductivity of less than 0.1 micro-mho/cm and silica less

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than 0.015PPM. DM water from the outlet of the mixed-bed unit will be stored in two (2) Nos. DM water storage tanks, each of 400 M^3 capacity and in condensate storage tank of 300 M^3 capacities. DM water from these tanks will be supplied as feed make-up to HRSGs and makeup for GT inlet air coolers, by two (2) nos. (1w+1s) DM water transfer pumps

One (1) no. HRSG fill pump will also draw suction from the DM water storage tanks during initial filling of HRSG. The DM plant will be provided with associated acid/ alkali regeneration system and regenerate effluent neutralsation/ disposal system.

The backwash water from the filters of the RO pre-treatment plant and the regeneration effluent from the DM plant will be led to the neutralizing pit. The pit will be in two compartments of 50 M^3 capacity (each). Facilities for addition of acid/ alkali for neutralizing the effluent are proposed. The neutralized effluent will be led to the guard pond by two (2) Nos. (1w +1s) neutralizing system pumps. The RO plant reject will also be led to the guard pond.

The UF - RO and the DM plant will be housed in the DM plant enclosure of open type (top covered – with open sides). However, control room & MCC room will be of RCC construction. The permeate water pumps and the DM water transfer pumps will also be located in the DM plant enclosure.

37. Service and Potable water system:

The service and potable water requirements of the plant will around 20 M^3/hr and will be tapped from RO-1 permeate. The service and potable water system will cater to the plant potable water system requirements, makeup to the HVAC system and other miscellaneous services such as plant washing, canteen and toilets. Water will be pumped to the service water overhead tank of 200M^3 capacity from where water will flow by gravity to various consumption points.

It is propose to provide ccalcite cartridge filters for raising the TDS and PH to make it suitable for potable purpose.

38. Fire Protection System:

Fire protection system comprises different fire protection facilities to protect the plant against any fire hazard. The fire protection system consists of:

- Hydrant system for different areas of the plant.
- High velocity water spray protection system for transformers & turbine lube oil tanks.
- Medium velocity water spray system for cable galleries.
- Portable extinguishers and hand appliances for extinguishing small fires in different areas of the plant.
- Carbon dioxide flooding system for GTG and the local electrical containers / control cubicles room, which is a part of the GTG package.
- Mobile fire tender

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Requirements of the plant hydrant and spray systems is handled by two (2) numbers of vertical turbine type firewater pumps each of capacity 410M³/hr and 88 MWC discharge head (1 motor driven and 1 diesel engine driven).

Two jockey pumps (1 motor driven and 1 diesel engine driven) each of capacity 15M³/ hr and 90 MWC discharge head(1W+1S),Two air compressors (1W+1S), and one hydro – pneumatic tank of capacity 18 M³ are provided for make-up of the system leakages and for maintaining the system pressure. All the pumps are located at the raw water pump house. Motor driven and corresponding diesel driven pumps are interchangeable in respect of speed, capacity etc.

Starting of fire protection systems will be automatic while stopping of the pumps will be manual. Reserve storage will be provided in the raw water storage tank to cater to the requirements of fire protection system.

39. Hydrant System:

The hydrant system shall consist of a large network of piping, both underground and above ground which shall feed pressurised water to a number of valves located outdoor as well as indoor and to a number of outdoor fixed water monitors. Water in the pipe network shall be kept pressurised by hydro pneumatic tank and jokey pump arrangement. The hydrants would be provided on a network of hydrant mains drawing water from the fire water pump, which starts automatically in the event of reduction of water pressure in the hydrant mains due to opening of any hydrant valves.

40. High velocity water spray system:

Automatic high velocity water spray (HVWS) system is proposed for the generator transformers and unit aux. transformers. The system would consist of a number of high velocity projectors mounted on a pipe network around the transformers. Water supply from mains to this pipe network would be through deluge valves. Quartzoid bulb detectors mounted around the transformers would get fused in the event of a fire at the rated (high) temperature. This would cause the deluge valve to open resulting pressure drop in the water mains. A pressure switch would sense the pressure drop and the pump would be start automatically. The spray of water would take place. Provision would also be made for remote manual operation. Remote/manual HVWS system would be provided for turbine lube oil tank. In the event of fire, the deluge valve would be actuated from a local push button and once the deluge valve is open, water spray would take place to extinguish the fire in the tank and the spray pump starts automatically due to fall in the main pressure. Minimum and maximum water pressure maintained in the system shall be 3.5 to 5 KSC

41. Medium velocity water spray system:

Medium velocity water spray (MVWS) protection is proposed for the cable vaults and galleries of switch gears rooms. The system is automatic with facilities for remote/ manual operation on similar lines as that of HVWS system for the transformer tanks. However, to limit the demand of water and reduce water damage, the cable galleries are divided into a number of zones and with the help of a suitable alarm and detection system and control

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logic, only the zone on fire and two adjacent zones on either side would be sprayed with water. Water required for this system shall be tapped from HVWS system minimum pressure maintained in the MVWS system shall not be less than 2.8 KSC.

42. Gas Turbine Protection:

Gas turbine generators are provided with automatic carbon dioxide (CO_2) flooding type of protection and this system is usually supplied along with the GTG package.

43. Fire extinguishers and Fire station equipment:

It is propose to provide adequate number of following types of fire extinguishers in the various plant buildings in the plant boundary as per TAC requirement.

- Pressurised water type 9 litre capacity
- Carbon dioxide type of 4,5 Kg/9 kg capacity
- Mobile type carbon dioxide of 22.5 kg capacity
- Dry chemical powder type of 6 kg capacity
- Mobile type Dry chemical powder type of 50 kg capacity
- Mechanical foam type of 9 litre capacity
- 1 No foam tender as per IS 10460 with all accessories
- 1 No fire water tender of type B as per IS 950 with all accessories

44. Fire detection and alarm system:

Fire detection and alarm system shall be of microprocessor based analogue addressable type comprising of automatic fire detectors, manual call points, fire alarm panel, fire warning system including centralised microprocessor based monitoring system located at main control room.

The fire detection and alarm system shall be covered for GTG/STG building, Switch gear, Control and electronic cubicle room (below and above false ceiling), Battery room, Cable galleries, Gas station, Transformers yard and all other critical equipment areas.

45. Chemical Laboratory Equipment:

It is propose to have a chemical laboratory with all suitable equipments required for testing and analyzing of water, oil, gas, flue gas with all accessories required for the normal operation of plant along with general testing equipments required for the chemical laboratory. Equipments like spectrophotometer, explosimeter, gas chromatograph with data processor shall be housed in the laboratory.

It is propose to have a ambient air quality monitoring system for monitoring the respirable particulate matter (PM10 and PM 2.5), SO2, NOX, and CO. Ambient air, weather monitoring system comprising of wind wane , anemometer, thermometer , hygrometer, sunshine recorder and rain fall recorder with high volume sampler is proposed in the air quality monitoring system.

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46. Effluent disposal system:

The various waste water generated in the combined cycle power plant shall be handled as below.

- The cooling tower blow down shall be transferred to the guard pond.
- HRSG blow down and drains shall be pumped to the guard pond.
- Reject from the RO plant, backwash from filters and regeneration effluents from the mixed bed units will be led to the neutralizing pit, treated and led to the guard pond.
- Effluent after plant washing, cleaning, etc. will be led to the guard pond.
- Plant drains from SG / TG area will be led to a sump, which will also collect oily wastes from transformer area. These oily effluents will be further treated in an oil-water separator in lamella clarifier for removal of oil traces. The clear water will be led to the guard pond while the dirty oil will be disposed off in drums separately.

Treated effluents from the lamella clarifier shall conform to

- Suspended solids maximum of 100mg/l
- Oil traces maximum of 10mg/l

All the liquid effluent after required treatment shall be led to guard pond which acts as an equalization basin. The pond will have 24 hours of detention period calculated on the average flow of effluents. Ideal effluent disposal schemes have to be devised to achieve the maximum reuse of effluent collected.

The water collected in the guard pond will be treated for pH correction. A provision for dilution line to draw water from the raw water storage tank would be made to treat the water collected in the guard pond in case the disposed water exceeds the standards stipulated in the Environment (Protection) Rules. The water will be then pumped to raja Kaluve leading to Yelahanka lake, located within the plant boundary.

A portion of the water collected in the guard pond will be reused for gardening purpose and development of green belt. All the efforts shall be made for reusing the remaining substantial portion of effluent water within the plant. It is proposed divert sanitary waste to soak pits /septic tanks.

47. Air Conditioning and Ventilation System:

a. Air conditioning system:

Water cooled air conditioning plant with screw type chillers is proposed to cater the air conditioning requirement of main control room, control equipment room, gas analyzer room, switch yard relay room, UPS and battery charger room, and inter connected technical building in BC bay of steam turbine building. The temperature in the air conditioned areas would be maintained at 24.5 ± 1.5°C dry bulb temperature and relative humidity not exceeding 60%.

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The air conditioning plant is of a centrally located common chilled water system comprising of 2 x100% water cooled screw chillers , chilled water pumps, condenser cooling water pumps, FRP cooling tower and air handling units. The conditioned air from the AHU is distributed to the air conditioned areas by galvanized sheet ducts and extruded grilles/diffusers. The return air is collected above the false ceiling and led back to the AHU rooms which act as mixing plenum for return and fresh air.

For the remaining areas such as RO plant control room, chemical lab, instrument lab and all other control room with PLC/Microprocessor based controls (for various equipments/System) located in the auxiliary building shall be provided with independent air cooled split air conditioning units.

b. Ventilation system:

Ambient air ventilation system shall be provided for the ventilation of

- GTG and STG areas
- Switch gear room and cable spreader room in power house building
- DG set room
- Battery room
- AC plant room
- Compressor house
- BFP building
- MCC and cable vaults
- Toilets proved in all the buildings

For the above areas the supply air fan/lovers and exhaust fan/roof extractors or combination of both shall be provided. Fresh air pressurized ventilation system is provided for MCC/Switch gear rooms in various auxiliary buildings by means of wall mounted axial flow fan with filters, relief dampers etc. Battery room is ventilated with spark proof epoxy painted axial flow fans. Propeller type single phase exhaust fans shall be provided to all the toilets, pantry, and store rooms etc.

48. Compressed air System:

The compressed air system is proposed to supply the compressed plant air and instrument air though distribution network to meet the requirement various system/equipments. Separate system is provided for instrument and plant air requirement. The instrument air is required for the operation of pneumatically operated valves and instruments and plant air is required for the general plant services.

Two (2) numbers oil free, screw type air compressors of 10 Nm^3/min capacity at discharge pressure of 8 KSC are proposed to meet the requirement of both instrument and plant air of the plant air. The compressors are proved with inter coolers, step up gear box, silencer,

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and all other accessories. After coolers and inter coolers of the compressor shall utilize the passivated DM water for cooling. Two numbers of (1w+1S) air drying equipments shall be proved to supply moister free air at 8 KSC to all control instruments.

The compressed air system shall be provided with accessories such as moisture separators and two air receivers of $10M^3$ capacity etc. It is propose to make provision for the interconnection of service and instrument airlines to meet the emergency requirement of instrument air.

49. Equipment handling and maintenance facilities:

a. EOT cranes:

One double girder overhead EOT crane as per IS 3177/IS-807 of capacity 95/25T is proposed for the maintenance of TG related equipments excluding the generator rotor. The crane shall be of double girder, indoor duty, M5 class. EOT crane is provided with cross travel and long travel arrangement with VVVF drive for all the motions.

Double girder EOT cranes as per of different capacities for each of the following equipment/area are proposed. Each crane shall be indoor duty M5 class. Crane control shall be though pendent push button only.

- CW pump house -1no of 20T capacity
- Generator rotor handling -1no of 50T capacity
- BFP handling -1no of 15T capacity

Span and lift of each of the EOT crane shall be as per the layout requirement.

b. Miscellaneous cranes:

Single girder EOT cranes as per IS -3177 of different capacities and span as per requirement for each of the following equipment/area are proposed. These cranes shall be of single girder, indoor duty, M5 class and crane control shall be though pendent push button only.

- Air compressor building -1no
- Raw water pump house -1no
- Workshop building -1no
- Emergency DG building -1no

c. Electric wire rope hoist:

Electric wire rope hoist (2T and above) confirming to IS -3938 of suitable capacity shall be provided for following areas.

- Air washer room for GTG
- Air washer room for STG
- Air washer room for STG BC row

- Control room building elevator M/C room
- AC plant room
- CWPH outside for handling screens and gates
- BFB building
- Vacuum pump handling
- GT cooler /slip ring end shield handling
- DMCW pump handling
- Hot well make up pump /HRSG fill pump handling
- End shield turbine side handling
- GSC handling
- GTG - GCB handling
- STG - GCB handling
- BFB building MCC room
- RWPH screens and gates

d. Chain pulley blocks:

Manually operated chain pulley blocks with/without travelling trolley shall be provided for general maintenance in TG building or in other areas as required to meet the lifting requirement of capacity ≤1T. Chain pulley blocks shall be as per IS 3832, Class II duty.

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CHAPTER – VII

INSTRUMENTATION AND CONTROL

1. General:

The function of the Control & Instrumentation system would be to aid the operator in achieving safe and efficient operation of the Combine Cycle Power Plant (CCPP), resulting in cost effective power generation with optimum fuel consumption and reduced emission levels. The C&I system would be of the type which normally relieves the operator of continuous duties and would take real time corrective actions in case of process drift or if unsafe trends or conditions develop in any regime of operation viz. start up, shutdown, normal working and emergency conditions.

As per the current practice the main CCPP plant shall be operated, controlled and monitored through Distributed Digital Control Monitoring & Information System (DDCMIS) with monitors/keyboard/mouse devices from central control room. A Unit Control Desk (UCD) for mounting monitors/keyboards/mouse would be provided. In addition, a mosaic type Unit Control Panel (UCP) for mounting a few back up instruments/control devices/hardwired alarm annunciations shall be provided for operation during disturbed/emergency operating conditions in the plant.

The control, monitoring & operation of the auxiliary plants like water pre-treatment plant, DM plant, air compressors, HVAC plant, effluent treatment plant, fire protection & detection system etc. shall be carried out from the respective plant control rooms. However important process parameters and information of abnormalities, alarms etc. of these plants shall be interfaced with main plant DDCMIS system for overall monitoring.

2. Instrumentation philosophy:

The plant shall be provided with extensive instrumentation for operation, control, monitoring and protection. Adequate redundancy would be built in the instrumentation to ensure that failure of an instrument would not lead to equipment control failure / trip.

Critical control loops such as boiler drum level control, SH steam temp control, hot well level control etc. shall be provided with three transmitters for 2 out of 3 logic. Selected non critical control loops shall have redundant field sensors. All trip interlocks such as boiler drum level, turbine lubricating oil failure, condenser vacuum trip etc. shall be provided with three independent sensors used for 2 out of 3 logic.

The primary measuring instruments such as local gauges, switches, temperature elements, transmitters etc., for the measurement of parameters like pressure, temperature, level, flow etc., shall be used. All transmitters shall be smart transmitters. SMART transmitters' calibration shall be carried out through a PC based system to be located in the computer room. All temperature elements shall be duplex RTD/TC type. Microprocessor based vibration monitoring system for monitoring of vibration of major equipment/HT drive

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would also be provided. Vibration switches shall be provided for the CT fans for protection and interlock. Turbine supervisory monitoring system would be provided for the GTG & STG set monitoring.

All sensors are proximity type. Monitors provide bar graph display of the values. High and very high limits are provided for alarm and trip functions. All critical drives such as BFPs, CWPs, CEPs, shall be provided with temperature monitoring of the bearing metal and motor windings.

3. **Control & Monitoring system for main CCPP plant:**

The control and monitoring system for steam turbine, heat recovery steam generator and their auxiliaries in bottoming cycle and regenerative cycle and electrical systems is built around max DNA a microprocessor based distributed digital control system, specifically designed and developed to suit power plant environment. The control system is configured in a geographically centralized but functionally distributed architecture to enable plant operation from a central control room. Gas turbine controls are configured in dedicated hardware (Speedtronic mark Vle). The control system shall be structured to facilitate operator interventions at any stage of operation and during abnormal mode of operation.

The generators synchronization shall be through DDCMIS. 6.6 kV and 415 V switchgears, incomers, outgoing feeders, bus-couplers shall be controlled and monitored through DDCMIS from the central control room.

4. **Main CCPP C&I system:**

a. **Gas turbine generator:**

Mark Vle based gas turbine controls with standard features and construction is proposed for GTG C&I system and shall perform,

- GT sequence start-up and shut down, speed and load control, exhaust gas temperature control operation.
- Turbine protection system
- Synchronization through GCP or from Mark Vle HMI
- Load setting through GCP or from Mark Vle HMI as per operators decision
- Shutdown from either GCP or Mark Vle HMI
- Push button provision for emergency shutdown
- Generator, generator excitation & GCB controls
- Other miscellaneous GTG related controls

The GTG controls and monitoring system will be stand-alone control system and will be supplied by GTG vender along with the main equipment.

b. **Steam Turbine:**

STG C&I system shall include the following:

- EHG Control System (EHGC) for speed/load control
- Automatic Turbine Run Up System (ATRS) including synchronization and loading

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- HP and LP Bypass Control System (LPBP/HPBP)
- Turbine Stress Control System (TSE)
- Automatic Turbine Testing System(ATT)
- Turbine Protection System(TP)
- Turbine Supervisory Instruments(TSI)
- Gland Steam Pressure Control(GSPC)
- Generator, Generator Excitation and Generator Transformer breaker Control System
- STG Area drains & vents including start up drains & vents
- Binary Control of the auxiliaries of the STG
- Other miscellaneous STG related controls.
- HMI system for control and monitoring of steam turbine (Integral Part of DCS)

c. **Heat Recovery Steam Generator(HRSG):**

HRSG -C&I system shall generally include the following:

- HRSG Protection and Logics System
- Modulating Control of HP/LP/IP drums level, final steam temperature, diverter damper control etc.
- Binary Controls of HRSG like exhaust gas guillotine damper control etc.
- Modulating control of the feed water/condensate cycle e.g. condenser hot well level control, deaerator level & pressure control, APRDS control etc.
- Binary controls of FW/condensate cycle auxiliaries, steam cycles e.g. HP/LP, BFP, CEP, MOVs of drain & vent system etc.
- Automatic dosing system.
- Other miscellaneous controls like CWP, ACWP, DMCCWP, CT fans etc.

5. **Electrical control system:**

Electrical control system for the main plant (other than motors feeders) broadly consists of

a. **CRT control system(DDCMIS based)for;**

- Operation of GT EHV breakers, GCB, 6.6KV breakers of unit and station switch boards, 415V breakers of MCCs/PCCs
- Dead bus closing (synchronising) of all breakers of 6.6KV unit and station switch boards
- Closing of 6.6.KV breakers of outgoing transformers feeders, other switch boards, and non-synchronising tie breakers
- Dead bus closing of 415V breakers(PCC,MCC I/C,B/C)
- Closing of all 415V breakers (PCC O/G)
- Trip selection and closing for planned changeover of 415V switch gear.
- Exciter system channel selection, field breaker close and trip , low and raise control and on off.
- Governor System Control.
- Emergency DG start/stop control, voltage, speed, OLTC raise /lower control, initiation of auto synchroniser of generator.

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b. **Soft interface between electrical system and DDCMIS:**
Communication relays for with communication protocol (3Nos) for generator, GT, UT relay panel.

c. **Hard wired control system (Electrical Control Board):**
A hard wired control board is proposed and will be located at CCR

6. **Performance calculation station:**
Performance calculation station for monitoring and calculation of STG heat rate, plant heat rate, HRSG efficiency, availability factor, load factor and auxiliary power is proposed.

7. **Integrated sequence of events recording and annunciation system:**
A microprocessor based integrated sequence of events recording (SER)and Integral Annunciation System (IAS) would be provided to perform the following functions of SER and the annunciation system.

- The SER system with an input capacity of 256 points would be provided to log trips, cause of trips and other important faults to diagnose the cause of plant trip with a resolution of one millisecond. The system would be provided with a dedicated printer located in the main control room.
- The annunciation system of 300 points would be provided with ISA (Instrument Society of America) sequence ring back feature. The system would have the features of first up and non-first up sequences along with re flashing facility for the grouped faults displayed in a single window. A set of annunciation push buttons would be provided at three different sections of the unit control desk. The annunciation windows shall be located on the control desk above the bank of CRT's. The ISA may also be integrated with the plant DCS through a serial link.

8. **Steam & Water Analysis System (SWAS):**
Steam & Water Analysis System including analyzers of analytical instruments is proposed for continuous monitoring of quality of demineralized water, condensate, feed water and steam. The water and steam analyzers would be located in an air conditioned SWAS room for better performance and shall provide services like, PH, conductivity (specific In-situ), catalytic conductivity, dissolved silica, sodium, hydrazine, Phosphate, chloride ,ammonia(NH3) etc.
Gas analysers for measurement of SO2– and Nox– in the flue gas required to meet the pollution control board's requirements are proposed and will be located in the Ambient Air Monitoring system room.

9. **Vibration Monitoring System:**
A vibration monitoring system complete with transducers and remote monitors is envisaged for monitoring the bearing vibrations of HT drives like high pressure boiler feed pumps, condense extraction pumps and condensate cooling water pumps. The bearing vibrations for these auxiliaries would be measured and monitored in one direction for each bearing.

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10. Final Control Element Actuators:

All final control elements of regulating type (control valves, shut-off valves and control dampers) will have actuators of pneumatic type. All actuators would be sized so that the final control elements would operate properly even when the upstream pressure is 110% of maximum value. Pneumatic actuators would be provided with air failure lock and remote release, limit switches, adjustable minimum and maximum stops, local position indicators, positioners, electronic position transmitters and solenoid valves in accordance with the system requirement.

11. Local Instruments:

- Adequate numbers of local instruments like Pr. Gauges/ Transmitters/Switches, Diff. Pr. Transmitters, Level gauges/Switches/Transmitters, (Ultra/Sonic type), Temperature gauges/ transmitters, Thermo couples, RTD, s (4wire type) would be provided to enable local operators to supervise and monitor equipment/process.
- All transmitters for measurement and control would be SMART – transmitters of four (4) wire system types with 4-20 mA DC output.
- All the thermocouples and RTDs would be duplex type (K Type) and the signal transmission of thermocouple would be through compensating cables.

12. Air supply for pneumatic equipment:

Non-lubricated dry instrument air at a pressure of 5-7 KSC would be drawn from the instrument air header for various instrument auxiliaries. All pneumatic equipment, which requires air supply, would be provided with an air-filter regulator.

13. Power supply:

An uninterrupted power supply (UPS) would be provided to cater to the 240V AC single phase, 50 Hz, 2 wire power supply requirements of the I&C systems for MMI ,DDCMIS,SWAS and gas analyzer, closed loop controls, sequence controls, protection and interlock system, integrated sequence of events recording and annunciation system. 24V DC Power supply would be derived from UPS and shall be used as per the requirements.

14. Instrumentation pipes / tubes and fittings:

All pipes mounted instruments, pipes and fittings of appropriate material would be used. For all high pressure and temperature services (above 62 bar or 425°C), two isolating valves of NB 25 size would be used. For level and flow instruments, NB 25 size isolating valves would be used. For other services and measurements, NB15 size valves would be used.

For remotely located instruments, like transmitters, tubes and fittings, of appropriate material and rating would be used. Open type transmitter racks would be provided to group and mount all pressure, flow and level transmitters. Junction boxes would be provided for termination of all field switches like pressure, temperature and level and also

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for the transmitters. Necessary testing & calibration Instruments required for the complete I & C system would be provided. Separate electronic earthing with dedicated pits would be envisaged as part of DCS system.

Closed circuit TV is proposed for control room, security office and other areas of the plant for surveillance.

15. System Configuration:

a. Max DNA system:

MaxDNA system provides rugged, high performance signal conditioning. The hardware/equipment in this system represents the front end interface to the plant. The tasks involved are signal acquisition, monitoring and conditioning.

Salient features of max DNA system are

- Surface mounted electronics- compact, reliable and efficient.
- Surge withstand as per IEEE 472- 1974.
- ADC resolution 15 bits+sign.
- Individual channel protection and status indication.
- On-line replacement of any I/O module.
- Relay mounted on digital output module.
- Optical isolation for analog and binary inputs/outputs.

MaxDNA control system has an extensive selection of input and output modules that can be packaged (maxPAC) in a chassis complete with terminations or in a rack with remote set of terminations. They combine the best characteristics of both process and programmable logic controllers. Signal types and signal levels can handle any type of process.

The input / output modules are housed in the Remote Processing Units (RPU), along with the Distributed Processing Unit (DPU), which are also rack mounted modules. The I/O cards are connected to the DPUs via a parallel I/O bus that runs along the back of the rack and is extended to each rack below and to more racks in adjacent cabinets if required. The I/O bus may connect the DPU to I/O modules in the same I/O rack or another rack up to approx. 50 feet away.

These RPUs are connected to the data highway (maxNET) which serves as a transport medium. This ultra-high speed communication network (maxNET) forms the backbone to link various RPUs and the upstream connected man-machine interface systems (maxSTATIONS).

b. Open and closed loop control systems:

The open loops and closed loops pertaining to various sub-systems of steam turbine controls, HRSG controls and balance of plant controls are implemented in the maxDPU4F. A redundant pair of multifunction controllers (wherever applicable) and decentralized

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organization of electronic hardware permits realization of a transparent automation hierarchy. Each RPU houses the group/ sub group controller(s). The DPU-wise allocation of open and closed loops (functional grouping) can be finalized as per the requirement during the detailed engineering. Control loops are realized with controller redundancies, to reflect process relationships.

Drive control functions are realised via I/O hardware and software blocks residing in the multifunction controllers. The I/O modules accept automatic commands from group /sub group level controllers or from CRT consoles via data highway. The functional schemes of OLCS and CLCS and drive control blocks are implemented by using functional building blocks. There are three types of function blocks namely atomic block, standard block and custom block. The atomic and standard blocks are available as library functions in the DPU configurator utility of maxTOOLS.

Modulating (closed loop) control typically covers the auto controls. These auto controls and binary (open loop) control typically covers the controls as per machine / equipment manufacturer's recommendations.

c. Communication System (maxNET):

The maxNET communication system is a full duplex 100 Mbps switched fast ethernet network. All stations (maxSTATIONS, maxLINK and Network DPU's) are direct connected on a single full duplex redundant 10T base T link to a switched hub mounted in the RPU cabinet.

Salient features of maxNET are

- Each RPU / station connected to the maxNET has a dedicated link. No station shares a link with other stations.
- There are no collisions or delays - even under worst case condition.
- Cable breaks or station failures are isolated to one station only.
- All ports are active simultaneously.
- MaxNET supports twisted pair and fibre optic cables.
- Industry standard proven hardware.
- Standard TCP/IP protocol provides open system
- Capacity greatly exceeds maximum loading — 100 Mbps bandwidth available.
- Uses Ethernet standard cables (100 base — TX. 100 base — FX).

The maxNET is an industry proven highly reliable, secure, ultra-fast, flexible communication system that handles data bursts and alarms with ease without highway overloading. MaxNET is based upon the fast Ethernet (100 Mbps) concept which uses switching hubs with wire speed cut through capability.

The maxNET is an integrated data highway that can serve both Remote Processing Units (RPUs), which include Distributed Processing Unit (DPUs) and I/O modules, and work stations without the need for multiple levels and gateways that can be bottlenecks to fast response. All stations have unlimited access without delay and without need for a traffic director. A set of Ethernet switches is used at HMI end to connect the maxSTATIONS to the

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maxNET. Another set of Ethernet switches is used at the RPUs to connect the DPU controllers to the maxNET. The Ethernet switches are interconnected by using fibre optic communication cables.

d. Human-Machine Interface and Plant Information System (HMIPIS):

The MMIPIS comprehensively caters to the functions of CRT based man machine interface and plant information system for the complete plant and resides directly on the maxNET. The system is realised in 32-bit workstation environment and includes a modern windows 7 based human-machine interface system. Apart from providing a centralised resource for plant information, long term storage, report generation and on-line documentation. The MMIPIS also includes the vital tools for engineering, sequence of events recording and diagnostics for the entire DDCMIS. The MMI is supported by a variety of operator periphery (colour CRT consoles, inkjet printers & laser printer etc.)

The HMIPIS proposed will have the following components:

- Operator workstations for plant controls, alarm & monitoring functions of TG, HRSG, station C&I (BOP) controls & electrical controls.
- Engineer's workstation for centralised engineering, documentation and diagnostics.
- PC with CD drive (read / write) for historian.
- Workstation (maxLINK) for interface to off-site PLCs.
- Vibration monitoring system.
- Large video screen (67") of DLP type.
- Ethernet switches and network cables.
- Inkjet A4- B/W / colour laserA4/ dot matrix printers

The assignment of OWS will be done as per the requirements and also so as to provide an ergonomic solution for realising the various functional requirements. Necessary security features are built into the HMIPIS at various levels to ensure correct operation and prevent inadvertent or unauthorised use of certain functions. All the graphic displays like group, profile, trends, alarms, curves, all plant logs and performance calculation functions are implemented in the HMIPIS.

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CHAPTER - VIII

ELECTRICAL SYSTEMS

1. Electrical generator features:

One gas turbine generator rated about 236.82 MW at 28°C ambient air temperature, 0.85 PF lag, 15.75 kV, 3000 rpm, 50 Hz and One steam turbine generator rated about 133.40 MW at 28°C ambient air temperature, 0.85 PF lag, 15.75 kV, 3000 rpm, 50 Hz are proposed to be installed. The generator will deliver rated MVA output under ±5% variation in voltage and +3 to -5% variations in frequency. The generator winding would be double star connected with the phase and neutral terminals brought out. The star point of the generator would be connected to earth through an earthing transformer, the secondary of which is connected to an earthing resistor.

2. Construction features of gas turbine generator:

a. Stator:

The stator outer housing is of gas tight and explosion proof welded construction, circumferential and axial ribs are provided on its inner surface. The end shields contain shaft seal (to prevent escape of H2 at the shaft ends) and bearing components. Main components of stator are outer housing, core and winding assembly, stator core assembly, sStator winding, and hydrogen coolers.

b. Rotor:

The rotor shaft is a single piece solid forging manufactured from a vacuum casting. The rotor winding is made of silver bearing copper for increasing the thermal stability. Slip rings and carbon brushes are used to transfer the excitation current to the rotating generator rotor. The rotor is supported in the end shield mounted journal bearings at either end of the machine. During start up and turning gear operation hydraulic jacking of the shaft is provided. All bearings are insulated from stator frame and base plate to avoid shaft current. Two generator bearings are connected to the turbine oil supply. Shaft seals are supplied with pressurised oil to prevent escape of H2 at the shaft ends. Grounding bushes are fitted to the turbine end stator end shield to remove the static charges of the shaft.

c. Generator cooling:

The Gas generator is designed with direct hydrogen cooling for the rotor winding and indirect hydrogen cooling for the stator winding. The iron, friction, windage and stray losses are dissipated to hydrogen. The hydrogen is circulated in the generator interior in a closed circuit by two axial flow fans arranged in either side of rotor. Cold gas is drawn by the fans from hydrogen coolers. The cooling gas is divided in to three flows to cool the different parts of the Generator. The Hydrogen coolers are arranged horizontally in parallel to the machine centre line. The required cooling water volume depends on the generator capacity and is automatically adjusted by temperature control valve.

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3. Construction features of steam turbine generator:

The steam turbine generator base frame carries the stator, the bearings, the enclosure, exciter stator and the machine accessories. The rotor shaft is forged from vacuum cast steel ingot. The field current is supplied to the rotor through an exciter machine (rotating rectifier bridge) arranged at the shaft end. The generator cooling air is circulated by two axial flow fans located on the two shaft ends. The steam turbine generators is equipped with an indirect air cooled stator winding and a radial direct air cooled rotor winding. The generators would be provided with class-F insulation. However temperature rise would be limited to class-B.

4. Generator excitation system:

The gas turbine generator excitation system would be of static type. Digital automatic voltage regulators, regulates the voltage from the synchronous machine by direct control of the rotor current (field current) using (static) thyristor converters. The excitation system mainly consists of,

- The excitation transformer
- The control unit
- Thyristor convertor
- The field flashing and de excitation equipment

In "shunt" excitation, the excitation power is drawn from the generator stator. Initially there is not enough permanent voltage in the rotating generator to build up the generated voltage. Excitation of the generator is started by closing the field circuit breaker (FCB) and field flashing breaker. This supplies current to the field, which excites the generator up to 15..30% *U*. The generator then supplies voltage to the converter via the excitation transformer. Starting from approximate 10% of the generator voltage, the firing electronics and the converter are able to continue the voltage built-up, so that the field flashing circuit is relieved of current. Once the voltage exceeds approx. 25% of *U* the field flashing breaker is finally opened, having no current. The diode bridge at the input to the field flashing breaker prevents a backflow of current to the field flashing source.

Redundancy in the regulation section is ensured by means of two fully separate channels with independent measuring inputs and extensive monitoring. Provision will be made to operate these channels in manual mode for commissioning and checking purposes.

The continuous acting Automatic Voltage Regulator (AVR) is proposed controlling excitation of the synchronous generator main exciter field. The machine set consists of synchronous generator, main exciter unit with rotating rectifiers and permanent auxiliary exciter.

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5. The major parameters of the gas and steam turbine generators.

Sl No.	Generator Parameters	Ratings	
		GTG	STG
1.	Rating, MW @ 28°C	236.82	133.40
2.	Voltage rating, kV	15.75	15.75
3.	Rated Power factor	0.85 Lag	0.85 Lag
4.	Rated frequency, Hz	50	50
5.	Rated speed, rpm	3000	3000
6.	Rated current	10214 Amps	5753 Amps
7.	Type and Rating of Field current and Voltage at MCR	2315A/263V	Brushless 1027A/266V
8.	Insulation class of winding	CLASS- F	CLASS- F
9.	Type of cooling 1. Stator winding 2. Stator core 3. Rotor	-Indirect H2 Cooling. -Direct H2 cooling -Direct radial H2 Cooling	CACW (cold air cold water)
10.	Efficiency at rated pf.	98.94%	98.58%
11	Short circuit ratio.	0.58	Sat >0.50
12	Synchronous reactance(xdUnsat)	191.7%	206.2%
13	Transient reactance (x'd Sat.)	23.7%	20.5%
14	Sub transient reactance(x"d sat)	16.2%	12.6%
15	Negative sequence reactance	20.3%	13.2%
16	Zero sequence reactance.	11.6%	9.1%
17	The generator would deliver the rated MVA output under voltage and frequency variations as per	IEC-60034	IEC 60034

6. Generator bus duct:

The terminals of both the gas turbine generator and steam turbine generator will be connected to the generator transformer through Isolated Phase Bus Duct (IPBD) of adequate short circuit withstand capability with suitably rated tap-off to the unit auxiliary transformers. The bus duct will be natural air cooled and will run partly indoors and partly outdoor. The bus duct installation will be complete with line side CTs, UAT side CTs, VTs required for metering, voltage regulation and automatic turbine run up system, surge protection equipment consisting of lightning arrestors with suitable discharge characteristics to suit the generator basic insulation level, generator phase and neutral side current transformers required for protection.

The Isolated phase bus duct for GTG consists of main bus duct(GTG) of 15.75kV, 8160Amps (natural air cooled) connecting the generator line side terminals to the generator transformer and neutral side terminals and tap-off bus duct(GTG) of 15.75kV, 800 amps(natural air cooled) connecting to unit transformers, LAVT, SPVT cubicle and NG cubicle.

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The isolated phase bus duct for STG consists of main bus duct (STG) of 15.75kV, 5830 amps (natural air cooled) connecting the generator line side terminals to the generator transformer and neutral side terminals and tap-Off bus duct (STG) of 15.75kV, 800 amps (natural air cooled) connecting to unit transformers, ET, LAVT/SPVT cubicle and NG cubide.

7. Ratings of generator isolated phase bus duct (IPBD):

Sl. No	Particulars	Rating	
		GTG	STG
1.	Type of Bus Duct	IPBD / Natural air cooled	IPBD / Natural air cooled
2.	Nominal Service Voltage / frequency	15.75 kV / 50 Hz	15.75 kV / 50 Hz
3.	Rated voltage.	24 kV	24 kV
4.	Continuous current rating at 50 deg. C a) Main b) Tap off	 8160 A 800 A	 5830 A 800 A
5.	Basic impulse insulation level (1.2/ 50 micro-sec)	95 KV Peak	95 kV peak.
6.	One minute power frequency withstand voltage	38 Kvrm	38 Kvrm
7.	Bus duct and conductor material a) Bus bar b) Enclosure material	 Aluminium Alloy (63401 main and Tap) Al alloy(19501/31000-Main, 31000-Tap)	 Aluminium Alloy (63401-Main/tap) Al alloy (31000-Main/Tap)
8.	Dynamic current rating a) Main b) Tap-off	 148 KA peak 280 KA peak	 148 KA peak 280 KA peak
9.	Short time current rating (rms) for 1 Sec. a) Main b) Tap-off	 58 KA 110 KA	 58 KA 110 KA
10	Max. Temp rise of busbar at continuous full load rating over the specified ambient temp. of 50 deg.C. a) Plain Bolted. b) Silver plated. c) Bus duct Enclosure	 40deg.C 55 deg.C 30 deg.C	 40deg.C 55 deg.C 30 deg.C
11	Clearance between live point and earth.	220 mm	220 mm

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12.	Line side CTs	8160/5A, 3 cores	5830/5A, 3 cores
13.	Neutral side CTs	8160 A/5A, 4 cores for GTG 0.2 class for metering and PG test, 0.5 class for AVR and 5P/PS class for protection.	5830/5A, 5 cores for STG, 0.2 class for metering and PG test, 0.5 class for AVR and 5P/PS class for protection.
14.	VT & SP cubicle		
	(a) Voltage transformer	15750/ $\sqrt{3}$ kV / 110 / $\sqrt{3}$ V / 110 / $\sqrt{3}$ V, 3 nos., 100 VA / ph 0.2 / 3P class for PG test and metering 0.5 / 3P class for AVR and protection.	15750/ $\sqrt{3}$ kV / 110 / $\sqrt{3}$ V / 110 / $\sqrt{3}$ V, 3 nos., 100 VA / ph 0.2 / 3P class for PG test and metering 0.5 / 3P class for AVR and protection.
	(b) Lightning Arrestor	18kV Metal oxide type, with nominal discharge current of 10 kA.	18kV Metal oxide type, with nominal discharge current of 10 kA.

8. Gas turbine generator start up system:

The start-up of the gas turbine can be done with a static start system uses a Load Commutating Inverter (LCI) with adjustable frequency drive as the starting means for the gas turbine. By providing variable frequency power directly to the generator terminals, the generator is used as a synchronous motor to start the gas turbine. The generator will be turning via a low speed turning gear, prior to LCI starting. With signals from the turbine control, the LCI will accelerate or decelerate the generator to a self-sustaining speed required for purge, light off, water wash etc. Deceleration is a coast down function.

9. Generator transformers:

The gas turbine generator and steam turbine generators would be connected to the 220 kV switchyard through generator transformers. The transformers would be rated 323.1 MVA for STG and 158.3 MVA for GTG and would be provided with off circuit tap changer on the HV side. Generator Transformer are OFAF cooled with 2(two) nos. 100% capacity separately mounted radiator banks. Each bank is fitted with adequate number of fan & pumps with spare pump and fan. The winding of the transformer is of paper insulated electrolytic grade copper conductor. The core of the transformer is of CRGO steel.

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10.Generator Transformer Ratings:

Sl. No.	Parameters	Rating	
		GTG Transformer (Outdoor)	STG Transformer (outdoor)
1.	Type of cooling	ONAN/ONAF/OFAF	ONAN/ONAF/OFAF
2.	OFAF MVA rating	323.1	158.3
3.	No load voltage ratio kV/kV	15.75/230	15.72/230
4.	Vector group	YNd1	YNd1
5.	Type of tap changer	off circuit	off circuit
6.	Total Loss at rated voltage on principal tapping & rated frequency.	462kW (max)	462kW (max)
7.	Tapping a) Range - b) Number of steps c) Type of voltage variation	+5% to -5% 4(four) HV side & Constant flux	+5% to -5% 4(Four) HV Side & Constant flux
8.	Impedance Voltage at rated current for principal tapping. (HV-LV Side)	15.38 + 15% TOL	14.87 ± 5%TOL
9.	Impedance voltage at rated current for extreme taps a) HV-LV (Max. Tap) b) HV-LV(Min. Tap)	 15.65 + 15% TOL 15.10 + 15% TOL	 15.10 + 15% TOL 15.60 + 15% TOL
10.	Reactance at rated current and rated frequency(HV-LV)	15.0(approx.)	14.80(approx.)
11.	No load current at rated voltage and rated frequency	<0.5(approx.)	<0.5(approx.)
12.	Efficiencies at 75 deg..C at Unity power factor a) At full load b) At 3/4 full load c) At 1/2 Full Load	 99.76% 99.80% 99.82%	 99.71% 99.76% 99.79%
13	Terminal arrangement a) HV b) LV c) Neutral	 OIP Condenser Bushing Porcelain Bushing Porcelain Bushing	 OIP Condenser Bushing Porcelain Bushing Porcelain Bushing
14.	Number and size of coolers	2x 50%	2x 50%

11.Switch Yard (220KV) :

Generated power shall be evacuated at 220 kV voltage level to the KPTCL substation built within the premises. The scheme proposed shall be more reliable and provides for continuous evacuation of power even during outage of a bus or circuit breaker.

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The 220 kV switch yard would consist of the following circuits

(a)	Generator transformers	- 2 nos.
(b)	Lines	- 3 nos.
(c)	Bus Coupler	- 1nos.

12.Switchyard parameters:

Sl. No.	Parameters	Ratings, 220 kV switchyard
1.0	Technical Data for Switchyard	
1.1	Design Voltage Levels	
(a)	Nominal Voltage	220 kV
(b)	Highest system voltage	245 kV
(c)	impulse withstand Voltage	1050 kV peak.
(d)	Fault level	40 kA for 1 sec.
e)	Bus Rating	1600 A
f)	Power frequency withstand voltage	460k Vrms
1.2	Minimum creepage distance	31 mm /kV
2.0	Circuit Breakers	
2.1	Type of breaker and tank(live/Dead)	SF6 (Live tank)
2.2	Applicable standards	IEC – 62271-100
2.3	Rated Voltage(k Vrms)	245 kV
2.4	Rated continuous current at temp. of 50 deg.C	1600/2500A
3.0	Isolators	
3.1	Type of mounting and execution of poles	Centre break Horizontal-upright
3.2	Applicable Standards	IS 9721
3.3	Rated voltage & Current	245kV & 1600A
3.4	Number of Pole & type of Gang	3 poles are mechanically ganged
3.5	Pole to pole spacing(mm)	4500/4000
3.6	Opening and closing time of isolator	12 sec.
3.7	Rated short time current of isolator for 1 sec and dynamic current	40 kA/100kAp
4.0	Current transformers	
4.1	No. of Current transformer and rating	(one no. of 220 kV, 40kA for 1 Sec, 1600/1A, 5 core for metering & protection and one no. of 220 kV, 40kA for 1 Sec, 1600/1A, 2 Core for Tariff metering)
4.2	Type	Single phase, oil immersed, Outdoor type.
4.3	CT Ratio	1600/1A,

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4.4	Accuracy class for metering cores	0.2 for revenue metering and 0.5 for others
4.5	No. of cores per CT	5 core for metering & protection, 2 Core for Tariff metering.
4.6	Applicable standards	IS 2705
5.0	Capacitor voltage transformer	
5.1	Type installation	Electromagnetic for Tariff metering, Capacitor for others, Single phase, oil immersed, outdoor type
5.2	No. of CVT	One no. for metering, synchronization, & Protection; One for tariff metering
5.3	Voltage Ratio:	1) $220/\sqrt{3}$ kV/$110/\sqrt{3}$ V/$110/\sqrt{3}$ V/ $110/\sqrt{3}$ V, 2) $220/\sqrt{3}$ kV/$110/\sqrt{3}$ V/$110/\sqrt{3}$ V/
5.4	Rated voltage factor	1.2 continuous 1.5 for 30 sec.
5.5	Method of connection	Star
5.6	Accuracy class for metering cores	0.2/3P for revenue metering and 0.5/3P for others
5.7	Applicable standards	IS 3156
6.0	Lightning Arrestor	
6.1	Arrester class & Type	Metal oxide, gap less
6.2	Rated voltage	198 kV
6.3	Max. continuous operating voltage(COV)	168 kV
6.4	Minimum discharge capability at rated vg.	5 KJ/KV
6.5	Nominal discharge current	10 kA
6.6	Low current / long duration class	Class III
6.7	Pressure relief class	A
6.8	Applicable standards	IEC – 99

For all the outgoing lines, precision energy metering will be provided. The metering panel will be located near the PTs such that the length of the metering cable is kept to a minimum to reduce errors in energy recording. Space will be provided adjacent to this metering panel to enable KPTCL to install check metering for verification. The metering panel will have active and reactive energy, active and reactive/apparent power measurement with 0.2 class accuracy.

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Communication between receiving stations shall be provided by means of PLCC / microwave / optic fibre for the purpose of protection, telemetering and communication. Each line will have adequate protection / speech / data channels

13. Evacuation of power:

The proposed scheme for power evacuation is shown in Exhibits-11 & 12. The power evacuation would be at 220 kV level and the plant will be connected to the Yelahanka substations of KPTCL through one no. double circuit and one no. single circuit.

14. Auxiliary power supply system:

The total unit and station auxiliaries' electrical power is derived through Two Unit Auxiliary Transformer (2 Nos. UAT), the auxiliary power system scheme proposed for the power plant for meeting the power requirements of all auxiliaries is shown in Exhibit-10. Various auxiliaries will be supplied at the following nominal voltages depending upon their ratings and functions:

a. 6600 V, ± 10%, 50 Hz ± 5%, 3 phase, 3 wire, and medium resistance grounded AC supply for motors rated above 200kW
b. 415 V, ± 10%, 50 Hz ± 5%, 3 phase, 3 wire, solidly grounded AC supply for motors rated 200kW and below and other L.T. services
c. 240 V, ± 10%, 50 Hz ± 5%, 1 phase AC supply for lighting, space heating of motors and panels, single phase motors, etc.
d. 110 V, 1 phase, grounded AC supply for AC control circuits
e. 230 V, 1 phase AC uninterruptible power supply for Instrumentation and control systems such as closed loop controls, sequence control, automatic turbine run-up system, protection and interlock system, sequence of events recording system and annunciation system.

15. Unit auxiliary transformer:

Two nos 100% unit auxiliary transformers (UAT), rated at 20/25 MVA, 15.75 kV/6.9 kV, ONAN / ONAF cooling, with on load tap changer with range +10% in steps of 1.25% on the HV side would be provided. The cooling control is affected from cooler control cubicle mounted on transformer tank. These transformers are connected to the gas turbine generators. In the event of outage of one of the unit auxiliary transformers, the other UAT can cater to the unit load. Each unit auxiliary transformer would feed one section of the 6.6 kV unit switchgear. The proposed auxiliary power supply scheme is shown in Exhibit-10. UAT is connected to 2 Nos. 6.6 kV unit switchboards. UAT is sized to meet the MVA requirements for the following:

a. Running load of GTG corresponding to MCR condition
b. Running loads of STG corresponding to MCR condition.

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16. Service transformers:

Mineral oil filled service transformers are provided to feed various auxiliaries of the plant with ratings as shown in Exhibit-10 with 6.6 kV / 433V, ONAN cooling and with off-circuit tap changer would be provided for catering to the 415 V loads. These transformers would be fed from the 6.6kV switchgear. 2X100% rated transformer are connected to each PCC/PMCC. A margin of 10% is considered while selecting the capacity of these service transformers. Constructional aspects and fittings and accessories for oil filled service transformers in general are in conformance to CBIP manual on transformers.

17. Auxiliary Transformer Ratings:

Sl. No.	Parameter	Unit Auxiliary transformers	Service transformers
1.	MVA rating	20/25 MVA	1. 1000 KVA Booster stn. 2. 1000 KVA RO Plant 3. 1000 kVA for STG 4. 1600 kVA for CWPH 5. 1600 kVA for GTG 6. 1600 kVA for SST
2.	Type of cooling	ONAN / ONAF	ONAN
3.	No load voltage ratio (kV/kV)	15.75/6.9	6.6/0.433
4.	Vector group	Dyn11	Dyn11
5.	Impedance	10%	7% for 1600 kVA 5% for 1000 kVA
6.	Type of tap changer	On load	Off circuit
7.	Tap range	±10%	±5%
8.	Step on HV voltage windings	1.25%	2.5%
9.	Applicable standard	IS-2026	IS-2026

18. Medium voltage switchgear (6.6KV):

Total plant is provided with one no. sectionalized 6.6kV unit switch board. Each section of unit switchboard of each module is fed from respective UATs. Fast auto changeover facility is provided to ensure quick restoration of power supply to auxiliaries in the event of failure of one incoming supply to the 6.6kV unit switch board. All motors of rating above 200kW are connected to 6.6kV switchboard. Planned change over facility is also provided between 6.6kV interconnected buses. The 6.6kV system would be medium resistance earthed with fault current limited to 300A (approx.) and would be rated to withstand a three phase fault level of 40kA for one second. The 6.6kV switchgear would be vacuum type with fully draw-out construction. The 6.6kV incomers and feeders would be provided with necessary protection for individual equipment.

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19. Medium voltage switchgear (6.6KV)ratings :

Sl. No.	Particulars	Rating
1.0	Switch gear	
1.1	Nominal system voltage, phases & frequency	6600 V; 3 Phase; 50 Hz
1.2	Maximum continuous voltage Switchboard, breaker& CT/VT	7.2 kVrms
1.3	Impulse withstand voltage Switchboard, breaker& CT/VT	60 kV Peak
1.4	SC current withstand capability. Switchboard, breaker& CT/VT	40/sec
1.5	Momentary current withstand	100kAP
1.6	System Neutral Earthing	Medium resistance earthed
1.7	Applicable standards	IEC 62271-100&200
1.8	Bus bar material, Continuous current rating	Aluminium, 2000A
2.0	Circuit breaker	
2.1	Type	Vacuum / SF6, indoor, drawout type
2.2	Operating duty	O –3 min – CO-3 min-CO.
2.3	Rated symmetrical breaking current & making current	40kA/100kAP
2.4	Rated SC current withstand	40 kA/Sec
2.4	One minute power frequency withstand voltage.	20kV
2.5	Impulse withstand voltage.	60kVP
2.6	Mechamsm	Motor charged spring closing
2.7	Total break time	MAX 80ms

20. Medium voltage segregated phase bus duct:

6.6kV segregated phase bus ducts (SPBs) are provided to connect UAT to the 6.6kV unit switch board. SPB is suitable for indoor/outdoor duty with natural cooling. Aluminium conductor is supported on epoxy insulators inside the bus duct enclosure. The bus duct enclosure is made of aluminium alloy sheet. Bus duct is complete with accessories like rubber bellows, flexible's, seal off bushings. Space heaters are provided to maintain IR value inside the bus duct. Bus duct is generally supported from ground in outdoor areas and from ceiling in indoor areas. Each set of 6.6 kV, 2500/1600 Amps bus duct shall be complete with aluminium alloy enclosure and conductor with epoxy bus support insulator arrangement.

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21. Technical details of segregated phase bus duct:

Sl. No.	Particulars	Rating
1.0	System Maximum Voltage	7.2kV
1.1	Continuous Current rating	2500A
1.2	Short circuit current rating for 1 sec withstand	40kA
1.3	Short circuit current (peak)	100kA peak
1.4	1 min dry power frequency withstand voltage kVrms	20kV rms
1.5	Reference standard	IS-8084

22. Low voltage switchgear(415V System):

Low voltage switchgear comprises of 415v power control centres (PCCs), 415V motor control centres (MCC), power cum motor control centres (PMCC), 415v/240v AC Distribution Board (ACDB) and local control centres. PCCs and PMCCs are for auxiliary power distribution. LV switchgears conform generally to IS: 13947. Motor rated 200kW and below are connected to 415V system. The 415V, 3 phase, 3 wire power for the 415V auxiliaries will be obtained from 6.6 kV / 433 V transformers. The system will be a solidly earthed system. For maximum reliability, alternate power supplies with auto changeover facility will be provided for the essential power and motor control centres. The 415V switchgear will be of metal enclosed design with a symmetrical short circuit rating of 50 kA for 1 sec. All power and motor control centres will be compartmentalised and will be of double front execution. They will be of fully draw-out design with all circuit components mounted on a withdrawable sheet metal chassis. The circuit breakers will be of air break type. Motor starting will be direct-on-line. All LT motors will be controlled by air break, electro-magnetic type contactors provided with ambient temperature compensated, time lagged, hand reset type thermal overload relays, having adjustable setting with built-in single phase preventer backed up by HRC fuses for protection against short circuits.

23. Technical particulars of 415V switchgear :

Sl. No.	Particulars	Rating
1.0	Switch gear rating	
1.1	Rated voltage/No. of phases/frequency	415V / 3 Ph / 50 Hz
1.2	System neutral earthing	Solidly earthed
1.3	Short circuit rating a) Interrupting Symmetrical b) Short time for 1 sec	 50kA 50 kA rms
1.4	One minute power frequency withstand voltage	
	(a) Power circuit	2500 V
	(b) Control circuit	1500 V
	(c) Aux. Circuits connected to CTs	2000 V
1.5	Maximum allowable Temperature of Bus bars and Type	90°C,Aluminium
1.6	Short circuit withstand of Bus bars	50 kA for 1 sec.

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1.7	Dynamic rating of busbars	105 kA peak
2.0	Circuit breakers	
2.1	Type	Air break, motor charged spring closing mechanism
2.2	Operating duty	0 – 3 min – CO-3 min – CO
2.3	Short circuit withstand current	50 kA for 1 sec.
2.4	Rated making current	105 kAP
3.0	Starters	
3.1	Type	Automatics
3.2	Contactor rated duty as per IS 2959 & IS 8544	Continuous & Intermittent
3.3	Utilisation categories as per IS 2959	AC 3 & AC 4
4.0	Applicable standards	IS 13947

24. LV Non Segregated Phase Bus duct:

Metal enclosed, natural air cooled, non-segregated phase bus ducts (NSPBs) of aluminium conductor suitable for indoor/outdoor duty are provided for interconnection between LV Service Transformer and LV switchgear. Conductor & inside surface of enclosures are treated with mat black paint for efficient heat dissipation. Bimetallic connectors are provided in case equipment terminals and material of bus conductor are different.

25. Technical particulars of non –segregated phase bus duct:

Sl. No.	Particulars	Rating
1.0	Rated voltage/No. of phases/frequency	415V / 3 Ph / 50 Hz
1.1	Insulation level a) 1 min. Hipot b) Basic impulse	 2.5kV rms 95 kV peak
1.1	Continuous Current rating	2500A
1.2	Short circuit current rating for 1 sec withstand	50kA
1.3	Material- a) Conductor b)Bus enclosure	Aluminium Sheet steel
1.4	Bus insulator type	Bus post type
1.5	Reference standard	IS-8084

26. DC system (battery, battery chargers and distribution board):

220V DC system is provided for steam turbine, HRSG and station DC loads like switchgear, protection, emergency lighting, DC drives etc. Plant DC System will essentially cater for control/monitoring, alarm/ annunciation of all circuit breakers and spring charging, emergency lube oil pumps and emergency DC lighting. The system will comprise 2x100% duty 220 V lead acid plant batteries with 2 hr. back up, each with Main float plus float cum boost chargers and DC distribution boards using MCCBs in incomer circuits and other feeders. The float mode charger is capable of meeting continuous normal DC power

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requirement and trickle charging the battery. In Boost mode charger is sized to recharge the fully discharged battery to its normal capacity in a period of 8-10 hours. The chargers are of static type, comprising of silicon-controlled rectifiers connected in three phase, full wave, and full controlled bridge circuit. The charger is provided with auto and manual voltage regulation. Separate chargers of 125V DC Output with adequate battery bank capacity will be installed for GTG system. 48 V DC Output with adequate battery bank capacity will be installed for switchyard equipment's and PLCC.

Following protections are provided for the batteries and the battery chargers:

a. Fuse/MCB for short circuit protection of battery.
b. Earth fault protection.
c. Current limiting, DC under voltage & over-voltage and AC under voltage
d. Protection for charger.

220V DCDB is indoor, metal enclosed, modular construction, fixed execution, and floor mounted type. Switch fuse units are considered for outgoing and incoming feeders.24V DC required by DCS system would be derived from plant UPS system. The ampere-hour ratings of these batteries would be firmed up during detail engineering stage.

27. Protection and control philosophy:

The details of the protections that will be provided for the various electrical equipment viz., Generators, generator transformers (GT), Unit Auxiliary transformer (UAT), service transformers, 220 kV switching equipment, 220 kV lines, MV/LV motors, switchgear, etc., are indicated below.

The selection of the protective scheme will be based mainly on reliability, sensitivity, selectivity and technical merits. All main protections will be through composite or individual Numerical relays of proven design. Hand-reset lockout relays are envisaged. Associated auxiliary relays, VT voltage supply supervision relays and DC supply supervision relays for the protection scheme are also included.

28. Generator protections:

A generator relay panel (GRP) will be provided for each Generator. This panel will be located in the unit control room. The following protection schemes will be provided in the GRP and the protections will be divided into two groups; each group being 100% redundant and on separate DC supply, so that even if one group of protections is not available or under maintenance, the generator is protected by the other group.

a. Generator differential protection (87G) for both GTG & STG
b. Generator stator 0 – 95% earth fault protection (64 G1)
c. Generator stator earth fault (95 – 100%) protection (64G2)
d. Generator back-up stator earth fault (0-95%) protection (64G3)
e. Rotor earth fault protection (2 stage) (64F)
f. Generator negative phase sequence protection (46G1 & 46G2)

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g. Generator reverse/low forward power protection (32G1 & 32G2)
h. Generator loss of excitation protection (40G1 & 40G2)
i. Generator pole slipping protection (78G)
j. Generator under frequency protection (81G & 81G2)
k. Generator over-voltage protection (59G1 & 59G2)
l. Generator backup impedance protection (21G)
m. Generator stator overload protection (50GS)
n. Generator VT fuse failure protection (60G) for each of the 6 PT circuits
o. Dead machine protection (61B)
p. Generator field over-voltage protection (can be a part of excitation system)(59F)
q. Generator, Generator Transformer and Unit Auxiliary Transformers over-fluxing protection (99G)
r. In case of static excitation, excitation transformer protection will be a part of the excitation system.
s. Generator under voltage protection (27G1,27G2)
t. Generator dead machine protection(50GDM1, 50GDM2)
u. Generator breaker failure protection for GCB(50LBB)
v. Generator definite time over current protection for stator(51G)
w. Generator VT voltage supply supervision relays.
x. Generator inter-turn protection based on phase & neutral side zero sequence voltage comparison (95G)

29. **Generator transformer protections:**

The following protections will be provided for the generator transformer:

a. Generator transformer HV winding restricted earth fault protection (64GT)
b. Generator and generator transformer overall differential protection (87GTU) for STG. Generator, generator transformer and unit auxiliary transformer overall differential protection (87OA) for STG.
c. Generator transformer to switchyard overhead line differential protection (87OH) (to be mounted in SRP).
d. Generator transformer neutral over-current protection (51NGT)
e. Buchholz (63), winding temperature (49WT) and oil temperature (490T) protections
f. Generator transformer pressure relief protection (63PTX)
g. Generator transformers fire protection trip, oil level low, cooler trouble, alarms.
h. GT HV over current protection(50/51GT)
i. GT restricted E/F protection (87NGT)

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30. Unit auxiliary transformer protections:

The protections that will be provided for the unit auxiliary transformers:

a. UAT differential protection (87UAT) and short circuit protection (50UAT)
b. UAT back-up over current protection on HV and LV sides (51)
c. Restricted earth fault protection (64 ST)
d. IDMT earth fault relay on LV side (51NUAT)
e. Buchholz (63), winding temperature (49WT) and oil temperature (490T) protection
f. UAT pressure relief protection (63PTX)
g. UAT fire protection and trip (63 RTX)
h. UAT fire protection trip, oil level low, cooler trouble, alarms.

31. 6600 V / 433 V service transformer protections:

The following protections will be provided for service transformers:

a. IDMT Over current protection on HV and LV sides (51) and instantaneous over current protection (50) on HV side
b. Buchholz (63), winding temperature (49WT) and oil temperature (490T) protections

32. 220 kV line protections:

The 220 kV lines will have the following protections:

a. 3 zone distance protection (21-1) as main-1
b. 3 zone distance protection (21-2) as main-2
c. Fuse fail relay (FFR) for each secondary of CVT / EMVT
d. Under voltage relays for live – line / dead bus and dead – line / live bus closing and safe grid re-establishment (27-1, 27-2, 27S)
e. Distance to fault locator (FL)
f. Fault recorder (FR)
g. Over voltage protection
h. Auto reclose scheme

33. Local Breaker Back-up (50 LBB):

All 220 kV circuit breakers including generator transformer breaker will be provided with local breaker back-up protection. In the case of LBBS of generator transformer, the relay shall be sensitive enough to operate after a time delay during which current decrement takes place.

The local breaker back-up protection relay will be a triple pole over-current relay with high drop-off to pick-up ratio with fast acting feature. This protection will be initiated by primary fault detecting relays and time delayed to permit the breaker to trip.

An LBB scheme based on a time delay shall be provided for all 6.6 kV breaker. The operation of the trip relay and non-opening of its breaker for a set time shall trigger LBB operation.

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34.Circuit Breaker Protection:

All the trip coils of the circuit breakers will be supervised. The following protections will also be included:

a. Pole discrepancy protection
b. Trip coil supervision relay for each trip coil (98L1 to L6).
c. Anti-pumping device for breaker closing (94).

35.Protection of 6.6 kV Motors:

All 6.6 kV motors will be provided with the following protections:

a. Thermal overload protection
b. Overload alarm protection
c. Instantaneous over current protection
d. Locked rotor protection
e. Negative sequence protection
f. Differential protection (for motor ratings of 1000 kW and above)
g. Earth fault
h. Bus under voltage
i. Bearing temperature monitor
j. Winding temperature monitor

36.Protection of 415 V Motors:

Motors rated below 100 kW will have bi-metallic relays for thermal overload protection and HRC fuses for short circuit protection. Motors rated 100 kW to 200 kW will be provided with locked rotor protection in addition to above. Motors rated below 30 kW will be fed by motor circuit breakers.

37.Power supply and lighting circuits:

The power supply feeders will have properly rated HRC fuses for short-circuit protection. Lighting circuits will be fed from lighting transformers and protected by miniature circuit breakers.

38.Generator and auxiliary power supply system control:

The indication, measurements, annunciation and sequential event logging for the generator and its subsystems will be provided in DCS. All 6.6 kV and 415V breakers including those requiring check synchronising will be controlled from DCS. Initiation of Generator auto synchroniser will be from DCS. Control, synchronising, indication, essential metering and annunciation for the generator will be provided in the unit control desk. Manual generator synchronising will be from unit control desk

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39. 220kV switchyard control system:

The 220 kV switching equipment comprising circuit breakers and the associated isolators would be controlled from the unit control room. The control, measurement, indication and annunciation functions would be performed by microprocessor based Supervisory Control and Data Acquisition System (SCADA). All the associated control equipment would be located in unit control room.

For increased reliability, a back-up control system with a panel comprising miniature switches for breaker control, minimum number of indicating instruments and facia type window annunciators is proposed. For this back-up system a hard wired solid state logic system is planned. The control panels will be located in main control room.

Relay panels would be provided for each generator transformer, interconnection transformers, line and busbar protection. These relay panels would be of simplex type. All the relay panels would be located in proposed 220 kV switchyard relay room.

40. Cabling system:

The power cables would be selected based on the following criteria:

a. Continuous circuit current rating
b. De-rating factors for ambient temperature variation and grouping of cables
c. Short circuit rating of the circuit
d. Voltage dip
e. Standardisation of cable sizes to reduce inventory.

41. Types of cable:

a. 6.6 kV system:

6.6 kV unearthed grade, stranded aluminium conductor, triple extruded semi conducting compound, inert gas cured, gas cooled, triple extruded and tree retardant cross-linked polyethylene (XLPE) insulated, triple extruded semiconducting compound in combination with copper tape for insulation screen inner sheath of extruded black PVC, galvanised single steel wire armoured for three core, or aluminium wire armoured for single core and overall sheath of FRLS extruded black PVC cables conforming to IS: 7098.

b. Low voltage system:

Power cables of 1100V grade, stranded aluminium conductor, XLPE insulated, inner sheath of extruded black PVC, galvanised single steel flat armoured for three core or aluminium flat armoured for single core and overall FRLS extruded black PVC cables conforming IS: 7098.

c. Control applications:

1100V grade annealed high conductivity stranded copper conductor, extruded PVC insulated, extruded PVC inner sheath, galvanised single steel wire armoured and overall FRLS extruded black PVC outer sheathed cables conforming to IS: 1554.

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d. Instrumentation applications :

1100V grade, 0.5 sq.mm, multi-stranded high conductivity annealed, tinned copper conductor, multicore, extruded PVC insulated flexible twisted pair/triplets, individually and overall shielded for low level analog signals and overall shielded for digital signals) extruded PVC inner sheathed, steel wire armoured and overall FRLS PVC sheathed cable.

42. Cabling:

Cables would be laid in prefabricated steel ladder type or perforated type cable trays in the station and other auxiliary buildings. Between buildings, the cables would be laid in built-up trenches. Cables to other plant areas located far off from the GTG/STG buildings may be directly buried in soil.

43. Fire Sealing System :

Fire sealing system with two hour fire rating is provided for sealing cable entry below switchgear panels/control panels, cable penetration through walls and floors in main plant area to restrict the propagation of fire (prevent spreading of fire from one area/floor to another) and reduce the damage due to fire. Fire sealing system material is non-hygroscopic, mechanically study, non-toxic, and physically & chemically stable under fire conditions.

44. Lighting system:

- Suitable illumination necessary to facilitate normal operation and maintenance activities and to ensure safety of working personnel would be provided in the plant.
- For switchyard and transformer yard illumination, floodlights would be installed at suitable locations to provide requisite levels of illumination. Pole mounted high pressure sodium vapour fixtures would be used for approach and work roads.
- Generally, fluorescent fixtures would be used for indoor illumination. High pressure sodium vapour fixtures would be used for steam generator platforms while high pressure mercury vapour lamps would be used for GTG hall.
- The illumination levels at different places would be maintained as per accepted codes. The lighting system design would be to ensure uniform illumination as far as feasible.
- The supply to lighting panels would be through 415 V, 3 phase, and 4 wire system derived through 415/433 V lighting transformers. Suitable number of lighting panels would be located in each area.
- About 80% of the total light fittings in turbine buildings, HRSG, transformer yard & control room would be connected to the normal AC lighting supply and the balance 20% to the emergency DG set supply.
- DC emergency lights are envisaged at strategic points in the power station viz., near entrance, staircase, control rooms, etc. These would be fed from the 220V DC system, which would be normally off when AC power is available. These would be automatically switched on when the normal AC supply fails. In off-site buildings like circulating water pump house, RO plant, Raw water pump house self-contained battery backed installite type emergency light fittings would be used.

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45. Recommended illumination levels:

	Area	Illumination level in lux
i.	Main control room	500
ii.	Other control rooms	300
iii.	Switchgear rooms	250
iv.	Turbine hall	200
v.	HRSG platforms	50-150
vi.	Battery room	150
vii.	Off-site pump houses	250
viii.	Main road/secondary road	15/10
ix.	Ancillary buildings	150
x.	Outlying areas	20
xi.	Switchyard & transformer yard	30 to 50

46. Lightning protection:

Lighting protection for the buildings and structures is provided as per IS:2309. Lightning protection system comprising of requisite number of parallel conductors (GI strips) running horizontally over the roof. Vertical air termination and down comers would be provided for all structures with a calculated risk index requiring protection as per applicable standards.

47. Station earthing and system grounding:

a. Station earthing:

A safety earthing system, earthing grid would be provided for switchyard and other areas. This would be connected to the earth grids in various buildings. The buried earth grids would be further connected to earthing electrodes. The selection of earth conductor sizes would be based on the applicable fault levels.

The design of the below ground earthing system is as per IEEE-80 and IEEE-665. Mild steel rods are provided for earth conductor/electrodes and the depth of burial of earthing rods is 600mm. The earth conductors are designed to withstand the maximum earth fault current for a period of one second. The earth conductor dimension is chosen taking into account the corrosion effect for steel at the rate of 0.12mm per year for a plant life of 30 years.

For above ground earthing, conductors of galvanised iron (GI) flats/GI wire are provided. All equipments are earthed at two points for reliability and they are bolted type and at the other end they are welded type. For system earthing, neutral points are grounded at two points through test-pits.

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b. System grounding:

Grounding philosophy envisaged for the power supply system in the plant is as follows:

- Each generator neutral is high resistance grounded by means of neutral grounding transformer with secondary loading resistor.
- HV side neutral of generator transformer is solidly grounded.
- Neutrals of 6.6 kV side of each UAT & ST are low resistance grounded, utilising a grounding resistor and limiting the earth fault current to 300A.
- 415V system is solidly grounded at the 415V neutral of all LV service transformers.
- For electronic system earthing, all cable screens are brought at one point (preferably at 24V DCDB) and connected to station earth through a separate dedicated riser.
- 220V DC system is ungrounded.

48. Communication system:

For effective communication in the plant, public address system, electronic private automatic branch exchange system (EPABX) and P&T telephone system with the features described below are proposed:

a. Public Address System:

A public address system (PAS) common for station is provided to cover all operational areas of the complete plant. A total 50 nos, Handset stations are envisaged for the plant. Each point is provided with a Handset station and its associated loudspeaker. Additionally, three nos. Portable type handsets are envisaged. PAS complete with loud speakers and integrated with intercom telephone system shall be provided. PAS is envisaged to have two modes, i.e. paging mode and party mode. Each of the two modes is open line, common talking type. Paging mode can be used for locating a person and for general instructions. Party mode can be used for conversation between individuals without broadcasting the same over the loudspeaker. Simultaneous operation on both modes; i.e some handsets on party channel and some handsets on paging channel, is possible without any crosstalk between the two channels. Future suitable indication of power supply on & party channel busy is envisaged on hand set stations.

b. P&T Telephones:

Necessary number of P&T telephone sets would be provided at strategic locations.

49. Fire detection and alarm system:

Fire detection and alarm system shall be Microprocessor based analogue type comprising automatic fire detectors, manual call points, fire alarm panel, fire warning siren, cables, junction boxes, any other items to complete the system shall be provided for the power plant. Fire detection and alarm system would provide visual and audible fire detection at the incipient stage of fire in the power station. This system comprises automatic fire detectors such as optical type smoke detectors, rate of rise of temperature detectors with fixed temperature setting, linear heat detectors etc. which provide continuous surveillance in an area. Based on the type of fire expected in an area, switchyard and transformer yard where only manual call points would be provided. The detectors would be grouped

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zone wise and alarm signals would be transmitted to local and main control panels to indicate the location of fire. Fire detection and alarm system, on detection of fire by sensors, would initiate shutting off air conditioning & ventilation system and initiation of automatic fire protection system such as water spray system as required.

The equipment/system supplied shall comply with the standards IS-2189. A centralized microprocessor based fire detection & alarm system with a computerized analogue addressable system including a central monitoring station shall be provided and located in Main control room.

50. Area covered under fire detection and alarm system:

Area	Type of detector
GTG/STG Building	Manual call points(MCP)
Switchgear room control & electronic-cubicle rooms, Battery charger room	Manual sensor detector & MCP
Battery Room	rate of rise of temperature detectors with fixed temperature element
Fan room	MCP
Below false floor of control room	Photoelectric smoke detector and linear heat sensor cables.
Above false ceiling of control room	Multi sensor detectors
Cable galleries	Photoelectric smoke detectors and liner heat sensing cables
Gas station	Flame proof type MCPs
Transformer Yard& Switchyard	Pedestal mounted MCPs

51. Emergency diesel generating (DG) set:

Certain important plant auxiliaries require a reliable source of power supply to enable safe shut down of the unit in the event of failure of complete AC supply in the station. For this purpose, two nos. 750 kVA, 415V , 3 phase, 1500 rpm, Auto ON on-mains failure (AMF) Diesel Generator set have been envisaged for the plant. Diesel engine shall be of 4 stroke water cooled – radiator type, turbo- low temperature after cooled, suitable for HSD operation and generating set applicable as per IS-3046. The alternator is rated for 750 KVA, 415V, 0.8 pf, 3ph, 50 HZ at 1500 rpm. Each DG set shall consist of diesel engine coupled with brush less alternator,

The diesel generator set would energise the 415V switchgear from which all the essential loads such as AC emergency lube oil pump, lubricating oil pumps for BFP, seal oil pumps, jacking oil pumps, battery chargers, emergency lights, etc. would be supplied.

52. Fire proof sealing system:

Fire proof sealing system would be provided for all cable penetrations through walls and floors to prevent spreading of fire from one area/floor to another. All motors, electrical

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equipment and fittings etc. located in the hazardous area would be suitable for the hazardous area classification as per relevant codes, standards and practices.

53. Elevators:

One number, 8 passenger(884 Kg), rated speed- 1M/sec elevator will be provided for catering to the control room building to facilitate movement of operation and maintenance personnel. This elevator will have access to different floors of the control room building. Elevator shall be designed as per relevant IS 14665 all parts. Elevators shall be provided with microprocessor based ACVVVF type control system.

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CHAPTER -IX

CIVIL ENGINEERING FEATURES

1. Topographical Survey:

The ground level in the main plant area varies from RL906 M to RL 894 M above the mean sea level and is slopping towards South East. The ground level of power house and switch yard area in the proposed plot plan, varies from RL 901M to RL 897 M and for the BOPs like CW system, cooling tower, RODM plant etc. varies from RL 904M to RL 902 M.

It is propose to locate the raw water reservoir at Eastern part of the plant where the ground level is around RL 898-896 M. By observing the site grade level, the finished ground level (FGL) of the plant can be fixed at around RL 900 M. The exact FGL of the plant can be finalized during the detailed engineering considering the natural slope for rain water /road drains/Plant drains and the level of existing storm water drain (Nala) and cost of excavation/filling required.

Hence it is propose to carry out the detailed topographical survey of the proposed plot plan area and whole plant area. The plant boundaries and terminal points can be finalized after completion of the survey. Compound wall construction work can be taken up for plant boundaries where the compound wall does not exist.

Natural nala is passing within the plant boundary and is connected to Yelahanka lake in the downstream. Presently the surrounding area around natural nala area is not properly utilized and has become unapproachable due to heavy bushes, greenery, slushy area and has occupied 1/5th plant area. Hence it is proposed to remodel the natural nala by converting to box type concrete open nala (to the extent as per the revenue records) and the balance area can be developed for plantation etc. It is also proposed to make provision for collecting the water from the nala and utilizing the same for plant purposes after due water treatment.

2. Geo-technical data & foundation system:

Detailed geo technical survey of the plot plan area needs to be carried out before taking up the detailed engineering for the foundation of major equipments/structures. With available data, shallow foundation can be adopted for all the structures. For heavier loads raft foundations or bored cast in situ piles with sufficient penetration into hard laterite bed with N value more than 50 can be adopted. The grade of concrete for all foundations shall be M25/ M30.However this shall be confirmed by fresh geotechnical investigation at proposed location before starting detail engineering.

MAIN POWER HOUSE BUILDINGS:

3. Gas turbine/steam turbine generator building

Three storied RCC framed structer building common for GTG and STG with control room is proposed. These building shall be of structural steel frame work. Overhead EOT cranes of

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95/25 tonnes capacity for handling TG related equipments and a separate EOT crane of 50 Tonnes capacity for handling the Generator rotor are envisaged in the buildings.

The exterior walls of the building for an initial height of 3.00m, shall be of brick masonry and the remaining upper portion of the wall shall be provided with insulated sand witched permanently color co··.d metal cladding system. However, the wall in front of transformers shall be of adequate height (about 6.0m) to act as a fire protection wall. All internal walls / partitions shall be of brick masonry / aluminum with glass and vineratex board panels. The roof of the building shall be of RCC provided over metal deck sheeting. The intermediate floor slabs shall be of RCC. The external walls and firewalls between transformers shall be provided with resin bonded granular textured finish (vineratex). All internal walls shall be plastered. The flooring shall have granite, vitrified tiles, kota stone, carborandum tiles, ceramic tiles and metallic hardener as required. The ceiling and internal wall shall have a combination of acrylic emulsion and oil bound distemper painting over the plaster of paris. The structural steel surface shall be painted with epoxy based paint. The rear side of the building i.e. HRSG area up to stack shall be paved. Internal columns and floor framings wherever applicable would also be of structural steel. The turbine generator foundation would be of frame type in RCC. All equipment foundations would be of either block type or frame type depending on its height from the ground and would be suitably isolated from the main building foundations and super structures. Both gas turbine and steam turbine generator buildings and their foundation would be designed for normal/earthquake or wind loads with appropriate load combinations.

4. Switchgear and control room building:

A common main control and switchgear room building would be located as indicated in the enclosed plot plan. The building would be of reinforced concrete framing with hollow concrete block/ brick wall cladding. Separate switchyard control room is not envisaged and propose to locate in the main plant building itself.

5. Balance civil works and auxiliary buildings :

The following civil works are proposed to include in the main civil works. These are

- Plant roads and culverts
- Sewage line and sewage disposal system
- GT and ST foundation
- Gas conditioning skid and fuel heating area
- ETP (including guard pond, wash water waste sump, blowdown sump, sludge pit etc.)
- Service building
- BFP foundation with building
- Compressor building
- HRSG and main stack foundation
- Chlorination , CW Chemical treatment , CW Ozonisation plant buildings
- Pipe /cable racks and trenches
- Transformer yard
- Pavement in HRSG and transformer yard

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- GCB building
- CWPH with fore bay, Annex building, CW channel etc.
- Emergency DG building
- Fire station with drill tower
- Air quality monitoring room
- Service water overhead tank
- DM/CST storage tank foundation
- H2/CO2 storage area
- Gas booster station building
- DM plant building
- RCC Raw water storage reservoir to meet the Six (6) day water requirement of the plant including dead storage for fire water with raw water and fire water pump house.

All the auxiliary buildings would be of reinforced concrete construction with hollow concrete block/ brick wall cladding. It is propose to make use of the existing buildings of IOCL for Ware house, Chemical / Electrical laboratory and for other utility purposes during construction.

6. Roads, drains & sewage disposal:

a. Roads:

Double lane road (7.5 m wide black topping) has been considered all-round the main power house area. Other approaches shall be single lane road (3.75 m wide black topping). All roads shall be designed and constructed as per the Indian Road Congress recommendations.

b. Drainage:

The storm water drainage from the plant area is envisaged to be achieved by gravity through open brick masonry / RCC drains, which will finally dispose into the nearby natural drain or may be integrated with the existing drains. Catch drains shall be provided to convey respective buildings drainage in to main drains.

c. Sewage disposal:

Network of sewage pipelines of HDPE construction would be provided to carry sewage from the building toilets and other drains to a septic tank. Outflow from septic tank is led to soak pit. Treated water may be utilised for gardening. Water containing oil would be passed through oil separator unit before leading into guard pond.

7. Boundary Wall, fencing and watch tower:

Requirement for new boundary wall for main plant complex is not envisaged at this stage as the proposed plant is located inside the existing diesel power plant premises. However for water treatment area, fuel gas area requires individual boundary with security arrangement. Chain link fencing for specific equipments may have to be provided wherever required as per local requirements during detail engineering. Existing watch towers can be used with modification.

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8. Township:

No separate township has been proposed for the project. However accommodation for essential staff for the operation of plant shall be provided within the plant premises.

9. Infrastructural Facilities:

Construction water can made available from the existing bore wells with necessary storage arrangements and construction power will be available from the existing source of KPCL with required modification.

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CHAPTER - X

ENVIRONMENTAL ASPECTS

1. **Definition:**

a. "environment" includes water, air and land and the inter- relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property;

b. "environmental pollutant" means any solid, liquid or gaseous substance present in such concentration as may be, or tend to be, injurious to environment;

c. "environmental pollution" means the presence in the environment of any environmental pollutant;

2. **Type of pollution:**

The environmental protection measures of the proposed Combined Cycle Power Plant (CCPP) as per Environmental (protection) Rules 1986 issued by Ministry of Environment and Forest, covering the following aspects is presented in this chapter:

a. Site features
b. Air pollution
c. Water pollution
d. Gaseous fuel vents and liquid condensate
e. Thermal pollution
f. Noise abatement
g. Pollution monitoring and surveillance systems

The basic information required for environmental appraisal of the project is furnished in Appendix-4.

3. **Site Features:**

The site proposed for the installation of the combined cycle power plant is located in the existing DG plant area in the revenue limits of Kenchenahalli/Puttenehalli village, Yelahanka of North Bangalore in Karnataka State. The required land for the power plant is already in the possession of KPCL. Hence land acquisition, displacement of people and their resettlement are not involved.

4. **Air pollution:**

The proposed plant shall utilize the waste heat from the gas turbine exhaust. Natural gas (NG) will be used as a fuel for gas turbine. NG is the cleanest burning fossil fuel due to negligible sulphur and ash content. On an average, power plant that run on natural gas, emits half of carbon dioxide, less than one third of the nitrogen oxides, one percent of the sulfur oxides, and much lower level of mercury than the plants that burn coal.

The main air pollutants due to burning of fuel are:

- Sulphur Dioxide (SO2)
- Nitrogen Oxides (NOx)

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The combustion of this fuel results in virtually no atmospheric emissions of sulphur dioxide or small particulate matter. However SOx levels in flue gas depends upon the sulphur content in the fuel used. Hence only Nitrogen oxides (NOx) will be the air pollutant in flue gas. As per environment norms NOx emission level will be limited to 50 PPM (as per the environmental protection rules 1986). Dry Low Nox (DLN) burners in the combustors of the gas turbines will be used to reduce the level of NOx emission.

The guarantee value of NOx for the proposed CCPP is 25 PPM. However, to release the exhaust gases from HRSG to atmosphere to avoid local dispersion as per the norms, a stack height of about 45mtr above the ground level is considered adequate. Automatic On – line stack monitoring instrument will be provided for monitoring of NOx emission.

The expected emissions and its characteristics from the proposed combined cycle power plant stack are:

	Pollutant	Flue gas emission characteristics
1	Oxides of Nitrogen(NOx)	25 ppmvd@15%O2 at GT Exhaust
2	Sulphur dioxide (SO2)	Depends on the sulphur levels in fuel (Nil).
3	Particulate matter	Nil

The Central Pollution Control Board under the 'Air (Prevention and Control of Pollution) Act, 1981' have notified the National Ambient Air Quality Standards in respect of Sulphur dioxide (SO2), Oxides of nitrogen (NOx). The concentration limits stipulated for industrial areas is furnished in table below.

5. Regulations for limiting air pollution (Indian Standards):

The concentration limits stipulated for industrial areas is furnished as below.

Sl No	Pollutant	Time weighted average	Concentration in ambient air (Industrial area)
1	Sulphur dioxide (SO2)	Annual average	80 micrograms per cubic meter
		24 hours	120 micrograms per cubic meter
2	Oxides of Nitrogen(NOx)	Annual average	80 micrograms per cubic meter
		24 hours	120 micrograms per cubic meter
3	Particulate matter emission		
	a. Generation capacity 210 MW or more		150 Milligrams per cubic metre
	b. Generation capacity less than 210 MW		350 milligrams per cubic metre.

Note:1. Annual average is the annual arithmetic mean of minimum104 measurements in a year taken twice a week 24 hourly at uniform interval.

2. 24 hourly values should be met 98% of the time in a year. However, 2% of the time it may exceed but not on two consecutive days.

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6. **Water Pollution**

The sources of water pollution are:

- Cooling tower blow down.
- HRSG blow down.
- Effluent from DM plant/ water treatment (WT) plant.
- Plant wash down water & miscellaneous drains.
- Sewage from various buildings in the plant.

7. **Effluents / waste water details**

Sl.no.	Blow down area /system	Quantity
1	Cooling tower blow down	4200 M^3/day indicative (175 M^3/hr, Continuous CT blow down)
2	HRSG blow down	180M^3/day (7.5M^3/hr Continuous Blow down of 2% of steam flow.)
3	Effluent from DM plant/ water treatment (WT)plant	Waste from RO-DM a. UF backwash waste: 144 M^3/day, 800ppm(Raw water TDS) b. RO1 reject: 312 M^3/day TDS:3000-3500ppm c. MB regen. Waste: 24M^3/day, TDS:6000-7000ppm d. Dilution water : 480M^3/day e. Total : 960 M^3/day (waste water from R.O plant and dilution water)
	Total(1+2+3)	About 5340 M^3/day (Refer Exhibit – 9)

8. **Regulations for Limiting Water Pollution (Indian Standards):**

Environmental (Protection) Rules 1986 issued by Ministry of Environment and Forests - Schedule-I stipulates the following limits for the effluent disposal:

a. Effluent from WT plant : Not Specified

b. Steam generator (HRSG) blow down

- Suspended solids : < 100 mg/l
- Oil and grease : < 20 mg/l
- Copper (total) : < 1.0 mg/l
- Iron (total) : < 1.0 mg/l

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c. Cooling tower blow down:

- Free available chlorine : < 0.5 mg/l
- Zinc : < 1.0 mg/l
- Chromium (total) : < 0.2 mg/l
- Phosphate : < 5.0 mg/l

As per the notification issued by the Ministry of Environment and Forests dated 19-05-1993, the Schedule – VI specifies the quality of effluent permitted to be discharged. The quality of effluents has been specified under the following categories.

- Inland surface water
- Public sewage
- Land for irrigation
- Marine coastal areas

For the proposed power plant at Yelahanka, the category to be considered would be under inland surface waters. The major effluent limits under this category are:

- Suspended solids : 100 mg/l (max).
- pH : 5.5 to 9.0
- Temperature : Shall not exceed 5°C above the receiving water temperature.
- Oil and grease : 20 mg/l and 10 mg/l max.

The quality of effluents will conform to the standards prescribed by KSPCB as per Appendix – 5. Notwithstanding the above regulations; it is proposed to completely utilize the power plant effluents for plant reuse. The details are furnished in Chapter – VI under water systems.

9. Details of plant effluents and its treatment:

a. Cooling tower blow down:

The blow down water from the CW system will have a temperature of around 36° C. Considering the quality of cooling water, it is propose to maintain COC of three (3) for the cooling water system. The blow down water will be led to the guard pond along with other influents to the guard pond which includes the effluents from the neutralizing pit, RO plant reject, clear water from the outlet of the oil-water separator and HRSG blow down. Water collected in the guard pond will be treated for pH correction and also diluted if required with water drawn from the tertiary water storage tank - to the standards as stipulated by Pollution Control Board. The water collected in the guard pond will partly used for plant cleaning, gardening, firefighting etc. Remaining water is pumped (after 24 hours detention period) to nala after necessary treatment (as per the norms of pollution control board).

b. HRSG blow down:

The main pollutant in HRSG blow down is pH and temperature of water. Suspended solids would be negligible. The pH would be in the range of 9.5 to 10.3 and the temperature of

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blow down water will be brought down by water spray from the ACW system. Hence the boiler blow down does not require any further treatment to achieve the limit. Also by operating with proper chemistry in the condensate and feed water systems, copper and iron are not present in significant quantities in the blow downstream. The blow down would have very less quantity of dissolved solids and hence it is proposed to lead to the guard pond through plant drains.

c. DM plant and water treatment plant effluent:

Effluents from pretreatment plant and filtration plant will be sent to sludge pit wherein sludge shall settle down at bottom and water shall be recovered. Sludge will be disposed from bottom portion of sludge pit at regular intervals and will be used for land filling. Over flow water from sludge pit will be led to the neutralizing pit.

The effluents from the regeneration of cation resin units in water treatment plant (DM plant) are generally acidic in nature and from an ion resin units are alkaline in nature. The combined waste water from DM plant would be neutralized in a neutralizing pit. The neutralized effluent is expected to have suspended solids less than 5 ppm and pH in the range of 6.5 to 8.5. This will be led to guard pond. The neutralized effluent is expected to have suspended solids of less than 5 PPM and pH in the range of 6.5 to 8.5.

d. Plant wash down water & miscellaneous drains:

The areas of plant wash water are:

- HRSG area
- Transformer yard area
- GT and ST area.
- Leakages from pumps & bearing cooling, oil burners

The oily waste from the above areas mainly comprise of floor wash, leakages from bearings cooling system, leakage from pumps, hydraulic couplings, oil leakage from burners etc, mainly consists of suspended solids , oil and grease. An underground retention pit is provided to collect waste water from these areas. From the retention pit the waste water is transferred to lamella clarifier located in the ETP area for removal of suspended solids and oil. Separated oil is collected in the storage tank. The treated water from lamella clarifier shall be finally sent to guard pond.

Lamella clarifier output will be limited to following standards.

- Oil free conc. 10mg/l max
- Suspended solids 100 mg/l max

e. Sewage from various buildings in the plant

Sewage from various buildings in the power plant area will be conveyed through separate drains to septic tanks. The effluent from septic tanks will be disposed of in the soil by providing dispersion trenches. There will be no ground pollution because of leaching. Sludge shall have to be removed and disposed of as landfill.

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10. Gaseous fuel vents and liquid condensate :

All the gas lines and gas scrubber vent connections would be terminated at a safe height of about 2m above the roof level. The vent lines would be terminated with flame arrestors. The condensate removed from the fuel gas in the scrubber would be collected in a collection tank and would be periodically processed for product recovery.

11. Thermal pollution:

The combined cycle power plant envisages installation of unfired heat recovery steam generators to utilize the heat content of the exhaust gas from the gas turbines. As the Natural Gas/RLNG has no sulphur the flue gas temperature at HRSG exit would be approximately 100 degree celsius. Installation of HRSG to recover heat from the gas turbine exhaust gas would enable reduction of the temperature of the exhaust gas to the lowest possible value thereby reducing the thermal heat discharge into the atmosphere. Hence simple cycle operation of CCPP is not envisaged, no by-pass stack is provided on the up-stream of the HRSG. Combined cycle power plants due to their inherent high efficiency, discharge least quantity of heat to the atmosphere through the cooling water system and flue gas .

12. Noise pollution:

a. Source of noise pollution:

The sources of noise pollution in a power plant are:

- Air inlet & exhaust gas streams
- Steam turbine generator
- Other rotating equipment
- Combustion induced noises
- Flow induced noises
- Steam safety valves

b. Regulations for limiting noise pollution (Indian Standards):

Environmental (Protection) Rules 1986 issued by Ministry of Environment and Forests- Schedule III and as per KSPCB, The limits in the noise levels are:

- Industrial area : 75 dB(A) in day time (6 AM to 9 PM)
  : 70 dB(A) in night time (9 PM to 6 AM)

The equivalent World Bank norms are:

- Industrial area : 70 dB (A) in day time (7 AM to 10 PM)
  : 70 dB (A) in night time (10 PM to 7 AM)

All the measurements are to be taken at noise receptors located outside the project boundary.

All the equipment in the waste heat recovery power plant will be designed / operated to have noise level not exceeding 85 -90 db (A) measured at a distance of 1.5 m from the

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equipment. Also, all the measures will be taken to limit the noise levels at the plant boundary within the stipulated limits.

It is propose to develop a green belt of suitable species for width 5-10 mtr all along the project boundary and also in vacant spaces within the plant area of approx. 10 acres (40468.73 Sq.m) to minimize the nose pollution from the plant.

The Occupational Safety and Health Administration Standards (OSHA), USA indicate the following permissible noise:

Duration per Day (Hours)	Sound Level (dBA)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25	115

c. Noise Abatement:

All the equipment in the power plant would be designed to have a total noise level not exceeding 85 dB (A). Generally the manufacturers of the gas turbine generators indicate the following noise level values:

- 85 dB (A) at a distance of 1.5 m from the gas turbines
- 65 dB (A) at a distance of 120 m from the gas turbines

The inlet air and exhaust gas streams would be provided with silencers for noise reduction. Generally there would not be any operators near the gas turbine generator on a continuous basis. However, maintenance personnel working local to gas turbine generator building would be provided with adequate protection against noise. The steam turbine generator would be housed in a closed building thereby reducing the transmission of noise to the outside environment.

13. Pollution monitoring and surveillance system:

A well-defined environmental monitoring programme would be instituted with trained and qualified staff who would monitor the ambient air as well as stack gas quality to ensure that the quality of effluents is maintained within the permissible levels. The stacks of the heat recovery steam generators would be provided with suitable ports to monitor the flue gas quality from the stacks. Suitable analyzers will be provided for exhaust gas quality analysis. The quality of the blow down water from the heat recovery steam generator drums and the other water effluents from the plant would be analysed on a daily basis or as required to ensure that effluents are maintained within the permissible levels.

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14. Facilities for sampling and analysis:

Facilities that would be used for sampling and analysis are,

- Continuous ambient air quality monitoring system (for respirable particulate matter, SO_2, NOx, CO).
- Stack monitoring kit complete with all accessories for manual monitoring of stack gases.
- For water analysis - conductivity meter, Alfoc test kit for oxygen, pH meter, turbidity meter, BOD / COD incubator, spectro-photometer.
- For oil analysis - oxidation stability test, red wood viscometer, flash point apparatus.
- For gas analysis – three bulb orsat, explosimeter, hydrogen purity apparatus, gas monitoring kit.
- Environmental lab equipment – High volume samplers like Wind vane and anemometer etc.

15. Impact of pollution / environmental disturbances:

All necessary pollution control measures to maintain the emission levels of dust particles, Sulphur dioxide and nitrogen oxides within the permissible limits would be taken and necessary treatment of effluents to satisfy the standards stipulated under the Water (Prevention and Control of Pollution) Rules as well as the state pollution control boards would be carried out. Hence, it is considered that there would be no adverse impact on either the air or the water quality in and around the proposed power plant site.

16. Environmental impact and risk analysis study:

In this regard KPCL have taken up the study of environmental impact and risk analysis considering gas as fuel to analyze in detail the impact of the proposed combined cycle power plant on environmental aspects. Appendix – 4 gives the environmental appraisal for the proposed 350±20% MW combined cycle power plant in the format required by the National Committee on Environmental planning and coordination.

17. Clean development mechanism (CDM):

Clean Development Mechanism, aims in assisting developing countries in achieving sustainable development by promoting environmental friendly investment from Industrialized country governments and businesses. CDM allows industrialized / developed counties to invest in emission reduction projects that generate 'CER" (Certified Emission Reductions) for use by the investing countries or companies against their own emission litigation targets. Realizing the severity of climate change problem and immediate need for adopting mitigation measures, India has already started promoting clean development mechanisms. Adoption of cleaner fuel like Natural Gas and efficient use of energy specifically in the combined cycle mode of operation could qualify to gain the carbon credits through CDM cycle. This would not only reduce the dependence on fossil fuels in the industrial systems but also reduce the GHG (Green House Gas) emission.

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Central Electricity Authority of India has published the carbon di-oxide baseline database for the Indian Power Sector to assist CDM project developers for speedy approval of CDM Project. As per CEA's user guide (version- 4) released in Oct. 2008, the prevailing baseline emissions based on the data for the FY 2007-08 are as below.

GRID	Average	OM	BM	CM
NE- WNE	0.81	1.00	0.6	0.8
Southern	0.72	0.99	0.71	0.81
India	0.79	1.00	0.63	0.81

Weighted average emission factor, simple operating margin (OM), build margin (BM) and combined margin (CM) of all grids for FY 2007-08 (inter-grid and cross-border electricity transfers included), in tons of CO2/MWh. Average is the average emission of all stations in the grid, weighted by net generation.OM is the average emission from all stations excluding the low cost/must run sources.BM is the average emission of the 20% (by net generation) most recent capacity addition in the grid. CM is a weighted average of the OM and BM (here weighted 50:50). Since the emissions are comparatively low, this project may be considered for CDM benefits.

18.Advantages of the project:

Advantages in favor of the proposed 1x350±20% MW Combined cycle power plant at Yelahanka DG Power Plant:

- The project will be located on land available within premises of Yelahanka DG power plant. Thus, implementation of the project does not require land acquisition or change in land usage. The question of land losers / resettlement of people do not arise.
- The project will utilize tertiary treated sewage water to meet its make-up water requirements, thereby conserving the sparse fresh water resources.
- The project will be utilizing natural gas as fuel, which is the cleanest fuel, and will be sourced through pipeline. Thus, hazards associated with transportation of coal and ash evacuation are ruled out.
- It is proposed to use Dry Low NOx (DLN) burners to maintain NOx emission to approximately 15 ppm. Emissions of other pollutants will be insignificant.
- All the infrastructures required for implementation of the project are available at the site.

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CHAPTER - XI

PROJECT EXECUTION PLANS

1. Project schedule:

The project schedule for the proposed power plant is shown in Exhibit-15. The schedule has been prepared on the following basis:

- Zero date for the project program has been considered as the date of placement of order (LOA) for supply and services of combined cycle power plant equipment.
- It has been assumed that the statuary clearances by different agencies of the government would be obtained prior to placement of order for main plant equipment.
- Financial closer for funding the project requirement.
- The synchronisation and trial operation of the unit in combined cycle mode is proposed to complete within thirty (30) months from the zero date/effective date.

However by closely monitoring the supply, erection and commissioning activities (with best efforts schedule) the unit synchronisation and trial operation can be completed within twenty eight (28) months from the date of zero /effective date. The commercial operation (COD) of the combined cycle power plant can be completed within three (3) months after synchronisation.

2. The list of important activities/clearances required for the project:

Sl. no	Particulars	Action
01	Land availability	Already available within the premises of Yelahanka DG power plant. Getting clear tittle deed in favor of KPCL is under progress.
02	Water requirement and supply arrangements	KPCL has obtained formal consent from BWSSB for the supply of tertiary treated water of required quantity from their treatment plants to the proposed site.
03	Gas requirement and supply arrangements	M/s GAIL has agreed to supply the required qty. of Gas to Yelahanka project and necessary modification in the existing GT agreement by changing the delivery point and rescheduling of the supply date is required.
04	Environment and forest Clearance.	EIA studies are under progress. MOEF has issued TOR for the same. Studies are likely to complete within 3-4 months.
05	Airport authority clearance for chimney height restriction.	KPCL has initiated action for obtaining clearance from AAI for stack height restriction.
06	Power purchase arrangements.	Existing PPA has to be modified with KERC and BESCOM.

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07	Power evacuation and connectivity	M/s KPTCL have agreed to evacuate the generated power from Yelahanka 220/66KV substation. Charging of Yelahanka substation by constructing new 200/66KV transmission lines is under progress.
08	Statuary clearances	KPCL has initiated action for getting all the statuary clearance like Arocolgy, Fisheries ,Health ,Forest, Defense , BBMP etc.
09	Land survey and fixing plant boundaries	KPCL has completed survey work and has fixed the plant boundaries.
10	Dismantling of required structures/systems of the existing DG plant	KPCL/IOCL have initiated action for dismantling the railway marshaling yard and all the available infrastructures of IOCL.
11	Remodeling/restructuring of existing raja Kaluve	KPCL in consultation with BBMP has initiated the remodeling /restructuring work of Raj Kaluve.
12	Sources of finance	Combination of debt and equity with financial institutions/commercial banks.
13	CEA	For enhancement generation capacity

3. Project Execution:

It is proposed to execute the project through an engineering, procurement, construction (EPC) contract. The EPC contractor will be responsible for detailed engineering, procurement, project management, construction, testing, commissioning up to satisfactory performance test and handing over.

Considering the necessity of the power requirement and also delay in finalising the EPC contract through tender basis, it is propose to entrust the EPC works to M/s BHEL on nomination basis by bench marking the cost of EPC works.

In this regard, GoK vide order No. EN 28 PPC 2014, dated 27.07.2014 has accorded approval for establishing first block of gas based combined cycle power plant of 350 MW capacity at Yelahanka with LNG as the fuel and has exempted M/s.KPCL from the KTPP act and permitted KPCL to implement the project by entrusting EPC works to M/s.BHEL. GOK order is enclosed as Appendix #8.

To speed up the implementation of the proposed project, pending all the statuary clearance mentioned above, KPCL have issued LOI for the implementation of 1x 350±20% MW CCPP, EPC works.

4. Man power and Organisational:

Personnel requirements for construction and O&M of the combined cycle power plant are shown in Exhibit# 13 &14.

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a. Construction:

It is propose to implement the project on EPC mode only and hence minimum departmental staff is considered for overall supervision from engineering discipline. Total manpower requirement for the proposed plant during construction is expected to be around 25-40.In order to monitor and ensure the Quality, Safety, and Environmental aspects QHSE manger is proposed during the construction and also during the O& M of plant. The organization chart for construction is attached as Exhibit # 13.

Proposed CCPP construction shall be headed by project manager. Project manager shall be assisted by senior executives along engineers from respective disciplines. They will hold independent charge of their departments and shall coordinate with all departments during construction for the speedy implementation of the project.

Security guards are not considered in this organization chart. Security guards may be outsourced on fixed term basis during construction period.

During construction total manpower requirement of departmental and contractor for the proposed plant is expected to be 50 and 1500 respectively.

b. Operation & Maintenance:

The proposed CCPP shall be headed by plant manager. Plant manager shall be assisted by senior executives. They will hold independent charge of their departments and their functions. The organization chart for Operation & Maintenance is attached as Exhibit # 14.

Following major departments are considered:

- Operations, planning and efficiency
- Maintenance Mechanical
- Maintenance Electrical and Instrumentation
- Maintenance Civil
- Purchase & Stores
- Administration and Accounts

General operation of the station would be the responsibility of shift in charge (operation) who will report to the plant manager. Shift in charge will be assisted by engineers & technicians. Planning and efficiency engineers shall be reporting to the plant manager and shall monitor the plant efficiency and make planning for long term maintenance(preventive) , purchase of capital spares and scheduling of major OH works , contracts ,tenders etc.,

The Maintenance wing is headed by maintenance manager and would be assisted by engineers who would have adequate technically sound / qualified personnel to look after the maintenance work under respective disciplines. Maintenance wing is expected to take care of routine and preventive maintenance of the plant.

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All purchases of materials and services will be handled by P&S Manager. P&S manager will be assisted by purchase officer and stores in charge. Administration and Accounts department is headed by administration and accounts manager and would be assisted by administrative and accountants executives. Apart from above there will be the requirement of QHSE team.

During O&M, the total manpower requirement of departmental and contractor for the proposed plant is expected to be 100 and 250 respectively.

Security officers and security guards are not considered in this organization chart. Security staff & guards may be outsourced on fixed term basis. All the above staffing is based on the O&M philosophy of optimizing the manpower requirement with the benefit of deploying the latest automation and control systems. Hence minimum number of staff will be in attendance during the evening and night shifts on the assumption that only temporary and minor works can be carried out during this period. It is proposed to outsource the major/ routine/preventive maintenance works from the experienced contractors to carry out the skilled work required for the plant.

5. Health, Safety and Environment:

During construction phase, it will be ensured that proper safety measures for all workmen, materials & equipments are in place. Provision for all safety notices and safety equipment required for all concerned deem necessary is made. A safety manual will be developed by establishing safety guidelines and requirements for all involved in the project.

6. Project Quality Control:

A comprehensive quality control organization (Q.C.O.) shall be set up for quality control, inspection and testing, both at the contractor's workshop, at his subcontractor's workshops and on site, of all equipment supplied and works performed. This Q.C.O. shall either be a special organization set up by the contractor and independent of its' manufacturing organization either a specialized subcontractor. In the latter case, the selection of this subcontractor has to be approved by the owner.

Inspection and tests shall cover all phases of manufacturing and construction to ascertain that all works comply with the specifications and with the applicable codes and standards, that materials and workmanship are of good quality and that all parts of the works are appropriate for the purposes which they were intended to fulfill. Inspection and testing shall include but not be limited to:

- Acceptance tests on prime materials;
- Welding, fabrication and control procedures qualification;
- Performance and functional tests on completion;
- Inspection before packing and shipping;
- Inspection at delivery for possible transport damages;
- Dimensional checks;

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After each inspection visit, the contractor shall send to the owner an inspection certificate with the relevant test records and certificates. As manufacturing and construction are in progress, the contractor shall keep complete files with records of inspection and testing. These files shall contain, equipment by equipment, all records of inspection and testing such as:

- Material certificates;
- Welding, fabrication and control procedures qualification;
- Records of inspection;
- Certificates of non-destructive testing (US, X-rays, die penetrate, etc.);
- Records of alignment for rotating machinery;
- Records of verticality and tolerance checks;
- Records of start-up tests (vibration, pressure, temperature, flow, etc.);
- Records of functional tests;
- Performance Tests certificates;
- Records of repair works, etc.

7. **Codes, Standards and Regulations:**

The plant shall be designed, built, tested and commissioned according to the most stringent of the following;

- The mandatory applicable national and international codes, standards and regulations.
- Unless in contradiction with the local codes, standards & regulations, the plant shall be designed, built & commissioned in conformity with standards and codes as applicable.

If there is a conflict between codes or standards, the more stringent code or standard shall be considered. In case of discrepancy, the national and local rules take precedence. Advanced and proven technologies shall be integrated in the design of the plant. Highly efficient and reliable equipment shall be chosen. The plant shall be designed & constructed to provide all necessary facilities to allow easy and safe operation and maintenance activities.

8. **Safety regulation and standards for gas handling:**

The following regulations and safety standards for gas handling shall be applied wherever applicable.

a. **Applicable statutory regulations:**
   - Hazardous Chemical Rules (MSIHC) -1989 (Safety)
   - PNGRB – (i) T4S -2009 : Standard specification for Construction of Pipeline and associate facilities
   - PNGRB – (ii) ERDMP-2010 – disaster Management Plan (Safety and Mitigation)
   - PNGRB – (ii) PIMS- 2012 - Integrity Management system of Pipeline

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b. In addition to the statutory regulations and acts, the following Oil Industry Safety Directorate (OISD) guidelines, are applicable .

- OISD-105 – Safety work permit System
- OISD -110 –Static Electricity
- OISD- 113 – Hazardous Area Classification
- OISD- 115 –Fire Fighting Equipment
- OISD-GDN-145 – Internal Safety audit
- OISD-GDN-206 –Safety Management System
- OISD-226 –Design and Construction of Pipeline and associate facilities

9. Corporate Social Responsibility (CSR):

The plant authority shall consider overall development of manpower of the plant, surrounding areas by building up civic amenities in consultation with local authorities.

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CHAPTER - XII

PROJECT COST ESTIMATE

1. Project cost estimate:

The project cost estimate has been worked out based on the indicative offer submitted by M/s BHEL for the implementation of 1x350±20% MW CCPP with latest 109FB Gas turbine. The indicative offer submitted by M/s BHEL is based on the standard technical specification of CCPP as supplied and commissioned to other customers.

Estimates are based on the preliminary plant layout and is shown in Appendix -6

2. Cost of Land :

KPCL is already in possession of the land required for the project. And hence cost of the land is not included in the project cost.

3. Civil Works:

- Plant development works like dismantling of the existing structures/ system required for the project and development of Raj Kaluve, Construction of balance compound wall, Improvement of residential buildings, Guest House etc. are considered in the project cost.
- It is propose to construct RCC raw water tank to meet the plant water requirement for six (6) days including the dead storage for fire water system. The cost of RCC water tank is included in the scope of EPC works.
- It is propose to use the existing buildings like Administrative building, Security building, Guest house etc. And hence the cost is not included in the estimate.
- It is proposed to utilise the existing infrastructure of IOCL for ware house, chemical lab, electrical lab and construction office buildings etc. and hence the cost is not included in the estimate.
- Workshop building and equipments are excluded from the scope of EPC contract.

4. Main Plant:

The cost of main equipment package i.e. Gas Turbine Generator, Heat Recovery Steam Generator, Steam Turbine Generator and associated auxiliaries on turnkey basis are based on standard specification for CCPP of similar project implemented by BHEL. The turnkey prices include the cost of standard control and auxiliaries, main step-up transformer, neutral grounding cubical, non-segregated bus duct, basic on-and-off site services to allow turnkey plant operation including engineering, project management, technical and start up support, civil works for these equipment, minimum inland transport, construction and installation.

The EPC prices considered in the estimate include all applicable import duties at prevailing rates, under power certificate route SL. No 370 of customs notification 12/2012. The EPC prices also consider CD and ED exemption available for water treatment plant as per GOI notification 14/2004 -Cus. Dtd. 08/01/2004 and 3/2004 -CE Dtd. 8.01.2004 respectively.

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All taxes, duties & levies other than those indicated in the EPC prices i.e. Turnover tax, Entry tax, Exit tax, Octroi, GST, (Goods and Services Tax) or any other local taxes and levies on both supply and services are excluded from prices and shall be paid extra at actuals as per prevailing terms and rate during the execution of contract.

BOGW is not included in the EPC prices, and same shall be paid extra at actuals as per prevailing terms and rate during the execution of contract.

5. **Major details considered for project cost estimate and tariff calculation:**

- The CIF content included in the EPC prices is INR 3250 .00 Million (for Supply and services together) at the exchange rate of 1 USD=60.61 INR and 1 Euro=84.40 INR
- Cost of all mandatory spares (Mechanical & Electrical Spares) has been included in the EPC cost. However the cost of Long Term Parts Management (LTPM) required for the gas turbine is not considered in the project cost estimate.
- For all indigenous BOP equipment, excise duty and sales tax are included in the EPC cost. Local freight and insurance for imported equipment and ex-works price for indigenous components has been included in the EPC cost.
- Cost towards plant erection, testing and commissioning (based on the data from similar projects for major equipments) has been included in EPC cost.
- For physical contingency, provision has been made at the rate of 2 % of the total cost of EPC works.
- It is proposed to get the Operational and Maintenance staff trained in M/s BHEL concerned manufacturing units and at site and hence cost of training is not considered in the project cost.
- The cost of Natural Gas/RLNG is considered at the price (Spot and MDP price) provided by M/s GAIL for the month of April 2015.
- The fuel cost in rupees per metric tonne is based on calorific value of 9880 kcal/Scm (14114 Kcal/Kg). The exchange rate is considered at Rs. 62 /USD.
- The cost of transmission system has not been included in the cost of electrical works as it has been assumed that the entire transmission between the KPCL switchyard and KPTCL substation would be suitably designed and executed by KPTCL.

6. **Details considered for computing interest during construction (IDC), Project Cost estimation and tariff calculations (As per 2014 CERC guidelines):**

a. **Use full life :**

For all the Gas /Liquid based thermal generating stations : 25 Years

b. **Capital Cost :**

Debt 80 % and 20 % Equity.

c. **IDC :**

If project implementation is delayed

- Due reasons not attributable to generating company or due to uncontrollable factors, IDC for extended period is permitted.

- Due to reasons attributable to generating company or due to controllable factors, IDC for the extended period is not allowed.

d. **Initial Spares :**
4 % Maximum of the plant and machinery cost (capital cost) can be capitalized

e. **Tariff structure:**
Capacity charge (fixed cost) plus energy charge (variable cost)

f. **Capacity charge (Fixed cost):** Includes

i. Return on Equity : Base rate /(1-t); Base rate=15.5%; t=tax rate

ii. Interest on Loan capital :
Repayment for the tariff period shall be equal to the depreciation allowed for the corresponding period and the rate of interest shall be weighted average rate of interest.

iii. Depreciation :
- 10% of capital cost as Salvage value
- 90 % capital cost is considered for Depreciation.
- Land cost is not considered for depreciation.
- Depreciation on straight line method for all machineries and equipments at the Maximum rate of 5.28% per year up to 12 years and balance is equally divided for remaining period of useful life.

iv. Interest on working capital :
The Working Capital shall include the following components.
- 30 days Fuel cost @ Normal Annual PAF (NAPAF).
- 15 Days Liquid fuel cost if it is used.
- 30% of O& M cost towards the maintenance spares.
- Receivables equivalent to two(2) months of capacity and energy charge@ Normal Annual PAF(NAPAF).
- O& M expenses per month at the rate of Rs 18.72/Mw per year (Considering 18-19 as the COD of plant).
- Rate of interest shall be considered as bank rate as on 01.04.2015 or as on 1st April of tariff year of COD.

v. Operation and maintenance (O&M) Expenses :
- Rs 14.67 Lacks / MW for year 2014-15
- Rs 15.59 Lacks / MW for year 2015-16
- Rs 16.57 Lacks / MW for year 2016-17
- Rs 17.61 Lacks / MW for year 2017-18
- Rs 18.72 Lacks / MW for year 2018-19

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g. **Energy Charge (variable Cost):**
Energy charge rate is calculated in Rs / Kwh (ex bus) up to three decimal points in accordance with the formula

ECR = GHR x LPPF x 100/ (CVPF x (100-Aux))

h. **Normal Annual Plant Availability Factor (NAPAF) :**
85% for all the thermal station except for the station mentioned in CERC report

i. **Normal Annual Plant Load Factor (NAPLF):**
85% for all the thermal station except for the station mentioned in CERC report

j. **Gross Station Heat rate:**
For all the stations achieving COD on or after 01.04.2009

105 x Design Heat rate of the unit/block for natural gas

k. **Auxiliary Energy Consumption(AEC):** 2.5%

l. **Time schedule for implementation:**
Thirty (30) months for first block of green field project.

7. **Details considered for the tariff estimation:**
Following details are considered for tariff estimation

- Landing of cost of fuel including transportation:
  - 10.77 $ /MMBTU (Spot Market Rate)
  - 15.25 $ /MMBTU (MDP Contract Price
- Exchange rate of dollar : Rs 62/Dollar
- Design gross heat rate of the unit in CCPP Mode : 1470 Kcal/Kwh
- Station Aux consumption as per CERC Guidelines : 2.5%
- ROE : Base rate/(1-t);
  Base rate =15.5%, t=tax rate
- Interest on capital : 12.5%
- Interest on working Capital : 12.5%
- Debt Equity ratio : 80:20
- Gross heating value of the fuel : 9880 Kcal/Scm
- Density of fuel : 0.7 Kg/Scm

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8. Capital Cost Estimates:

The abstract of project cost is furnished in Appendix-6. The cost of generation is furnished in Appendix –7

The cost per MW of installed capacity works out to be Rs.4.246 Crores including interest during construction and financing charges. The cost of generation per Kwh for the proposed 350±20%MW combined cycle power plant at station bus bar after allowing for auxiliary power consumption and considering a minimum rate of return of 15.5 % on equity portion works out to be

- Rs:7.356/kwh at 100 % PLF and Rs:7.718/kwh at 80% PLF with gas price of **15.25 $ /MMBTU (MDP Price).**
- Rs:5.556/kwh at 100 % PLF and Rs:5.904/kwh at 80% PLF with gas price of **10.77 $/MMBTU (Spot Price).**

9. Phasing of expenditure:

The phasing of capital expenditure of the proposed combined cycle power plant

Sl.No	Year	Percentage Amount (%)
1	1	12
2	2	56
3	3	32

10. Tariff Estimation :

The two part tariff model has been adopted to calculate the selling price of energy. As per this model the tariff for energy is sum of two components a fixed charge component and a variable charge component as discussed below.

a. Fixed Charges:

The items of cost forming a part of the fixed charge components are:

- Interest on term loan
- Return on equity
- Interest on working capital
- Depreciation
- Operation & Maintenance

b. Variable Charges: The variable charge component of the tariff includes cost of fuel (gas) and water charges per Kwh.

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APPENDICES

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APPENDIX – 1

SITE INFORMATION AND METEOROLOGICAL DATA

1.	Location of plant site	:	Yelahanka DG plant, S N Halli post, Near Puttenehalli, Bangalore district, 560064 Karnataka, India.
2.	Latitude and Longitude(ref. 0,0 coordinates of the plant)	:	13°6' 59.03" N Latitude 77° 34'44.50" E Longitude
3.	Climatic Condition		
	a) Dry Bulb Temperature		
	- Maximum temperature (ever recorded)	:	39°C
	- Minimum temperature (ever recorded)	:	9.9°C
	- Annual mean of daily maximum temperature	:	37°C
	- Annual mean of daily minimum temperature	:	11.5°C
	b) Relative Humidity	:	79% @ 830 hrs 52% @ 1730Hrs
	- Annual mean	:	65.5%
	- During monsoon	:	89%
	c) Rainfall		970 mm
	Annual average rainfall is about 970mm (most of which occurs during the monsoon season from June to September)		

4. Seismic Conditions: The proposed site is located in seismic zone-II as per theIndian standard IS-1893 (1984).

5. Elevation above mean sea level: 900m above the mean sea level.

6. Basic wind speed : 33 m/sec as per IS: 875(3) – 1987

Note: IMD is not having a Meteorological observatory at Yelahanka and hence Metrological data of Bangalore city is considered.

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APPENDIX – 2

ANALYSIS OF NATURAL GAS/RLNG (TYPICAL)

Sl. No.	Component Name	Formula	Concentration	Molar fraction % (GAIL DATA)	Volume %
1.	Nitrogen	N2	0.01 – 1.0	0.02612	0.71
2.	Methane	C1	75 - 90	91.97691	95.49
3.	Carbon Dioxide	CO2	2 - 5	0.02743	0.01
4.	Ethane	C2	6 - 8	6.75148	2.45
5.	Propane	C3	2 - 5	0.96059	0.9
6.	I.Butane	C4	1 - 3	0.09063	0.33
7.	I.Pentane	IC5	0.5 – 1.0	0.02098	0.05
8	Carbon Monoxide	(CO)	≤ 10 PPM Vol.	NA	
9.	Hydrogen sulphide	H2S	< 24 PPM WT.	< 10 PPM Vol.	
10.	Total Sulphur content	S		< 24 PPM WT.	

Average Cal .Value (Kcal/Scm) : 9880

Gross Cal. Value (kcal / Scm) : 9880

Net Cal. Value (kcal / kg) : 11577.00

Average Gas Density : 0.7 Kg/M3

Temperature at Terminal Point : 25°C- 30°C

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APPENDIX – 3

QUALITY OF RAW WATER (Data as provided by BWSSB)

Sl. No.	Particulars	Units	Values
1	Colour	Hazen Units	<5
2	Odour		Unobjectionable
3	Turbidity	NTU	0.6
4	pH value		7.2-7.3
5	BOD	ppm	<5
6	COD	ppm	<10
7	Total Suspended Solids	ppm	4.0
8	Total Dissolved Solids	ppm	<800
9	Alkalinity	ppm	24.7
10	Chloride as Cl	ppm	<200
11	Sulphates as SO_4	ppm	<60
12	Silica – dissolved as $Si\ O_2$	ppm	23.5
13	Silica – colloidal as $Si\ O_2$	ppm	3
14	Ca hardness – as $CaCO_3$	ppm	140
15	Mg hardness – as $CaCO_3$	ppm	94
16	Total hardness – as $CaCO_3$	ppm	300
17	% Sodium	ppm	12.14
18	Ammonical Nitrogen	ppm	6.57
19	Iron as Fe	ppm	0.31
20	Manganese as Mn	ppm	<0.05
21	Total Kjeldhal Nitrogen	ppm	3.4
22	Total Residual Chlorine	ppm	<0.5
23	Phosphate as PO_4	ppm	1.3
24	Free Ammonia	ppm	<0.5
25	Total Phosphorus	ppm	1.0
26	Oil & Grease	ppm	<1.0
27	Nitrate nitrogen	ppm	1.3

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28	Sulphide	ppm	<0.05
29	Flouride as F	ppm	0.39
30	Copper as Cu	ppm	<0.05
31	Zinc as Zn	ppm	<0.05
32	Lead as Pb	ppm	<0.02
33	Total Chromium as Cr	ppm	<0.05
34	Mercury as Hg	ppm	<0.001
35	Cyanide as CN	ppm	<0.05
36	Phenolic Compounds as C6H5OH	ppm	<0.05
37	Nickel as Ni	ppm	<0.05
38	Arsenic as As	ppm	<0.001
39	Coliform Organisms/100ml	ppm	<1
40	Faecal Coliform Organisms/100ml	ppm	
41	MPN Count/100ml		
42	E-Coli		

* The worst TDS expected from the tertiary water is about 800 ppm. The equipment/system shall be designed for the same.

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	f. Others		Nil
2.3.3	Present use of land		128 MW DG plant (not in service), Establishing new gas based Combined Cycle Power Plant (CCPP) by dismantling the required structure of the existing DG plant.
2.3.4	Area proposed to be built-up or developed		The available 120 acres land is adequate for installation of 700MW combined cycle power plant in two stages and for development of green belt.
2.3.5	Specify site characteristics river basin / estuarine / coastal / others		The proposed site is neither a river basin nor a coastal land.
2.4	Is the site situated in the forest area? Give following details:		No
2.4.1	Area		Not applicable
2.4.2	Type of forests	:	Not applicable
2.5	Is site situated near to the forests? Give the distance from the site	:	No
2.6	Give a description of the flora within 10 km of your plant site under the following heads:-		
	a. Crops b. Forest c. Grassland d. Endangered species e. Other (specify)	: : : : :	Nil Nil Nil Nil Nil
2.6.1	Give a general description of the fauna, especially wildlife, endangered species, etc., within a radius of 25 km.	:	Nil
2.6.2	Give details of the following features, if they exist, within a radius of 5 km of the proposed site?		
	a. Fisheries	:	Nil
	b. Sanctuary / natural park / biosphere reserves	:	Nil
	c. Lakes / ponds / reservoir	:	Puttenehalli lake(water body) on upstream side of the Nala Yelahanka Kere (water body) on the downstream side of the Nala.

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	d. Stream / river	:	Strom water drain is passing within the plant boundary.
	e. Estuary / sea	:	Nil
	f. Hill / mountains	:	Nil
	g. Historic/Cultural/Tourist/Archaeological/Scenicsites/Defense installations	:	Nil
2.7	Human Settlement		
2.7.1	Total number of persons a. During construction b. During operation	:	Departmental Contractor Total 50 1500 1550 : 100 250 350
2.7.2	Do you propose to build a township / housing quarters for your employees / contractor's workers?	:	No,Tentatively additional housing quarters are not envisaged and existing colony will be utilized by renovation.
2.7.3	Area required for above	:	Not applicable.
2.7.4	Population to be accommodated	:	Not applicable.
2.7.5.	Distance and direction of township from plant site	:	Not applicable
2.7.6	Service provided in township	:	Not applicable
	a. Daily consumption of water	:	Existing bore wells within the plant boundary shall meet the requirement of Colony (township) and existing 175M³ overhead water tank is being utilized.
	b. Sewage system	:	Provided (Through soak pits)
	c. Drainage	:	Provided
	d. Any other	:	-
2.7.7	Number of persons to be displaced along with details of their occupation and incomes	:	Nil
2.7.8	Number of persons who do not own property but derive their sustenance from the land to be acquired		Nil
2.7.9	Details of rehabilitation plan for the oustees	:	Not applicable as the land is already owned by KPCL
2.7.9.1	Site where they will be resettled	:	Not applicable
2.7.9.2	Compensation to be paid	:	Not applicable
2.7.9.3	Authority responsible for their resettlement	:	Not applicable

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APPENDIX – 4

BASIC INFORMATION FOR ENVIRONMENTAL APPRAISAL

1.0	**General information about the project:**		
1.1	Name / Title of the project	:	Yelahanka 350 MW Combined cycle power plant
1.2	Name and address of the project proponent		KARNATAKA POWER CORPORATION LTD., ShakthiBhavan, No. 82, Race Course Road, Bangalore – 560 001.
1.3	Site where proposed plant will be located		Yelahanka DG plant, S N Halli post, Near Puttenehalli, Bangalore district, 560064 India.
1.4	Capacity of the project under consideration		350±20% MW Combined Cycle Power Plant.
1.4.1	Whether alternative sites were explored? If so, give following details for each site (Maps to be enclosed)		No (As the land is already available) Refer Exhibit-04
1.4.2	Land use pattern of the land		Land is under the ownership of KPCL.
1.4.3	Cost of land per acre / hectare		Land for proposed project is already in the possession of KPCL.
1.4.4	Govt. land / private land / others	:	Owned by KPCL
1.4.5	Topographicalfeatures, demographic profile & physiography.		The land inside the plant is plainand is sloping towards south East
1.4.6	Nature of soil		Top layer(0.5M) of soil is brownish red clay with silt sand and gravel followed by Sandy silt (up to 5mtr) and pink yellowish grey sand up to 20Mtr depth and detailed soil investigations (SBC) shall be available after Geotechnical investigation studies.(Under progress)
1.4.7	Distance from the nearest town / city / major human settlement	:	18 kms. from Bangalore, 25 kms. away from Bangalore International Airport
1.4.8	Population to be displaced	:	No population is expected to be displaced
1.4.9	Distance from water source	:	Tertiary sewage treatment plant situated in Jakkur/Yelahanka which is 5-6 kms. from site.
1.4.10	Area of forest land, if involved		Nil
1.4.11	Distance of forests from the site	:	Not applicable

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1.4.12	Give basis for selection of the final site	:	Availability of land, water & gas and other infrastructural facilities.
1.5	Is this an extension? If so indicate capacity of the existing plant		No (Establishing New Gas based Combined Cycle Power plant in place of DG Plant)
1.6	What is the ultimate capacity?	:	350±20% MW in 1st stage Another 350±20% MW in 2nd stage
1.7	Name and address of the consultant, if any.		1. Tractebel Engineering Private Limited, New Delhi for the preparation of detailed feasibility report 2. CEGSW KPCL, Bangalore for the preparation of DPR.
2.0	**General Environmental Information:**		
2.1	Details of major industries, thermal power plants, mines, quarries etc. existing within a radius of 25 km of your plant.	:	Rail Wheel factory (RWF) and Federal-Mogul Goetz India Pvt. Ltd. Other industries of Yelahanka / Bangalore.
2.2	What is the total human population within a radius of 25 km of the plant site indicate the pattern of population dispersal	:	Site is within Bangalore (BBMP) Limits.
2.3	Give a broad description of the site. Attach maps showing topographical feature		Refer Exhibits-1&4
2.3.1	Nature of soil		Refer item 1.4.6
2.3.2	Area of the land proposed to be acquired (Attach layout plan)		Refer Exhibits-5
	a. Area required for plant		Not applicable
	b. Ash disposal		Not applicable
	c. Colony (indicate separately for departmental staff, Contractors staff and others, (if any)		Existing colony in 4.2 Acres for departmental staff.
	d. Transmission corridors and power evacuation system		Power evacuation would be at 220 kV level and the plant will be connected to the existing KPTCL 220KV sub station established within Yelahanka Plant boundary.
	e. Approach road, railway, bridges etc.		The site is located on BangaloreDoddaballapura Road and 1KM from Yelahankarailway station.

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3.0	Fuel Use :				
3.1	Type quantity and characteristics of fuel used :				
	Fuel	Quantity	% Ash	% Sulphur	Source of supply and its distance from the site
	Natural Gas/RLNG	1.47mmscmdor 1027 mtpd (550mmscmper annum or 0.37mmtpa)	NA	Nil	M/s GAIL has commissioned Dabhol-Bangalore Gas Pipe line. KPCL has issued request for proposal to GAIL for sourcing Natural gas/RLNG for the power project. M/s GAIL have agreed that, they are in a position to offer Henry-Hub linked RLNG sourced from the US, to meet whole or part of the KPCL's requirement. And also opined by GAIL that, long term fuel supply agreement shall be the best option available to the consumers in India. The final source shall be finalized considering the merits and de-merits of long term, medium term and spot prices available in the market.
3.2	Has the linkage been established?		:		Yes,M/s GAIL have agreed to modify the GT agreement signed for 1x 700MW Bidadi CCPP by changing the terminal Points and delivery date.
3.2.1	Name of Mine / Block		:		Not applicable
3.2.2	Is it a working mine or yet to be opened?		:		Not applicable
3.2.3	Is the mine situated in the forest area?		:		Not applicable
3.3	Please furnish a fuel analysis report from a recognized laboratory (Details to include percentage contents of C,H,N S and Oxygen (if any) and gross calorific value)		:		Refer Appendix – 2
3.4	Indicate the type of fuel firing to be adopted		:		Natural Gas/RLNG.
3.5	Air to fuel ratio to be specified		:		33 for gas turbine
4.0	Water:				
4.1	Water use and liquid wastes (provide a detailed water balance diagram)		:		Detailed Water balance diagram is enclosed in the Exhibit – 9

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4.2	Will it be adequate for future use? Do you propose any measures to augment the water supply and how it affects other users?	:	Yes. It is propose to draw tertiary treated sewage water from BWSSB treatment plant at Jakkur/Yelahanka.
4.3	Lean season flow	:	Not applicable
4.4	Give details of the receiving water body	:	It is proposed to store in a raw water storage tank (6 days Capacity) within the plant boundary.
4.5	Average daily quantity of water required for		
	a. Cooling	:	525 m^3/hr continuous CW make up Refer **Exhibit – 9**
	b. Wet ash disposal	:	Not applicable
	c. Process	:	55 m^3 / h as make-up to HRSG and GT inlet air cooler at water treatment plant inlet
	d. Others	:	20 m^3 / hr (For Dilution at ETP)
	e. **Total**	:	**Total (a to d) 600 m^3 / hr or 14 400 M3/Day**
4.6	What type of cooling system is proposed once through / closed	:	Closed
	a. Give temperature difference between inlet and outlet water	:	9-10 degree Celsius
	b. Annual temperature profile of the receiving water	:	Not applicable since closed cycle cooling is envisaged.
4.7	Quantity and expected characteristics of the waste water discharged per day from the plant		
	a. Cooling	:	4200 m^3/day(175 M^3/hr)of blow down from CW system(1800-2000 TDS) with 3 COC
	b. Ash disposal	:	Not Applicable
	c. Process	:	180 m^3/ day blow down from heat recovery steam generators.
	d. Others/RO DM plant	:	1) UF backwash waste :144 m^3/ day TDS: Raw waterTDS(800ppm PH 7.3) 2) RO1 reject: 312 m^3/ day TDS:3100 ppm PH 7.2 3) MBReg./RO CIP Waste: 24 m^3/day TDS:6000 – 7000ppm

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			4) Dilution water: 480m³ /day 5) Total : 960 m3/day (waste water from R.O plant and dilution water)
	Total	:	**About 5340 m³/day** **(Refer Exhibit – 9)**
4.8	Type of waste water treatment proposed to be adopted for each stream.	:	Conventional type. The effluents will be treated suitably to meet the pollution regulations.
4.9	Applicable standards and regulations for the effluents	:	MINAS / Pollution Control Board requirements.
4.10	Points of final discharge Fallow land / agricultural land / sewer / river / lake / bay / estuary / sea	:	Downstream of Storm water drain after treatment suitably to meet the pollution regulations.
4.11	Mode of final discharge open channel / pipe line / covered drains	:	By pipe line Open channel
4.12	If the liquid effluents are finally discharged in river / pond / lake, the impact on the quality of water at the nearest human settlement should be mentioned	:	The effluents will be treated to meet the required standards and hence no impact on water quality is expected.
4.13	Details of the reuse of wastewater	:	Treated waste will be used for Gardening, Plant washing, Fire hydrant etc. to the maximum possible extent.
5.0	**Air Emissions:**		
5.1	Please furnish for your location		
5.1.1	Wind rose	:	wind rose diagram
5.1.2	Mean, maximum and minimum temperature for every month of the year	:	Annual Mean of daily Maximum - 37 Deg C Anhual Mean of daily Minimum – 11.5Deg C
5.1.3	Mean wind speed	:	33 M/sec
5.1.4	Humidity, rainfall	:	At 8.30 hrs --79% At 17.30 hrs --52% Annual average rainfall 970 mm.
5.1.5	Mean cloud cover	:	Later
5.2.2	Number of flues in stack	:	One Single flue
5.2.3	Inter-stack distance	:	Not applicable
5.2.4	Height of each stack	:	45 m height (HRSG stack)

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5.2.5	Internal diameter of each stack at the base and top	:	6.5 M at the base and 5.9 m at stack exit
5.2.6	Gas velocity	:	18 M/S
5.2.7	Flue gas characteristics	:	
	a. Volume (through each stack)	:	599 M^3 /S (approximately)
	b. Temperature c. (with gas firing)	:	97^0 C (temp will be still less at the exit of chimney)
	d. Density	:	1.257 kg/M^3
	e. Size distribution of particles	:	Not applicable
	f. Gas composition	:	N_2:(72.9%), CO_2:(4%), O_2:(11.6%), H_2O:(10.6%), AR :(0.86%)
5.2.8	Heat emission rate of gases (kcal /hr) from stack	:	About 12.89 x 10^6 Kcal/hr
5.2.9	Emission rate of SO_2, NOx and particulates from each stack	:	NOx : 25ppmvd@15% O_2 at GT Exhaust SO_2 will depend on the sulphur levels in fuel (Nil).
5.2.10	Back ground pollution levels of SO_2, NOx and particulates in kg / hr	:	EI studies under progress
5.3	a. What kind of stack emission monitoring is proposed	:	Monitoring of oxides of nitrogen and sulphur-di-oxide content in the flue gas.
	b. What equipment is proposed to be acquired or used for this purpose	:	Stack / ambient air monitoring equipment
5.4	Give details of the air pollution control equipment proposed to be installed	:	Dry Low Nox (DLN) burners for gas firing
5.5	Give details of the organization set-up for maintenance of pollution control equipment and level of expertise and authority of person in charge.	:	Qualified engineers will be in charge of the job
5.6	Emission rate of particulates and sulphur dioxide to be released when control equipment is	:	Particulates / Sulphur dioxide
	a. Functioning normally	:	Nil / Nil
	b. Not functioning	:	Not applicable / Not applicable

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5.7	What special procedure do you propose to lay down for the pollution control during the period when emission exceeds prescribed limits for any reason including malfunction of pollution control equipment?	:	Gas turbine will be shut down
5.8	Other types of pollution	:	Nil
5.8.1	Details of measures to control noise	:	Off base Acoustic enclosure, inlet &exhaust silencer to limit the noise levels (arithmeticaverage) to 85 dBA at 1 m from enclosure and 1.5 m from ground. Equipment would be designed to limit the noise level to meet the stipulations.
5.8.2	Details regarding prevention and control of fire and explosion hazards	:	Fire detection and firefighting system would be provided as per the requirements of TAC and other codes and standards.
6.0	**Transportation of Fuel :**		
6.1	Proposed mode of transport of coal / oil / gas	:	Pipeline would be laid for supply of Natural Gas/RLNG by gas supplier.
6.1.1	By rail	:	Not applicable
6.1.2	By sea	:	Not applicable
6.1.3	By road	:	Not applicable
6.1.4	Others	:	Not applicable
7.0	**Coal and Ash Handling:**		
7.1	What procedure will be adopted for coal handling at the plant site?	:	Not Applicable
7.2	Give details of dust suppression / collection equipment for reducing pollution from coal fines and other fugitive emissions from coal handling (wagon tippling, conveyor transfer points, storage, crushing mills, bunker filling etc.)	:	Not applicable

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7.3	How do you propose to prevent / treat the run – off from the coal storage / handling area?	:	Not applicable
7.4	What quantity of fly ash and bottom ash will be produced per day?	:	Not applicable
7.5	Indicate the method of collection, transport and disposal of the ash	:	Not applicable
7.6	What effects have been made or you wish to make towards utilisation of ash: Bricks / cement / road construction / land fill / soil stabilisation / other forms of disposal or use?	:	Not applicable
7.7	What precautions are proposed to be taken to prevent pollution of water course and ground water from solid waste disposal, especially with regard to coal particles and ash slurry?	:	Not applicable
7.8	What land is available for ash disposal? Will it be sufficient for the expected life of the plant (say 30 – 35 years)?	:	Not applicable
8.0	**Construction Materials:**		
8.1	Indicate source of supply of stones and location of quarries in the site map with the alignment of the roads to the projects site and the distance from the site	:	From nearest available quarries.
8.2	Sources of supply of sand and its distance from the site	:	From nearby available sources
8.3	If new roads are built whether their alignment is through agricultural land / forest / grazing land / human settlement / fallow land	:	Not applicable
8.4	Mode of transportation of heavy equipment, cement & steel i.e., by road or rail or sea	:	Road/ Rail

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8.4.1	Name of the nearest rail stop where they will be off loaded and its distance from the site.	:	Yelahanka Railway Station at a distance about 1 km.
8.4.2	If a new road is to be built from the rail head, the details of land to be acquired should be given	:	Not applicable
9.0	**Occupational safety and health:**		
9.1	Health status of workers especially those engaged in the coal handling, ash collection and ash disposal area.	:	Not applicable
9.2	Whether any adverse health at least due to noise were observed among the workers engaged in the turbine, compressor room, crushing mills etc.	:	Not applicable, However Safety PPE shall be compulsorily used by all workers during the works
9.3	If the plant is new, precautionary measure proposed to be taken for safety and health protection of workers may be mentioned	:	All necessary precautions would be taken as per the safety regulations
10.0	**Environmental Management:**		
10.1	Give details of organizational set-up you propose to have for pollution monitoring and control	:	Qualified engineers would be in charge of the job.
10.2	What is the level of expertise of the person in charge of pollution control	:	Qualified engineers would be in charge of the job.
10.3	Briefly outline the proposed environmental monitoring programme, mention number of observations addressing to the following parameters:		
10.3.1	Air	:	Continuous Ambient air quality monitoring system shall be established tomonitor the respirable particulate matter (PM10 and PM 2.5), SO2, NOX, and CO.
10.3.2	Water	:	Chemical Laboratory shall be established with conductivity meter, Aflac test kit for oxygen, pH meter, turbidity meter, BOD / COD incubator, Spectro-photometer for Water analysis.
10.3.3	Ground water	:	- do -

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10.3.4	Stack Monitoring	:	Stack monitoring system shall be established with all accessories for manual monitoring of stack gases
10.4	Have you been asked by the Central State Pollution Control Boards to take any special environmental control measures and how do you propose to carry out these obligations?	:	Generation from existing DG Units has been stopped due to environmental issues. To address the issue, environmental friendly Gas based power station is being established by dismantling the DG units.
10.5	Raising of green belt (Area may be indicated in a map)	:	The site is already provided with a green belt. Additional development of green belt as per norms will be taken up.
11.0	**Details of existing units :**		
11.1	If it is an extension, please furnish the following details in respect of the existing units:	:	Not applicable

Sl. No.	Existing units and their capacity	Effi-ciency of ESP	Fuel consumption (coal/oil/gas) (Tonnes / days)	Sulphur content	Stack height	Heat emission rate in kcal/hr from each stack	Stack emission in kg/hr (each stack		
							SO_2	NOx	Parti-culates
Not Applicable									

11.2	Have there been public complaints or questions in the Parliament or State Assembly regarding the Environment Problems posed by the existing Units. If so, give details	:	Generation from existing DG Units has been stopped due to environmental issues. To address the issue, environmental friendly Gas based power station is being established by dismantling the DG units.

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12.0	Have there been any representation / protests from the public / voluntary organizations against the siting of the new units / plant at the proposed locations if so, give details	:	No
13.0	**Economics of Pollution Control:**		
13.1	What is the total project cost?	:	1571.2 cores including IDC and Non EPC works (Ref Appendix 6)
13.2	Indicate costs of pollution control	:	Rs. 2-3 Crores(included in the project Cost)
13.2.1	Capital / Recurring (annual)		
13.2.1.1	Air	:	Continuous Ambient air quality monitoring system shall be established (Only capital cost and minimum. O& M cost)
13.2.1.2	Fly ash control	:	Not applicable
13.2.1.3	Sulphur-di-oxide control	:	Not applicable
13.2.1.4	Oxides of Nitrogen control	:	DLN(dry low NOx) Combustor(burners)are used (Only capital Cost and minimum O& M Cost)
13.2.2	Water	:	Chemical Laboratory shall be established to monitor the Effluents (Only the capital Cost and minimum O& M Cost)
13.2.3	Solid waste	:	Not applicable
13.2.4	Other (specify)	:	Later
	Total	:	Later

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APPENDIX - 5

KARNATAKA STATE POLLUTION BOARD NORMS FOR WATER POLLUTION

The treated effluent shall conform to the standards given below:

Sl. No.	Characteristics	Tolerance Limits
1	Colour & Odour	See note (1) below
2.	Suspended Solids, mg/l. Max.	100
3.	Particle size of Suspended Solids	Shall pass 850 micron IS Sleeve
4.	pH Value	6.5 to 8.5
5.	Temperature	Shall not exceed 5°C above the receiving water temperature
6.	Oil and Grease, mg/l. Max.	10
7.	Total Residual Chlorine, mg/l. Max.	1.0
8.	Ammonical Nitrogen (N) mg/l, Max.	50
9.	Total Kjeldhal Nitrogen (as N), mg/l Max.	100
10.	Free Ammonia (as NH_3), mg/l, Max.	5.0
11.	Bio-chemical Oxygen Demand, mg/l (5 days at 20°C) Max.	30
12.	Chemical Oxygen Demand, mg/l. Max.	250
13.	Arsenic (as AS), mg/l. Max	0.2
14.	Mercury (as Hg), mg/l. Max.	0.01
15.	Lead (as Pb), mg/l. Max.	0.1
16.	Cadmium (as Cd), mg/l. Max.	2.0
17.	Hexavalent Chromium (as Cr+6.), mg/l. Max.	0.1
18.	Total Chromium (as Cr), mg/l. Max.	0.2
19.	Copper (as Cu), mg/l. Max.	1.0

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20.	Zinc (as Zn), mg/l. Max.	1.0
21.	Selenium (as Se), mg/l. Max.	0.05
22.	Nickel (as Ni), mg/l. Max.	3.0
23.	Cyanide (as CN), mg/l. Max.	0.2
24.	Flouride (as F), mg/l. Max.	2.0
25.	Sulphide (as S), mg/l. Max.	2.0
26.	Phenolic Compounds (as C6 H5 OH), mg/l. Max.	1.0
27.	Radioactive Materials:	
	a) Alpha emitters micro curie / mg/l. Max.	10^{-8}
	b) Beta emitters micro curie / mg/l. Max.	10^{-7}
28.	Bio – assay test	90% survival of fish after 96 hours in 100% effluent
29.	Manganese (as Mn), mg/l. Max.	2.
30.	Iron (as Fe), mg/l	1.0
31.	Vanadium (as V), mg/l	0.2
32.	Nitrate Nitrogen, mg/l	10
33.	Dissolved phosphates (as P) mg/l, Max.	5.0

Note:1 All efforts shall be made to remove colour and unpleasant odour as far as practicable.

The domestic effluent from the plant shall be treated to the standards given below:

Sl. No.	Characteristics	Tolerance Limits
1.	Total Suspended Solids, mg/l. Max.	30
2.	Biochemical Oxygen Demand for 5 days at 20°C, mg/l Max.	20

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APPENDIX –6

PROJECT COST ESTIMATE

Sl. No	Item	Amount (in Lakhs)
1.01	**Land and site development**	
A.1	**Preliminary expenses**	
1	Preliminary investigation (land survey, and water testing, soil testing etc.)	50
	Sub Total cost of - A.1	**50**
A.2	**Land**	
1	Green belt development	100
2	Water supply works (BWSSB)	6500
3	Gas piping from supplier to power plant site(ROE)	100
4	Dismantling and disposing of existing structures and buildings of DG Plant system/structures excluding the cost of salvage value. (BHEL exclusion)	100
5	Dismantling and disposing of existing structures/systems of railway marshalling yard excluding the cost of salvage value. (BHEL/IOCL exclusion)	1000
	Sub Total - A.2	**7800**
1.02	**EPC WORKS**	
1	**Total cost of EPC works(Civil ,Elect ,Mech.) as per BHEL offer**	**120200**
2	Spares @4% on Sl.No.1 (Included in Sl. No.1)	
3	Excise duty on indigenous equipment @ 10% on Sl.No.1 (Included in Sl.No.1)	0
4	Cess on ED @ 3% on 3(Included in Sl.No.1)	0
5	Entry tax on supply scope of EPC works @ 2% (On 90000 lacks)	1800
	Sub Total EPC of works -1.02	**122000**

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1.03	NON EPC works	
	Civil works (NON EPC) (exclusions of BHEL offer)	
1	Site leveling, grading and fencing	50
2	Earthwork (excavation and filling) at designated areas	50
3	Landscaping and horticulture	100
4	Plant area drainage	50
5	Plant boundary wall	50
6	Fencing and gates	25
7	Sanitary and sewage system	50
8	Raj Kaluve development works	1000
9	Roads and culverts	100
10	Construction power, water and other enabling works	100
11	Miscellaneous plant buildings like, ware house, DG rooms, electrical/chemical lab buildings, workshop, guest house, residential colony and other facilities.	2500
	Sub-total - 1.03	4075
1.04	Sub Total of 1.01 to 1.03	133925
1.05	Contingency @ 2% on cost of works (On 1.04)	2679
1.06	Total cost of works (1.04+1.05)	136604
1.07	Establishment charges & pre-operative expenses @ 2% of 1.06	2732
1.08	Project management and consultancy charges(LS)	250
1.09	Project Cost excluding IDC(1.06+1.07+1.08)	139586
1.10	IDCand financing charges on EPC works	12787
1.11	IDCand financing charges on non EPC works	4745
1.12	Total project cost with IDC	157118

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APPENDIX - 7

ESTIMATED COST OF GENERATION

I. Fuel price at 15.25 $/MMBTU (MDP price)

A. Variable cost per Kwh:

Sl no	Parameters	Units	100% PLF	90% PLF	85% PLF	80% PLF
1	Output	MW	370.0	370.0	370.0	370.0
2	PLF	%	100.0	90.0	85.0	80.0
3	Aux. consumption	%	2.5	2.5	2.5	2.5
4	Density of fuel	Kg/scm	0.7	0.7	0.7	0.7
5	Gross heating value of fuel	Kcal/scm	9880	9880	9880	9880
6	Combined cycle heat rate on LHV	Kcal/Kwh	1543	1543	1543	1543
7	No. of days per annum	days	365	365	365	365
8	Dollar exchange rate	Rs/$	62	62	62	62
9	Fuel cost per mmbtu including cost of transportation	$/mmbtu	15.25	15.25	15.25	15.25
10	Cost of raw water	Rs /M³	5	5	5	5
11	Gross units generated	Mu/day	8.880	7.992	7.548	7.104
12	Aux. consumption	Mu/day	0.222	0.200	0.189	0.178
13	Net units generated (Ex- bus)	Mu/day	8.658	7.792	7.359	6.926
14	Annual gross power generation	Mu	3241.2	2917.1	2755.0	2593.0
15	Annual net power generation (Ex- bus)	Mu	3160.2	2844.2	2686.1	2528.1
16	Gross heating value of fuel	Kcal/Kg	14114.3	14114.3	14114.3	14114.3
17	Low heating value of fuel	Kcal/Kg	14114.3	14114.3	14114.3	14114.3
18	No. of units generated per Kg of fuel	Kwh/Kg	9.147	9.147	9.147	9.147
19	Specific Gas Consumption (SGC)	Kg/Kwh	0.109	0.109	0.109	0.109

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20	Specific Gas Consumption (SGC)	Scm/Kwh	0.156	0.156	0.156	0.156
21	Gas consumption per day	mmscmd	1.387	1.248	1.179	1.109
22	Gas consumption per annum	mmscm	506.191	455.572	430.263	404.953
23	Raw water consumption	M^3/Kwh	0.004	0.005	0.005	0.005
24	Fuel consumption cost	Rs/Kwh	5.789	5.789	5.789	5.789
25	Fuel charges (Ex bus)	Rs/Kwh	5.937	5.937	5.937	5.937
26	Raw water charges	Rs/Kwh	0.022	0.024	0.025	0.027
27	Total variable cost per annum	Crore	1883.1	1695.5	1601.7	1507.9
28	**Variable cost per Kwh**	Rs/Kwh	5.959	5.961	5.963	5.964

B. Fixed Cost per Kwh:

Sl No.	Parameters	Units	100% PLF	90% PLF	85% PLF	80% PLF
1	Total capital cost	Crore	1571.176	1571.176	1571.176	1571.176
2	Cost per MW	Crore / MW	4.246	4.246	4.246	4.246
3	Total debt (80% capital)	%	1256.9	1256.9	1256.9	1256.9
4	Total equity (20% capital)	%	314.2	314.2	314.2	314.2
5	Working capital @ Normal Annual PAF(NAPAF)					
a	Fuel cost (30Day) @ NAPAF	Crore	131.08	131.08	131.08	131.08
b	Fuel stock for 15 days @ NAPAF	Crore	65.54	65.54	65.54	65.54
c	O&M cost for 1 month	Crore	5.77	5.77	5.77	5.77
d	Spares @ 30% of O&M cost	Crore	20.78	20.78	20.78	20.78
e	Receivables (2 months) Capacity charge plus Energy charge @ NAPAF	Crore	349.428	349.428	349.428	349.428
6	**Total Working Capital@ NAPAF (a+b+c+d+e)**	Crore	572.61	572.61	572.61	572.61
7	RoE on equity =Base rate /1-t; Base rate =15.5%, t=tax rate	Crore	61.921	61.921	61.921	61.921

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8	Interest on loan. (12.5% on debt)	Crore	157.118	157.118	157.118	157.118
9	Depreciation (5.28% of the capital)	Crore	82.958	82.958	82.958	82.958
10	O&M Cost(18.72 Lacks/MW)	Crore	69.264	69.264	69.264	69.264
11	Interest on working capital (12.5%)	Crore	71.576	71.576	71.576	71.576
12	Total fixed cost @ NAPAF	Crore	442.837	442.837	442.837	442.837
13	**Fixed cost per Kwh**	Rs/Kwh	**1.401**	**1.557**	**1.649**	**1.752**

C. **Cost of Generation (Ex-bus) at fuel price of 15.25$/MMBTU (MDP price)**

Sl No.	Parameters	Units	100% PLF	90% PLF	85% PLF	80% PLF
1	Variable cost per Kwh	Rs/Kwh	5.959	5.961	5.963	5.964
2	Fixed cost per Kwh	Rs/Kwh	1.401	1.557	1.649	1.752
3	Cost of Generation(Ex-bus)	Rs/Kwh	7.360	7.518	7.611	7.716

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II. Fuel price at 10.77 $/MMBTU (Spot price)

A. Variable cost per Kwh:

Sl No.	Parameters	Units	100% PLF	90% PLF	85% PLF	80% PLF
1	Output	MW	370.0	370.0	370.0	370.0
2	PLF	%	100.0	90.0	85.0	80.0
3	Aux. consumption	%	2.5	2.5	2.5	2.5
4	Density of fuel	Kg/scm	0.7	0.7	0.7	0.7
5	Gross heating value of fuel	Kcal/scm	9880	9880	9880	9880
6	Combined cycle heat rate on LHV	Kcal/Kw	1543	1543	1543	1543
7	No. of days per annum	days	365	365	365	365
8	Dollar exchange rate	Rs/$	62	62	62	62
9	Fuel cost per mmbtu including cost of transportation	$/mmbtu	10.77	10.77	10.77	10.77
10	Cost of raw water	Rs /M³	5	5	5	5
11	Gross units generated	Mu/day	8.880	7.992	7.548	7.104
12	Aux. consumption	Mu/day	0.222	0.200	0.189	0.178
13	Net units generated (Ex- bus)	Mu/day	8.658	7.792	7.359	6.926
14	Annual gross power generation	Mu	3241.2	2917.1	2755.0	2593.0
15	Annual net power generation (Ex - bus)	Mu	3160.2	2844.2	2686.1	2528.1
16	Gross heating value of fuel	Kcal/Kg	14114.3	14114.3	14114.3	14114.3
17	Low heating value of fuel	Kcal/Kg	14114.3	14114.3	14114.3	14114.3
18	No. of units generated per Kg of fuel	Kwh/Kg	9.147	9.147	9.147	9.147
19	Specific Gas Consumption (SGC)	Kg/Kwh	0.109	0.109	0.109	0.109
20	Specific Gas Consumption (SGC)	Scm/Kwh	0.156	0.156	0.156	0.156
21	Gas consumption per day	mmscmd	1.387	1.248	1.179	1.109

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22	Gas consumption per annum	mmscm	506.191	455.572	430.263	404.953
23	Raw water consumption	M^3/Kwh	0.004	0.005	0.005	0.005
24	Fuel consumption cost	Rs/Kwh	4.088	4.088	4.088	4.088
25	Fuel charges (Ex-bus)	Rs/Kwh	4.193	4.193	4.193	4.193
26	Raw water charges	Rs/Kwh	0.022	0.024	0.025	0.027
27	Total variable cost per annum	Crore	1331.9	1199.4	1133.2	1066.9
28	**Variable cost per Kwh**	Rs/Kwh	4.215	4.217	4.219	4.220

B. Fixed Cost per Kwh:

Sl No	Parameters	Units	100% PLF	90% PLF	85% PLF	80% PLF
1	Total capital cost	Crore	1571.176	1571.176	1571.176	1571.176
2	Cost per MW	Crore / MW	4.246	4.246	4.246	4.246
3	Total debt (80% capital)	%	1256.9	1256.9	1256.9	1256.9
4	Total equity (20% capital)	%	314.235	314.235	314.235	314.235
5	Working capital @ Normal Annual PAF(NAPAF)					
a	Fuel cost (30Day) @ NAPAF	Crore	92.58	92.58	92.58	92.58
b	Fuel stock for 15 days @NAPAF	Crore	46.29	46.29	46.29	46.29
c	O&M cost for 1 month	Crore	5.77	5.77	5.77	5.77
d	Spares @ 30% of O&M cost	Crore	20.78	20.78	20.78	20.78
e	Receivables (2 months) Capacity charge plus Energy charge @ NAPAF	Crore	266.319	266.319	266.319	266.319
6	**Total Working Capital@ NAPAF (a+b+c+d+e)**	Crore	431.73	431.73	431.73	431.73
7	RoE on equity =Base rate /1-t; Base rate =15.5%, t=tax rate	Crore	61.921	61.921	61.921	61.921
8	Interest on loan (12.5% on debt)	Crore	157.118	157.118	157.118	157.118

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9	Depreciation (5.28% of the capital)	Crore	82.958	82.958	82.958	82.958
10	O&M Cost(18.72 Lacks/MW)	Crore	69.264	69.264	69.264	69.264
11	Interest on working capital (12.5%)	Crore	53.967	53.967	53.967	53.967
12	Total fixed cost @ NAPAF per annum	Crore	425.228	425.228	425.228	425.228
13	Fixed cost per Kwh	Crore	1.346	1.495	1.583	1.682

C. Cost of Generation (Ex-bus) at fuel price of 10.77$/MMBTU (Spot price)

Sl No.	Parameters	Units	100% PLF	90% PLF	85% PLF	80% PLF
1	Variable cost per Kwh	Rs/Kwh	4.215	4.217	4.219	4.220
2	Fixed cost per Kwh	Rs/Kwh	1.346	1.495	1.583	1.682
3	Cost of Generation (Ex-bus)	Rs/Kwh	5.560	5.712	5.802	5.902

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PROCEEDINGS OF THE GOVERNMENT OF KARNATAKA

Sub: Establishing 1 x 350 MW Gas Based Power Plant at Yelahanka by dismantling the existing Diesel Generation Plant by Karnataka Power Corporation Limited.

Read: KPCL letter No.A1Q5D dated: 22.03.2014 and 10.04.2014.

***

PREAMBLE:

1. KPCL in the letter read above has stated that the Board of Karnataka Power Corporation Limited(KPCL) in its 229th Meeting held on 08.08.2013 had approved inprinciple for conversion of existing Diesel Generation Plant at Yelahanka to Gas Based power plant.

2. Further, based on the Report submitted by M/s Tractable Engineering Pvt. Ltd., New Delhi, the Board of KPCL in its 238th meeting held on 13.02.2014 has decided to replace the existing facility with a Combined Cycle Power Plant of 350 MW capacity for optimizing the infrastructure and Resolved as follows:

   a. *Establishing 1x350MW Combined Cycle gas power plants (CCPP) in 1st Stage by dismantling the required existing Structure/system of the DG Plant;*

   b. *Establishing another 350 MW CCPP in 2nd stage depending on cost/availing of gas, cost of generation, load demand and financial viabilities*

3. The following infrastructures are available at the existing DG Plant area for the implementation of the Gas based power plant:

   - 120 acres of land of KPCL is available;
   - The Gas Pipeline is already established by GAIL in the outer-ring road, which could be utilized to get the required gas from the GAIL terminal Point (SV3) and GAIL shall make necessary arrangement for laying pipe line for supply of gas to the proposed plant;
   - BWSSB has established 64 MLD capacity Secondary water treatment plant near Hebbal and has agreed to supply required treated water (22 MLD) to the proposed plant;
   - KPTCL has established 220 KV Substation with 2 x150 MVA 220/66/11kv transformers within the existing DG Plant area, which could be utilized for power evacuation;

5. In order to avoid delay in the process of floating the tender and awarding the work to the successful bidder, which requires sufficient time and to meet the power requirement of the State, KPCL has proposed to award the EPC work of the 1x350 MW Gas based combined Cycle Power Plant to M/s BHEL on MOU basis at a negotiated benchmark price.

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6. Further, KPCL has stated that M/s.BHEL vide letter dated: 22.03.2014 has proposed to takeup the implementation of the 1x350 MW Combined Cycle Gas Power Plant (CCPP).

7. After detailed examination of the proposal, the following orders are issued.

GOVERNMENT ORDER NO. EN 28 PPC 2014,
BANGALORE, DATED 28th JULY 2014

Under the circumstances explained above, Government are pleased accord approval for the following:

a) KPCL is permitted to implement 1x350 MW Combined Cycle Gas Power Plant (CCPP) in 1st stage by dismantling the required existing structure/system of the DG Plant at Yelahanka;

b) KPCL is exempted from KTPP Act, to entrust the work to BHEL on MOU basis as per the Notification No. ಆಇ 418 ಖಜ -12/14 ದಿನಾಂಕ: 01.07.2014 issued by the Finance Department.

c) To entrust the EPC work to M/s BHEL on MOU basis, with benchmark prices by conducting further negotiation with M/s, BHEL for reduction in the benchmark price to reduce the project cost and tariff to the consumers of the State.

d) To provide similar support to the proposed project also as provided for 700 MW±20% Gas based Bidadi CCPP vide GO dated 05.07.2011, with a debt service liability of Rs.2069 crores during the tenure of the loan.

e) To modify the existing PPA in respect of the existing DG Plant with 108 MW to 350 MW Gas Based Combined Cycle Power Plant with BESCOM.

BY ORDER AND IN THE NAME OF
GOVERNOR OF KARNATAKA,

(K.L.RAMACHANDRA) 28/7/14
DEPUTY SECRETARY TO GOVERNMENT,
ENERGY DEPARTMENT,
☎ 080-22034680.

To: The Compiler, Karnataka Gazette, Government Press for publication and to supply 50 copies to this department.

Copy to:

1. The Accountant General (A&E), Karnataka, Bangalore-1.
2. The Additional Chief Secretary to Hon'ble Chief Minister, Vidhana Soudha, Bangalore.

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3. The Additional Chief Secretary to Government, Finance / Water Resources/ Commerce & Industries Departments.
4. The Managing Director, Karnataka Power Corporation Limited, No: 82, Shakti Bhavan, Race Course Road, Bangalore-1. – alongwith the copy of the Notification No. ಆಇ 418 ಪಸ್ತ -12/14 ದಿನಾಂಕ: 01.07.2014 issued by the Finance Department.
5. The Managing Director, Karnataka Power Transmission Corporation Limited, Kaveri Bhavan, Bangalore-9.
6. The Secretary, Karnataka Electricity Regulatory Commission, M.G. Road, Bangalore-1.
7. The Managing Directors, BESCOM / MESCOM / HESCOM / GESCOM / CESC.
8. The Managing Director, Karnataka Renewable Energy Development Limited, No.39, Shanthi Gruha, Place Road, Bharath Scouts and Guides Building, Bangalore-1.
9. The Managing Director, Power Company of Karnataka Limited, Kaveri Bhavan, Bangalore-9.
10. The Chief Electrical Inspector to Government, 32/1, 2nd Floor, Crescent Towers, Crescent Road, Bangalore-1.
11. The Chief Engineer, Load Dispatch Centre, Ananda Rao Circle, Bangalore
12. P.S. to the Chief Secretary to Government, Vidhana Soudha, Bangalore-1.
13. P.S. to Energy Minister, Vidhana Soudha, Bangalore-1.
14. P.S. to the Additional Chief Secretary to Government, Energy Department. Vikasa Soudha, Bangalore-1.
15. P.A. to Deputy Secretary to Government, Energy Department, Vikasa Soudha, Bangalore-1.
16. S.G.F/Spare Copies/Office Copy.

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Minutes of the Meeting between M/s KPCL and M/s GAIL

Held at Shakti Bhawan, Race Course, Bangalore on 21st August, 2014

KPCL	GAIL
1. Shri Ritesh Kumar Singh IAS, MD	1. Shri Rajeev Mathur, ED (Marketing)
2. Shri P Bhaskar, Technical Director	2. Shri A Balasubramanian, DGM (Marketing)
3. Shri S.Muthunjaya, CE/GSW	3. Shri Murlimohan, DGM (Construction)
3. Shri. Haveri IS EE KPCL	4. Shri Arun Modi, DGM (O&M)
4. Shri. S Ashok EE KPCL	5.Shri Vinukumar S Balakrishnan

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The meeting was held in the chambers of MD KPCL to discuss regarding the supply of gas to the proposed 1x350 MW CCPP at Yelahanka and the status of KPCL's Bidadi CCPP.

1. At the outset, MD, KPCL welcomed Executive Director, GAIL and his team and introduced his team to GAIL.

2. MD, KPCL informed GAIL that Government of Karnataka (GoK) has approved the setting up of 1X 350 MW Combined Cycle Power Plant at Yelahanka DG Plant, Bangalore.

3. Executive Director (Marketing), GAIL expressed appreciation for the efforts taken by KPCL to get the project approval and also the initiative taken by GoK to establish gas based power plants in the state.

4. ED, GAIL informed KPCL that in anticipation of the GoK approval for the CCPP at Yelahanka, GAIL has already made a tap off provision at GAIL's SV Station (SV 3B) located at Kuvempu Circle on Outer Ring Road. The option of spur line from Hebbal fly over via NH 7 is also under review. Further, informed that GAIL has also done a preliminary route survey from the tap-off location at SV-3B/ Hebbal Flyover Junction to KPCL, Yelahanka. Details of the proposed pipeline route were shared with KPCL and same was discussed in detail.

5. KPCL stated that, BWSSB is also planning to lay a pipeline to meet the water requirements of the proposed plant, along NH from Hebbal fly over. They further brought out that, the coordinating project activities with BWSSB will help optimize the construction corridor and also ensuring the construction is synchronized. GAIL requested KPCL to organise a joint meeting between KPCL, BWSSB and GAIL's project team so that the modalities for project coordination can be worked out.

6. KPCL informed that the project would be implemented in phases and that the first phase of 350 MW, would have a gas requirement of around 1.4 MMSCMD. KPCL also stated that they might also go for second phase of another 350 MW in the same location. It was clarified by KPCL that the present GoK approval is only for first phase. They requested GAIL to consider setting up last mile connectivity (LMC) taking into account of the requirement of both phases i.e. about 3 MMSCMD. Considering that laying additional pipeline on a later date in the urban areas might

not be practical, GAIL appreciated the point brought out by KPCL and assured that KPCL's request would be considered at the time of system design.

7. Pressure requirement at the consumption point was discussed. KPCL stated that, as per inputs received from BHEL the pressure requirement at Yelahanka would be around 42 kg/cm2. In reply GAIL stated that spur line to the proposed power plant is planned from 18" Bangalore pipeline, which is laid in the congested city area along ORR. It would be prudent to restrict the pressure in the city line for which GAIL is already in the process of installing a pressure reduction system at the tap off point of 18" pipeline and therefore it may not be possible for GAIL to deliver high pressure of 42 kg/cm2 required by KPCL. GAIL informed that the delivery pressure at KPCL, Yelahanka is expected to be around 17-19 kg/cm2 and suggested to KPCL that they may revisit the matter with BHEL and if required organize a joint meeting of KPCL, GAIL and BHEL. It was further suggested that if the pressure requirement cannot be brought down then KPCL/BHEL may consider setting up a compressor at Yelahanka site.

8. GAIL informed that land would be required inside the KPCL premises for setting up of gas receiving terminal. KPCL informed GAIL that the same shall be provided in the plot plan of the project , which is being finalized. GAIL requested for early earmarking and handover the land for receiving terminal considering that civil works take considerable amount of time and that, survey, soil testing, designing, tendering etc. have to be carried out before commencement of site works. KPCL agreed to expedite the matter and it was agreed that a separate meeting at working level would be held shortly to discuss details of GAIL's requirement.

9. GAIL requested KPCL to give a formal request for adding KPCL's Yelahanka plant as an additional re-delivery under the GTA dated 16.02.2013. GAIL further requested for a copy of the GO in which approval for the project was communicated by GoK to facilitate internal approvals for the connectivity. KPCL agreed to send a request for additional re-delivery point and also to provide a copy of the GoK order.

10. KPCL sought to understand the Gas supply options that would be available to them and likely courses of action in this regard. The merits and de-merits of long term, medium term and spot prices were discussed in detail. GAIL informed that, they are in a position to offer Henry Hub linked RLNG sourced from the US, to meet whole or part of the KPCL's requirement. It was also opined by GAIL that, long term fuel supply agreement shall be the best option available to the consumers in India. KPCL requested GAIL to formally submit a supply offer for their proposed Yelahanka plant and requested to make presentation in this regard. GAIL agreed to do so.

11. KPCL discussed the issue of change of commencement date agreed as per the CT #1 dated 16.02.2013. GAIL informed that it was decided in the meeting dated 20th July, 2013 between Hon'ble Chief Minister, GoK, Hon'ble Minister, MoPNG and CMD (GAIL) that GAIL would consider the request of KPCL after the EPC contract for Bidadi plant is awarded. GAIL requested KPCL to accordingly submit a request and agreed to consider the same.

The meeting ended with MD, KPCL thanking everyone present in the meeting.

Shri Ritesh Kumar Singh IAS, MD

Shri Rajeev Mathur, ED (Marketing)

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APPENDIX – 10

31 JAN 2015

KARNATAKA POWER TRANSMISSION CORPORATION LIMITED

Proceedings of the meeting held on 17.1.2015 with M/s KPCL regarding evacuation of power from proposed 1X350MW Gas Based Combined Cycle Power Plant at Yelahanka

Members Present: As per Annexure-I

M/s KPCL presented issues regarding evacuating power from their proposed 2X700MW Gas Based Combined Cycle Power Plant at Bidadi.

Chief Engineer (GSW), KPCL, explained the problems encountered with the evacuation of power from gas based plant at Bidadi. Central Electricty Authority (CEA) had approved the proposal of construction of 400/220kV Gas Insulated Sub Station (GIS) at Bidadi by PGCIL by Looping in and Looping out (LILO) of existing 400kV DC Nelmangala-Somanhalli line. PGCIL had agreed to evacuate power from the proposed 2X700MW power plant through their 400/220kV Bidadi GIS during the meeting held on 01.06.2009. However, now PGCIL has informed KPCL that as per CERC regulations, KPCL will have to pay applicable POC (Point of Connectivity) charges at Rs.1 Lakh/MW/Month each for injection and withdrawal. Hence, KPCL requested KPTCL to intervene in this issue in order to avoid payment of POC Charges. For this, KPTCL will have to plan a new evacuation scheme without using PGCIL assets.

Director (Transmission), KPTCL stated that decision regarding this can be taken only after inspecting the spot. Director (Transmission), KPTCL also instructed SE (Plg), EE (Plg) South and EE(PSS) to inspect Bidadi Power Plant location of M/s KPCL and furnish a report regarding the possibility of evacuating power within 15 days.

KPCL raised the issues regarding evacuation of 1X350MW generation proposed at DG Plant premises.

Load flow studies are conducted and it is proposed to have 4 number of 220kV lines with Drake ACSR from the generating station to proposed 220kV station at Yelahanka, for evacuating 1X350MW power of M/s KPCL.

M/s KPCL requested for extension of 220kV bus of 220/66kV sub station at Yelahanka to proposed 220kV bus of KPCL generating station

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Director (Transmission), KPTCL instructed SE (Plg), EE (Plg) South and EE (PSS) to inspect Yelahanka and furnish report within a fortnight. Director (Transmission), KPTCL also instructed to explore the possibility of constructing a new 220kV DC line (UG cable/Overhead line) from the proposed generating station of M/s KPCL at Yelahanka to existing 220/66kV BIAL substation.

The meeting concluded with a vote of thanks.

Chief Engineer(Electy),
Planning & Coordination
KPTCL, Kaveri Bhavan,
Bangalore

To,

1. CEE(GSW), KPCL, "Sudarshan Complex", 2nd Floor, No.22/23, Sheshadri Road, Bangalore- 560009 for information and needful.
2. SEE(Plg), KPTCL for information and needful.
3. EE(E) and EE(ME), KPCL O/o Chief Engineer (GSW), "Sudarshan Complex", 2nd Floor, No.22/23, Sheshadri Road, Bangalore- 560009 for information and needful.
4. EE (Plg) South, EE(PSS) and AEE(Plg) for information and needful.
5. EA to D (T) to place it before D (T), KPTCL.
6. PS to TD, KPCL "Sudarshan Complex", 2nd Floor, No.22/23, Sheshadri Road, Bangalore- 560009 to place before TD, KPCL.
7. OC

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www.bwssb.org

Phone No :- 080-22945116

APPENDIX-11

ಬೆಂಗಳೂರು ನೀರು ಸರಬರಾಜು ಮತ್ತು ಒಳಚರಂಡಿ ಮಂಡಳಿ

BANGALORE WATER SUPPLY AND SEWERAGE BOARD

Office of the Chief Engineer (NI &NW), 7th Floor,
Cauvery Bhavan, K.G. Road, Bangalore 560 009

No. BWSSB/ CE (NI & NW) /TA / 373 /2014-15 DT: ~~01/2015~~ 02/02/2015

To

Chief Engineer (Civil) / Bidadi,
No. 116/2, Trade Centre,
2nd Floor, Race Course Road,
Bengaluru- 560001.

Sir,

Sub: Supply of 22 MLD tertiary treated water to 2X350 MW Gas Based Combined Cycle Power Plant at Yelahanka- Reg: Issue of allotment letter.

Ref: No. CE(C)/Bidadi (YDG)/CCPP/RWS/302 dt: 23.01.2015

****

With reference to the above subject, as per the request made vide letter cited under reference, you are hereby accorded and allocated to utilize 22 MLD Tertiary Treated Water from Jakkur & KHB Colony STP's for 350 MW CCP plant at Yelahanka.

Now, around 12-15 MLD of tertiary treated water will be supplied initially from Jakkur STP and balance 10-12 MLD will be supplied from the proposed TTP of KHB Colony, Puttenahalli. However, the BWSSB will take up the above work under D.C Works of KPTCL.

Thanking you

Yours faithfully

31/1/15

Chief Engineer (NI &NW),
7th Floor, Cauvery Bhavan,
K.G. Road, Bangalore 560 009

31/1/15

Office Of The CE(C)/Bidadi
KPTCL Transmission Ltd.,
No.- A31 02/02/15
GM SE(C) CE(C)/Bidadi

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EXHIBITS

625

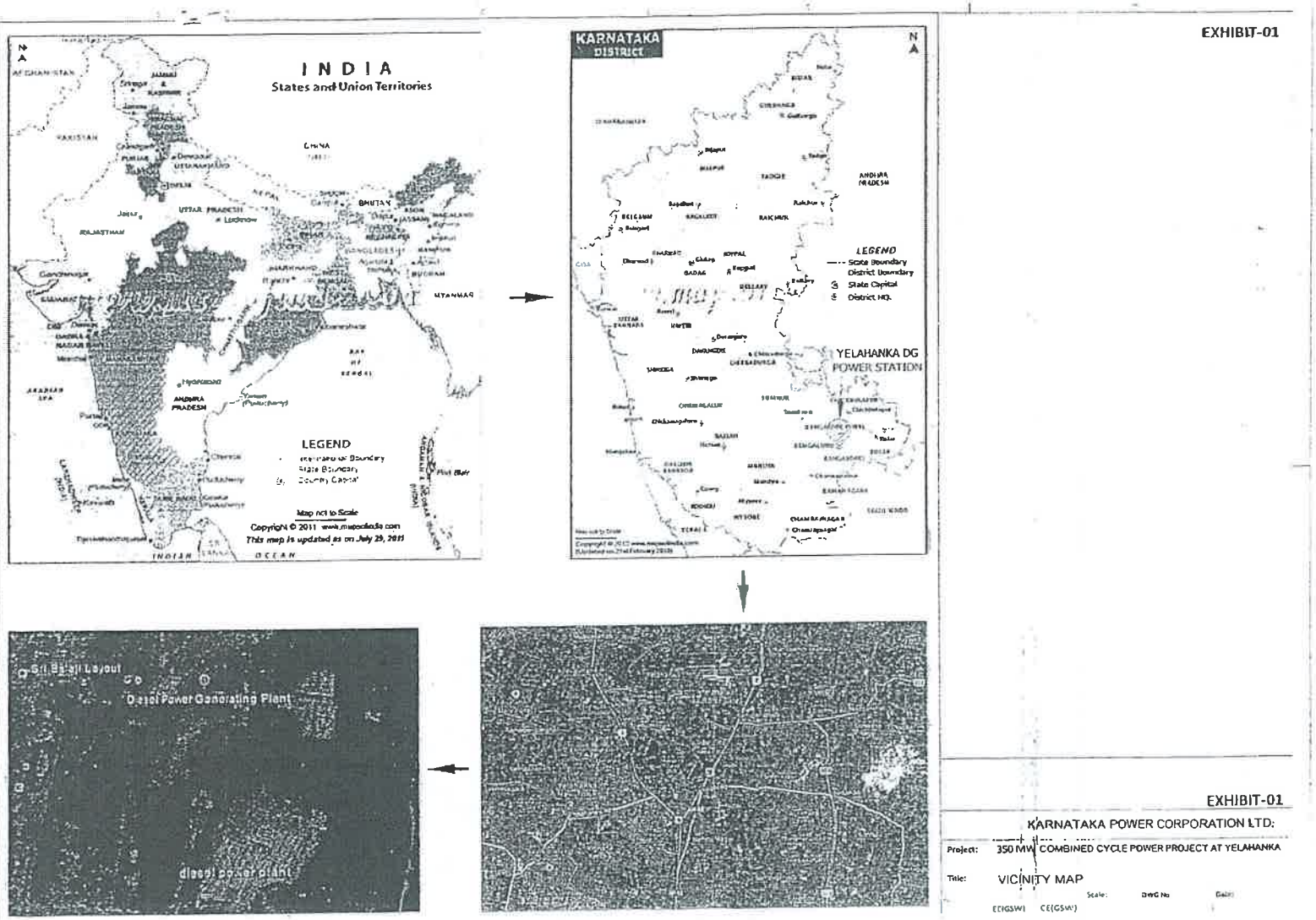

EXHIBIT-01

EXHIBIT-01

KARNATAKA POWER CORPORATION LTD.

Project: 350 MW COMBINED CYCLE POWER PROJECT AT YELAHANKA

Title: VICINITY MAP

Scale: Dwg No Date:

EE(GSW) CE(GSW)

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GRID MAP OF KARNATAKA STATE

EXHIBIT-02

(765 kV, 400kV and 220 kV - Existing & Proposed Network)

(As on 30-09-2013)

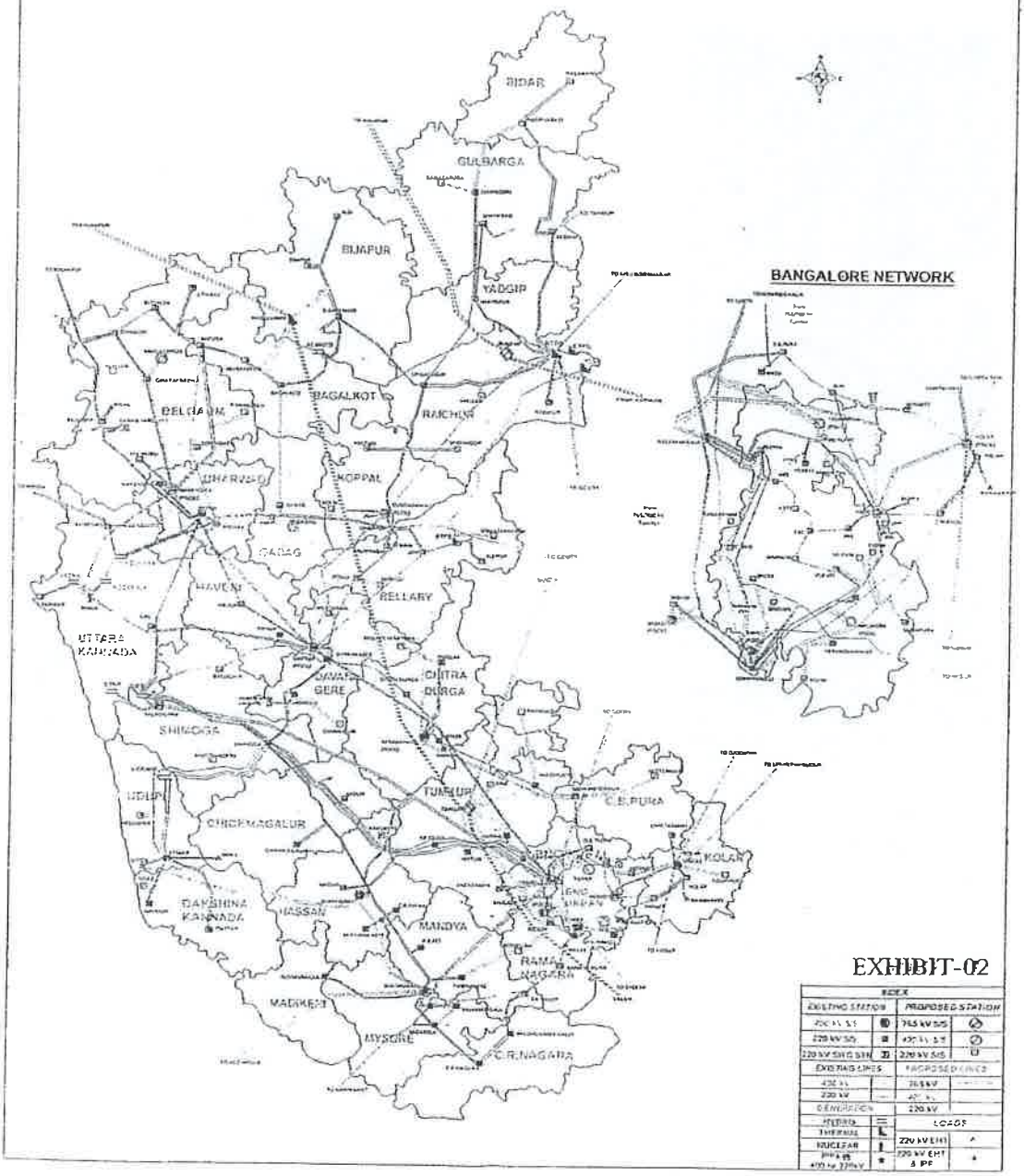


EXHIBIT-02

INDEX		
EXISTING STATION		PROPOSED STATION
765 kV S/S	●	765 kV S/S
400 kV S/S	■	400 kV S/S
220 kV SWG STN	◘	220 kV S/S
EXISTING LINES		PROPOSED LINES
400 kV		765 kV
220 kV		400 kV
GENERATION		220 kV
HYDRO		LOADS
THERMAL		
NUCLEAR		220 kV EHT
400 kV, 220kV		220 kV EHT & IPP

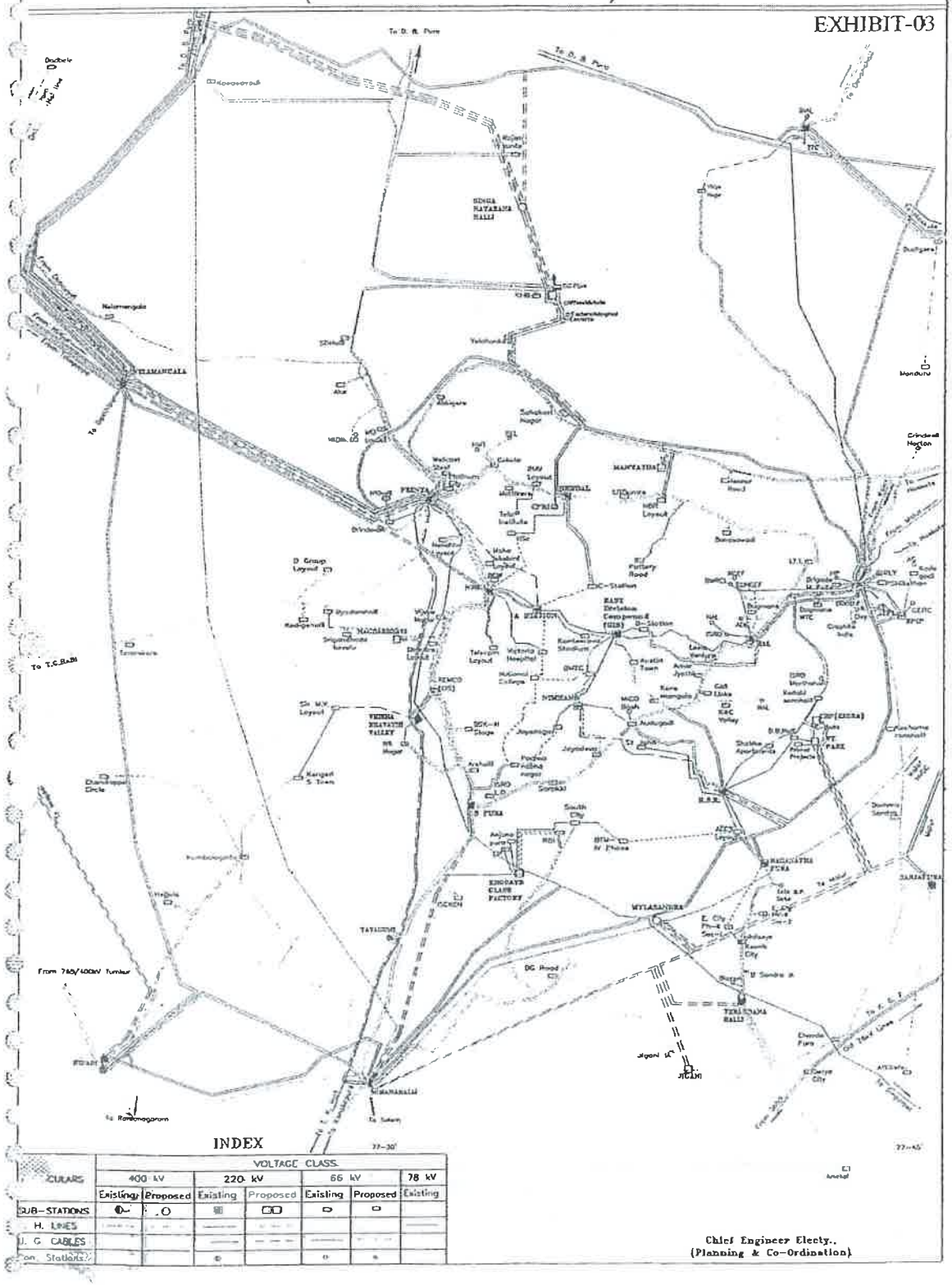
627

KARNATAKA POWER TRANSMISSION CORPORATION LIMITED

BANGALORE METROPOLITAN AREA NETWORK

(UPDATED AS ON 28.02.2014)

EXHIBIT-03



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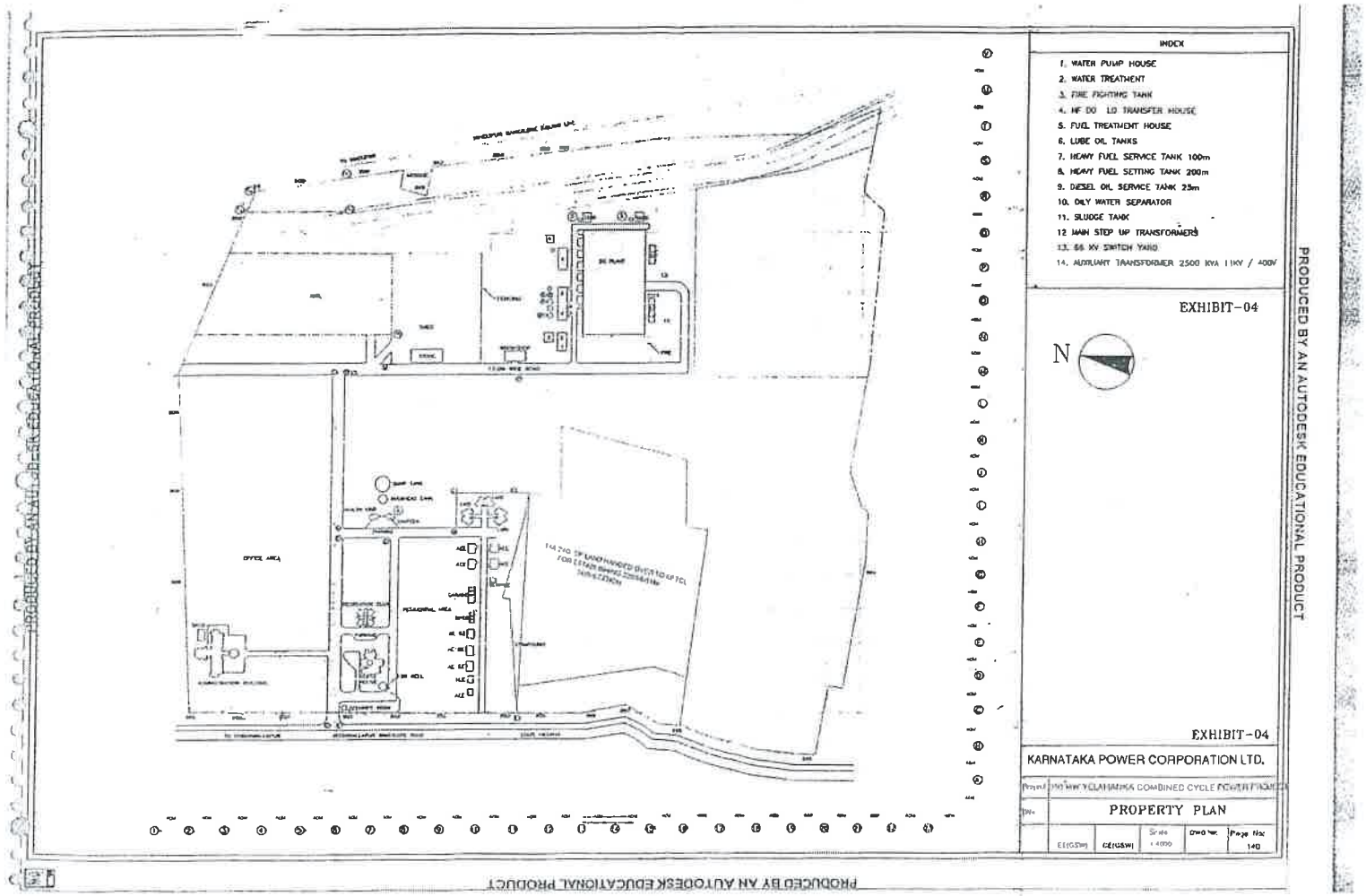
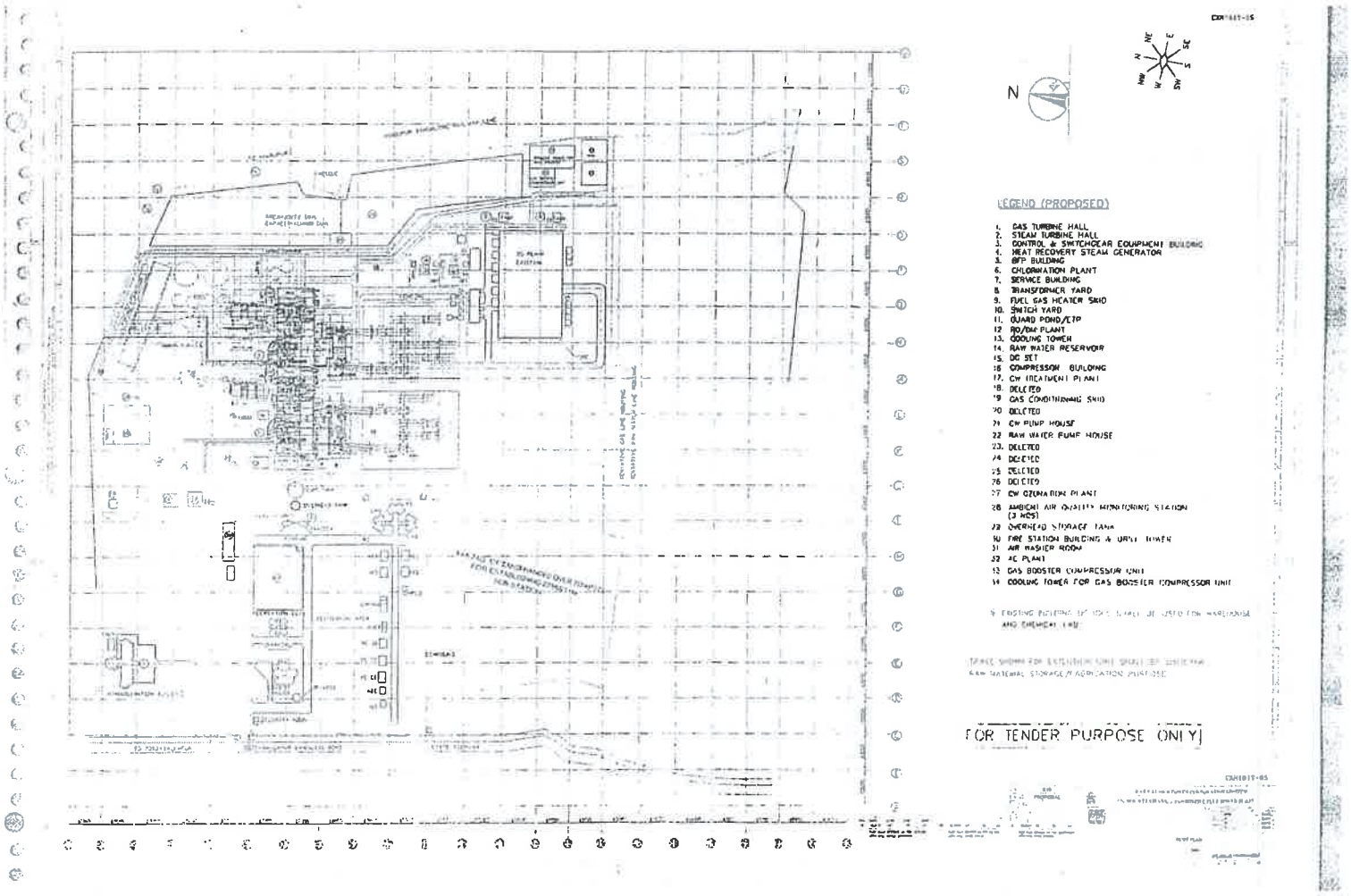
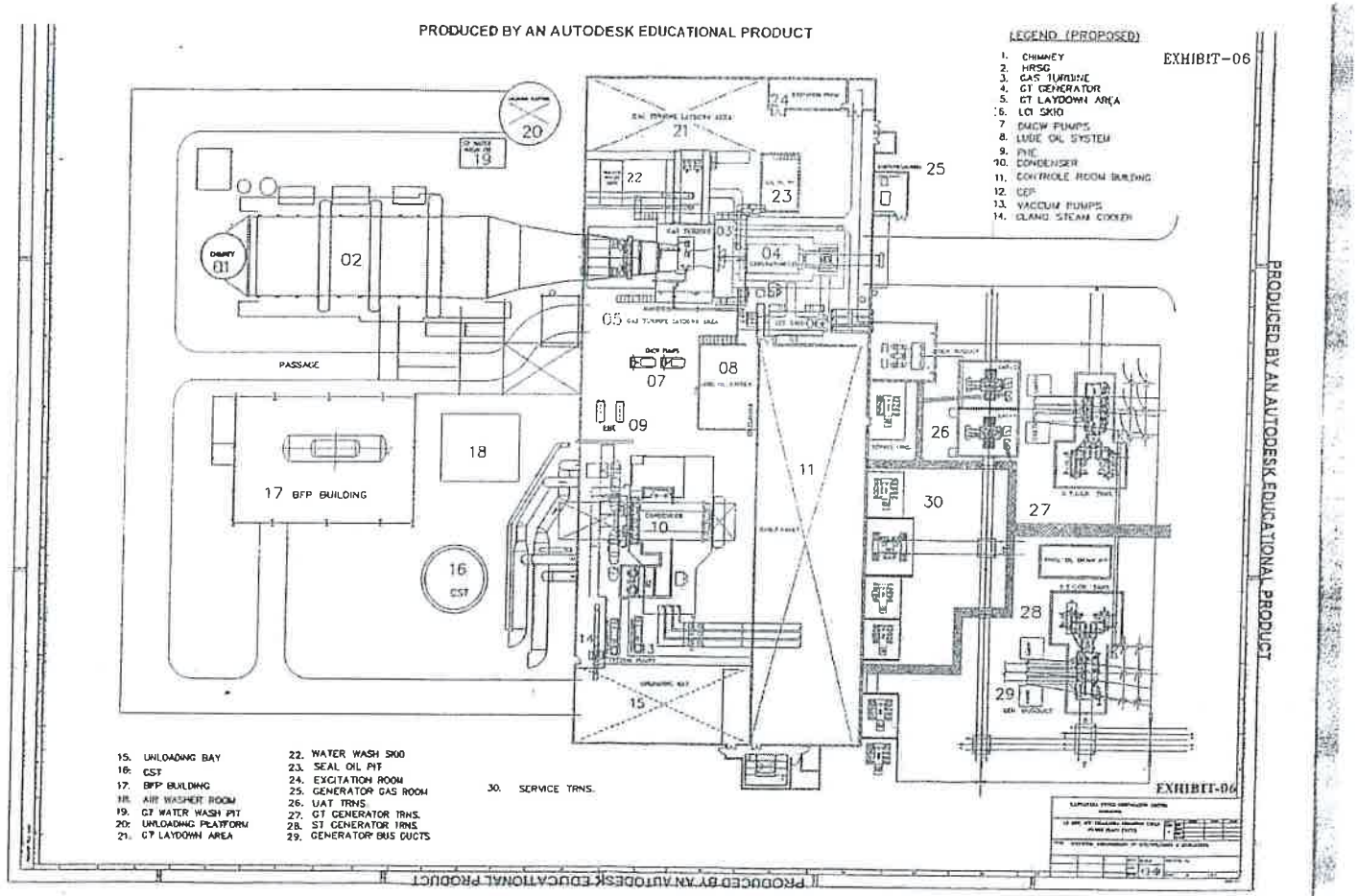

INDEX
1. WATER PUMP HOUSE
2. WATER TREATMENT
3. FIRE FIGHTING TANK
4. HF DO LO TRANSFER HOUSE
5. FUEL TREATMENT HOUSE
6. LUBE OIL TANKS
7. HEAVY FUEL SERVICE TANK 100m
8. HEAVY FUEL SETTING TANK 200m
9. DIESEL OIL SERVICE TANK 25m
10. OILY WATER SEPARATOR
11. SLUDGE TANK
12 MAIN STEP UP TRANSFORMERS
13. 66 KV SWITCH YARD
14. AUXILIANT TRANSFORMER 2500 KVA 11KV / 400V
EXHIBIT-04
N
EXHIBIT-04
KARNATAKA POWER CORPORATION LTD.
PROPERTY PLAN
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

629


N
LEGEND (PROPOSED)
1. GAS TURBINE HALL
2. STEAM TURBINE HALL
3. CONTROL & SWITCHGEAR EQUIPMENT BUILDING
4. HEAT RECOVERY STEAM GENERATOR
5. BFP BUILDING
6. CHLORINATION PLANT
7. SERVICE BUILDING
8. TRANSFORMER YARD
9. FUEL GAS HEATER SKID
10. SWITCH YARD
11. GUARD POND/ETP
12 RO/DM PLANT
13. COOLING TOWER
14. RAW WATER RESERVOIR
15. DG SET
16 COMPRESSOR BUILDING
17. CW TREATMENT PLANT
18. DELETED
19 GAS CONDITIONING SKID
20 DELETED
21 CW PUMP HOUSE
22 RAW WATER PUMP HOUSE
23. DELETED
24 DELETED
25 DELETED
26 DELETED
27 CW OZONATION PLANT
28 AMBIENT AIR QUALITY MONITORING STATION (3 NOS)
29 OVERHEAD STORAGE TANK
30 FIRE STATION BUILDING & DRILL TOWER
31 AIR WASHER ROOM
32 AC PLANT
33 GAS BOOSTER COMPRESSOR UNIT
34 COOLING TOWER FOR GAS BOOSTER COMPRESSOR UNIT
FOR TENDER PURPOSE ONLY

630

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT



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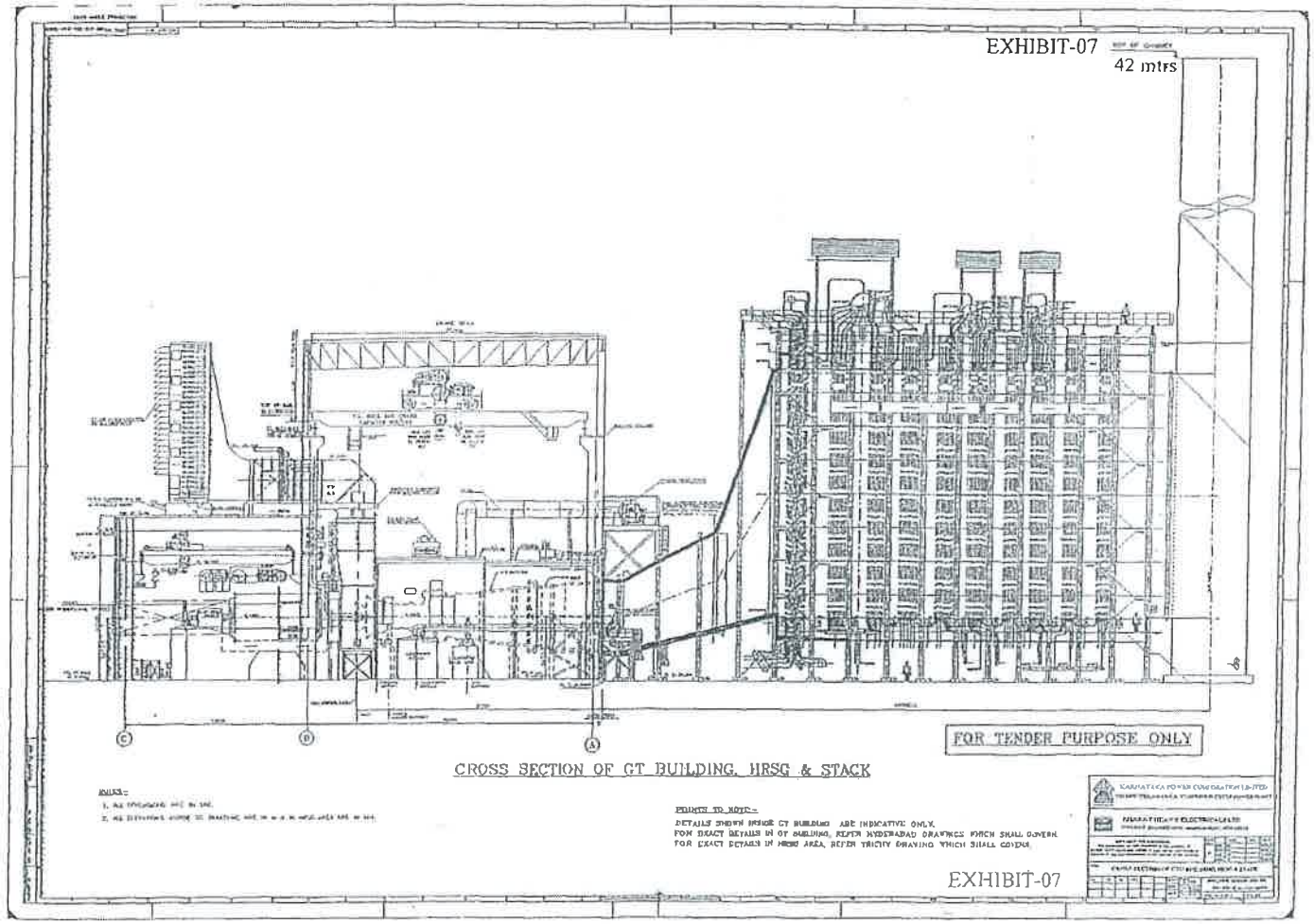
EXHIBIT-07
42 mtrs
FOR TENDER PURPOSE ONLY
CROSS SECTION OF GT BUILDING, HRSG & STACK
EXHIBIT-07

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EXHIBIT-08

FUEL SUPPLY SCHEME

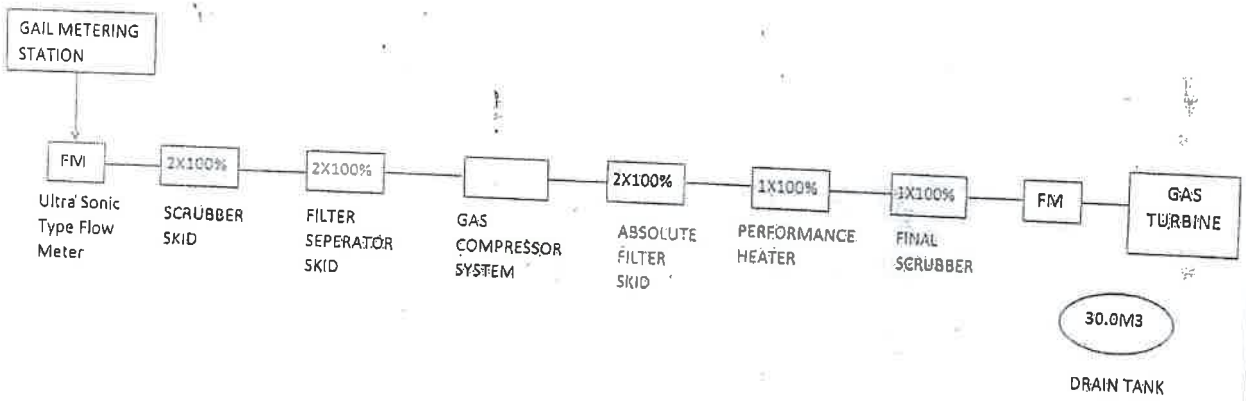

EXHIBIT-08

KARNATAKA POWER CORPORATION LIMITED				
Project:	350 MW YELAHANKA COMBINED CYCLE POWER PROJECT			
Title:	FUEL SUPPLY SCHEME			
EE(GSW)	CE(GSW)	Scale:	DWG No:	Date:

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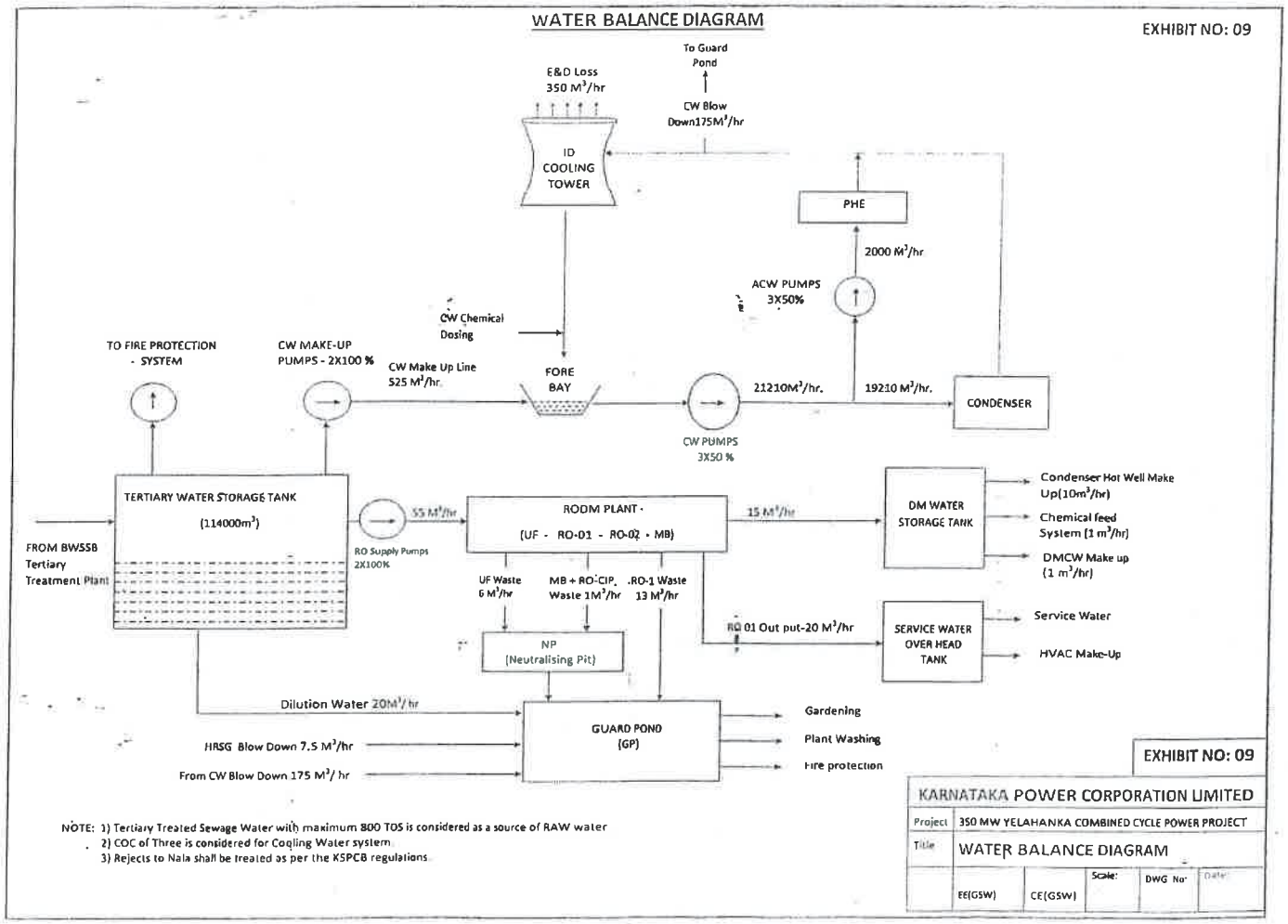
WATER BALANCE DIAGRAM

EXHIBIT NO: 09



NOTE: 1) Tertiary Treated Sewage Water with maximum 800 TDS is considered as a source of RAW water
2) COC of Three is considered for Cooling Water system
3) Rejects to Nala shall be treated as per the KSPCB regulations

EXHIBIT NO: 09

KARNATAKA POWER CORPORATION LIMITED					
Project	350 MW YELAHANKA COMBINED CYCLE POWER PROJECT				
Title	WATER BALANCE DIAGRAM				
	EE(GSW)	CE(GSW)	Scale:	DWG No:	Date:

634

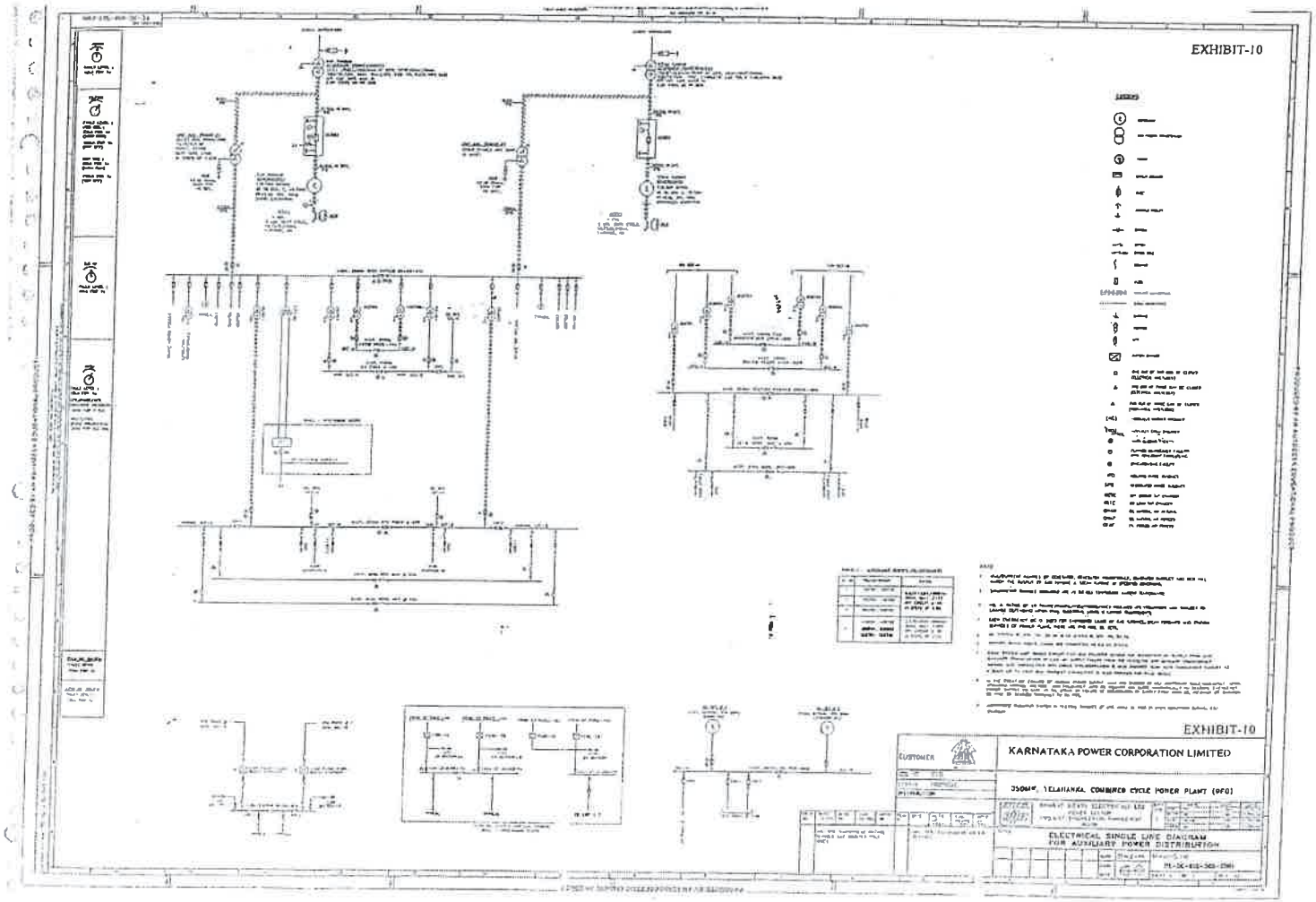


EXHIBIT-10
EXHIBIT-10
KARNATAKA POWER CORPORATION LIMITED
ELECTRICAL SINGLE LINE DIAGRAM
FOR AUXILIARY POWER DISTRIBUTION

635

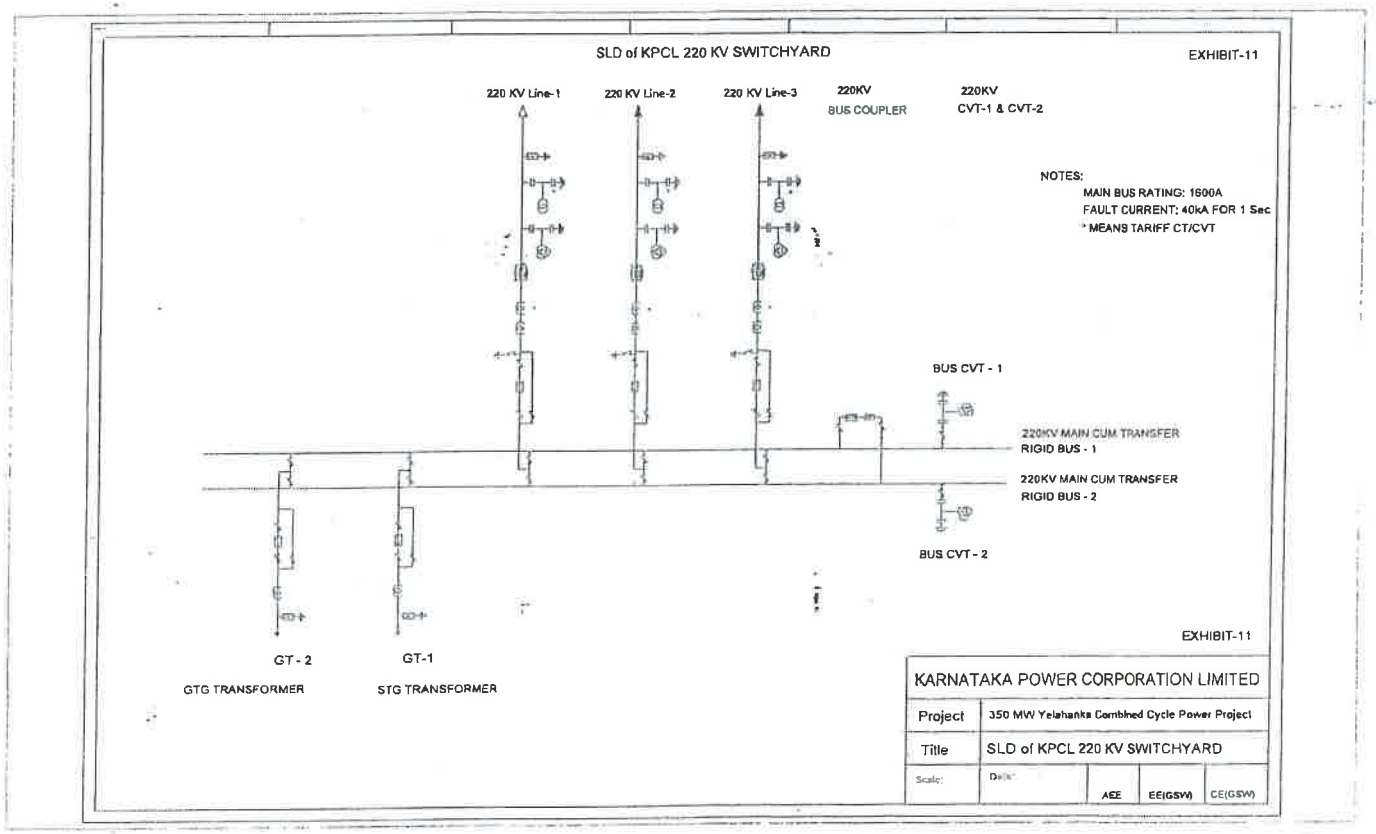

SLD of KPCL 220 KV SWITCHYARD
EXHIBIT-11
220 KV Line-1
220 KV Line-2
220 KV Line-3
220KV
BUS COUPLER
220KV
CVT-1 & CVT-2
NOTES:
MAIN BUS RATING: 1600A
FAULT CURRENT: 40kA FOR 1 Sec
* MEANS TARIFF CT/CVT
BUS CVT - 1
220KV MAIN CUM TRANSFER
RIGID BUS - 1
220KV MAIN CUM TRANSFER
RIGID BUS - 2
BUS CVT - 2
GT - 2
GTG TRANSFORMER
GT-1
STG TRANSFORMER
EXHIBIT-11
KARNATAKA POWER CORPORATION LIMITED
Project
350 MW Yelahanka Combined Cycle Power Project
Title
SLD of KPCL 220 KV SWITCHYARD
Scale:
Date:
AEE
EE(GSW)
CE(GSW)

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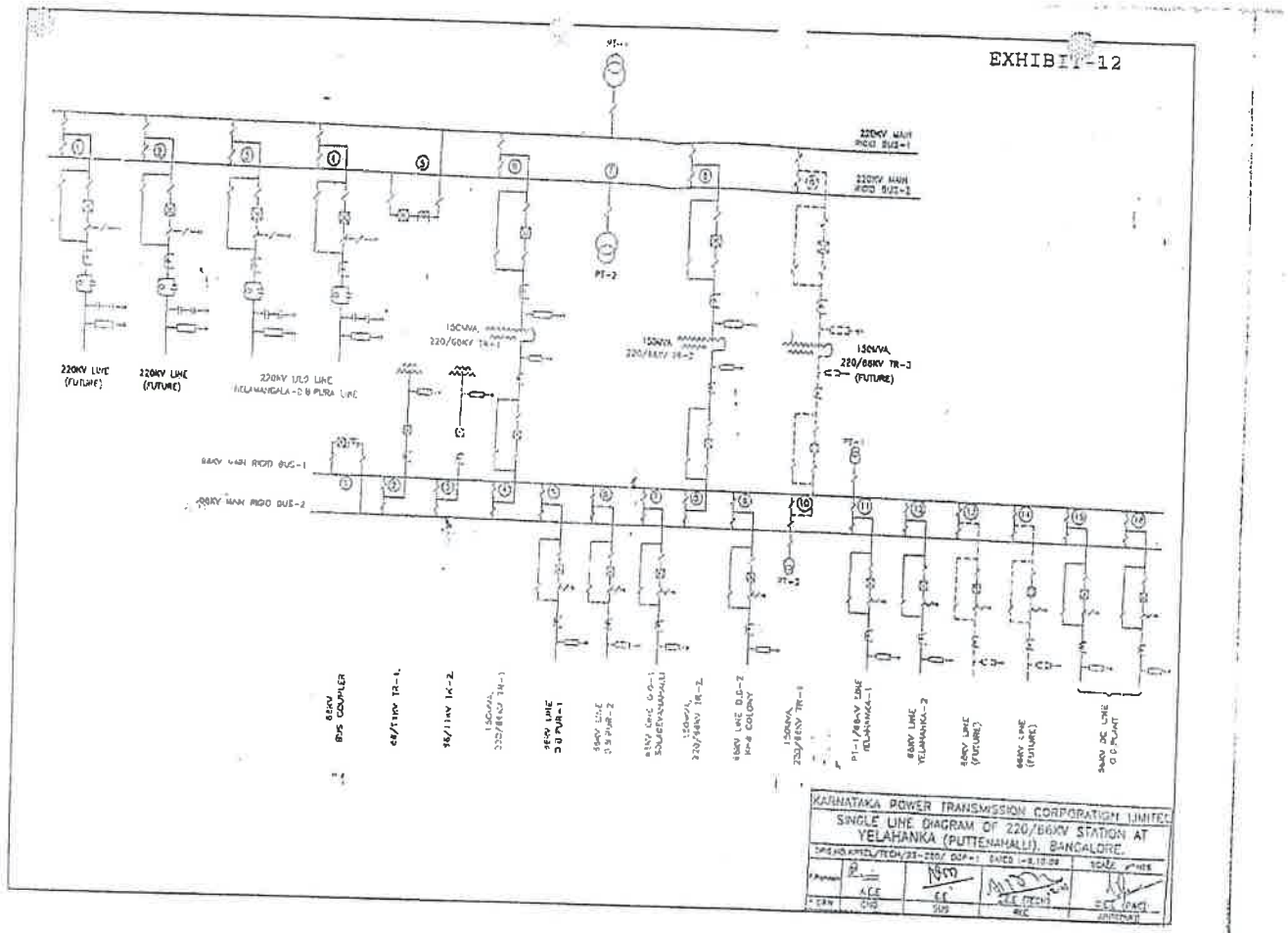
EXHIBIT-12



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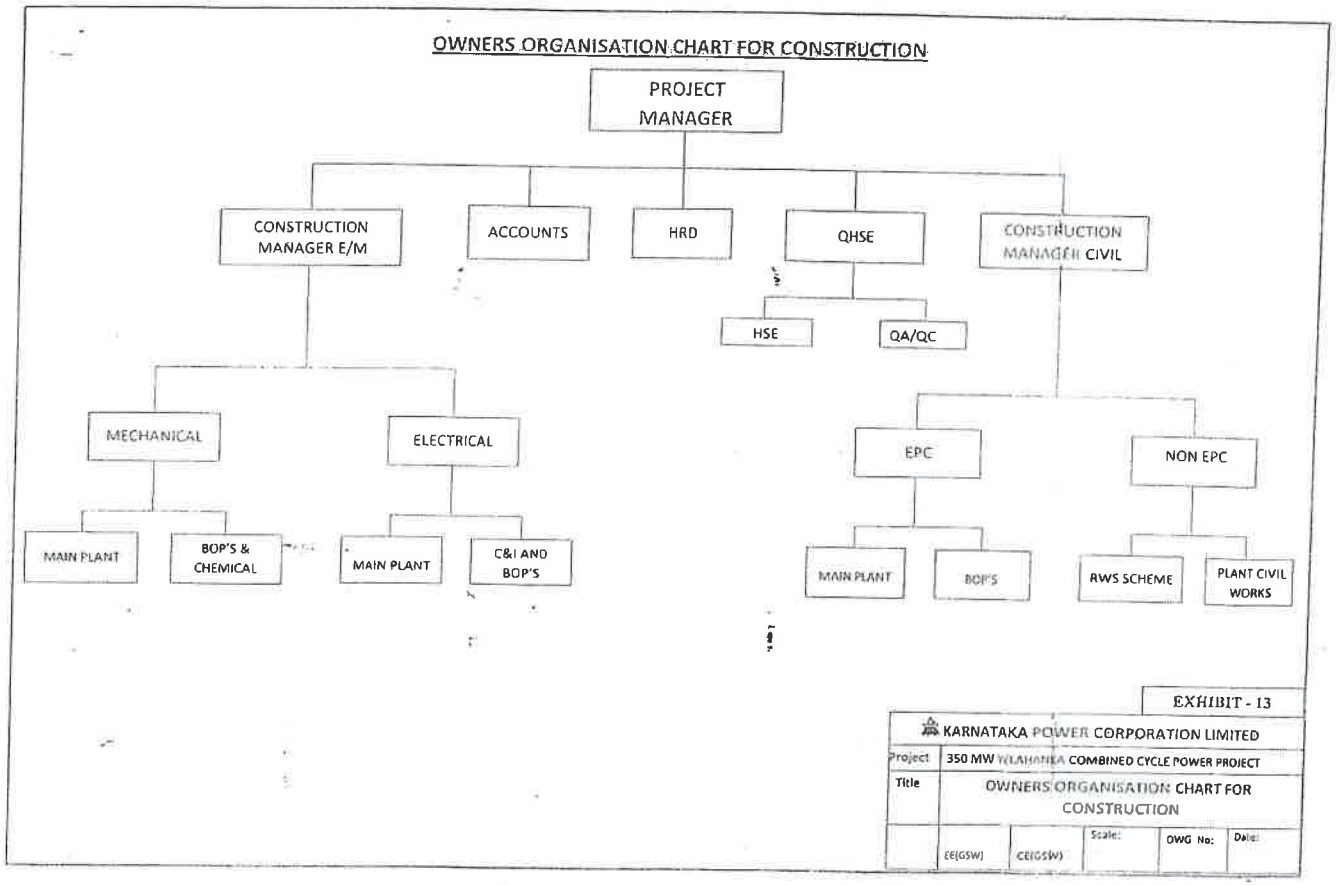
OWNERS ORGANISATION CHART FOR CONSTRUCTION
PROJECT MANAGER
CONSTRUCTION MANAGER E/M
ACCOUNTS
HRD
QHSE
CONSTRUCTION MANAGER CIVIL
HSE
QA/QC
MECHANICAL
ELECTRICAL
EPC
NON EPC
MAIN PLANT
BOP'S & CHEMICAL
MAIN PLANT
C&I AND BOP'S
MAIN PLANT
BOP'S
RWS SCHEME
PLANT CIVIL WORKS
EXHIBIT - 13
KARNATAKA POWER CORPORATION LIMITED
Project
350 MW YELAHANKA COMBINED CYCLE POWER PROJECT
Title
OWNERS ORGANISATION CHART FOR CONSTRUCTION
EE(GSW)
CE(GSW)
Scale:
DWG No:
Date:

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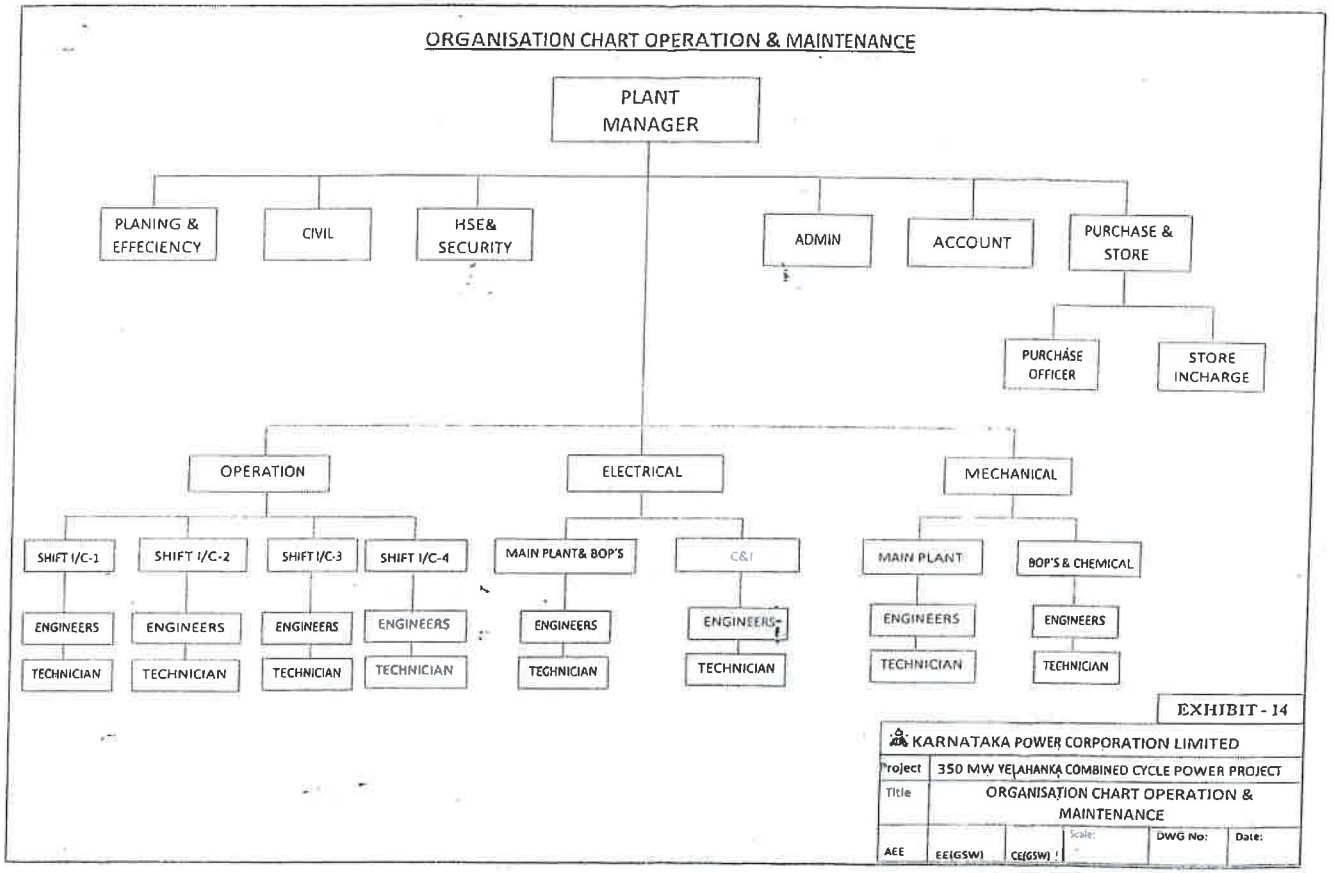
ORGANISATION CHART OPERATION & MAINTENANCE
PLANT MANAGER
PLANING & EFFECIENCY
CIVIL
HSE& SECURITY
ADMIN
ACCOUNT
PURCHASE & STORE
PURCHASE OFFICER
STORE INCHARGE
OPERATION
ELECTRICAL
MECHANICAL
SHIFT I/C-1
SHIFT I/C-2
SHIFT I/C-3
SHIFT I/C-4
MAIN PLANT& BOP'S
C&I
MAIN PLANT
BOP'S & CHEMICAL
ENGINEERS
TECHNICIAN
EXHIBIT - 14
KARNATAKA POWER CORPORATION LIMITED
Project
350 MW YELAHANKA COMBINED CYCLE POWER PROJECT
Title
ORGANISATION CHART OPERATION & MAINTENANCE
AEE
EE(GSW)
CE(GSW)
Scale:
DWG No:
Date:

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EXHIBIT-15

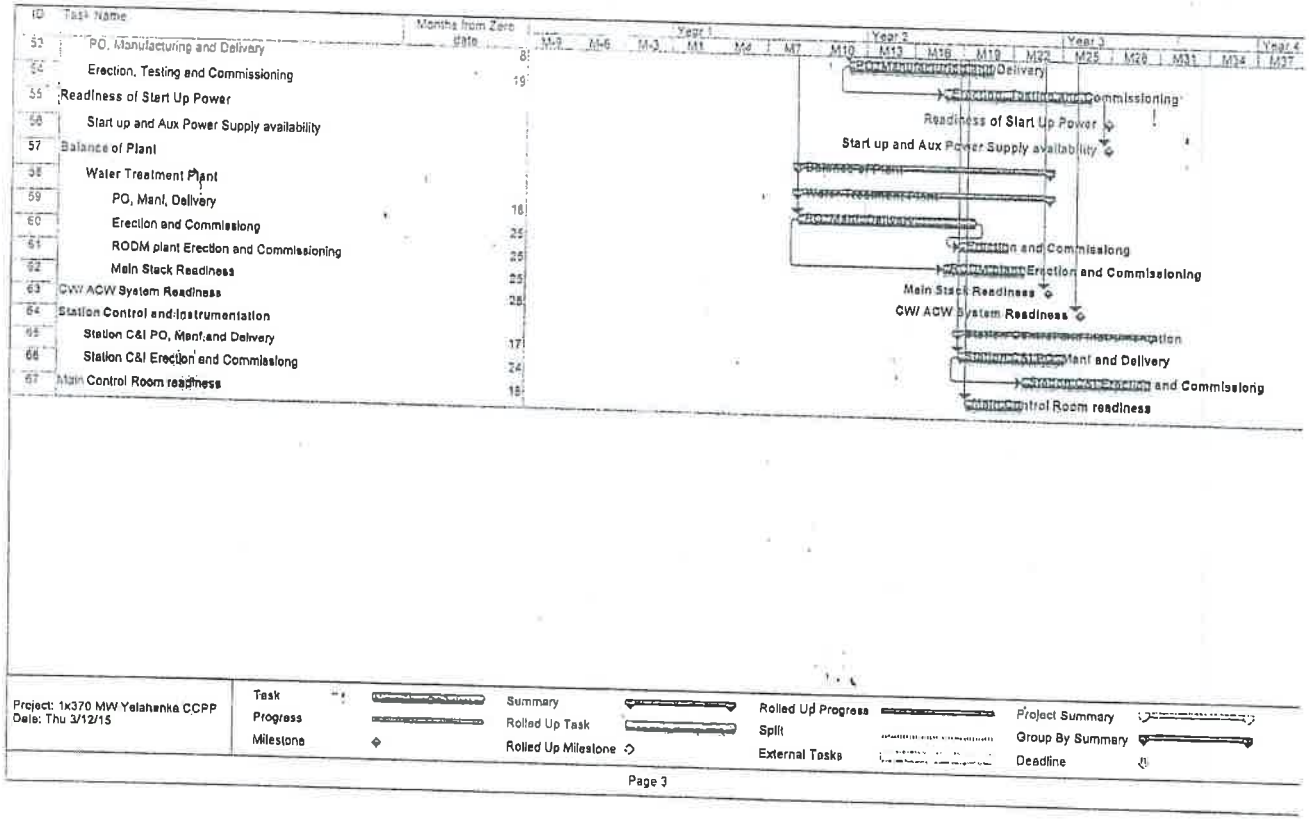

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EXHIBIT-15

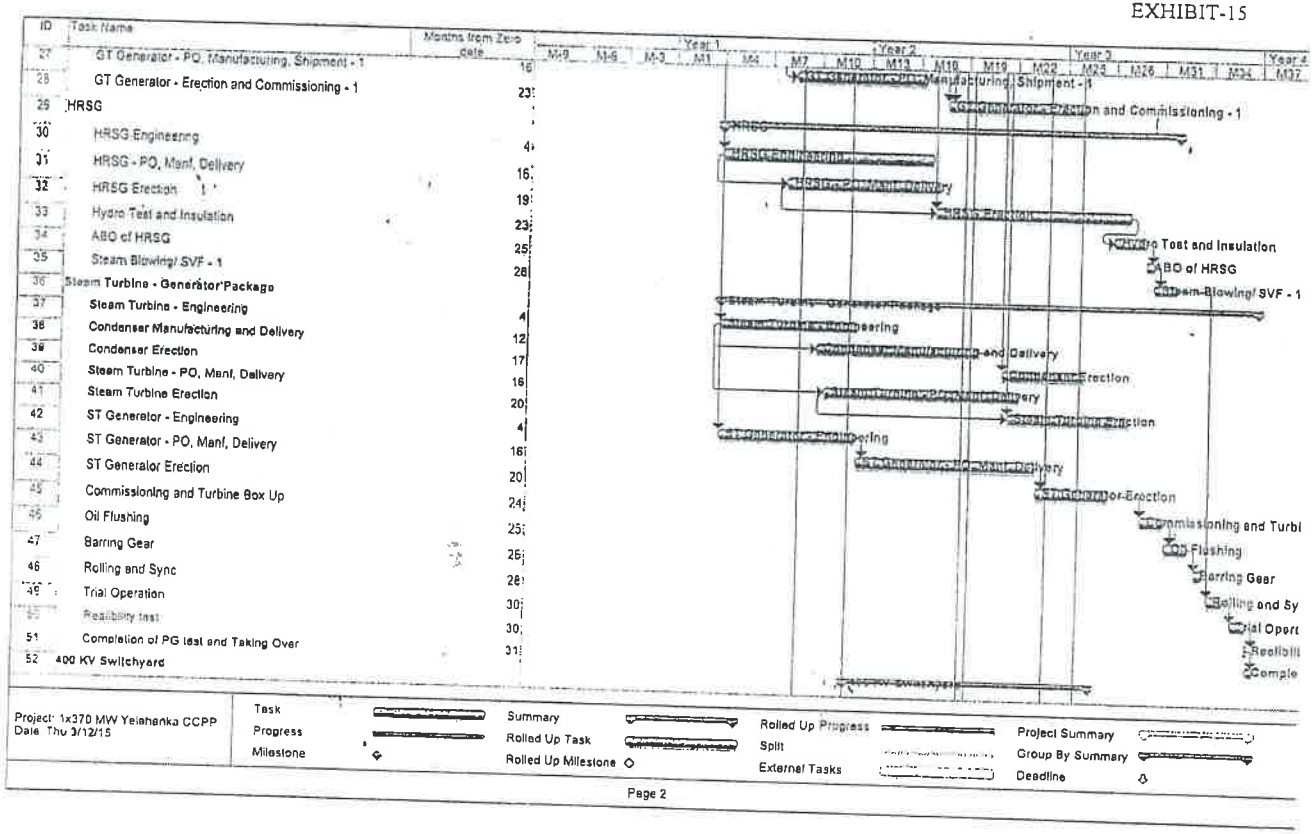

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EXHIBIT-1

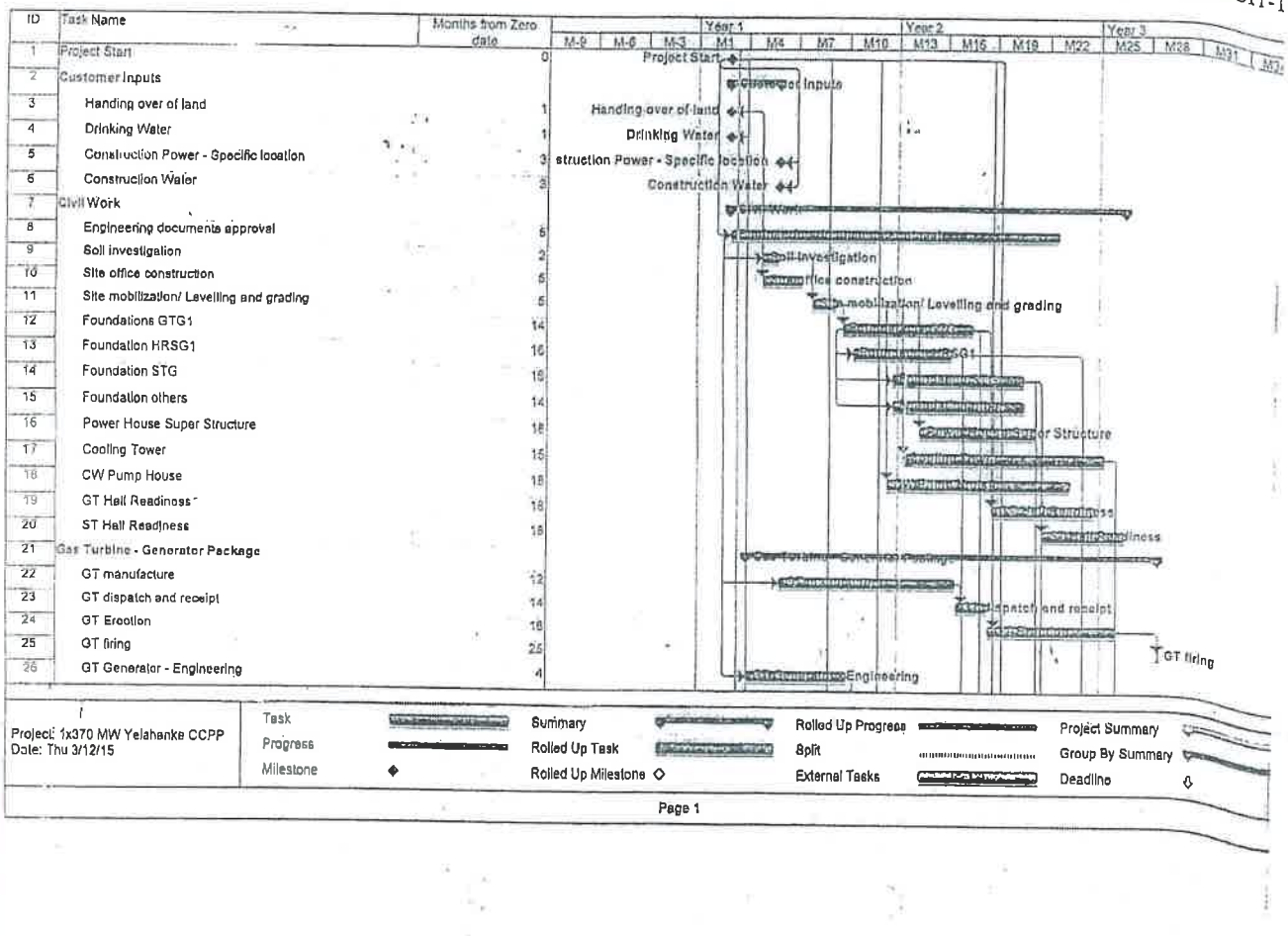

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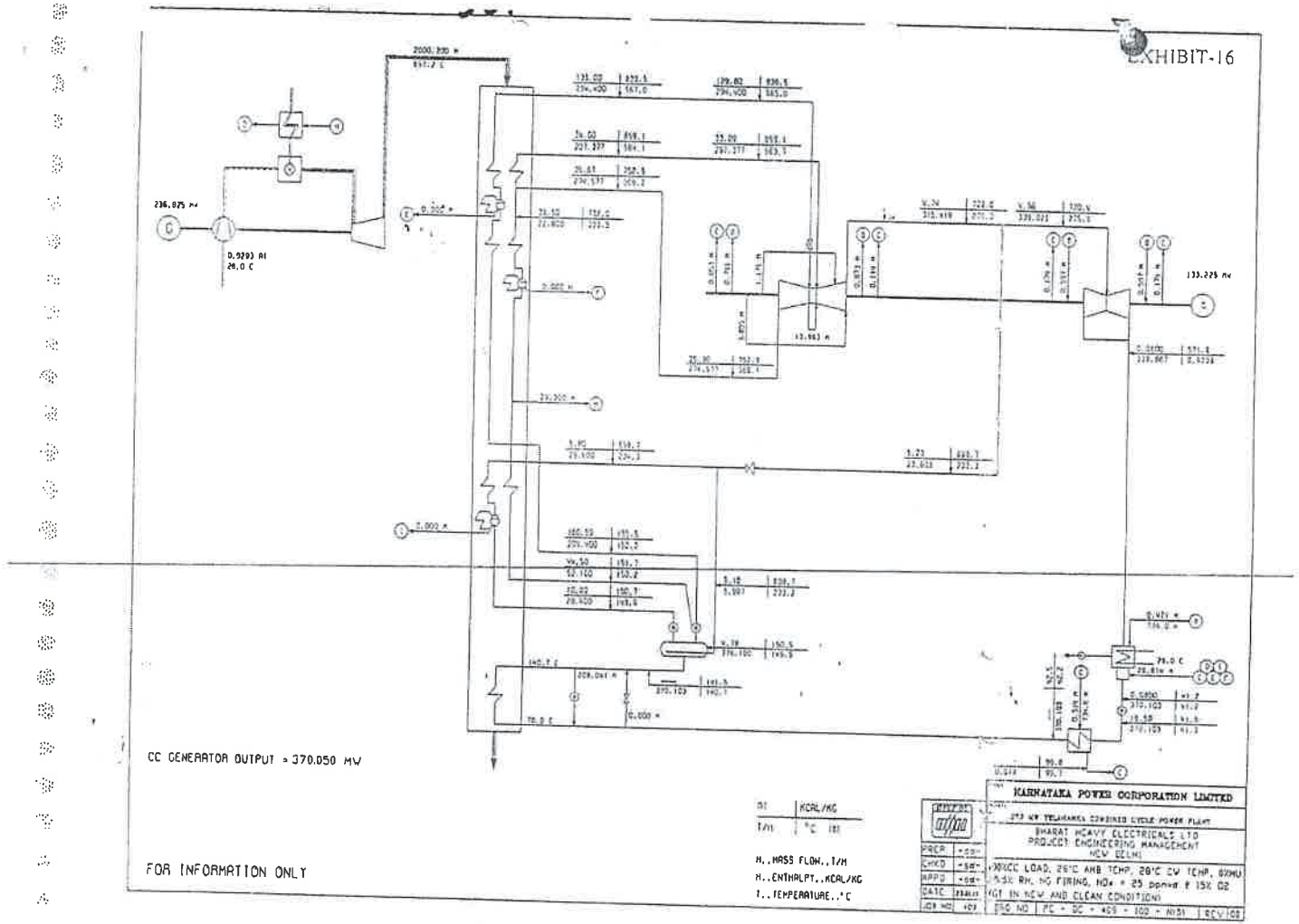
EXHIBIT-16



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Annexure-R9

KPCL
ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತ
KARNATAKA POWER CORPORATION LTD.,
(A Government Company)
CIN: U40101KA1970SGC001919

CE(EI&TA)/Env/ Yelahanka/374 Dated: 10-08-2015

Member Secretary, SEAC
Karnataka State Environment Impact Assessment Authority,
M.S Building,
Bangalore

Sir,

Sub: Environmental Clearance for 1x350 MW Yelahanka CCPP -

Ref: 1.TOR issued vide No. SEIAA 20 IND 2014

2..SEAC held on 05-08-2015- Compliance to observations

We are furnishing herewith the compliance to the observations raised during the SEAC meeting held on 05-08-2015.

1. The authorization letter in respect of Shri S Mruthyunjaya, Executive Director (Hydro), KPCL (Annexure-I)
2. The NABET accreditation certificate for our consultants- M/s Mantec Consultants New Delhi. (Annexure-II)
3. Compliance to TOR No-9- regarding Surface Hydrology.(Annexure-III)
4. Compliance to TOR-12- Study material in respect of Dry Low Nox Burners(Annexure-IV)
5. Compliance to TOR 17-Feasibilty of zero discharge(Annexure-V)
6. Compliance to TOR 18- Details of green belt (Annexure-VI)
7. Compliance regarding dismantling Existing DG plant structures (Annexure-VII)

We request your kind self to issue the Environmental Clearance for our proposed 1x350 MW Yelahanka, CCPP at the earliest.

Thanking You,

Yours faithfully,
for Karnataka Power Corporation Limited

Chief Engineer (EI&TA)

ಮುಖ್ಯ ಅಧಿಯಂತ್ರರು ಸ.ಇ (ಇಐ ಮತ್ತು ಟಿಎ) ಸುದರ್ಶನ್ ಕಾಂಪ್ಲೆಕ್ಸ್, 3ನೇ ಮಹಡಿ, ನಂ. 22/23, ಶೇಷಾದ್ರಿ ರಸ್ತೆ, ಬೆಂಗಳೂರು-560 009
Office of the Chief Engineer (EI & TA), "Sudarshan Complex", 3rd Floor, No. 22/23, Sheshadri Road, Bangalore-560 009
Telefax : 080-22250431 EPABX : 080-22202950-55 E-mail : ceita@karnatakapower.com Website : www.karnatakapower.com

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KPCL
ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತ
KARNATAKA POWER CORPORATION LTD.,
(A premier power generating company of Government of Karnataka)

CE(EI&TA)/Env/ Yelahanka/ 398 Dated: 25-08-2015

Member Secretary,
Karnataka State Environment Impact Assessment Authority,
M.S Building,
Bangalore

Sir,

Sub: Environmental Clearance for 1x350 MW Yelahanka CCPP -

Ref: 1.TOR issued vide No SEIAA 20 IND 2014
2. SEAC held on 05-08-2015- Compliance to observations
3. T.O Letter No. CE (EI&TA) Env/Yelahanka/374 dated 10.8.2015 addressed to Secretary SEAC, M.S Building, Bengaluru.

The EAC, in the meeting held on 5.8.2015, had raised certain observations and sought some additional documents from KPCL. These documents along with compliance to the observations were submitted to Secretary, SEAC, vide letter cited under reference 3 above.

However, we are submitting herewith one more set of documents and compliance to the observations for your kind perusal:

1. The authorization letter in respect of Shri S Mruthynjaya, Executive Director (Hydro), KPCL (Aneexure-I)
2. The NABET accreditation certificate for our consultants- M/s Mantec Consultants New Delhi. (Annexure-II)
3. Compliance to TOR No-9- regarding Surface Hydrology.(Annexure-III)
4. Compliance to TOR-12- Study material in respect of Dry Low Nox Burners(Annexure-IV)
5. Compliance to TOR 17-Feasibility of zero discharge(Annexure-V)
6. Compliance to TOR 18- Details of green belt (Annexure-VI)
7. Compliance regarding dismantling Existing DG plant structures (Annexure-VII)

We request your kind self to issue the Environmental Clearance for our proposed 1x350 MW Yelahanka CCPP at the earliest.

Thanking You,

Yours faithfully,
for Karnataka Power Corporation Limited

Chief Engineer(EI&TA)

Encl: as above

ಮುಖ್ಯ ಅಭಿಯಂತರರು ಪ.ಇ. (ಇಐ ಮತ್ತು ಟಿಎ) ಸುದರ್ಶನ್ ಕಾಂಪ್ಲೆಕ್ಸ್, 3ನೇ ಮಹಡಿ, ನಂ. ೨೨/೨೩, ಶೇಷಾದ್ರಿ ರಸ್ತೆ, ಬೆಂಗಳೂರು-೫೬೦ ೦೦೯
Office of the Chief Engineer (EI & TA), "Sudarshan Complex", 3rd Floor, No. 22/23, Sheshadri Road, Bangalore-560 009

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NATIONAL ACCREDITATION BOARD FOR EDUCATION & TRAINING

QUALITY COUNCIL OF INDIA

QCI Office, 6th Floor, ITPI Building, Ring Road, I.P. Estate, New Delhi

Scheme for Accreditation of EIA Consultant Organizations

Minutes of 20th Accreditation Committee Meeting for Re-Accreditation held on

May 09, 2014

Present

1. Prof. C. K. Varshney - Alt. Chairman
2. Mr. K. P. Nyati - Member
3. Prof. A. K. Maitra - Member
4. Dr. A. N. Jha - Member

Leave of absence was granted to Dr. Prodipto Ghosh, Dr. B. Sengupta and Sh. Chandra Bhushan Prof. Varshney chaired the meeting.

NABET Secretariat was represented by:

Dr. Hari Prakash – Joint Director and Mr. Abhay Sharma - Accreditation Officer

The following were discussed/ decided:

1. The minutes of 19th RA AC meeting dated Apr. 25, 2014 were considered and approved

2. Cases for Re-Accreditation

   a. Mantec Consultants Pvt. Ltd., Delhi
   b. Perfact Enviro Solutions Pvt. Ltd., Delhi

2.1 Mantec Consultants Pvt. Ltd., Delhi

Closure action taken by Mantec Consultants on NCs and Obs. raised were noted. Following observations are made:

Results of the Re-accreditation (RA) assessment are given below:

The ACO has overall obtained more than 60 % marks and therefore qualifies for Cat. A.

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2.1.1 Scope of Accreditation

Sl. No.	Sector No. as NABET Scheme	Name of Sector	Cat.
1	1	Mining	B
2	2	Offshore and onshore Oil & gas exploration	A
3	3	River valley and hydel projects	A
4	4	Thermal power plants	A
5	16	Chemical Fertilizers	A
6	27	Oil and Gas transportation pipeline	A
7	31	Industrial estates etc	B
8	33	Ports and Harbours etc	A
9	34	Highways and railways etc	A
10	38	Building and large construction projects	B
11	39	Area and township projects	B

2.1.2 Sectors approved for EIA Coordinators

a. The ECs approved earlier were assessed based on the RA criteria and the results are as follows:

Sl. No.	Name	Sectors approved in SA or subsequently		Status of sectors approved after RA		Remarks
		Sector	Cat.	Status	Cat.	
In-house						
1	Arvinder Singh Brara	33	B	Approval Renewed	A	
Empanelled						
2	Sanjeev Sharma	1	A	Approval Not Renewed		Candidature withdrawn by ACO
		10	A			
		33	A			
		34	A			

b. Additional sectors proposed for ECs approved earlier and fresh ECs proposed were assessed during RA and the results are given below

Sl	Name	Sectors			Cat	Remarks
		Applied	Recommended	Approved		
In-house						
1	Sanjeev Sharma	28			-	Candidature withdrawn by ACO
2	S B Sinha	1	Yes*	Yes*	B	*OC only
		4	Yes	Yes	A	Not recommended for Sectors 8 & 9 due to lack of clarity and comprehension on environmental aspects
		8	No	No	-	
		9	No	No	-	
		16	Yes	Yes	A	
3	Arvinder Singh Brara	1	Yes*	Yes*	B	*OC only
		4	No	No	-	Not recommended for Sector 4 due to lack of clarity and comprehension on environmental aspects Sector 10 due to inadequate experience
		10	No	No	-	

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TOR No. 9: Information regarding Surface Hydrology, water regime and impact of the same if any due to the Project:

The Puttenahalli and Yelahanka lake catchment areas forms a part of the South Pinakini Basin.

The drainage pattern of the Bangalore North taluk is more or less a level plateau and lies between 839 to 962 meters above mean sea level. In the middle of the taluk there is a prominent ridge running NNE-SSW. The highest point (Doddabettahalli 962m) is on this ridge.

The drainage towards the east is made up of a network of nalas, generally flowing from west to east with storage tanks along the nalas, ultimately feeding the South Pinakini River on the western half, the nalas generally flowing from east to west, ultimately drain into the Arkavati River.

Bangalore has no major rivers flowing in the district. The Arkavati River flows in the district for a small distance in Bangalore North taluk and the Dakshina Pinakini touches the borders of the district to the North-East of the Anekal Taluk.

The mean annual rainfall is 859.6 mm, with three different rainy periods covering eight months of the year. June to September being rainy season receives 54% of the total annual rainfall in the S-W monsoon period and 241-mm during the N-E monsoons (Oct - Nov.).

The catchment area of the Puttenahalli lake is 13.34 Sq kms and that of Yelahanak lake is about 56.87 Sq kms (13.34 + 43.53). The max rainfall recorded during Sept 2009 is 335.3 mm (Source – IMD rainfall data for the years 2009 to 2013). The length of the longest streams of Puttenahalli and Yelahnaka lakes are only 5.06 kms and 10.25 kms respectively. The time of concentration (T_c) for the Puttenahalli lake works out to 1 hour (calculation sheet attached), hence the floods due to the rain fall is instantaneous for the Puttenahalli lake. The flood calculated for the Puttenahalli lake and Yelahnaka lake is 1.2 cumecs and 5.2 cumecs respectively.

The proposed plant area lies between the Puttenahalli and Yelahanka lakes. The elevation of Puttenahalli lake and Yelahnaka lake are EL 890.0 M and EL 885.0 M respectively and the elevation of the Proposed plant area is about EL 899.0 M. The water from the Puttenahalli lake flows into Yelahanka lake through an existing nala that is situated on the southern side of the YCCPP plant

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area. From the catchment area map attached, it is clear that the Plant area is outside the flow regime leading into the Puttenahalli lake. Also, the plant is adjacent to main nala leading into Yelahanka lake and there is no obstruction to this main nala from the activities in the plant area. The rain fall falling inside the plant area drains through natural slope into the nala joining Yelahanka lake on the South – East side of the plant area. As the Plant area falls outside the flow regimes of the Puttenahalli and Yelahanka lakes, there is no impact on the natural flow regimes due to the proposed plant.

The flood discharge computed for the Puttenahalli lake is about 1.2 Cumecs and the existing nala will be able to safely discharge this into the Yelahanka lake. As the proposed plant is at a higher elevation, this megre flood discharge will not have any effect on the plant activities. It is also observed at the site that the KPTCL Sub-station which is adjacent to the existing nala has not been flooded even during worst flood.

Further, the water required for the plant is neither drawn from the lake nor the effluent is discharged to the lakes.

It is concluded that there is not impact on the water regimes of the Puttenahalli and Yelahnaka lakes due to the implementation of the Proposed 1x 350 MW Yelahanka Combined Cycle Power plant.

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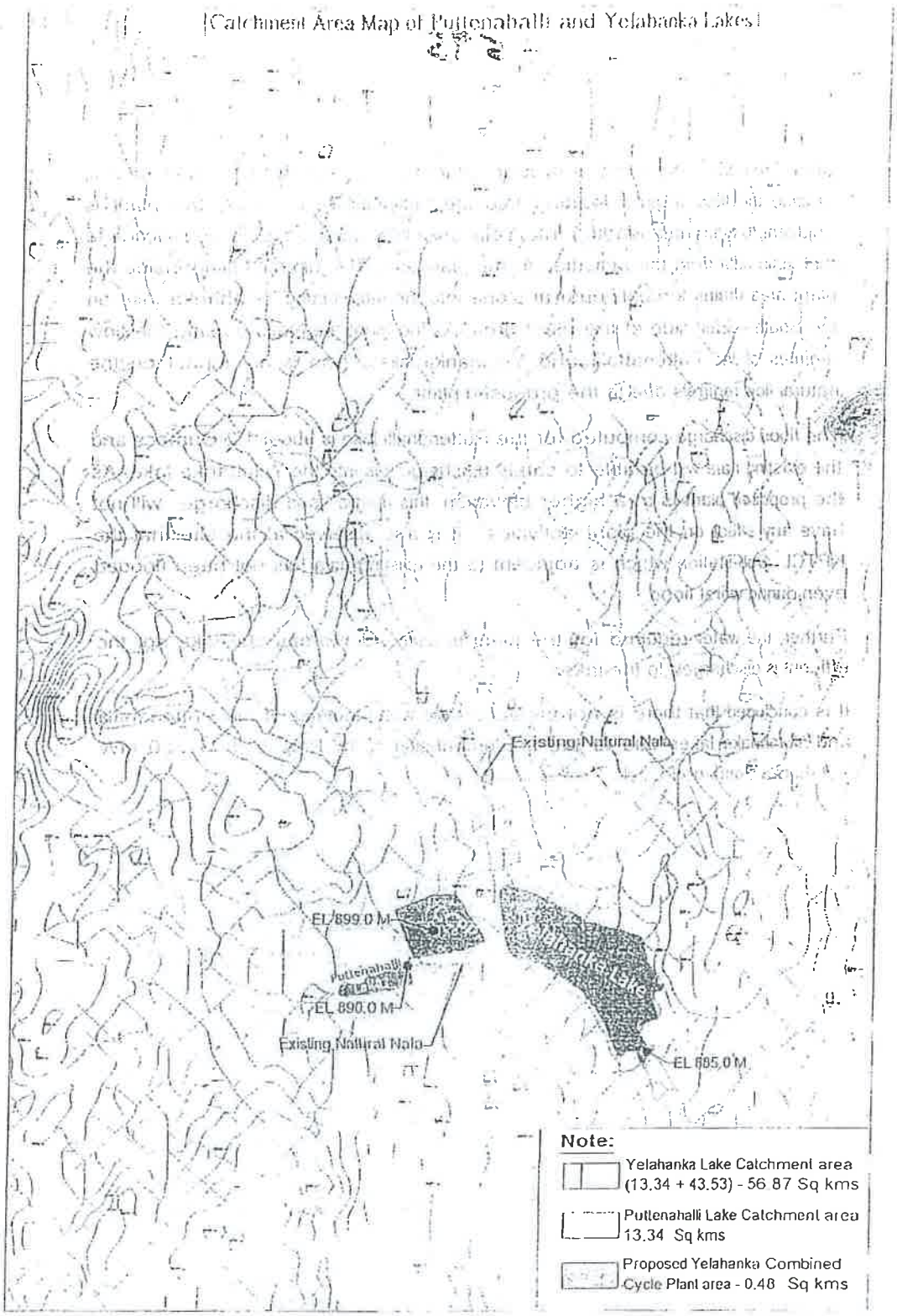
Catchment Area Map of Puttenahalli and Yelahanka Lakes
Existing Natural Nala
EL 899.0 M
Puttenahalli Lake
EL 890.0 M
Existing Natural Nala
Yelahanka Lake
EL 885.0 M
Note:
Yelahanka Lake Catchment area (13.34 + 43.53) - 56.87 Sq kms
Puttenahalli Lake Catchment area 13.34 Sq kms
Proposed Yelahanka Combined Cycle Plant area - 0.48 Sq kms

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Figure 1 : Catchment Area Map of Puttenahalli and Yelahanka Lakes

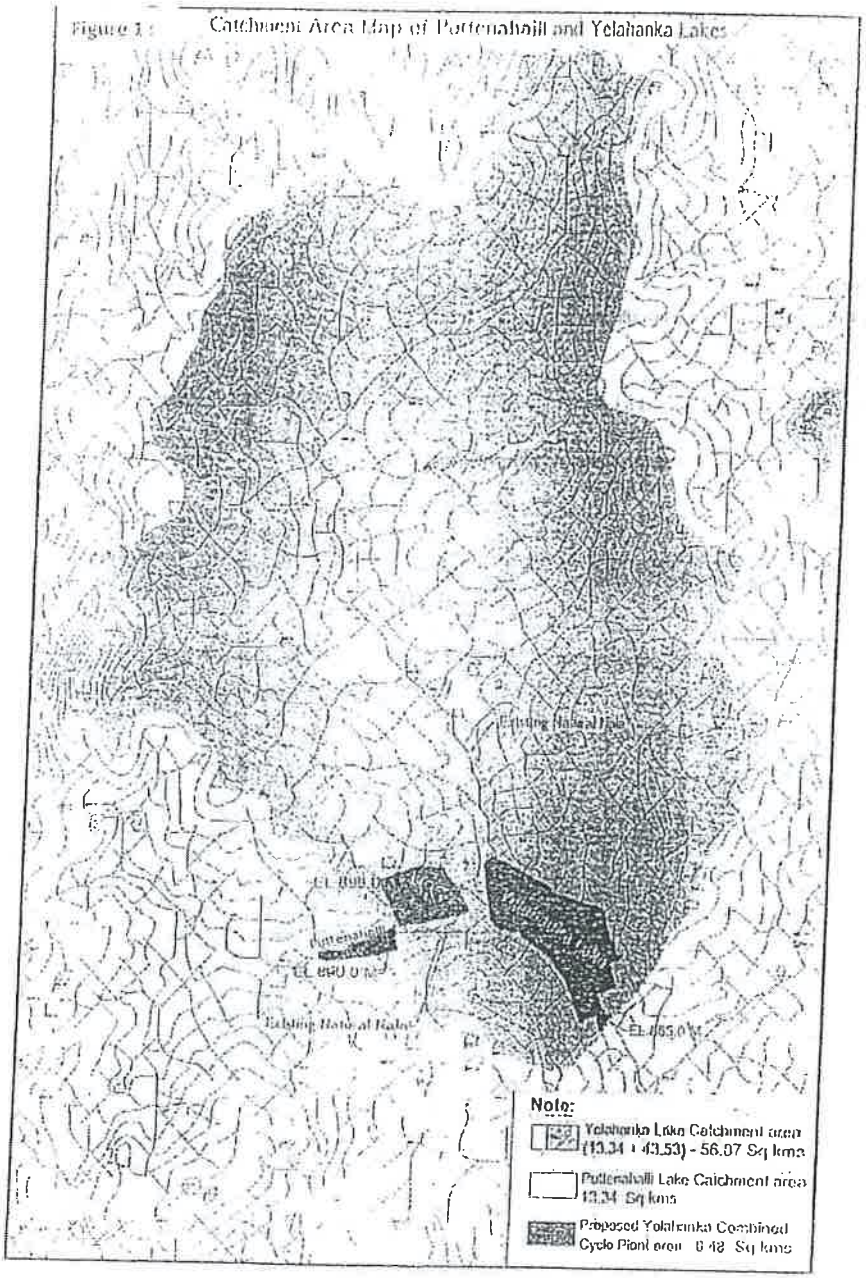

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Table 2: Flood Calculations:

Max Rain fall on Sept 2009 as per IMD data	335.3	mm
Average 1 hour rain fall that has occurred in Bangalore	0.465694	mm
Catchment area of Puttenahalli Lake	13.341	Sq kms
The normal Avg. run of coefficient	40%	
In the worst saturated condition - the run off coefficient considered	70%	
Qty of Flood water	0.004	M Cum
Flood Discharge for Puttenahalli Lake	1.2	Cumecs
Catchment area of Yelahanaka Lake	56.874	Sq kms
The normal Avg. run of coefficient	40%	
In the worst saturated condition - the run off coefficient considered	70%	
Qty of Flood water	0.019	M Cum
Flood Discharge for Yelahanka Lake	5.2	Cumecs

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HYDROMET DIVISION, NEW DELHI
INDIA METEOROLOGICAL DEPARTMENT
DISTRICT RAINFALL (mm) FOR LAST FIVE YEARS

District : BANGALORE URBAN

Note : (1) The District Rainfall in millimeters (R/F) shown below are the arithmetic averages of Rainfall of Stations under the District.
(2) % Dep. are the Departures of rainfall from the long period averages of rainfall for the District.
(3) Blank Spaces show non-availability of Data.

YEAR	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.
2009	8.1	-88	8.8	-100	15.2	162	63.9	97	123.8	32	125.4	111	38.7	-38	152.2	19	335.5	101	35.2	-71	66.8	67	17.5	33
2010	5.4	575	8.8	-100	17.4	100	97.5	178	123.9	19	57.3	-4	112.3	-15	121.2	-27	149.9	-24	93.8	-34	156.8	287	2.5	-92
2011	8.8	-100	18.2	172	2.8	-76	157.8	303	139.1	31	54.5	-26	92.6	-31	237.3	84	89.3	-51	178.8	7	64.3	20	5.5	-67
2012	8.1	-96	8.8	-100	8.6	-93	21.1	-46	108.1	2	9.2	-88	63.7	-30	130.5	1	41.3	-77	68.8	-62	108.5	87	17.1	-4
2013	8.8	-100	4.8	-40	2.5	-56	28.9	-26	118.1	4	93.1	26	76.2	-17	72.8	-44	249.3	38	95.5	-48	53.3	17	1.4	-93

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Annexure-IV

ToR-12# Action plan to follow National Ambient Air Quality Emission Standards issued by the Ministry vide G.S.R. No. 826(E) dated 16 November, 2009 should be included.

Compliance

The following details of DLN burners are provided

GE Make DLN-2 Burners shall be used in the proposed CCPP.

These burners are used in all the modern Combined Cycle Power Plants to reduce NOX and CO emission all over the word and in all the modern plants established in India.

1. Design , operation and maintenance philosophy of DLN Burners used in the proposed plant is enclosed
2. Performance of DLN Burners at various Load conditions is enclosed

GE Power Systems

Dry Low NO_x Combustion Systems for GE Heavy-Duty Gas Turbines

L.B. Davis
S.H. Black
GE Power Systems
Schenectady, NY

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Dry Low NO_x Combustion Systems for GE Heavy-Duty Gas Turbines

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Dry Low NO_x Combustion Systems for GE Heavy-Duty Gas Turbines

Abstract

State-of-the-art emissions control technology for heavy-duty gas turbines is reviewed with emphasis on the operating characteristics and field experience of Dry Low NO_x (DLN) combustors for E and F technology machines. The lean premixed DLN systems for gas fuel have demonstrated their ability to meet the ever-lower emission levels required today. Lean premixed technology has also been demonstrated on oil fuel and is also discussed.

Introduction

The regulatory requirements for low emissions from gas turbine power plants have increased during the past 10 years. Environmental agencies throughout the world are now requiring even lower rates of emissions of NO_x and other pollutants from both new and existing gas turbines. Traditional methods of reducing NO_x emissions from combustion turbines (water and steam injection) are limited in their ability to reach the extremely low levels required in many localities. GE's involvement in the development of both the traditional methods (*References 1 through 6*) and the newer Dry Low NO_x (DLN) technology (*References 7 and 8*) has been well documented. This paper focuses on DLN.

Since the commercial introduction of GE's DLN combustion systems for natural-gas-fired heavy-duty gas turbines in 1991, systems have been installed in more than 222 machines, from the most modern FA+e technology (firing temperature class of 2420 F/1326 C) to field retrofits of older machines. As of May 1999, these machines have operated more than 4.8 million hours with DLN; and more than 1.4 million hours have been in the F technology. To meet marketplace demands, GE has developed DLN products broadly classified as either DLN-1, which was developed for E-technology (2000°F/1093°C firing temperature class) machines, or DLN-2, which was developed specifically for the F technology machines and is also being applied to the EC and H machines.

Development of these products has required an intensive engineering effort involving both GE Power Systems and GE Corporate Research and Development. This collaboration will continue as DLN is applied to the H machines and combustor development for Dry Low NO_x on oil ("dry oil") continues.

This paper presents the current status of DLN-1 technology and experience, including dry oil, and of DLN-2 technology and experience. Background information about gas turbine emissions and emissions control is contained in the Appendix.

Dry Low NO_x Systems

Dry Low NO_x Product Plan

Figure 1 shows GE's Dry Low NO_x product offerings for its new and existing machines in three major groupings. The first group includes the MS3002J, MS5001/2 and MS6001B products. The 6B DLN-1 is the technology flagship product for this group and, as can be noted, is available to meet 9 ppm NO_x requirements. Such low NO_x emissions are generally not attainable on lower firing temperature machines such as the MS3002s and MS5001/2s because carbon monoxide (CO) would be excessive.

The second major group includes the MS7001B/E, MS7001EA and MS9001E machines with the 9 ppm 7EA DLN-1 as the flagship product.

The dry oil program focuses initially on this group.

The third group combines all of the DLN-2 products and includes the FA, EC, and H

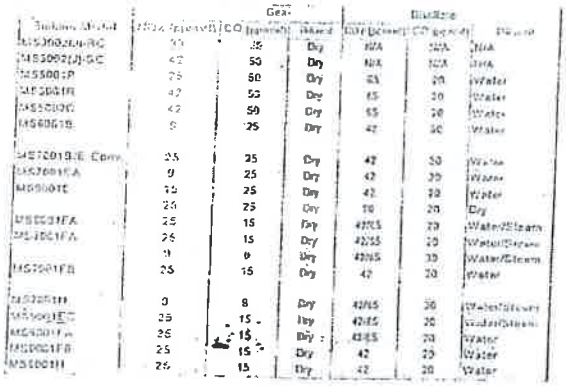

Figure 1. Dry Low NO_x product plan

machines, with the 7FA product as the flagship. As shown in *Figures 2 and 3*, most of these products are capable of power augmentation and of peak firing with increased NO_x emissions. With gas fuel, power augmentation with steam is in the premixed mode for both DLN-1 and DLN-2 systems.

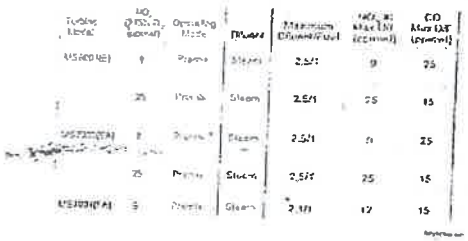

Figure 2. DLN power augmentation summary

	NO_x-Base (ppmvd)	NO_x-Peak (ppmvd)	CO-Base (ppmvd)	CO-Peak (ppmvd)
MS6001(B)	9	18	25	6
	25	50	15	4
MS7001(EA)	9	18	25	6
	25	50	15	4
MS7001(FA)	25	35	15	6
MS9001(E)	25	40	15	6

Figure 3. DLN peak firing emissions - natural gas fuel

The GE DLN systems integrate a staged premixed combustor, the gas turbine's SPEEDTRONIC™ controls and the fuel and associated systems. There are two principal measures of performance. The first is meeting the emission levels required at baseload on both gas and oil fuel and controlling the variation of these levels across the load range of the gas turbine.

The second measure is system operability, with emphasis placed on the smoothness and reliability of combustor mode changes, ability to load and unload the machine without restriction, capability to switch from one fuel to another and back again, and system response to rapid transients (e.g., generator breaker open events or rapid swings in load). GE's design goal is to make the DLN system operate so the gas turbine operator does not know whether a DLN or conventional combustion system has been installed (i.e., its operation is "transparent to the user"). A significant portion of the DLN design and development effort has focused on system operability. As operational experience

has increased, design and development efforts have moved towards hardware durability and extending combustor inspection intervals.

Design of a successful DLN combustor for a heavy-duty gas turbine also requires the designer to develop hardware features and operational methods that simultaneously allow the equivalence ratio and residence time in the flame zone to be low enough to achieve low NO_x, but with acceptable levels of combustion noise (dynamics), stability at part-load operation and sufficient residence time for CO burnout, hence the designation of DLN combustion design as a "four-sided box" (*See Figure 4*).

A scientific and engineering development program by GE's Corporate Research and Development, Power Systems business and Aircraft Engine business has focused on understanding and controlling dynamics in lean premixed flows. The objectives have been to:

- Gather and analyze machine and laboratory data to create a comprehensive dynamics data base
- Create analytical models of gas turbine combustion systems that can be used to understand dynamics behavior
- Use the analytical models and experimental methods to develop methods to control dynamics

These efforts have resulted in a large number of hardware and control features that limit dynamics, plus analytical tools that are used to predict system behavior. The latter are particularly useful in correlating laboratory test data from full scale combustors with actual gas turbine data.

DLN-1 System

DLN-1 development began in the 1970s with the goal of producing a dry oil system to meet the United States Environmental Protection Agency's New Source Performance Standards of 75 ppmvd NO_x at 15% O_2. As noted in *Reference 7*, this system was tested on both oil and gas fuel at Houston Lighting & Power in 1980 and met its emission goals. Subsequent to this, DLN program goals changed in response to stricter environmental regulations and the pace of the program accelerated in the late 1980s.

DLN-1 Combustor

The GE DLN-1 combustor (shown in cross section in *Figure 5* and described in *Reference 8*) is a two-stage premixed combustor designed for use with natural gas fuel and capable of operation on liquid fuel. As shown, the combustion system includes four major components: fuel injection system, liner, venturi and cap/centerbody assembly.

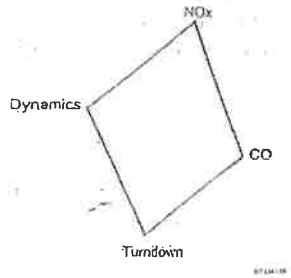

Figure 4. DLN technology - a four sided box

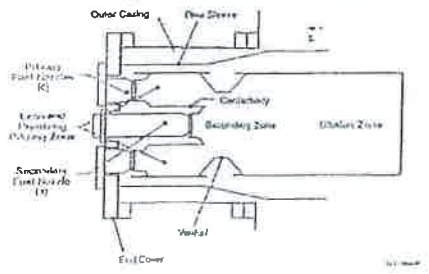

Figure 5. Dry Low NO_x combustor

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The GE DLN-1 combustion system operates in four distinct modes, illustrated in *Figure 6*, during premixed natural gas or oil fuel operation:

These components form two stages in the combustor. In the premixed mode, the first stage thoroughly mixes the fuel and air and delivers a uniform, lean, unburned fuel-air mixture to the second stage.

Mode/Operating Range

- *Primary* – Fuel to the primary nozzles only. Flame is in the primary stage only. This mode of operation is used to ignite, accelerate and operate the machine over low- to mid-loads, up to a pre-selected combustion reference temperature.
- *Lean-Lean* – Fuel to both the primary and secondary nozzles. Flame is in both the primary and secondary stages. This mode of operation is used for intermediate loads between two pre-selected combustion reference temperatures.
- *Secondary* – Fuel to the secondary nozzle only. Flame is in the secondary zone only. This mode is a transition state between lean-lean and premix modes. This mode is necessary to extinguish the flame in the primary zone, before fuel is reintroduced into what becomes the primary premixing zone.
- *Premix* – Fuel to both primary and secondary nozzles. Flame is in the secondary stage only. This mode of operation is achieved at and near the combustion reference temperature design point. Optimum emissions are generated in premix mode.

The load range associated with these modes varies with the degree of inlet guide vane modulation and, to a smaller extent, with the ambient temperature. At ISO ambient, the premix operating range is 50% to 100% load with IGV modulation down to 42°, and 75% to 100% load with IGV modulation down to 57°. The 42° IGV minimum requires an inlet bleed heat system.

If required, both the primary and secondary fuel nozzles can be dual-fuel nozzles, thus allowing automatic transfer from gas to oil throughout the load range. When burning either natural gas or distillate oil, the system can operate to full load in the lean-lean mode (*Figure 6*). This allows wet abatement of NO_x on oil fuel and power augmentation with water on gas.

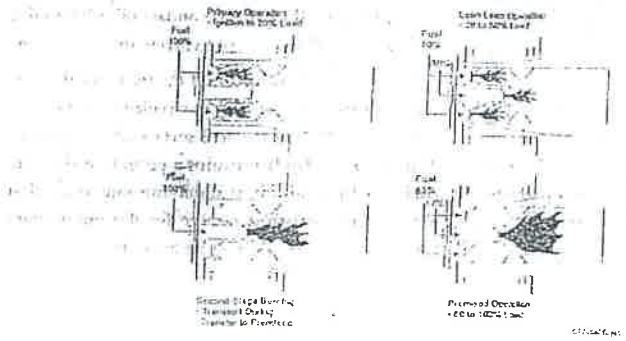

Figure 6. Fuel-staged Dry Low NO_x operating modes

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The spark plug and flame detector arrangements in a DLN-1 combustor are different from those used in a conventional combustor. Since the first stage must be reignited at high load in order to transfer from the premixed mode back to lean-lean operation, the spark plugs do not retract. One plug is mounted near a primary zone cup in each of two combustors. The system uses flame detectors to view the primary stage of selected chambers (similar to conventional systems), and secondary flame detectors that look through the centerbody and into the second stage.

The primary fuel injection system is used during ignition and part load operation. The system also injects most of the fuel during premixed operation and must be capable of stabilizing the flame. For this reason, the DLN-1 primary fuel nozzle is similar to GE's MS7001EA multi-nozzle combustor with multiple swirl-stabilized fuel injectors. The GE DLN-1 system uses five primary fuel nozzles for the MS6001B and smaller machines and six primary fuel nozzles for the larger machines. This design is capable of providing a well-stabilized diffusion flame that burns efficiently at ignition and during part load operation.

In addition, the multi-nozzle fuel injection system provides a satisfactory spatial distribution of fuel flow entering the first-stage mixer. The primary fuel-air mixing section is bound by the combustor first-stage wall, the cap/centerbody and the forward cone of the venturi. This volume serves as a combustion zone when the combustor operates in the primary and lean-lean modes. Since ignition occurs in this stage, crossfire tubes are installed to propagate flame and to balance pressures between adjacent chambers. Film slots on the liner walls provide cooling, as they do in a standard combustor.

In order to achieve good emissions performance in premixed operation, the fuel-air equivalence ratio of the mixture exiting the first-stage mixer must be very lean. Efficient and stable burning in the second stage is achieved by providing continuous ignition sources at both the inner and outer surfaces of this flow. The three elements of this stage comprise a piloting flame, an associated aerodynamic flow recirculation between the pilot flame and the inner surface of the main stage flow, and an aerodynamic device to create a stable flame zone on the outer surface of the main stage flow exiting the first stage.

The piloting flame is generated by the secondary fuel nozzle, which premixes a portion of the natural gas fuel and air (nominally, 17% at full-load operation) and injects the mixture through a swirler into a cup where it is burned. Burning an even smaller amount of fuel (less than 2% of the total fuel flow) stabilizes this flame as a diffusion flame in the cup. The secondary nozzle, which is mounted in the cap centerbody, is simple and highly effective for creating a stable flame.

A swirler mounted on the downstream end of the cap/centerbody surrounds the secondary nozzle. This creates a swirling flow that stirs the interface region between the piloting flame and the main-stage flow and ensures that the flame is continuously propagated from the pilot to the inner surface of the fuel-air mixture exiting the first stage. Operation on oil fuel is similar except that all of the secondary oil is burned in a diffusion flame in the current dry oil design.

The sudden expansion at the throat of the venturi creates a toroidal re-circulation zone over the downstream conical surface of the venturi. This zone, which entrains a portion of the venturi cooling air, is a stable burning zone that acts as an ignition source for the main stage fuel-air mixture. The cone angle and axial loca-

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tion of the venturi cooling air dump have significant effects on the efficacy of this ignition source. Finally, the dilution zone (the region of the combustor immediately downstream from the flame zone in the secondary) provides a region for CO burnout and for shaping the gas temperature profile exiting the combustion system.

DLN-1 Controls and Accessories

The gas turbine accessories and control systems are configured so that operation on a DLN-equipped turbine is essentially identical to that of a turbine equipped with a conventional combustor. This is accomplished by controlling the turbines in identical fashions, with the exhaust temperature, speed and compressor discharge pressure establishing the fuel flow and compressor inlet-guide-vane position.

A turbine with a conventional diffusion combustor that uses diluent injection for NO_x control will use an underlying algorithm to control steam or water injection. This algorithm will use top level control variables (exhaust temperature, speed, etc.) to establish a steam-to-fuel or water-to-fuel ratio to control NO_x.

In a similar fashion, the same variables are used to divide the total turbine fuel flow between the primary and secondary stages of a DLN combustor. The fuel division is accomplished by commanding a calibrated splitter valve to move to a set position based on the calculated combustion reference temperature (*Figure 7*). *Figure 8* shows a schematic of the gas fuel system for a DLN-equipped turbine.

The only special control sequences required are for protection of the turbine during a generator breaker open trip, or for a Primary Zone Ignition or Primary Re-Ignition (PRI) (i.e., flame is established in first stage during premixed operation). When either the breaker

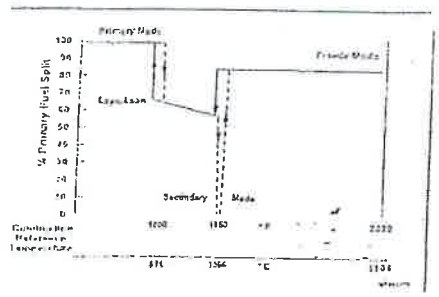

Figure 7. Typical DLN-1 fuel gas split schedule

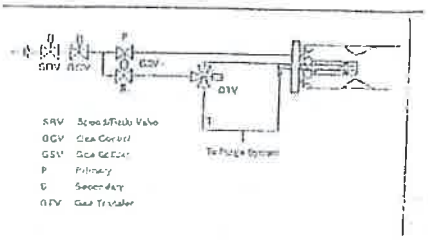

Figure 8. Dry Low NO_x gas fuel system

opens at load or a PRI is sensed by ultraviolet flame detectors looking into the first stage, the splitter valve is commanded to move to a predetermined position. For the breaker open event the combustor returns to normal operation in primary mode at full speed no load (FSNL). In the case of a PRI there is no hardware damage and the combustor maintains load but operates in extended lean-lean mode with high emissions.

DLN-1 Emissions

The emissions performance of the GE DLN system can be illustrated as a function of load for a given ambient temperature and turbine configuration. *Figures 9 and 10* show the NO_x and CO emissions from typical MS7001EA and MS6001B DLN systems designed for 9 ppmvd NO_x and 25 ppm CO when operated on natural

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gas fuel. Note that in premixed operation, NO_x is generally highest at higher loads and CO only approaches 25 ppm at lower premixed loads. The MS9001E DLN system has very similar behavior but with somewhat higher NO_x emissions (*See Figure 1*). *Figures 11 and 12* show NO_x and CO emissions for the same systems operated on oil fuel with water injection for NO_x control, rather than premixed oil. These figures are for units equipped with inlet bleed heat and extended IGV modulation.

At loads less than 20% of baseload, NO_x and CO emissions from the DLN are similar to those from standard combustion systems. This result is expected because both systems are operating as diffusion flame combustors in this range. Between 20% and 50% load, the DLN system is operated in the lean-lean mode. On gas fuel the flow split between the primary fuel nozzles and

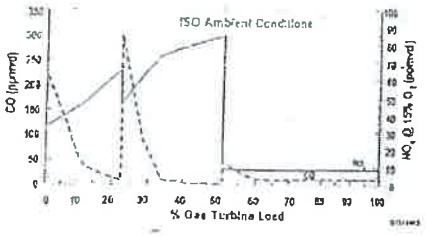

Figure 9. MS7001EA/MS9001E emissions - natural gas fuel

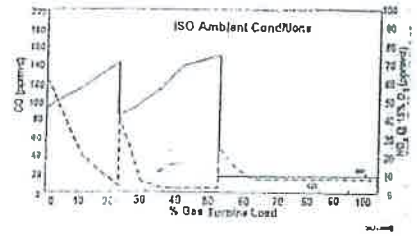

Figure 10. MS6001B emissions - natural gas

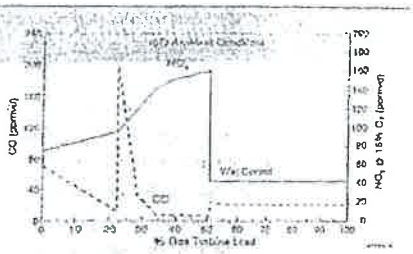

Figure 11. MS7001EA Dry Low NO_x combustion system performance on distillate oil

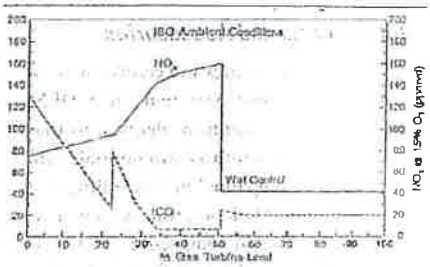

Figure 12. MS6001B emissions distillate oil fuel

secondary nozzle may be varied to optimize emissions, while on oil fuel the flow split is fixed.

From 50% to 100% load, the DLN system operates as a lean premixed combustor when operated on gas fuel, and as a diffusion flame combustor with water injection when operated on oil fuel. As shown in *Figures 9–12*, NO_x emissions are significantly reduced, while CO emissions are comparable to those from the standard system.

DLN-1 Experience

GE's first DLN-1 system was tested at Houston Lighting and Power in 1980 (*Reference 7*). A prototype DLN system using the combustor design discussed above was tested on an MS9001E at the Electricity Supply Board's (ESB) Northwall Station in Dublin, Ireland, between October

1989 and July 1990. A comprehensive engineering test of the prototype DLN combustor, controls and associated systems was conducted with NO_x levels of 32 ppmvd (at 15% O_2) obtained at baseload. The results were incorporated into the design of prototype systems for the MS7001E and MS6001B.

The 7E DLN-1 prototype was tested at Anchorage Municipal Light and Power (AMLP) in early 1991 and entered commercial service shortly afterward. Since then, development of advanced combustor configurations have been carried out at AMLP. These results have been incorporated into production hardware.

The MS6001B prototype system was first operated at Jersey Central Power & Light's Forked River Station in early 1991. A series of additional tests culminated in the demonstration of a 9 ppm combustor at Jersey Central in November 1993.

As of May 1999, 44 MS6001B machines are equipped with DLN-1 systems. In total, they have accumulated more than 1.4 million hours of operation. There are, in addition, 4 MS7001E, 8 MS7001B/E, 39 MS7001EA, 27 MS9001E, 2 MS5001P and 4 MS3002J DLN-1 machines that have collectively operated for more than 2 million hours. Excellent emission results have been obtained in all cases, with single-digit NO_x and CO achieved on many MS7001EAs. Several MS7001E/EA machines have the capability to power augment with steam injection in premixed mode.

Starting in early 1992, eight MS7001F machines equipped with GE DLN systems were placed in service at Korea Electric Power Company's Seoinchon site. These F technology machines have achieved better than 55% (gross) efficiency in combined-cycle operation, and the DLN systems are currently operating between 30 and 40 ppmvd NO_x on gas fuel (the guarantee level is 50 ppmvd). These units have operated for more than 250,000 hours. Four additional F technology DLN-1 systems were commissioned at Scottish Hydro's Keadby site and at National Power's Little Barford site. These 9F machines have operated more than 80,000 hours at less than 60 ppm NO_x.

The combustion laboratory's testing and field operation have shown that the DLN-1 system can achieve single digit NO_x and CO levels on E technology machines operating on gas fuel. Current DLN-1 development activity focuses on:

- Application of single-digit technology to the MS6001B and MS7001EA uprates.
- Application of DLN-1 technology for retrofitting existing field machines (including MS3002s and MS5000s, some of which will require upgrade before DLN retrofit)
- Completing the development of steam power augmentation as needed by the market
- Completing the development of lean premixed oil fuel DLN-1 products.
- Increasing combustion inspection intervals.
- Improving overall system reliability and operability for operation on oil fuel.

DLN-2 System

As F-technology gas turbines became available in the late 1980s, studies were conducted to establish what type of DLN combustor would be needed for these new higher firing temperature machines. Studies concluded that that air usage in the combustor (e.g., for cooling) other than for mixing with fuel would have to be strictly

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limited. A team of engineers from GE Power Systems, GE Corporate Research and Development and GE Aircraft Engines proposed a design that repackaged DLN-1 premixing technology but eliminated the venturi and centerbody assemblies that require cooling air.

The resulting combustor is called DLN-2, which is the standard system for the 6FA, 7FA, and 9FA machines. Fourteen combustors are installed in the 7FA, 18 in the 9FA, and six in the 6FA. Two additional variants of the DLN-2 system have been developed to meet the additional design requirements imposed by either new machine cycles or reduced emissions levels. These combustors, the DLN-2.6 and the DLN-2+, will be described briefly in later sections.

DLN-2 Combustion System

The DLN-2 combustion system shown in *Figure 13* is a single-stage dual-mode combustor that can operate on both gaseous and liquid fuel. On gas, the combustor operates in a diffusion mode at low loads (< 50% load), and a premixed mode at high loads (> 50% load). While the combustor can operate in the diffusion mode across the load range, diluent injection would be required for NO_x abatement. Oil operation on this combustor is in the diffusion mode across the entire load range, with diluent injection used for NO_x control.

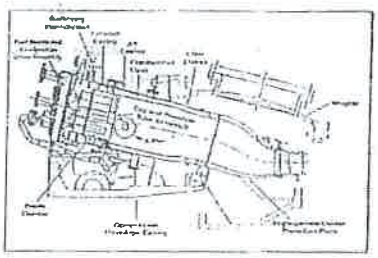

Figure 13. DLN-2 combustion system

Each DLN-2 combustor system has a single burning zone formed by the combustor liner and the face of the cap. In low emissions operation, 90% of the gas fuel is injected through radial gas injection spokes in the premixer, and combustion air is mixed with the fuel in tubes surrounding each of the five fuel nozzles. The premixer tubes are part of the cap assembly. The fuel and air are thoroughly mixed, flow out of the five tubes at high velocity and enter the burning zone where lean, low-NO_x combustion occurs. The vortex breakdown from the swirling flow exiting the premixers, along with the sudden expansion in the liner, are mechanisms for flame stabilization. The DLN-2 fuel nozzle/premixer tube arrangement is similar in design and technology to the secondary nozzle/centerbody of a DLN-1. Five nozzle/premixer tube assemblies are located on the head end of the combustor. A quaternary fuel manifold is located on the circumference of the combustion casing to bring the remaining fuel flow to casing injection pegs located radially around the casing.

Figure 14 shows a cross-section of a DLN-2 fuel nozzle. As noted, the nozzle has passages for diffusion gas, premixed gas, oil and water. When mounted on the end cover, as shown in *Figure 15*, the diffusion passages of four of the fuel nozzles are fed from a common manifold, called the primary, that is built into the end cover. The premixed passages of the same four nozzles are fed from another internal manifold called the secondary. The pre-mixed passages of the remaining nozzle are supplied by the tertiary fuel system; the diffusion passage of that nozzle is always purged with compressor discharge air and passes no fuel.

Figure 15 shows the fuel nozzles installed on the combustion chamber end cover and the connections for the primary, secondary and tertiary fuel systems. DLN-2 fuel streams are:

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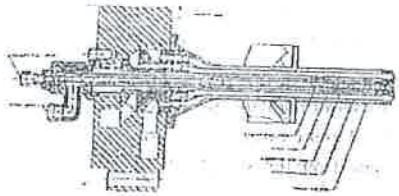

Figure 14. Cross-section of a DLN-2 fuel nozzle

- *Primary fuel* – fuel gas entering through the diffusion gas holes in the swirler assembly of each of the outboard four fuel nozzles
- *Secondary fuel* – premix fuel gas entering through the gas metering holes in the fuel gas injector spokes of each of the outboard four fuel nozzles
- *Tertiary fuel* – premix fuel gas delivered by the metering holes in the fuel gas injector spokes of the inboard fuel nozzle
- *The quaternary system* – injects a small amount of fuel into the airstream just up-stream from the fuel nozzle swirlers

The DLN-2 combustion system can operate in several different modes.

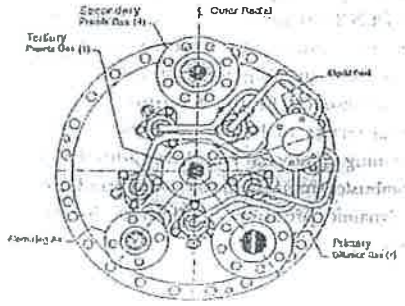

Figure 15. External view of DLN-2 fuel nozzles mounted

Primary

Fuel only to the primary side of the four fuel nozzles; diffusion flame. Primary mode is used from ignition to 81% corrected speed.

Lean-Lean

Fuel to the primary (diffusion) fuel nozzles and single tertiary (premixing) fuel nozzle. This mode is used from 81% corrected speed to a pre-selected combustion reference temperature. The percentage of primary fuel flow is modulated throughout the range of operation as a function of combustion reference temperature. If necessary, lean-lean mode can be operated throughout the entire load range of the turbine. Selecting "lean-lean base on" locks out premix operation and enables the machine to be taken to base load in lean-lean.

Premix Transfer

Transition state between lean-lean and premix modes. Throughout this mode, the primary and secondary gas control valves modulate to their final position for the next mode. The premix splitter valve is also modulated to hold a constant tertiary flow split.

Piloted Premix

Fuel is directed to the primary, secondary and tertiary fuel nozzles. This mode exists while operating with temperature control off as an intermediate mode between lean-lean and premix mode. This mode also exists as a default mode out of premix mode and, in the event that premix operating is not desired, piloted premix can be selected and operated to base-load. Primary, secondary and tertiary fuel split are constant during this mode of operation.

Premix

Fuel is directed to the secondary, tertiary and quaternary fuel passages and premixed flame exists in the combustor. The minimum load for

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premixed operation is set by the combustion reference temperature and IGV position in the typically ranges from 50% with inlet bleed heat on to 65% with inlet bleed heat off. Mode transition from premix to piloted premix or piloted premix to premix, can occur whenever the combustion reference temperature is greater than 2200 F/1204 C. Optimum emissions are generated in premix mode.

Tertiary Full Speed No Load (FSNL)

Initiated upon a breaker open event from any load > 125%. Fuel is directed to the tertiary nozzle only and the unit operates in secondary FSNL mode for a minimum of 20 seconds, then transfers to lean-lean mode.

Figure 16 illustrates the fuel flow scheduling associated with DLN-2 operation. Fuel staging depends on combustion reference temperature and IGV temperature control operation mode.

DLN-2 Controls and Accessories

The DLN-2 control system regulates the fuel distribution to the primary, secondary, tertiary and quaternary fuel system. The fuel flow distribution to each combustion fuel system is a function of combustion reference temperature and IGV temperature control mode. Diffusion, piloted premix and premix flame are established by changing the distribution of fuel flow in the combustor. The gas fuel system (*Figure 17*) consists of the gas fuel stop-ratio valve, primary gas control valve, secondary gas control valve premix splitter valve and quaternary gas control valve. The stop-ratio valve is designed to maintain a predetermined pressure at the control-valve inlet.

The primary, secondary and quaternary gas control valves regulate the desired gas fuel flow delivered to the turbine in response to the fuel command from the SPEEDTRONIC™ controls.

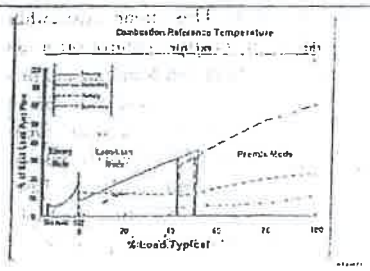

Figure 16. Typical DLN-2 gas fuel split schedule

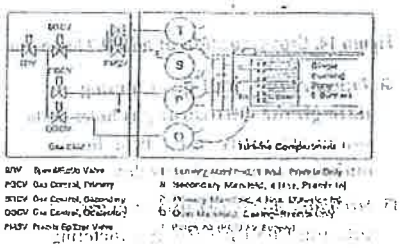

Figure 17. DLN-2 gas fuel system

The premix splitter valve controls the fuel flow split between the secondary and tertiary fuel system.

DLN-2 Emissions Performance

Figures 18 and 19 show the emissions performance for a DLN-2 equipped 7FA/9FA for gas fuel and for oil fuel with water injection.

DLN-2 Experience

The first DLN-2 systems were placed in service at Florida Power and Light's Martin Station with commissioning beginning in September 1993, and the first two (of four) 7FA units entered commercial service in February 1994. During commissioning, quaternary fuel was added and other combustor modifications were made to control dynamic pressure oscillations in the combustor.

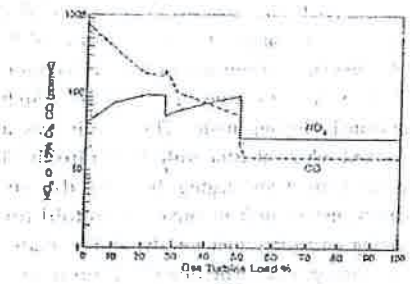

Figure 18. Gas fuel emissions in diffusion and premixed

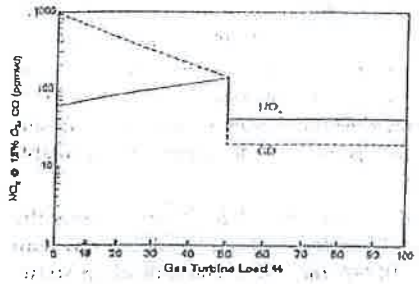

Figure 19. Distillate oil emissions with water injection above 50% load

After the 7FA DLN-2 entered commercial service the 9FA DLN-2 was introduced. Subsequent fleet experience indicated that to achieve adequate operational robustness against the entire range of site specific events, an improvement in premixer flashback resistance was needed. Under certain transient conditions flashback can occur where flame "holds" or is supported in the recirculation zone downstream of the premixed gas pegs. This region is not designed to withstand the abnormally high temperatures resulting from the presence of a flame. In the event of a flashback, the metal temperatures increase to unacceptable levels and hardware damage occurs. In some cases, these events have caused forced outages and adversely impacted availability. The solution chosen was to install full "fairings" on the downstream side of the cylindrical fuel injection pegs. Laboratory testing and subsequent fleet experience has demonstrated that full fairings are highly effective in reducing the probability of fuel nozzle flash-back. The fairings improve the peg aerodynamics in order to reduce the size of the recirculation zone downstream of the pegs. The result is to significantly reduce the probability of flame holding or attachment to the premixed pegs. *Figure 20* shows the original DLN-2 fuel nozzle while *Figure 21* illustrates the same nozzle with the addition of the fuel-peg fairings.

As of May 1999 there were 8 6FA, 26 7FA and 38 9FA units equipped with DLN-2 in commercial service. They have accumulated more than 1.1 million hours of operation.

DLN-2.6 Evolution

Regulatory pressures in the U.S. market in the early 1990s led to the need to develop a 9 ppm combustion system for the Frame 7FA. The result of this development is the DLN-2.6, which was first placed into service in March 1996 at Public Service of Colorado.

Reduction of NO_x levels from the DLN-2 at 25 ppm to 9 ppm required that approximately 6%

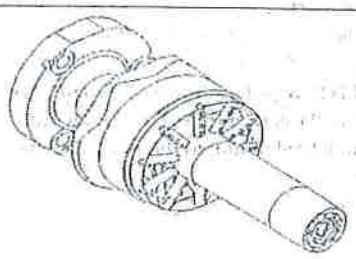

Figure 20. Un-faired DLN-2 fuel nozzle

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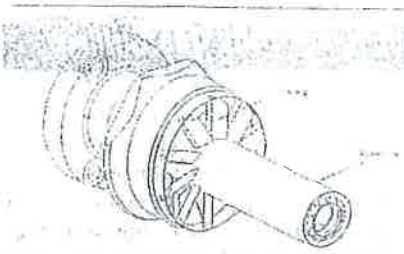

Figure 21. Fully tuned (flashback resistant) fuel nozzle

additional air was needed to pass through the premixers in the combustor (see Appendix for description of the NO_x and temperature relationship). This change in air splits was accomplished through reductions in cap and liner cooling air flows, requiring increased cooling effectiveness. However, without changes in the operation of the DLN-2 system, certain penalties would have been incurred for achieving 9 ppm baseload performance. The turndown of a DLN-2 combustor tuned to 9/9 operation was estimated to be about 70% load, compared to 40% load for the 25/15 system. A new combustor configuration was conceived based on the DLN-2 burner, but overcoming these difficulties. The DLN-2 burner was carried forward as the basis of the new combustor because of its excellent flame stabilization characteristics and the large database of knowledge, which had been accumulated on the parameters affecting combustion dynamics.

The key feature of the new configuration is the addition of a sixth burner located in the center of the five existing DLN-2 burners. The presence of the center nozzle enables the DLN-2.6 to extend its 9/9 turndown well beyond the five nozzle DLN-2. By fueling the center nozzle separately from the outer nozzles, the fuel-air ratio can be modulated relative to the outer nozzles leading to approximately 200°F of turndown from baseload with 9 ppm NO_x. Turning the fuel down in the center burner does not result in any additional CO generation.

Absent any other changes in the DLN-2 other than the addition of the center nozzle, the DLN-2.6 combustor would have required five fuel manifolds, compared to four on the DLN-2. An alternative scheme was proposed to operate the machine at startup and low load, which eliminated diffusion mode. The result was a premixed-only combustor with 4 manifolds: 3 premixed manifolds staging fuel to the six burners, and a fourth premixed-manifold for injecting quaternary fuel for dynamics abatement, (*See Figure 22*). The first three premixed manifolds, designated PM1, PM2, and PM3, are configured such that any number (1 to 6) of burners can be operated at any time. The PM1 manifold fuels the center nozzle, the PM2 manifold fuels the two outer nozzles located at the cross-fire tubes, and the PM3 manifold fuels the remaining three outer nozzles. The five outer nozzles are identical to those used for the DLN-2, while the center nozzle is similar but with simplified geometry to fit within the available space.

With the elimination of the diffusion mode the DLN-2.6 loads and unloads very differently than the DLN-2. The loading and unloading strategies are shown in *figures 23 and 24*. The additional mode changes are necessary to maintain the premixed flames within their burnable zones and so prevent combustor blowout. The

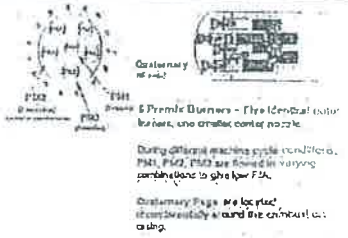

Figure 22. DLN-2.6 fuel nozzle arrangement

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gas fuel control system is also changed relative to the DLN-2. Control is accomplished with one stop ratio valve and four individual gas control valves, (*See Figure 25*). The splitter valve utilized in both the DLN-1 and DLN-2 combustion systems is eliminated.

Emissions performance of the DLN-2.6 depends on the operational mode (*See Figures 26 and 27*). As can be seen, the emissions goal

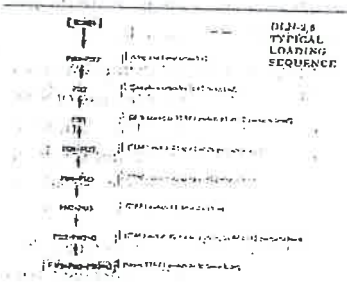

Figure 23. DLN-2.6 ignition, crossfire, acceleration, and loading strategy

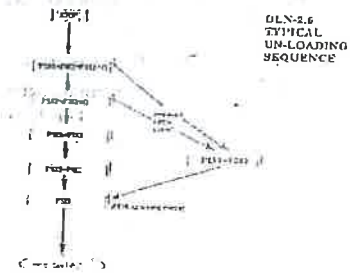

Figure 24. DLN-2.6 unloading and fired shutdown sequence

of 9 ppm NO_x and CO over a 50% load range was met. Since its introduction in 1996 the DLN-2.6 has been installed on 8 machines and accumulated approximately 17,000 hours of operation.

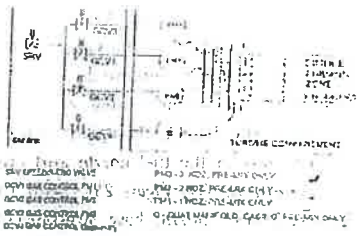

Figure 25. DLN-2.6 fuel distribution and controls system

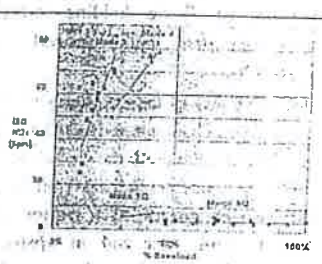

Figure 26. NO_x at 15% O_2 vs. percent load

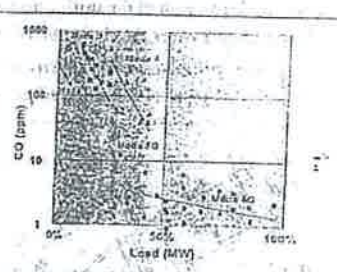

Figure 27. CO level vs. percent load

DLN-2+ Evolution

In late 1996 an uprated version of the Frame 9FA was introduced. Called the 9FA+e, the cycle for this machine increased the air and fuel flow to the combustion system by approximately 10%. In addition, the machine was intended for use with gas fuels ranging in heat content from

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approximately 70–100% of natural gas while still maintaining low emissions.

To meet these requirements an updated version of the DLN-2, called the DLN-2+, was developed. The DLN-2+ retains the basic architecture of the DLN-2 with adaptations for both the new requirements and to improve the operability and robustness of the existing system. In comparison to the DLN-2, the major changes are concentrated in the fuel nozzle and endcover arrangement (*See Figure 28*). Both the endcover and fuel nozzle have substantially enlarged fuel passages for the increased volumetric flow of fuel. In addition the fuel nozzle (*See Figure 29*), was redesigned for further improvements in flame holding margin, reduced pressure drop, and improved diffusion flame stability.

The additional gains in flameholding velocity margin result from cleaner aerodynamics in the premixers. This is achieved via a new swirler design, which incorporates fuel injection directly from the swirler surface. Each swirler vane comprises a turning vane and an upstream straight section. The straight section is hollow and houses the fuel manifolds plus the discrete injection holes. Upstream of the swirler an inlet flow conditioner improves the character of the flow entering the premixer, while downstream an integral outer shroud eliminates any potential flow disturbances after the point of fuel injection. The improvement in aerodynamics also reduces the overall system pressure drop to the level required by the new cycle.

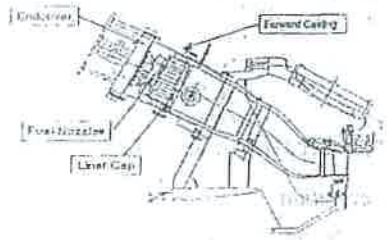

Figure 28. Parts highly modified for DLN-2+ as compared to DLN-2

Figure 29. DLN-2+ fuel nozzle

The nozzle tip geometry and the improvements in diffusion flame stability allow the use of a diffusion flame on every nozzle. This eliminates the lean-lean mode of the DLN-2 and results in the simplified staging methodology shown in *Figure 30*.

A further simplification illustrated in *Figure 30* is the elimination of the DLN-2 Quaternary fuel system. This is achieved through the use of biradial fuel staging in each swirler vane. In this design the radial fuel injection balance can be adjusted via fixed orifices on the endcover as part of the system setup procedure.

Overall, the fuel nozzle and endcover arrangement of the DLN-2+ can accept fuels with Wobbe Index ranging from 28 to 52. The fuel

Figure 30. DLN-2+ staging methodology

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delivery system is very similar to the one used for the DLN-2.6, with a stop ratio valve and independent gas control valves for each of the three gas fuel circuits.

The first installation and startup of a 9FA+e was in early 1999 at the Sutton Bridge Power Station in the UK. Emissions measured during the startup were well within design goals (*See Figures 30 and 31*). Additional machines will be commissioned throughout 1999.

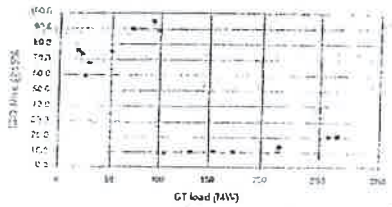

Figure 31. DLN-2+ combustion system NO_x emissions

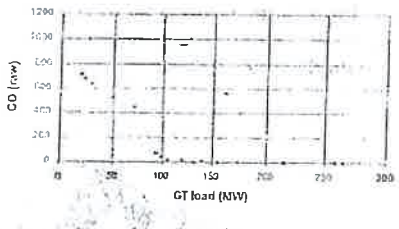

Figure 32. DLN-2+ combustion system NO_x emissions

Conclusion

GE's Dry Low NO_x Program continues to focus on the development of systems capable of the extremely low NO_x levels required to meet today's regulations and to prepare for more stringent requirements in the future. New unit production needs and the requirements of existing machines are being addressed. GE DLN systems are operating on more than 222 machines and have accumulated more than 4.8 million service hours. GE is the only manufacturer with F technology machines operating below 15 ppmvd.

Appendix

Gas Turbine Combustion Systems

A gas turbine combustor mixes large quantities of fuel and air and burns the resulting mixture. In concept the combustor is comprised of a fuel injector and a wall to contain the flame. There are three fundamental factors and practical concerns that complicate the design of the combustor: equivalence ratio, flame stability, and ability to operate from ignition through full load.

Equivalence Ratio

A flame burns best when there is just enough fuel to react with the available oxygen. With this stoichiometric mixture (equivalence ratio of 1.0) the flame temperature is the highest and the chemical reactions are the fastest, compared to cases where there is either more oxygen ("fuel lean," < 1.0) or less oxygen ("fuel rich," > 1.0) for the amount of fuel present.

In a gas turbine, the maximum temperature of the hot gases exiting the combustor is limited by the tolerance of the turbine nozzles and buckets. This temperature corresponds to an equivalence ratio of 0.4 to 0.5 (40% to 50% of the stoichiometric fuel flow). In the combustors used on modern gas turbines, this fuel-air mixture would be too lean for stable and efficient burning. Therefore, only a portion of the compressor discharge air is introduced directly into the combustor reaction zone (flame zone) to be mixed with the fuel and burned. The balance of

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the airflow either quenches the flame prior to the combustor discharge entering the turbine or cools the wall of the combustor.

Flame Stability

Even with only part of the air being introduced into the reaction zone, flow velocities in the zone are higher than the turbulent flame speed at which a flame propagates through the fuel-air mixture. Special mechanical or aerodynamic devices must be used to stabilize the flame by providing a low velocity region. Modern combustors employ a combination of swirlers and jets to achieve a good mix and to stabilize the flame.

Operational Stability

The combustor must be able to ignite and to support acceleration and operation of the gas turbine over the entire load range of the machine. For a single-shaft generator-drive machine, speed is constant under load and, therefore, so is the airflow for a fixed ambient temperature. There will be a five-to-one or six-to-one turndown in fuel flow over the load range. A combustor whose reaction zone equivalence ratio is optimized for full load operation will be very lean at the lower loads. Nevertheless, the flame must be stable and the combustion process must be efficient at all loads.

GE uses multiple-combustion chamber assemblies in its heavy-duty gas turbines to achieve reliable and efficient turbine operation. As shown in *Figure A-1*, each combustion chamber assembly comprises a cylindrical combustor, a fuel-injection system and a transition piece that guides the flow of the hot gas from the combustor to the inlet of the turbine. *Figure A-2* illustrates the multiple-combustor concept.

There are several reasons for using the multiple-chamber arrangement instead of large silo-type combustors:

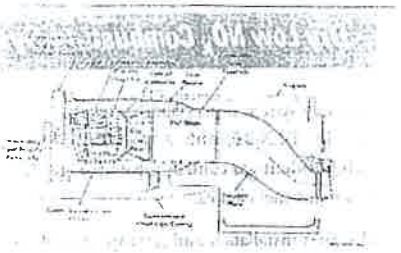

Figure A-1. MS7001E Dry Low NO_x combustion system

- The configuration permits the entire turbine to be factory assembled, tested, and shipped without interim disassembly
- The turbine inlet temperature can be better controlled, thus providing for longer turbine life with reduced turbine cooling air requirements
- Smaller parts can be handled more easily during routine maintenance
- Smaller transition pieces are less susceptible to damage from dynamic forces generated in the combustor; furthermore, the shorter combustion system length ensures that acoustic natural frequencies are higher and less likely to couple with the pressure oscillations in the flame

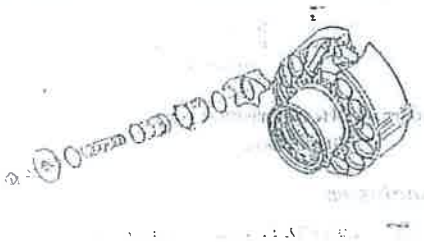

Figure A-2. Exploded view of combustion chamber

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For an MS7001EA gas turbine, an SCR designed to remove 90% of the NOx from the gas turbine exhaust stream has a volume of approximately 175 cubic meters and weighs 111 tons. It is comprised of segments stacked in the exhaust duct. Each segment has a honeycomb pattern with passages that are aligned in the direction of the exhaust gas flow. A catalyst, such as vanadium pentoxide, is deposited on the surface of the honeycomb.

SCR systems are sensitive to fuels containing more than 1,000 ppm of sulfur (light distillate oils may have up to 0.8% sulfur). There are two reasons for this sensitivity.

First, sulfur poisons the catalyst being used in SCRs. Second, the ammonia will react with sulfur in the presence of the catalyst to form ammonium bisulfate, which is extremely corrosive, particularly near the discharge of a heat recovery boiler. Special catalyst materials that are less sensitive to sulfur have been identified, and there are some theories as to how to inhibit the formation of ammonium bisulfate. This, however, remains an open issue with SCRs.

More than 100 GE units have accumulated more than 100,000 operating hours with SCRs installed. Twenty of the units are in Japan; others are located in California, New Jersey, New York and several other eastern U.S. states. Units operating with SCRs include MS9000s, MS7000s, MS6000s, LM2500s and LM5000s.

Lean premixed combustion is the basis for achieving low emissions from Dry Low NO_x and catalytic combustors. GE has participated in the development of catalytic combustors for many years. These systems use a catalytic reactor bed mounted within the combustor to burn a very lean fuel-air mixture. They have the potential to achieve extremely low emissions levels without resorting to exhaust gas cleanup. Technical challenges in the combustor and in the catalyst and reactor bed materials must be overcome in order to develop an operational catalytic combustor. GE has development programs in place with both ceramic and catalyst manufacturers to address these challenges.

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- Smaller combustors generate less NO_x because of much better mixing and shorter residence time
- As turbine inlet temperatures have increased to improve efficiency, the size of the combustors has decreased to minimize cooling requirements, as in aircraft gas turbine combustors
- Small can-type combustors can be completely developed in the laboratory through a combination of both atmospheric and full-pressure, full-flow tests. Therefore, there is a higher degree of confidence that a combustor will perform as designed across all load ranges before it is installed and tested in a machine.

Gas Turbine Emissions

The significant products of combustion in gas turbine emissions are:

- Oxides of nitrogen (NO and NO_2, collectively called NO_x)
- Carbon monoxide (CO)
- Unburned hydrocarbons or UHCs (usually expressed as equivalent methane (CH_4) particles and arise from incomplete combustion)
- Oxides of sulfur (SO_2 and SO_3) particulates.

Unburned hydrocarbons include both volatile organic compounds (VOCs), which contribute to the formation of atmospheric ozone, and compounds, such as methane, that do not.

There are two sources of NO_x emissions in the exhaust of a gas turbine. Most of the NO_x is generated by the fixation of atmospheric nitrogen in the flame, which is called thermal NO_x. Nitrogen oxides are also generated by the conversion of a fraction of any nitrogen chemically bound in the fuel (called fuel-bound nitrogen or FBN). Lower-quality distillates and low-Btu coal gases from gasifiers with hot gas cleanup carry various amounts of fuel-bound nitrogen that must be taken into account when emissions calculations are made. The methods described below to control thermal NO_x emissions are ineffective in controlling the conversion of FBN to NO_x.

Thermal NO_x is generated by a chemical reaction sequence called the Zeldovich Mechanism (*Reference 6*). This set of well-verified chemical reactions postulates that the generation of thermal NO_x is an exponential function of the temperature of the flame and a linear function of the time which the hot gases are at flame temperature. Thus, temperature and residence time determine thermal NO_x emissions levels and are the principal variables that a gas turbine designer can adjust to control emission levels.

For a given fuel, since the flame temperature is a unique function of the equivalence ratio, the rate of NO_x generation can be cast as a function of the equivalence ratio. *Figure A-3* shows that the highest rate of NO_x production occurs at an equivalence ratio of 1.0, when the temperature is equal to the stoichiometric adiabatic flame temperature.

To the left of the maximum temperature point (*Figure A-3*), more oxygen is available (the equivalence ratio is < 1.0) and the resulting flame temperature is lower. This is a fuel-lean operation. Since the rate of NO_x formation is a function of temperature and time, it follows that some difference in NO_x emissions can be expected when different fuels are burned in a given combustion system. Since distillate oil and natural gas have approximately a 100°F/38°C flame temperature difference, a significant dif-

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Estimated Performance	Units	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Load Condition		BASE	77.00%	76.30%	54.00%	53.00%	38.00%	37.00%
Ambient Temperature	deg C	25	25	25	25	25	25	25
Ambient Relative Humidity	%	65.5	65.5	65.5	65.5	65.5	65.5	65.5
Fuel Type		Dust Gas	Dust Gas	Dust Gas	Dust Gas	Dust Gas	Dust Gas	Dust Gas
Exhaust Flow	x 10^3 Kg/hr	2000.20	1712.70	1699.70	1470.10	1468.80	1327.20	1327.60
Exhaust Temperature	deg C	657.20	648.90	648.90	648.90	648.90	648.90	648.90

Exhaust Analysis % VOL.	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Argon	0.87	0.86	0.87	0.87	0.87	0.88	0.87
Nitrogen	72.97	73.11	73.12	73.3	73.31	73.48	73.5
Oxygen	11.56	11.97	11.80	12.52	12.55	13.06	13.11
Carbon Dioxide	4.09	3.9	3.95	3.65	3.63	3.4	3.36
Water	10.51	10.14	10.13	9.66	9.64	9.18	9.14

Fuel Composition (Volume %)	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Methane - CH4	95.49	95.49	95.49	95.49	95.49	95.49	95.49
Ethane - C2H6	2.45	2.45	2.45	2.45	2.45	2.45	2.45
Propane - C3H8	0.9	0.9	0.9	0.9	0.9	0.9	0.9
n-Butane - C4H10	0.33	0.33	0.33	0.33	0.33	0.33	0.33
n-Pentane - C5H12	0.05	0.05	0.05	0.05	0.05	0.05	0.05
n-Hexane - C6H14	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Nitrogen - N2	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Carbon Dioxide - CO2	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Totals	100	100	100	100	100	100	100

Results	Units	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Elevation	meter	900						
Site Pressure	bar	0.9118						
Inlet Loss	mm H2O	75						
Exhaust Pressure Loss	mm H2O	292.6	213.1	209.9	150.57	150.6	126	127.0
Exhaust Loss	mm H2O	415.03 @ ISO Conditions						
Application		Hydrogen Cooled Generator						
Power Factor (Lac)		0.85						
Combustion System		DLN Combustor						

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Project: 1xFr9FB GTG based CCPP, KPCL Yelahanka
FrSFS/CCPP/NG/DLN Combustion/Base, FSNL and Part Loads

Dated: 06.02.2015

Estimated Performance	Units	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Load Condition	%	BASE	77.00%	76.00%	54.00%	53.00%	38.00%	37.00%
Ambient Temperature	deg C	7.8	7.8	7.8	7.8	7.8	7.8	7.8
Ambient Relative Humidity	%	78	78	78	78	78	78	78
Fuel Type		Cust Gas	Cust Gas	Cust Gas	Cust Gas	Cust Gas	Cust Gas	Cust Gas
Exhaust Flow	x10^3 kg/hr	2200	1840.6	1826.2	1559.1	1541.2	1355.3	1343.4
Exhaust Temperature	deg C	635.7	648.9	648.9	648.9	648.9	648.9	648.9
Exhaust Analysis % VOL		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Argon		0.82	0.80	0.80	0.80	0.80	0.8	0.80
Nitrogen		74.3	74.05	74.35	74.64	74.55	74.71	74.73
Oxygen		11.82	11.97	11.98	12.51	12.54	13.03	13.07
Carbon Dioxide		4.14	4.07	4.06	3.82	3.81	3.55	3.56
Water		8.88	8.73	8.72	8.25	8.22	7.76	7.75
Fuel Composition (Volume %)		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Methane - CH4		95.49	95.49	95.49	95.49	95.49	95.49	95.49
Ethane - C2H6		2.45	2.45	2.45	2.45	2.45	2.45	2.45
Propane - C3H8		0.9	0.9	0.9	0.9	0.9	0.9	0.9
n-Butane - C4H10		0.33	0.33	0.33	0.33	0.33	0.33	0.33
n-Pentane - C5H12		0.05	0.05	0.05	0.05	0.05	0.05	0.05
n-Hexane - C6H14		0.06	0.06	0.06	0.06	0.06	0.06	0.06
Nitrogen - N2		0.71	0.71	0.71	0.71	0.71	0.71	0.71
Carbon Dioxide - CO2		0.01	0.01	0.01	0.01	0.01	0.01	0.01
Totals		100	100	100	100	100	100	100

Results	Units	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Elevation	meter	900						
Site Pressure	bar	0.9113						
Inlet Loss	mm H2O	75						
Exhaust Pressure Loss	mm H2O	350.1	246.2	242.3	175.2	172.6	133.4	131.1
Exhaust Loss	mm H2O	415.00 @ ISO Conditions						
Application		Hydrogen-Cooled Generator						
Power Factor (pf)		0.85						
Combustion System		DLN Combustor						

All values provided for information only

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Project: 1x1 STG based CCPP, KPCL Yelahanka
Fr9FB/GCFR/G/DLN Combustor/Base, FSNL and PSH Load

Dated: 05.08.2015

Estimated Performance	Units	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Load Condition	%	BASE						
Ambient Temperature	deg C	35	35	35	35	35	35	35
Ambient Relative Humidity	%	45	45	45	45	45	45	45
Fuel Type		Coal Gas	Coal Gas	Coal Gas	Coal Gas	Coal Gas	Coal Gas	Coal Gas
Exhaust Flow	x10^3 kg/hr	1384.3	1378.8	1402.1	1402.7	1391.4	1311.3	1295.4
Exhaust Temperature	deg C	657.2	648.2	648.5	648.9	648.9	648.5	648.5
Exhaust Gases % VOL		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Argon		0.86	0.86	0.87	0.87	0.87	0.87	0.87
Nitrogen		72.94	72.68	72.68	72.85	72.85	73.04	73.04
Oxygen		11.71	12.13	12.15	12.55	12.67	13.18	13.22
Carbon Dioxide		3.95	3.76	3.75	3.52	3.51	3.27	3.26
Water		10.94	10.57	10.55	10.11	10.09	9.63	9.61
Fuel Composition (Volume %)		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Methane - CH4		95.49	95.49	95.49	95.49	95.49	95.49	95.49
Ethane - C2H6		2.45	2.45	2.45	2.45	2.45	2.45	2.45
Propane - C3H8		0.9	0.9	0.9	0.9	0.9	0.9	0.9
n-Butane - C4H10		0.33	0.33	0.33	0.33	0.33	0.33	0.33
n-Pentane - C5H12		0.05	0.05	0.05	0.05	0.05	0.05	0.05
n-Hexane - C6H14		0.06	0.06	0.06	0.06	0.06	0.06	0.06
Nitrogen - N2		0.71	0.71	0.71	0.71	0.71	0.71	0.71
Carbon Dioxide - CO2		0.01	0.01	0.01	0.01	0.01	0.01	0.01
Totals		100	100	100	100	100	100	100
Results	Units	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Elevation	meter	900						
Site Pressure	bar	0.9113						
Inlet Loss	mm H2O	75						
Exhaust Pressure Loss	mm H2O	259.5	152.7	150.9	144	141.8	124.9	122.4
Exhaust Loss	mm H2O	415.00 @ ISO Conditions						
Relative Humidity	%	45	45	45	45	45	45	45
Application		Hydrogen Cooled Generator						
Power Factor (pg)		0.85						
Combustion System		DLN Combustor						

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Project: 1xFr9FB GTG based CCPP, KPCL Yelahanka
Fr9FB/CCPP/NG/DLN Combustor/Base, FSNL and Part Loads

Dated: 05.08.2015

Estimated Performance	Units	Case 1	Case 2
Load Condition	%	BASE	BASE
Ambient Temperature	deg.C	40	50
Ambient Relative Humidity	%	45	45
Fuel Type		Cust Gas	Cust Gas
Exhaust Flow	x10^3 kg/hr	1869.5	1735.7
Exhaust Temperature	deg.C	657.2	657.2
Exhaust Analysis % VOL.		Case 1	Case 2
Argon		0.86	0.84
Nitrogen		72.39	70.65
Oxygen		11.7	11.5
Carbon Dioxide		3.94	3.8
Water		11.11	13.21
Fuel Composition (Volume %)		Case 1	Case 2
Methane - CH4		95.49	95.49
Ethane - C2H6		2.45	2.45
Propane - C3H8		0.9	0.9
n-Butane - C4H10		0.33	0.33
n-Pentane - C5H12		0.05	0.05
n-Hexane - C6H14		0.06	0.06
Nitrogen - N2		0.71	0.71
Carbon Dioxide - CO2		0.01	0.01
Totals		100	100
Results	Units	Case 1	Case 2
Elevation	meter	900	
Site Pressure	bar	0.9113	
Inlet Loss	mm H2O	75	
Exhaust Pressure Loss	mm H2O	255.5	220.2
Exhaust Loss	mm H2O	415.00 @ ISO Conditions	
Relative Humidity	%	45	45
Application		Hydrogen-Cooled Generator	
Power Factor (lag)		0.85	
Combustion System		DLN Combustor	

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All values provided for information only

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Project: 1xFr9FB GTG based CCPP, KPCL Yelahanka

Dated: 06.08.2015

Fr9FB/CCPP/NG/DLN Combustor/Base, FSNL and Part Loads

Estimated Performance	Units	Case 2	Case 3
Load Condition	%	81.00%	82.00%
Ambient Temperature	deg C	26	26
Ambient Relative Humidity	%	65.5	65.5
Fuel Type		Cust Gas	Cust Gas
Exhaust Flow	x10^3 kg/hr	1764.3	1777
Exhaust Temperature	deg C	646.9	648.9
Exhaust Analysis % VOL		Case 2	Case 3
Argon		0.87	0.87
Nitrogen		73.09	73.09
Oxygen		11.91	11.89
Carbon Dioxide		3.93	3.94
Water		10.2	10.21
Fuel Composition (Volume %)			Case 3
Methane - CH4		95.49	95.49
Ethane - C2H6		2.45	2.45
Propane - C3H8		0.9	0.9
n-Butane - C4H10		0.33	0.33
n-Pentane - C5H12		0.05	0.05
n-Hexane - C6H14		0.06	0.06
Nitrogen - N2		0.71	0.71
Carbon Dioxide - CO2		0.01	0.01
Totals		100	100
Results	Units	Case 2	Case 3
Elevation	meter	900	
Site Pressure	bar	0.9113	
Inlet Loss	mm H2O	75	
Exhaust Pressure Loss	mm H2O	226.1	229.4
Exhaust Loss	mm H2O	415.00 @ ISO Conditions	
Relative Humidity	%	66	
Application		Hydrogen-Cooled Generator	
Power Factor (lag)		0.85	
Combustion System		DLN Combustor	

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ference in NO_x emissions can be expected if reaction zone equivalence ratio, water injection rate are equal.

As shown in *Figure A-3*, the rate of NO_x production dramatically decreases as flame temperature decreases (i.e., the flame becomes fuel lean). This is because of the exponential effect of temperature in the Zeldovich Mechanism and is the reason why diluent injection (usually water or steam) into a gas turbine combustor flame zone reduces NO_x emissions. For the same reason, very lean dry combustors can be used to control emissions. Lean, dry control is desirable for reaching the lower NO_x levels now required in many applications, and also to avoid the turbine efficiency penalty associated with diluent injection.

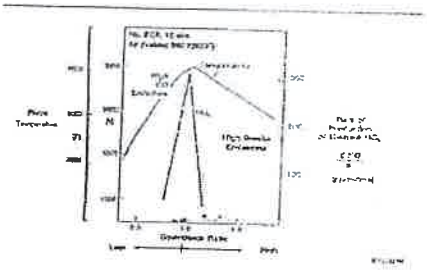

Figure A-3. NO_x production rate

There are two design challenges associated with very lean combustors. First, care must be taken to ensure that the flame is stable at the design operating point. Second, a turndown capability is necessary since a gas turbine must ignite, accelerate, and operate over the load range. Both of these challenges are driven by the need to operate the combustor at low flame temperatures to achieve very low emissions. Therefore the combustor operating point at full load is just above the flame blowout point, which is the point at which a premixed fuel and air mixture is unable to self sustain. At lower loads, as fuel flow to the combustors decreases, the flame temperature will approach the blowout point and at some point the flame will either become unstable or blow out. This behavior is in direct contrast to that of a diffusion flame combustor. In that type of combustor the fuel is injected unmixed and burns at maximum flame temperature using only a portion of the available air. This results in high NO_x emissions, but has the benefit of very good stability because the flame burns at the same temperature independent of fuel flow.

In response to these challenges, combustion system designers use staged combustors so a portion of the flame zone air can mix with the fuel at lower loads or during startup. The two types of staged combustors are fuel-staged and air-staged (*Figure A-4*). In its simplest and most common configuration, a fuel-staged combustor has two flame zones; each receives a constant fraction of the combustor airflow. Fuel flow is divided between the two zones so that at each machine operating condition, the amount of fuel fed to a stage matches the amount of air available. An air-staged combustor uses a mechanism for diverting a fraction of the airflow from the flame zone to the dilution zone at low

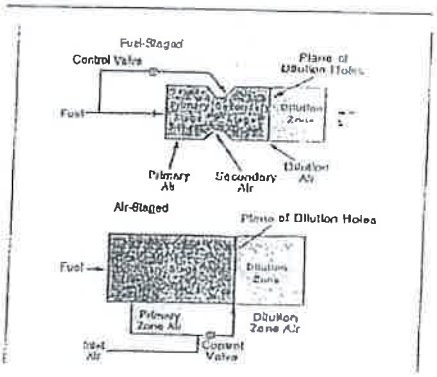

Figure A-4. Staged combustors

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lead to increase turndown. These methods can be combined, but both work to achieve the same objective, to maintain a stable flame temperature just above the blowout point.

Emissions Control Methods

There are three principal methods for controlling gas turbine emissions:

- Injection of a diluent such as water or steam into the burning zone of a conventional (diffusion flame) combustor
- Catalytic clean-up of NO_x and CO from the gas turbine exhaust (usually used in conjunction with the other two methods)
- Design of the combustor to limit the formation of pollutants in the burning zone by utilizing "lean-premixed" combustion technology

The last method includes both DLN combustors and catalytic combustors. GE has considerable experience with each of these three methods.

Since September 1979, when regulations required that NO_x emissions be limited to 75 ppmvd (parts per million by volume, dry), more than 300 GE heavy-duty gas turbines have accumulated more than 2.5 million operating hours using either steam or water-injection to meet required NO_x emissions levels, sometimes producing levels even lower than required. The amount of water required to accomplish this is approximately one-half of the fuel flow. However, there is a 1.8% heat rate penalty associated with using water to control NO_x emissions for oil-fired simple-cycle gas turbines. Output increases by approximately 3%, making water (or steam) injection for power augmentation economically attractive in some circumstances (such as peaking applications).

Single-nozzle combustors that use water or steam injection are limited in their ability to reduce NO_x levels below 42 ppmvd on gas fuel and 65 ppmvd on oil fuel. GE developed multi-nozzle quiet combustors (MNQC) for the MS7001EA and MS7001FA capable of achieving 25 ppmvd on gas fuel and 42 ppmvd on oil, using either water or steam injection. Since October 1987, more than 26 MNQC-equipped MS7001s that use water or steam injection have been placed in service. One unit that uses steam injection has operated nearly 50,000 hours at 25 ppmvd NO_x (at 15% O_2).

Frequent combustion inspections and decreased hardware life are undesirable side effects that can result from the use of diluent injection to reduce NO_x emissions from combustion turbines. For applications that require NOx emissions below 42 ppmvd (or 25 ppmvd in the case of the MS7001EA or MS7001FA MNQC), or to avoid the significant cycle efficiency penalties incurred when water or steam injection is used for NO_x control, one of the other two principal methods of NO_x control mentioned above must be used.

Selective catalytic reduction (SCR) converts NO and NO_2 in the gas turbine exhaust stream to molecular nitrogen and oxygen by reacting the NO_x with ammonia in the presence of a catalyst. Conventional SCR technology requires that the temperature of the exhaust stream remain in a narrow range (550°F to 750°F or 288°C to 399°C) and is restricted to applications with a heat recovery system installed in the exhaust. The SCR is installed at a location in the boiler where the exhaust gas temperature has decreased to the above temperature range. New high-temperature SCR technology is being developed that may allow SCRs to be used for applications without heat recovery boilers.

Annexure - V

TOR No. 17: Examine the feasibility of zero discharge. In case of any proposed discharge, its quantity, quality and point of discharge, users downstream etc. should be provided. The effluent shall be treated and reused to meet the service and greenbelt development water requirement.

Compliance:

In the gas based power plant most of the input water is used for CW make up, DM water generation Etc. As Ash / Coal handling system is not required for the proposed plant, waste water/ effluents generated from the gas based Combine cycle power plant is minimum and quality of the effluents generated shall be within the prescribed limits.

Following effluents will be generated from the proposed power plant

1. CW Blow down-175 M3 /hr
2. RO DM Plant reject : 20 M3 /hr
3. HRSG Blow down : 7.5 M3/hr
4. Plant wash drains etc : 2-3 M3 /hr

We are proposing

1. Reuse the CW Blow after softening treatment and Microfiltration for RO DM requirement and also for CW Make UP
2. RO DM reject by evaporation and crystallizer separating the sludge and permeate to be used for CW make UP
3. HRSG Blow down to be treated for PH correction and to be reused for CW make
4. Plant wash drains: shall be treated in a Lammell clarifier and used for green belt development.

All efforts shall be made to reuse the waste water generated from the plant for

1. Green belt development
2. Plant washing
3. Fire hydrant requirements
4. Toilets flushing etc

Zero discharge scheme shall be adopted for waste water disposal in the proposed gas based combined cycle power plant.

Proposed Process details are as below:

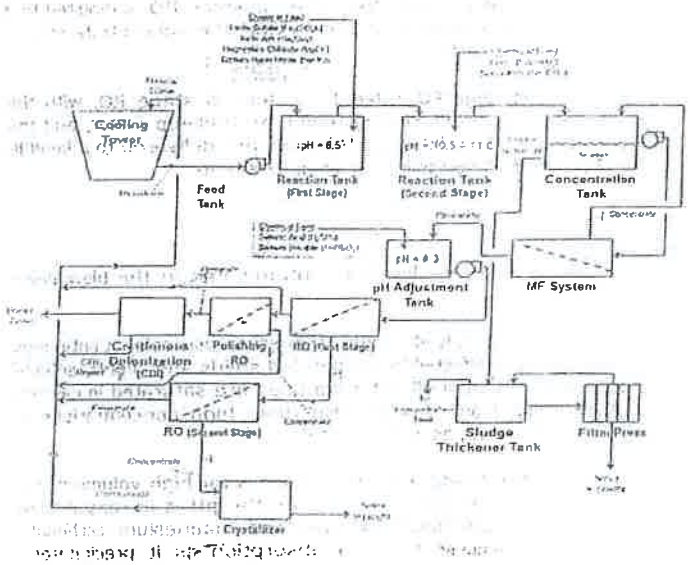
A Unique Zero Liquid Discharge System Utilizing Microfiltration Technology

Microfiltration (MF) technology is used to treat and reuse cooling tower blow down in a ZLD (Zero Liquid Discharge) process.

The process consists of chemical addition to the blow down water to effect hardness and silica removal by precipitation. The precipitated solids are then continuously removed with microfiltration technology.

The MF treated water (permeate) is pH adjusted and directed to a first stage reverse osmosis (RO) unit, where a portion of it is permeate is sent directly to the cooling tower as makeup water, and the remainder to a polishing RO with its permeate treated with Continuous Deionization (CDI) technology for boiler feed. The concentrate stream from the first stage RO unit is sent to a second stage RO with its permeate utilized as cooling tower makeup, and concentrate dewatered in a crystallizer. The polishing RO concentrate stream is utilized as cooling tower makeup water.

Below is a schematic of this system.



Process Description

Cooling tower blow down is pumped to a first stage reaction tank. Ferric sulfate, soda ash, magnesium chloride and sodium hypochlorite (bleach) are added; the pH in this tank is approximately 8.5, which initiates precipitation of calcium carbonate and silica.

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Effluent from the first stage reaction tank overflows into a second stage reaction tank which receives lime and soda ash, raising the pH to 10.5-11.0, to further precipitate calcium carbonate and silica.

This tank overflows into a concentration tank which also receives the concentrate ("reject") stream from a microfiltration (MF) system. The concentration tank collects precipitated and chemically saturated solids, and the resulting sludge is fed to a sludge thickener tank.

The suspended solids slurry in the concentration tank is directed to an MF system for virtually complete removal of these solids. The MF permeate (that portion of the feed stream that passes through the membrane), flows into the pH adjustment tank where it receives sodium bisulfite to neutralize chlorine (from the bleach addition) in the tank, and hydrochloric acid to lower the pH to 6.3.

As stated earlier, the MF concentrate (that portion of the feed stream that passes across and over the membrane surface) transports suspended solids out of the MF system and back to the concentration tank. Over time, the total solids concentration in this tank increases to about 5%, at which time, the solids are pumped to the sludge thickener tank that feeds a filter press. The dewatered solids are hauled to a landfill and the liquid portion is directed back to the concentration tank.

From the pH adjustment tank, the treated MF permeate is processed with reverse osmosis (RO) technology, and the first stage permeate stream is either returned as makeup to the cooling tower or fed to a polishing RO. The permeate from the polishing RO is directed to a Continuous Deionization system to produce boiler feed water, and the concentrate stream becomes part of the cooling tower makeup water.

The concentrate stream from the first stage RO is fed to a second stage RO, with the permeate from this system directed back to the cooling tower as makeup water, and the concentrate stream fed to a crystallizer. The solids from this unit are delivered to a landfill, and the crystallizer condensate returned to the cooling tower as makeup.

Filtration Requirements

As water evaporates, as in a cooling tower, the level of contaminants in the blow down water increases significantly.

The technologies required to remove dissolved solids (reverse osmosis, Continuous Deionization, and others), are deleteriously affected by suspended solids and slightly soluble salts that precipitate upon concentration. Almost all water supplies are saturated in calcium and magnesium carbonate. Additionally, many supplies also have high concentrations of silica, another relatively insoluble contaminant, as well as sulfate salts.

Conventional lime softening is the traditional water softening process for high volume flows, and involves adding lime [Ca(OH)2] and soda ash (Na2CO3). As the pH is increased from the lime addition, calcium carbonate, magnesium hydroxide and magnesium carbonate precipitate. Magnesium hydroxide also removes silica via absorption as it precipitates.

Virtually all reverse osmosis membrane elements are of the spiral wound configuration, as illustrated below.

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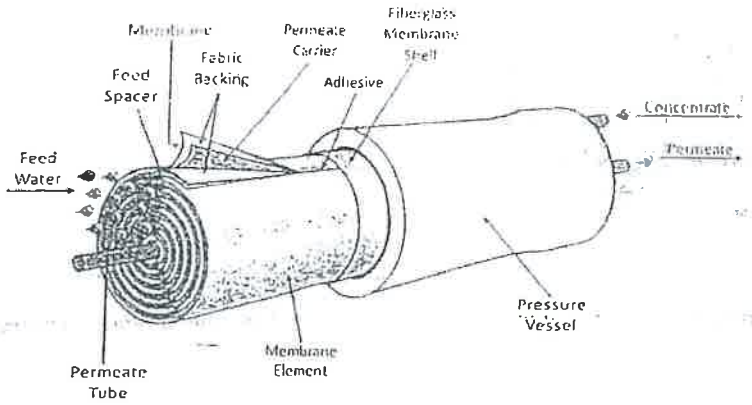
Spiral Wound Membrane Element inside a Pressure Vessel

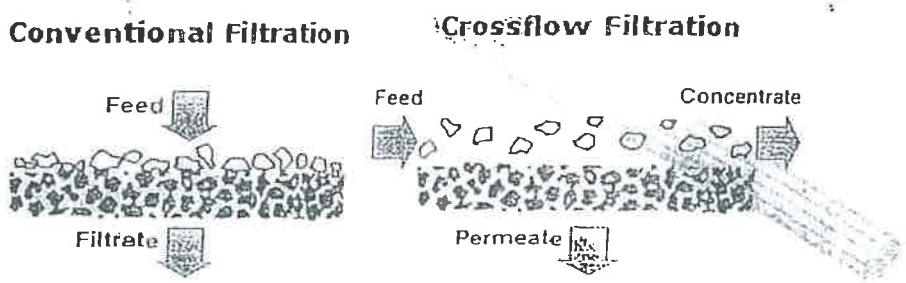


Although the least expensive of all the membrane element configurations, spiral wound reverse osmosis membrane elements are the most susceptible to fouling by suspended solids. In many cases, the normal multimedia filtration process, often utilized in lime softening, does not provide adequate suspended solids removal to minimize membrane fouling. This is where the superior filtration capabilities of MF technology can be exploited.

Microfiltration

Microfiltration is a cross flow, pressure-driven membrane separation technology designed to remove submicron (and larger) suspended solids from water supplies. It differs from conventional ("dead-end") filtration in that in this process, the entire water supply passes through the filter medium, whereas in the cross flow process, a portion passes through the membrane, becoming "permeate," while the remainder exits the system as "concentrate," carrying away almost all of the suspended solids.

The following illustration compares these two processes.



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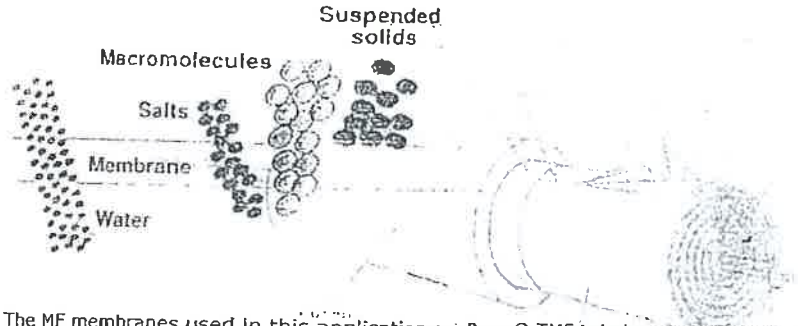
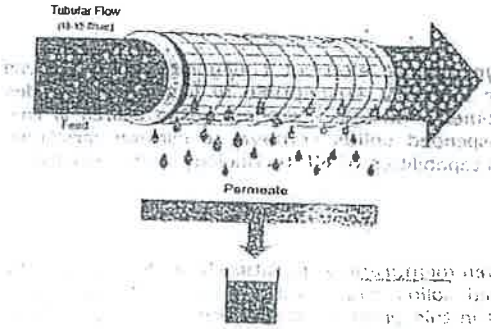
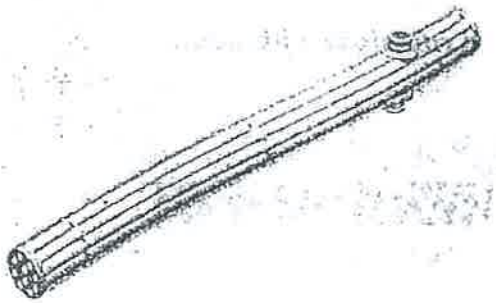
The mechanism of microfiltration is depicted below.



The MF membranes used in this application are Porex® TMF tubular membranes, depicted below.



Specifically, the tubes are 1" I.D., with a polyethylene substrate supporting a PVDF (polyvinylene fluoride) layer with 0.10μ pores. The membrane modules are illustrated below.



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Each membrane module consists of ten 72" long tubes enclosed inside a PVC housing. Specifications on the modules and tubes are as follows:

Modules	
Housing Diameter	6" Schedule 40
Permeate Port (Qty 2)	2.875"Ø x 1.89" L pipe stub
Concentrate Ports	6"Ø pipe Anvil Grimlok groove
Mounting Required	Horizontal, 2 point
Module Length	72"
Tubes	
Number of Tubes	10
Nominal ID	1"
Nominal OD	1.34"
Total Active Surface Area	15.2 ft²
Internal Liquid Volume	
Permeate Volume	4.33 gallons
Concentrate Volume	2.45 gallons
Total Volume	6.78 gallons
Materials of Construction	
Potting	Solvent Cement
Internal Supports	Polypropylene
Gasket Material	None
Preservative (Shipping)	Propylene Glycol
Membrane	PVDF

The feed flow is down the center of the tube (lumen feed) with the permeate passing through the tubular wall and collected from the area around the outside of the tubes inside the housing.

System Design

MF System

The modules are divided into six skids, each containing three trains of 12 modules linked in series. The feed stream enters one end of the first module with the concentrate exiting the other end as feed for the next module. This flow continues through the 12 modules, and returns to the concentration tank. Meanwhile, the permeate from each module is collected in parallel and fed to a header where it is directed to the pH adjustment tank for further treatment by reverse osmosis.

A train of 12 modules is illustrated below:

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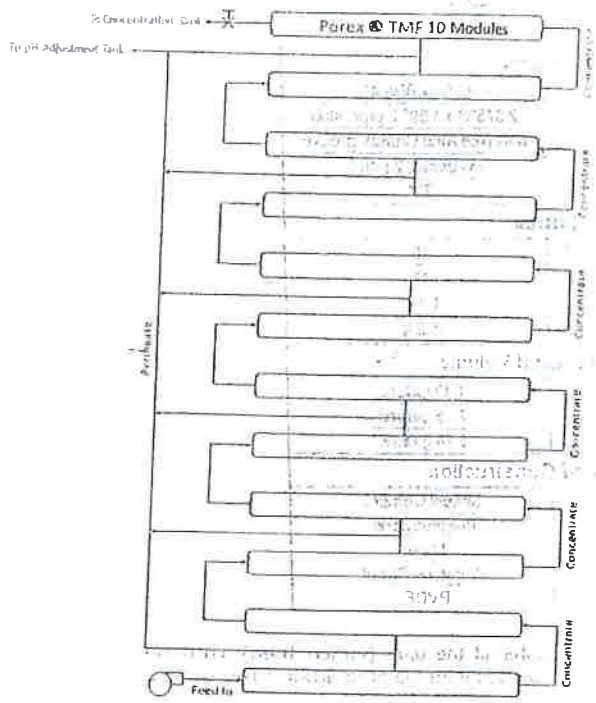
MF System Schematic



The following table summarizes the performance of this MF system:

Parameter	MF Feedwater	MF Permeate
pH	8.0	10.7
Total Hardness	2122 mg/L	127 mg/L
Total Alkalinity	58 mg/L	197 mg/L
Turbidity	4.63	0.03 NTU
Silica	99 mg/L	6 mg/L

Reverse Osmosis (RO)

The first stage RO removes dissolved solids with a portion of its permeate supplying the cooling tower with makeup water, and the remaining permeate flow directed to a polishing RO for additional dissolved solids removal and then further purified in a Continuous Deionization unit to produce high quality boiler feedwater.

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The concentrate streams from the first stage and polishing RO units are combined and fed to a second stage RO with its permeate utilized as cooling tower makeup water, and its concentrate treated in a crystallizer to produce solids for landfilling and the condensate used for cooling water makeup.

As the MF process so effectively removes suspended solids, the RO concentrate streams could actually be returned to the front end of the system for further treatment.

The following table lists the feed and permeate rates for the RO systems; along with the resulting recovery calculations (permeate rate ÷ feed rate) for each.

	Membrane Systems Flows and Recoveries		
	First Stage RO	Polishing RO	Second Stage RO
Feed Rate (gpm)	350	110	150
Permeate Rate (gpm)	255	82	100
System Recovery (%)	73%	75%	67%

Cleaning

Because the MF system continually dewaters the precipitated hardness and silica solids, removing the filtered water and returning the solids to the concentration tank, these solids steadily increase in this tank to 5% (wt%). At this point, the solids are drained into the sludge thickener tank ahead of the filter press.

As these solids in the concentration tank increase, the likelihood of fouling inside the tubular membrane elements also increases, which reduces the permeate flow through the membrane. To minimize this, the velocity of liquid is maintained at a high flow rate (12-15 ft/sec) to ensure turbulence inside the membrane elements.

Although chlorine is added to reduce bacterial activity, the high pH environment reduces the efficacy of this disinfectant, and care must also be taken to ensure that is completely removed prior to the RO units.

When fouling increases to a certain point, a number of procedures can be employed to restore flux, including back pulsing with air or permeate, backwashing with permeate, or interrupting the flow through the modules to allow the membranes to "relax," and fouling material to drop off the membrane surface.

Acid Cleaning

When the permeate rate from a skid drops to approximately 60 gpm, chemical cleaning is required. Usually, the modules are initially cleaned with a 3-5% hydrochloric acid (HCl) solution to dissolve accumulated calcium carbonate and other acid-soluble deposits.

Utilizing a dedicated CIP (clean-in-place) system, the acid solution is pumped into the skid, and this cleaning solution is circulated through the MF modules for 15 minutes, followed by a 45 minute soak. The solution is then re-circulated through the membrane system for another 45 minutes. This solution is then returned to the CIP storage tank and the modules flushed and rinsed with collected water, which is also returned to the rinse tank for reuse.

Caustic Cleaning

When acid cleaning is no longer effective in restoring the flux rate (usually between one and four times per month - a function of the time of year), a high pH cleaning is performed. This CIP system utilizes sodium hydroxide (NaOH) and sodium hypochlorite (NaOCl) in a cleaning solution containing 12-15% NaOCl at a pH of 12-13. This cleaning step is effective in removing biofilm and other organic foulants.

The solution is circulated through the MF modules for 30 minutes, followed by a 150 minute soak and 30 minutes of recirculation.

The MF system was designed with an extra skid so that one is always available for these cleaning processes, without affecting the total plant processing rate.

Conclusions

Each component in this system contributes to the overall success of this unique design. The chemical additions to the reaction tanks result in hardness and silica precipitation. The MF system continuously removes clarified water from the solids. This treated water is further polished with RO technology to remove salts to either generate cooling tower makeup water or to feed Continuous Deionization technology to produce boiler feedwater.

The effectiveness of MF technology is underscored by the fact that the RO units can recover a very high percentage of the treated water for complete reuse. In addition, the RO membranes need cleaning no more frequently than every six months.

The sludge resulting from hardness and silica precipitation is dewatered in a filter press and landfilled. The liquid stream from the filter press is redirected to the MF system.

The concentrated salts from the reverse osmosis units are rendered insoluble in a crystallizer with these solids landfilled. The crystallizer condensate is also used as cooling tower makeup.

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Annexure-VI

TOR 18. Details of green belt i.e., land with not less than 1500 trees per Ha giving details of species width of plantation, planning schedule etc.,

Compliance

Total land available for location the plant facilities and future expansion and green belt development is 65 acres or 26.4 hectares. It is proposed to develop green belt in 9 hectares of land which works out to 33% of the area available.

Design of Green Belt:

The following guidelines will be considered in green belt development.

Green Belt consisting of three tiers of plantations of native species around plant shall be raised in consultation with Forest Department.

The spacing between the trees will be maintained slightly less than the normal spaces, so that the trees may grow vertically and slightly increase the effective height of the green belt.

Planting of trees in each row will be in staggered orientation.

Since the tunks of the tall trees are generally devoid of foliage, it will be useful to have shrubs in front of the trees so as to give coverage to this portion.

Shrubs and trees will be planted in encircling rows around the project site.

The short trees (<10 m height) will be planted in the first two rows (towards plant side) of the green belt. The tall trees (>10 m height) will be planted in the outer three rows (away from plant side).

Nursery raised seedlings in polypots@1500 seedlings per ha will be planted in previously excavated and treated pits. Nine months to one and half year old seedlings will be used depending on growth characters. Pits will be dug of 45 cm. cube in June and September when soil is still moist and allowed to wither. To each pit a basketful of farm yard manure/compost and 30 gm basal dose of NPK will be added before planting to improve soil texture and nutrient status. Half moon trenches will be made on uphill side of sloping land or saucer made in flat land to conserve moisture.

Mulching will be done after first soil working/weeding in 1m radius to improve soil moisture and minimize weed growth. Plantation will be watered as and when required. As a preventive against termite, 20 gm of neem cake will be added around each plant. Plantation

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will be kept properly weeded; fire may protect and will be stone-wall fenced against cattle for 5 years till rise above browsable height. The choice of species will be as follows

Species Adaptable To the Site and Recommended

S. No.	Scientific Name	Common Name
1.	*Azadirachta indica*	Neem (Bhevu)
2.	*Bombax ceiba*	Red Silk Cotton (Buruga)
3.	*Butea monosperma*	Flame of the forest (Mutluga)
4.	*Cochlospermum gossypium*	White Silk Cotton (Kaduburuga)
5.	*Dendrocalamus strictus*	Bamboo
6.	*Erythrina indica/verigata*	Indian Coral Tree (Harivana)
7.	*Erythrina suberosa*	Erythrina (Mullu muruku)
8.	*Eugenia jambolana*	Jamun (Dudda Nerale)
9.	*Ficus benghalensis*	Banyan (Goni Mara)
10.	*Ficus racemosa*	Ficus (Aathi hannu)
11.	*Ficus religiosa*	Peepul (Aarali Mara)
12.	*Firmiana colorata*	Scarlet-Sterculia
13.	*Gliricidia sepium*	Gliricidia
14.	*Madhuca latifolia*	Mahua (Hippe)
15.	*Millingtonia hortensis*	Indian Cork Tree (Birate mara)
16.	*Parkia biglandulosa*	Badminton ball tree
17.	*Pithecellobium dulce*	Madras thorn (Bettada Hunise)
18.	*Pongamia pinnata*	Pongamia (Honge)
19.	*Spondias pinnata*	Amate Kai
20.	*Syzygium cumini*	Jamun (Sanna Nerale Mara)

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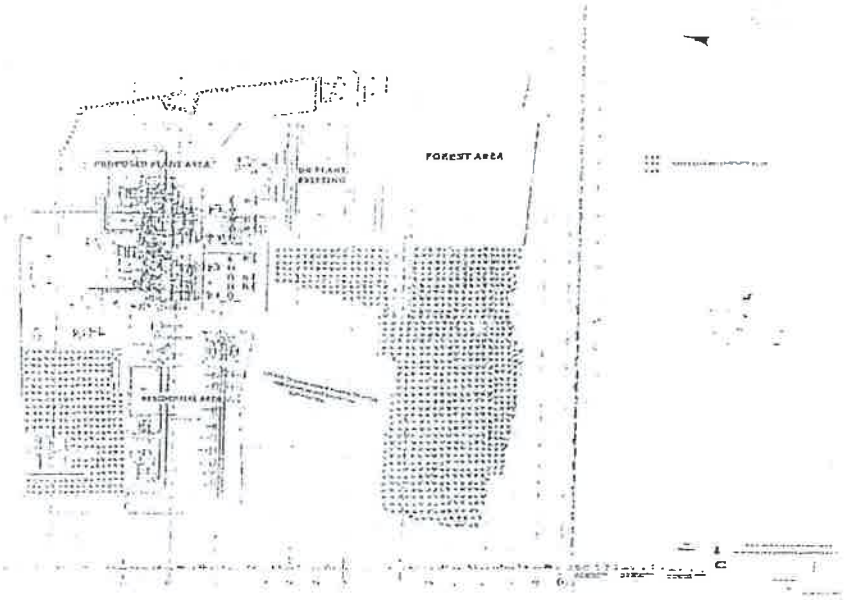

Fig: Green Belt Development Plan

Action Plan with Budget Allocation for Plantation

The proposed green belt development plan will be complete as per action plan

Action Plan With Budgetary For Plantation

Year	No. of plant	Area (ha)	Capital Cost (INR)	Recurring cost (INR)
1st Year	3200	2	50,000.00	15,000.00
2nd Year	3200	2	50,000.00	15,000.00
3rd Year	3200	2	50,000.00	15,000.00
4th Year	3200	2	50,000.00	15,000.00
5th Year	1600	1	20,000.00	10,000.00
Total	**14400**	**9**	**2,20,000.00**	**70,000.00**

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Annexure-VII

Compliance regarding dismantling of the Existing DG plant structures

Preamble:

KPCL owns and operated 128MW DG based power plant located at Yelhanka, Bangalore, spread approximately. 102 Acres which run on fuels such as diesel/LSHS/LSFO. The generation from DG plant has stopped from AUGUST 2013 due to high cost of generation and non availability of continuous supply of LSHS fuel.

A. Existing KPCL Infrastructure available at DG plant site.

1. Administrative Block
2. Guest House and Play Ground
3. Residential Buildings
4. Overhead tank and Sump
5. DG Plant and Associated facilities

B. Existing IOCL Infrastructure available at DG plant site.

1. Administrative main office building and other associated buildings like canteen, staff room, training and lab etc...
2. Fuel oil tanks, water tanks and Pipelines
3. Fire pump house and accessories
4. Railway marshaling yard with all infrastructure to handle Oil tankers received at site

C. Dismantling of structure/system for implementing 1×350 MW gas based Combined cycle power plant

It is proposing use all the existing building infrastructures for the plant activities like Ware house / Chemical building/Electrical labs/Contraction store rooms and offices Etc. A very few structure/system are to be dismantled for the proposed project which includes the following and will be dismantled by adopting best engineering practice duly considering safety and environmental aspects.

a. Railway sidings in the marshaling yard.
b. KPCL stores
c. All Fuel oil tanks, pipelines and other accessories.

D .Procedure adopted for dismantling of structure /system

All the proposed dismantling activities shall be carried out as follows

1. Dismantling activity shall be carried out under strict supervision (three levels) with assistance of experienced workers.
2. All the dismantling activities shall be carried out during the day hrs only (800 hrs to 1800 hrs).
3. All the electrical installation and connections are isolated before the start of any dismantling.

4. Simultaneous dismantling activity shall not be carried out and new activity shall be taken up only after the completion of each activity.
5. Suitable material handling equipments like Cranes, JCB, Jigs, and fixtures shall be used for dismantling.
6. To avoid the fire hazards .
   a. All the surrounding areas shall be cleaned; dry grass/bushes dead trees shall be removed.
   b. Arrangements shall be made for the fire hydrant system with mobile fire tenders.
   c. Necessary fire extinguishers in sufficiently quantity shall be made available
   d. Well trained Firefighting crews with all safety gadgets are made available

7. Dismantling of railway sidings:
   a. Experts workers shall be engaged for railway track removal
   b. Removal of Rails, clips, crossings and sleepers
   c. Removal of Product pipelines shifting to designated separate stock yard
   d. Dismantling and Removal of gantry structures and stocking in the designated places separately
   e. Removal of Concrete Aprons and Ballast by using pneumatic concrete breakers.
   f. Shifting of all dismantled materials and stocking it separately in the designated areas for easy disposal.

E. Removal of oil pipelines and storage tanks

Oil pipelines with Gantry which are used for the decantation of fuel oil from railway tankers to storage tanks runs around 100 mts varying size pipes including space heating system along with 9 numbers storage tank of capacity 15700KLiters.

All these dismantling works shall be carried out under supervision of IOCL staff and as per IOCL safety procedures and environmental precautions. KPCL staff shall ensure the Fire and Safety procedures to be followed as per the guidelines.

F. Dismantling of oil tanks

1. Ensure the emptying of oil tanks
2. Isolation the tanks by dismantling all connected pipe lines.
3. Isolate and dismantle all electrical connections if any
4. Remove all accessories /instruments.
5. All the surrounding areas shall be cleaned; dry grass/bushes dead trees shall be removed
6. Through cleaning and separate storing the sludge for disposal.
7. Filling up of tank with water to absorb temperature while cutting.
8. Fire shielding.
9. Necessary fire extinguishers in sufficiently quantity shall be made available
10. Well trained Firefighting crews with all safety gadgets are made available
11. Necessary arrangements like Cranes, Jigs, Fixtures and suitable materials handling equipments to be used while dismantling the steel structures.
12. Stack the dismantled steel martials separately at distance so as to keep easy access to dismantling areas.
13. While dismantling at higher elevation suitable safety gadgets shall be used by all the works

All possible efforts shall be made to dispose of the dismantled items and to keep the area clean and tidy. In case of excavation required for dismantling shall be filled back after the completion of the works.

Annexure-R10

State Level Environment Impact Assessment Authority-Karnataka

(Constituted by MoEF, Government of India under section 3(3) of EP(P)A, 1986)

No. SEIAA 20 IND 2014 Date: 01-09-2015

To,

M/s. Karnataka Power Corporation Limited
(A Govt. of Karnataka Enterprise)
22/23, Sudharshan Complex, Sheshadri Road,
Bengaluru- 560 009

Sir,

Sub: Establishment of 1No X 350±20%MW capacity Gas based Yelahanka Combined Cycle Power Plant at Survey Nos. 44(P), 45, 46, 47/1-2, 48, 56/1 to 9, 57, 58, 59, 60/1-2, 61, 62/1-2, 63, 64, 65, 66/1-2, 67 of Puttenahalli Village and Survey Nos. 24, 25, 26(P), 28(P) of Kenchenahalli Village, Yelahanka, Bengaluru District of M/s. Karnataka Power Corporation Limited - Issue of Environmental Clearance - Reg

*****

This has reference to your application dated 28th December 2014 addressed to SEIAA, Karnataka and subsequent letters addressed to SEIAA/SEAC, Karnataka seeking prior environmental clearance for the above project under the EIA Notification, 2006. The proposal has been appraised as per prescribed procedure in the light of the provisions under the EIA Notification, 2006 on the basis of the mandatory documents enclosed with the application viz., the Application in Form 1, EIA report, project report for an establishment of proposed Gas based Combined Cycle Power Plant and the additional clarifications furnished in response to the observations of the SEAC, Karnataka. SEAC has recommended for issue of Environmental Clearance in its meetings held on 5th & 6th August 2015.

2. It is, inter-alia, noted that M/s. Karnataka Power Corporation Limited have proposed for 1No. X 350 ±20%MW capacity Gas based Yelahanka Combined Cycle Power Plant. The total plot area is 26.4 Ha. Out of 26 Ha, 1.60 Ha area is for main plant, 0.4 Ha area is for Transformer yard, 0.8 Ha area is for Switch Yard, 0.05Ha area is for Guard Pond/ ETP, 0.39Ha area is for Cooling Tower, 2.32Ha area is raw water reservoir, 4 Ha area is for future expansion,

Room No. 706, 7th Floor, 4th Gate, M.S. Building, Bangalore - 560 001. Phone: 080 2202 [illegible] Fax: 080 22[illegible]
e-mail: mosejakarnataka@gmail.com Website: http://seiaa.kar.nic.in

7.8Ha area is for Miscellaneous facilities and 9Ha area is for Green Belt Development. The raw material used for power plant is Natural Gas of 1.47MMSCMD sourced from M/s GAIL Limited through Pipeline. Total water consumption of 14.4MLD will be met from BWS&SB supply out of which 8.4MLD for Evaporation and Drift Losses in cooling Tower, 4.2 MLD for Blow down from Cooling tower, 1.32MLD for RO and DM plant and 0.48 MLD for Dilution water to Guard Pond. The total wastewater generation will be 5.34MLD. The total cost of the project is Rs 1,571.18 Crores.

3. The project proposal has been considered by SEAC during the meeting held on 13th and 14th January 2015 and ToR was issued on 19th January 2015 for conducting Environment Impact Assessment (EIA) Study. The project is located within the notified industrial area and hence does not require public consultation. The EIA has been conducted and report submitted by M/s Mantec Consultants Pvt. Ltd. D-36, Sector-6, Noida, Gautambudh Nagar, Uttar Pradesh-201301.The proponent has submitted the EIA report on 23rd July 2015.

4. Based on the information submitted by you and your consultant M/s. Mantec Consultants Pvt. Ltd. D-36, Sector-6, Noida-201301, The State Level Expert Appraisal Committee (SEAC) examined the proposal in the meeting held on 5th and 6th August 2015 and has recommended for issue of Environmental Clearance.

5. The SEIAA Karnataka has considered the project in its meeting held on 29th August 2015 and after due consideration of the relevant documents submitted by the project proponent and additional clarifications furnished in response to its observations and the appraisal and recommendation of the SEAC, have accorded environmental clearance as per the provisions of Environmental Impact Assessment Notification-2006 and its subsequent amendments, subject to strict compliance of the following terms and conditions:-

Part A- SPECIFIC CONDITIONS

1. A stack of 45 m height shall be provided with continuous online monitoring equipments for SO_x, NO_x and RSPM.
2. Auxiliary Cooling Water System (ACW) shall be provided. The Effluents shall be treated as per the prescribed norms.
3. The treated effluents conforming to the prescribed standards only shall be re-circulated and reused within the plant.
4. Rainwater harvesting should be adopted. Central Groundwater Authority/ Board shall be consulted for finalization of appropriate rainwater harvesting technology within a period of three months from the date of clearance and details shall be furnished.
5. Adequate safety measures shall be provided in the plant area to check/minimize spontaneous fires. Copy of these measures with full details along with location plant layout shall be submitted to the SEIAA.

...Environmental Impact Assessment Authority, Karnataka
...Government of Karnataka
...Establishment of New Coal Based Thermal Power Plant
...Yelahanka Taluk, Bangalore Rural District
...by M/s. Yelahanka Power Company Limited

6. Storage facilities for the fuel shall be made in the plant area in consultation with Department of Explosives, Nagpur. Disaster Management Plan shall be prepared to meet any eventuality in case of an accident taking place due to storage of fuel.
7. Regular monitoring of ground water level shall be carried out by establishing a network of existing wells and constructing new piezometers.
8. Green Belt consisting of 3 tiers of plantations of native species around plant and at least 100 m width shall be raised. Wherever 100 m width is not feasible a 50 m width shall be raised and adequate justification shall be submitted. Tree density shall not be less than 2500 per ha with survival rate not less than 70 %. Heavy foliage indigenous tree species such as Mahagoni, Honga, Neem, Akash Mallige, Kadamba, Ficus, Ashoka, etc shall be planted. The plantation area shall not be less than 33 % of the total project area.
9. First Aid and sanitation arrangements shall be made for the drivers and other contract workers during construction phase.
10. Noise levels emanating from turbines shall be so controlled such that the noise in the work zone shall be limited to 75 dBA. For people working in the high noise area, requisite personal protective equipment like earplugs/ear muffs etc. shall be provided. Workers engaged in noisy areas such as turbine area, air compressors etc shall be periodically examined to maintain audiometric record and for treatment for any hearing loss including shifting to non noisy / less noisy areas.
11. Regular monitoring of ground level concentration of SO_2, NO_x, RSPM (PM_{10} & $PM_{2.5}$) and Hg shall be carried out in the impact zone and records maintained. If at any stage these levels are found to exceed the prescribed limits, necessary control measures shall be provided immediately. The location of the monitoring stations and frequency of monitoring, shall be decided in consultation with KSPCB. Periodic reports shall be submitted to the Regional Office of MOEF. The data shall also be put on the website of the company.
12. Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, creche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.
13. The proponent shall upload the status of compliance of the stipulated EC conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MoEF at Bangalore / KSPCB/ CPCB/ the Department of Ecology & Environment, Government of Karnataka, Bangalore and Regional Director (Environment), Department of Ecology & Environment, Government of Karnataka. The criteria pollutant levels namely; RSPM, SO_2, NO_x (ambient levels as well as stack emissions)shall be displayed at a conveinent location near the main gate of the company in the public domain.
14. The project proponent shall also submit half yearly reports on the status of compliance of the stipulated EC conditions including results of monitored

data (both in hard copies as well by e- mail) to the respective Regional Office of MoEF at Bangalore / KSPCB/ CPCB/, the Department of Ecology & Environment, Government of Karnataka, Bangalore and Regional Director (Environment), Department of Ecology & Environment, Government of Karnataka, Belgaum.

15. The environment statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of EC conditions and shall also be sent to the respective Regional Offices of the Ministry by e-mail.

16. Project proponent shall up-load the compliance status in their website and up-date the same from time to time, at least six monthly basis. Criteria pollutants levels including NOx (from stack & ambient air) shall be displayed at the main gate of the power plant.

17. The project proponent shall submit half yearly reports on the status of the implementation of the stipulated environmental safeguards to the Ministry of Environment and Forests, its Regional Office, Central Pollution Control Board and State Pollution Control Board. The project proponent shall upload the status of compliance of the environment of the environmental clearance conditions on their website and update the same periodically and simultaneously send the same by e-mail to the Regional Office, Ministry of Environment and Forests.

18. Separate funds shall be allocated for implementation of environmental protection measures along with item-wise break-up. These cost shall be included as part of the project cost. The funds earmarked for the environment protection measures shall not be diverted for other purposes and year wise expenditure should be reported to the Ministry.

19. The project authorities shall inform the Regional Office as well as the Ministry regarding the date of financial closure and final approval of the project by the concerned authorities and the dates of start of land development work and commissioning of plant.

20. Full cooperation shall be extended to the Scientists/Officers from the Ministry / Regional Office of the Ministry at Bangalore / CPCB/ KSPCB who would be monitoring the compliance of environmental status.

21. The Project-Authorities shall commence the construction activity only after obtaining required approval from the competent authority for supply of water for the project.

22. The project authority should conduct regular health checkup of the people living in the villages within a radius of 10 KM from the industry.

23. No additional land shall be used /acquired for any activity of the project without obtaining proper permission.

24. For controlling fugitive natural dust, regular sprinkling of water & green shields at appropriate distances in vulnerable areas of the plant shall be

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ensured. Necessary arrangement shall be made to adequate safety and ventilation arrangement in Turbine and Generator area.

25. Occupational health surveillance of the workers shall be done on a regular basis and record maintained as per Factories Act.

26. Adequate safety measures shall be provided to limit the risk zone within the plant boundary, in case of an accident. Leak detection devices shall also be installed at strategic places for early detection and warning.

B. GENERAL CONDITIONS:

1. A separate Environment Management Cell with qualified staff shall be set up for implementation of the stipulated environmental safeguards.
2. The project authorities shall strictly adhere to the stipulations made by the Karnataka State Pollution Control Board (KSPCB).
3. At no time, the emissions shall exceed the prescribed limits. In the event of failure of any pollution control system adopted by the unit, the unit shall be immediately put out of operation and shall not be restarted until the desired efficiency has been achieved.
4. No further expansion or modifications in the plant shall be carried out without prior approval of the SEIAA/Ministry of Environment and Forests as the case may be. In case of deviations or alterations in the project proposal from those submitted to this Authority for clearance, a fresh reference shall be made to the Authority to assess the adequacy of conditions imposed and to add additional environmental protection measures required, if any.
5. The project authorities shall strictly comply with the rules and regulations under Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 as amended in October 1994 and January 2000. Authorization from the KSPCB shall be obtained for collection, treatment, storage, and disposal of hazardous wastes.
6. The project authorities must strictly comply with the rules and regulations with regard to handling and disposal of hazardous wastes in accordance with the Hazardous Wastes (Management and Handling) Rules, 2003. Authorization from the KSPCB must be obtained for collection/treatment/storage/disposal of hazardous wastes.
7. Application of solar energy should be incorporated for illumination of common areas, lighting for gardens and street lighting in addition to provision for solar water heating. A hybrid system or fully solar system for lighting and heating should be provided. Details in this regard should be submitted to the SEIAA.
8. The overall noise levels in and around the plant area shall be kept well within the standards (85 dBA) by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels shall conform to the standards prescribed under Environment (Protection) Act, Rules, 1989 viz. DBA (day time) and 70 dBA (night time).
9. The project proponent shall also comply with all the environmental protection measures and safeguards as per the information provided.

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10. The implementation of the project vis-à-vis environmental action plans shall be monitored by MoEF Regional Office at Bangalore / KSPCB/ CPCB and the Department of Environment & Ecology, Bangalore. A six monthly compliance status report shall be submitted to monitoring agencies.

11. The project proponent shall inform the public that the project has been accorded environmental clearance by the SEIAA and copies of the clearance letter are available with the KSPCB and may also be seen at Website of the State Ecology and Environment department at http://seiaa.kar.nic.in, or http://seiaa.karnataka.gov.in This shall be advertised within seven days from the date of issue of the clearance letter, at least in two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned and a copy of the same shall be forwarded to the Regional Office of MoEF at Bangalore / KSPCB/ CPCB/, the Department of Ecology & Environment, Government of Karnataka, Bangalore and Regional Director (Environment), Department of Ecology & Environment, Government of Karnataka, Belgaum

12. The project authorities shall inform the Regional Office of MoEF at Bangalore / KSPCB/ CPCB/ the Department of Ecology & Environment, Government of Karnataka, Bangalore and Regional Director (Environment), Department of Ecology & Environment, Government of Karnataka, Belgaum, the date of financial closure and final approval of the project by the concerned authorities and the date of start of the project.

13. The SEIAA, Karnataka may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.

14. The SEIAA, Karnataka reserves the right to stipulate additional conditions, if found necessary. The company in a time bound manner will implement these conditions.

15. The above conditions will be enforced, inter-alia under the provisions of the Water (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, Hazardous Wastes (Management and Handling) Rules, 2003 and the Public Liability Insurance Act, 1991 along with their amendments and rules.

16. The issue of Environment Clearance doesn't confer any right to the project proponent to operate / run the project without obtaining statutory clearances / sanctions form all other concerned Authorities.

17. Concealing factual data or submission of false/ fabricated data and failure to comply with any of the conditions mentioned above may result in withdrawal of this clearance and attract action under the provisions of Environmental (Protection) Act, 1986.

18. Any Appeal against this environmental clearance shall lie with the National Environment Appellate Authority, if preferred, within a period of 30 days as prescribed under Section 11 of the National Environment Appellate Authority Act, 1997.

19. Officials from the Department of Environment and Ecology, Bangalore/ Regional Office of MoEF, Bangalore who would be monitoring the implementation of Environmental safeguards should be given full

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cooperation, facilities and documents/ data by the project proponents during their inspection. A complete set of all the documents submitted to MoEF / SEIAA should be forwarded to the Regional Office of MoEF at Bangalore / KSPCB/ CPCB/ the Department of Ecology & Environment, Government of Karnataka, Bangalore and Regional Director (Environment), Department of Ecology & Environment, Government of Karnataka, Belgaum.

20. In the case of any change(s) in the scope of the project, the project would require a fresh appraisal by this Authority.
21. The Authority reserves the right to add additional safeguard measures subsequently, if found necessary, and to take action including revoking of the environment clearance under the provisions of the Environment (Protection) Act, 1986, to ensure effective implementation of the suggested safeguard measures in a time bound and satisfactory manner.
22. All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation Act, 1980 and Wildlife (Protection) Act, 1972 etc. shall be obtained, as applicable by project proponents from the competent authorities.
23. These stipulations would be enforced among others under the provisions of water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) act 1981, the Environment (Protection) Act, 1986, the Public Liability (Insurance) Act, 1991 and EIA Notification, 2006.
24. Under the provisions of Environment (Protection) Act, 1986, legal action shall be initiated against the project proponent if it was found that construction of the project has been started without obtaining environmental clearance

Yours faithfully,

(RAMACHANDRA) 1/9/15
Member Secretary,
SEIAA - Karnataka.

Copy to:

1. The Secretary, Ministry of Environment, Forests and Climate Change, Indira Paryavaran Bhavan, Jor Bagh Road, Aliganj, New Delhi – 110 003.
2. The Commissioner, Bruhat Bengaluru Mahanagara Palike (BBMP), N.R. Square, Bengaluru – 560 002.
3. The Member Secretary, Karnataka State Pollution Control Board, Bengaluru.
4. The APCCF, Regional Office, Ministry of Environment & Forests (SZ), Kendriya Sadan, IV Floor, E & F wings, 17th Main Road, Koramangala II Block, Bengaluru – 560 034.
5. Guard File.

705

Annexure-R11

prises (MSMEs). gement men- ne with the gov- s on the 'Make mme, BEL will core areas while remaining por- the proportion kely to increase evels of 32 per

as a percentage of revenues would increase from eight per cent at present to around 10 per cent given focus on core technological development for existing projects. In addition, there would be product and system development at every unit for better locus of control. In line with this, BEL's incremental capex outlay will be largely towards new R&D centres, IDFC added.

ವಮೊಗ, ಮೊಗ 6-9-2015

ನಾತರ) ವಿರಡನೇ ಕರೆ

Date : 03-09-2015

ದ 2015-16ನೇ ಪಾಲಿ RIDF NABARD 20 ಶಕ್ಷ ಸೀಲ್‌ಕೆಯೆಂದ ಾಯಿಸಲು ಅರ್ಜಿ ಸ್ವೀಕರಿಸಲಾಗಿದ್ದು ಇ-ಪ್ರೊಕ್ಯೂರ್‌ಮೆಂಟ್ ಮಾದರಿಯ ನೆ. ಫಾರಂ ಜ & ಇಟಿಎಸ್‌ಟಿ ಇ-ಟೆಂಡರ್ ಬಗ್ಗೆ ಸಲಹೆ ವಿವರ

ಸಲ್ಲಿಸುವ 04.30 ಗಂಟೆ
ಸಲ್ಲಿಸಲಾದ 04.00 ಗಂಟೆ
ited to Technically Qualified Bidders
ಸಲ್ಲಿಸಬಹುದು

ಡರ	E.M.D. Amount	Tender Period
	5	6
	198000.00	6 Months (Excluding Rainy Season)

ಸಹಿ- ಗುತ್ತಿಗೆದಾರರ ಪೂರ್ಣ ವಿಳಾಸ
ಕಾರ್ಯ. ವಿಭಾಗ, ಕೆಪಿಟಿಸಿಎಲ್

ಾಗರ

ದಿನಾಂಕ: 20/08/2015

ಮುಂತಾದವರ)

Standard Tender Document
ಮೊದಲಾದುವು ಈ-ಪ್ರೋಕ್ಯೂರ್‌ಮೆಂಟ್

ಾಗೊಂಡಿರುವ ಸಲ್ಲಿ (ಮೀಸಲಾತಿ ಮಾಡಿರುವುದು)	ಗುತ್ತಿಗೆದಾರರ ಅರ್ಹತೆ	ಟೆಂಡರ್ ಫಾರಂ ಬೆಲೆ
6	7	8
ಪಿಂಗಳು	ದೋಷೋಪ ಯೋಗಿ ಇರಬೇಕು ನೋಂದಾಯಿತ ನೇ ರರ್ಜೆ	ಇ-ಗೌರ್ನೆನ್ಸ್ ರಂತೆ

-2015 ರ ಸಂಜೆ 4.00 ಗಂಟೆ ವರೆಗೆ
ಿಂದ ಮಾ.ಪ. ಸಾಗರ
ಾಯಿಸಲಾಗುವುದು.

ಸಹಾ ಸಿಬ್ಬಂದಿಗಳಿಗಾಗಿ
ಾಯಿಸಲಾಗಿದೆ. ಕೆಲಸ ಮಾಡಿಸಿಕೊಳ್ಳಲಾಗಿ
ಮಾ.ಪ. ಸಾಗರ/ ಸಹಾಯಕ

ಾಗರ

KARNATAKA POWER CORPORATION LIMITED

CIN: U51109KA1970SGC001919

No: CE(EI&TA)/YEL/440 Date: 04.09.2015

PUBLIC NOTIFICATION

The State Level Environment Impact Assessment Authority, Karnataka has accorded Environmental Clearance vide letter No. SEIAA 20, IND 2014 dated 01.09.2015 for implementing 1x350 ± 20% MW capacity Gas Based Combined Cycle Power Project at Survey Nos. 44(P), 45, 46, 47(P)-2, 48, 56/1 to 9, 57, 58, 59, 60/1-2, 61, 62/1-2, 63, 64, 65, 66/1-2, 67 of Punarahalli village and Survey Nos. 24, 25, 26(P), 28(P) of Kenchenahalli village, Yelahanka, Bengaluru District. The copy of the above clearance letter is available with the Karnataka State Pollution Control Board (KSPCB) and may also be seen at website of the State Ecology and Environment Department at https://seiaa.kar.nic.in or https://seiaa.karnataka.gov.in. Further details can be had from Chief Engineer (EI&TA), KPCL, 22/23, Sudarshan Complex, III Floor, Sheshadri Road, Bengaluru-560009. Telefax: 080-22258431.

ಸಾರಿಗೆ ಸಾಗರ

ಜಲ ಸೂಪನ್ಮೂಲ ಇಲಾಖೆ (ಸಣ್ಣ ನೀರಾವರಿ)

ಸಣ್ಣ ನೀರಾವರಿ ವಿಭಾಗ, ಮಂಡಪೇಠ

No.: EE/MID/VJP/AE-2/NON-NB/TENDER/ಎಸ್‌ಎಲ್-2015-16/4403 ದಿನಾಂಕ : 03.09.2015

ಆಮ್ಲಾವಧಿ ಟೆಂಡರ್ ಪ್ರಕಟಣೆ (ಎನ್‌ಐಟಿ ಸಂಖ್ಯೆ-4)

ಆರ್ ಸಂಸ್ಥೆಗಳಿಂದ ಬಲ ದರದ ಟೆಂಡರ್ ಪೂರೈಸಿ ಸಾಮರ್ಥ್ಯವಿರುವ ಸಂಸ್ಥೆಗಳಿಂದ ಮಾರಾಟಕ್ಕೆ ಅಧಿನಿಯಮ-2000 ಮತ್ತು ಇತ್ತೀಚಿನ ತಿದ್ದುಪಡಿಗಳಂತೆ ಈ ಕೆಳಗಿನ ಅರ್ಹತಾಮಾನದಂತೆ "ಇ-ಪ್ರೊಕ್ಯೂರ್‌ಮೆಂಟ್" ಮಾದರಿಯ ಟೆಂಡರ್ ಕರೆಯಲಾಗಿದೆ.

ಪ್ರಮಾಣ ಸಂಖ್ಯೆ :- ಮಾಗಡಿಯ ಚೆಕ್ಕೆ ಮತ್ತು ಸಾಲೂರ ಮುಖಂಡಿ ಸಣ್ಣ ನೀರಾವರಿ ಕೆರೆಗೆ ಬಾಲದ್ವಾರ ನಿರ್ಮಾಣ ಮತ್ತು ನೀರಾವರಿ ಯೋಜನೆಯ ಮುಖ್ಯಾಂಶಗಳು ಸೇರಿದ ಅಂದಾಜು ಮೊತ್ತ(ಜಿಎಸ್‌ಟಿ ಸೇರಿದಂತೆ) ರೂ.10711ಸಾವಿರಕ್ಕೆ ಇಂದಿನ ದಿನದ ರೂ.15,00,000-00, ಸಾಮರ್ಥ್ಯವಿರುವ ಸಂಸ್ಥೆಗಳಿಂದ ಸಾಮರ್ಥ್ಯ ಪತ್ರಗಳ ಸಹಿತ ಅರ್ಜಿಯನ್ನು ಆಹ್ವಾನಿಸಲಾಗಿದೆ.

ಗುತ್ತಿಗೆದಾರರು ಕರ್ನಾಟಕ ಸರಕಾರದ "ಇ-ಪ್ರೊಕ್ಯೂರ್‌ಮೆಂಟ್" ವೆಬ್‌ಸೈಟ https://eproc.karnataka.gov.in/eportal/index.seam ನಲ್ಲಿ ದಿನಾಂಕ 07.09.2015 ರಿಂದ Download ಮಾಡಿಕೊಳ್ಳಬಹುದು. ಟೆಂಡರ್‌ನ್ನು ಇಂದಿನ ಕಾಗದ ಟೆಂಡರ್ ಶುಲ್ಕದೊಂದಿಗೆ (ಪೆಪ ಸೈಜಿನ ಸರಿಸಿ ಮಾಡಿರುವ ಮಾರ್ಪಾಡಾದ ಬಿಲವಾ ಮಾರಾಟಾಧಿಕಾರಿಯ ಪರವಾಗಿ ಮಾಡಿ "ಇ-ಪ್ರೊಕ್ಯೂರ್‌ಮೆಂಟ್" ವೆಬ್‌ಸೈಟ https://eproc.karnataka.gov.in/eportal/index.seam ನಲ್ಲಿ ದಿನಾಂಕ: 30.09.2015ನೇ 16-00 ಗಂಟೆಯೊಳಗೆ ಸಲ್ಲಿಸಬಹುದು. ದಿನಾಂಕ: 21.09.2015ರಂದು ಕಾರ್ಯಾಪಾಲಕ ಇಂಜಿನಿಯರು ಸಣ್ಣ ನೀರಾವರಿ ವಿಭಾಗ ಮಂಡಪೇಠ ರವರ ಕಛೇರಿಯಲ್ಲಿ ಪ್ರಿನಿಧಿಗಳ ಸಮಕ್ಷಮ ಟೆಂಡರ್‌ಗಳನ್ನು ತೆರೆಯಲಾಗುವುದು. ಹೆಚ್ಚಿನ ಮಾಹಿತಿಗಾಗಿ ಕಛೇರಿಯ ಸಮಯದಲ್ಲಿ ಸಂಪರ್ಕಿಸಬಹುದು. ಸಾರ್ವಜನಿಕರಿಗೆ ಮಾಹಿತಿ ನೀಡಲಾಗಿದೆ. ಯಾವುದೇ ಟೆಂಡರ್‌ನ್ನು ಭಾಗಶಃ ಅಥವಾ ಸಂಪೂರ್ಣವಾಗಿ ತಿರಸ್ಕರಿಸುವ ಹಕ್ಕನ್ನು ಕಾಯ್ದಿರಿಸಲಾಗಿದೆ. ದಿನಾಂಕ: 29.09.2015ರ 16-00ಘಂಟೆಯೊಳಗೆ ಮಾಹಿತಿ ಕಛೇರಿಯಲ್ಲಿ (ದೂರವಾಣಿ-08352-277183) ಅಥವಾ "ಇ-ಪ್ರೊಕ್ಯೂರ್‌ಮೆಂಟ್" ಪೋರ್ಟಲ್‌ನಿಂದ(ದೂರವಾಣಿ-080-25501216 ಮತ್ತು 080-25501227) ಪಡೆಯಬಹುದು.

ಸಹಿ- ಕಾರ್ಯಪಾಲಕ ಅಭಿಯಂತರರು, ಸಣ್ಣ ನೀರಾವರಿ ವಿಭಾಗ, ಮಂಡಪೇಠ.

Government of Karnataka

Director, Department of Information and Public Relations

"Vartha Soudha", # 17, Bhagwan Mahaveer Road, Bangalore 560001, Phone: 080-22028052/56

NO.: DI/CVT/OCTA/2015-16, Date: 01-09-2015

APPLICATIONS ARE INVITED FROM ELIGIBLE SCHEDULED CASTE AND SCHEDULED TRIBE CANDIDATES FOR VIDEO FILMING AND EDITING TRAINING

Department of Information and Public Relations has organized a video filming and editing training program at Education Multimedia Research Centre (EMRC), Mysore University for Scheduled Caste and Scheduled Tribe candidates who have obtained a diploma / degree / post graduation in Journalism/Communication/Mass Communication or Electronic Media from recognised universities.

Applications from eligible Scheduled Caste and Scheduled Tribe candidates, aged below 40 years are invited for the said training program. The duration of the course is 30 days and lunch, boarding and lodging facilities will be provided during the training period. At the end of the training free movie cameras will be given to the candidates for self employment.

Eligible Scheduled Caste and Scheduled Tribe candidates may download the application from Department of Information and Public Relations website: "karnatakavartha.org" or apply along with the candidates name, age, address, educational qualification, caste (sub-caste), percentage of marks etc. with a self addressed envelope. Copies of the marks cards, caste certificate, and documents authorizing the address and age proofs should be enclosed along with the application. The envelop containing the application and other relevant documents and super scribed as "Application for the training in Video Filming and Editing" should be sent to the Director, Department of Information and Public Relations, "Vartha Soudha", # 17, Bhagwan Mahaveer Road, Bangalore 560001 so as to reach by 4.00 p.m. on or before 03-10-2015. For further details contact the Deputy Director, Edn. Division, Ph: 22028052/56.

DIP-780

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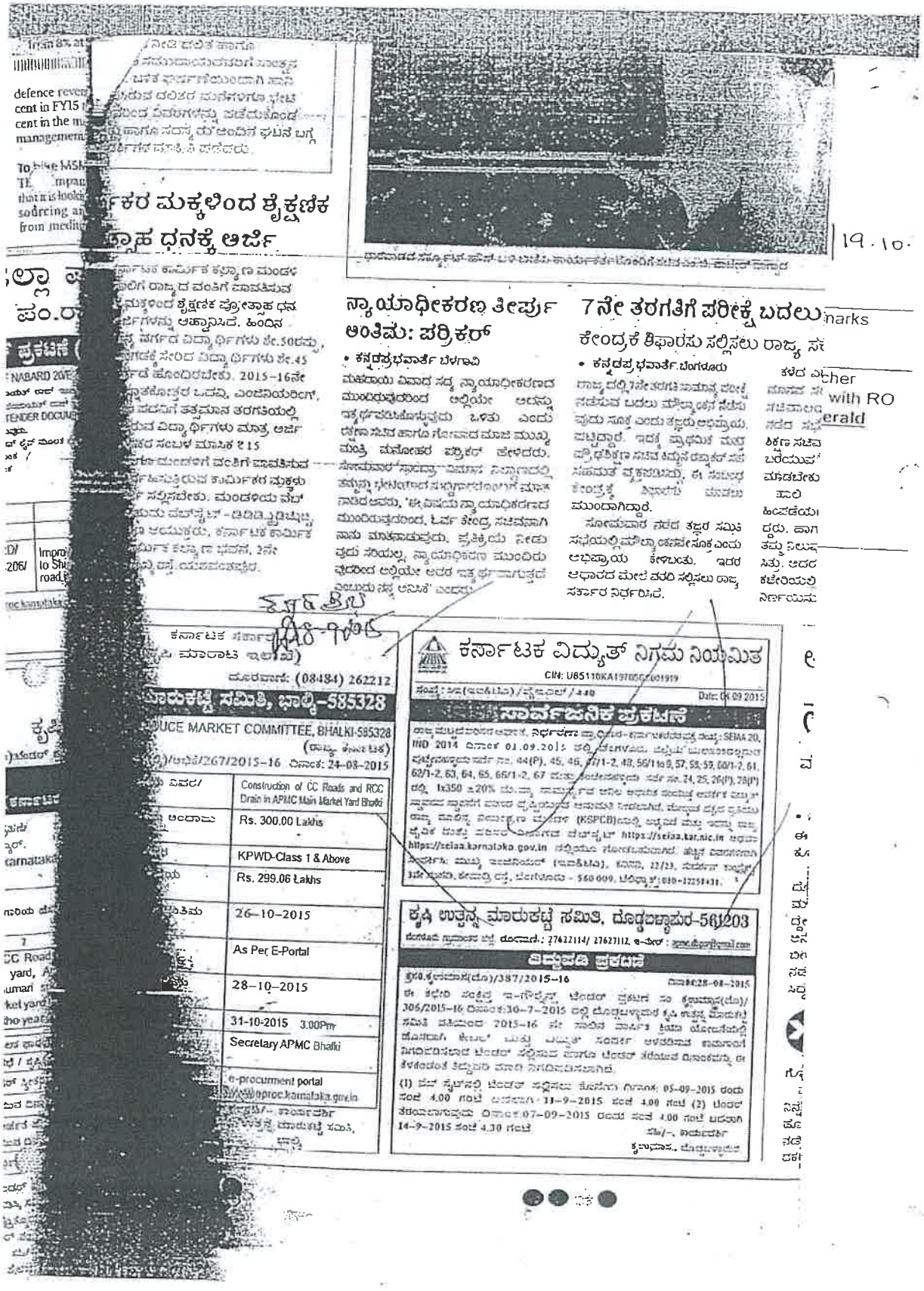

ನೀಡಿ ದಲಿತ ಹಾಗೂ
ಸಮುದಾಯಗಳಿಗೆ ಸೌಕ್ಷ್ಯ
ಚಿತ ಫಾರ್ಮಾಸಿಯಿಂದಾಗಿ ಹಾನಿ
ಗುವ ದಲಿತರ ಮನೆಗಳಿಗೂ ಭೇಟಿ
ಯಿಂದ ವಿವರಗಳನ್ನು ಪಡೆದುಕೊಂಡ
ಹಾಗೂ ಸರ್ವಸಮ್ಮತ ಆಯಿನ ಘಟನೆ ಬಗ್ಗೆ
ವರದಿಯನ್ನು ಸಿದ್ಧಪಡಿಸಿ ಪಾಲಿಸಲಿದೆ.

ರ್ಮಿಕರ ಮಕ್ಕಳಿಂದ ಶೈಕ್ಷಣಿಕ ಾಹ ಧನಕ್ಕೆ ಆರ್ಜಿ

ಾರ್ಮಿಕ ಕಾರ್ಮಿಕ ಕಲ್ಯಾಣ ಮಂಡಳಿ
ಲಿಗೆ ರಾಜ್ಯದ ವಂತಿಗೆ ಪಾವತಿಸುವ
ಮಕ್ಕಳಿಂದ ಶೈಕ್ಷಣಿಕ ಪ್ರೋತ್ಸಾಹ ಧನ
ರ್ಜಿಗಳನ್ನು ಆಹ್ವಾನಿಸಿದೆ. ಹಿಂದಿನ
ನ್ಯ ಮಾರ್ಗದ ವಿದ್ಯಾರ್ಥಿಗಳು ಶೇ.50ರಷ್ಟು,
ಾಡಕ್ಕೆ ಸೇರಿದ ವಿದ್ಯಾರ್ಥಿಗಳು ಶೇ.45
ಾರಿ ಹೊಂದಿರಬೇಕು. 2015-16ನೇ
ನ್ಸಾತಕೋತ್ತರ ಒದವಿ, ಎಂಜಿನಿಯರಿಂಗ್,
ಾ ಪದವಿಗೆ ತತ್ಸಮಾನ ತರಗತಿಯಲ್ಲಿ
ರುವ ವಿದ್ಯಾರ್ಥಿಗಳು ಮಾತ್ರ ಅರ್ಜಿ
ಸಲು ಅರ್ಹರು. ಪ್ರತಿ ಸಲಬಳ ಮಾಸಿಕ ₹ 15
ಾರ ಮುಂದಿನಂತೆ ವಂತಿಗೆ ಪಾವತಿಸುವ
ರ್ಮಿಕರು ಮಕ್ಕಳು
ಸಲ್ಲಿಸಬೇಕು. ಮಂಡಳಿಯ ವೆಬ್
ಮ ವೆಬ್‌ಸೈಟ್ - ಡಿಡಿಡಿ.ಟ್ರಿಡಿಬ್ಬಿಬ್ಬಿ.ಟ್ಟ
ಾ ಅಯುಕ್ತರು, ಕರ್ನಾಟಕ ಕಾರ್ಮಿಕ
ರ್ಮಿಕ ಕಲ್ಯಾಣ ಭವನ, 2ನೇ
ಮಿಲ್ಸ್ ಯಸವಂತಪುರ.

ಭಾವಚಿತ್ರ

19.10.

ನ್ಯಾಯಾಧೀಕರಣ ತೀರ್ಪು ಅಂತಿಮ: ಪರ್ರಿಕರ್

• ಕನ್ನಡಪ್ರಭವಾರ್ತೆ ಬೆಳಗಾವಿ

ಮಹದಾಯಿ ವಿವಾದ ಸಧ್ಯ ನ್ಯಾಯಾಧೀಕರಣದ ಮುಂದಿರುವುದರಿಂದ ಅಲ್ಲಿಯೇ ಅದನ್ನು ಇತ್ಯರ್ಥಪಡಿಸಿಕೊಳ್ಳುವುದು ಒಳಿತು ಎಂದು ಚಿನ್ನಾ ಸುವ ಹಾಗೂ ಗೋವಾದ ಮಾಜಿ ಮುಖ್ಯ ಮಂತ್ರಿ ಮನೋಹರ ಪರ್ರಿಕರ್ ಹೇಳಿದರು.

ಸೋಮವಾರ ಸ್ಥಾನದ್ರಾ ವಿಮಾನ ನಿಲ್ದಾಣದಲ್ಲಿ ತಮ್ಮನ್ನು ಭೇಟಿಯಾದ ಸಚಿವರೊಬ್ಬರಿಗೆ ಮಾತನಾಡಿದ ಅವರು, 'ಈ ವಿಷಯ ನ್ಯಾಯಾಧೀಕರಣದ ಮುಂದಿರುವುದರಿಂದ, ಓರ್ವ ಕೇಂದ್ರ ಸಚಿವನಾಗಿ ನಾನು ಮಾತನಾಡುವುದು, ಪ್ರಕಿಕ್ರಿಯೆ ನೀಡುವುದು ಸರಿಯಲ್ಲ. ನ್ಯಾಯಾಧೀಕರಣ ಮುಂದಿರುವುದರಿಂದ ಅಲ್ಲಿಯೇ ಅದರ ಇತ್ಯರ್ಥವಾಗುತ್ತದೆ ಎಂಬುದು ನನ್ನ ಅನಿಸಿಕೆ' ಎಂದರು.

7ನೇ ತರಗತಿಗೆ ಪರೀಕ್ಷೆ ಬದಲು

ಕೇಂದ್ರಕ್ಕೆ ಶಿಫಾರಸು ಸಲ್ಲಿಸಲು ರಾಜ್ಯ ಸ

• ಕನ್ನಡಪ್ರಭವಾರ್ತೆ ಬೆಂಗಳೂರು

ರಾಜ್ಯದಲ್ಲಿ 7ನೇ ತರಗತಿ ಸಾಮಾನ್ಯ ಪರೀಕ್ಷೆ ನಡೆಸುವ ಬದಲು ಮೌಲ್ಯಾಂಕನ ನೆಡೆಸುವುದು ಸೂಕ್ತ ಎಂದು ತಜ್ಞರು ಅಭಿಪ್ರಾಯ ಪಟ್ಟಿದ್ದಾರೆ. ಇದಕ್ಕೆ ಪ್ರಾಥಮಿಕ ಮತ್ತು ಪ್ರೌಢಶಿಕ್ಷಣ ಸಚಿವ ತಿಮ್ಮೆಗೌಡ ಸಹ ಸಹಮತ ವ್ಯಕ್ತಪಡಿಸಿದ್ದು, ಈ ಸಂಬಂಧ ಕೇಂದ್ರಕ್ಕೆ ಶಿಫಾರಸು ಮಾಡಲು ಮುಂದಾಗಿದ್ದಾರೆ.

ಸೋಮವಾರ ನಡೆದ ತಜ್ಞರ ಸಮಿತಿ ಸಭೆಯಲ್ಲಿ ಮೌಲ್ಯಾಂಕನ ಸೂಕ್ತ ಎಂದು ಅಭಿಪ್ರಾಯ ಕೇಳಿಬಂತು. ಇದರ ಆಧಾರದ ಮೇಲೆ ವರದಿ ಸಲ್ಲಿಸಲು ರಾಜ್ಯ ಸರ್ಕಾರ ನಿರ್ಧರಿಸಿದೆ.

ಕಳೆದ ಎ...cher
ಮಾಜಿ ಸ... with RO
ಸಚಿವಾಲಯ... erald
ನಡೆದ ಸ...
ಶಿಕ್ಷಣ ಸಚಿವ
ಬರೆಯುವ
ಮಾಡಬೇಕು
ಹಾಲಿ
ಹಿಂಪಡೆಯ
ದ್ದರು. ಹಾಗ
ತಮ್ಮ ನಿಲುವ
ಸಿತ್ತು. ಆದರ
ಕಡೇರಿಯಲ್ಲಿ
ನಿರ್ಣಯಿಸ

ಕರ್ನಾಟಕ ಸರ್ಕಾ...
ಕೃಷಿ ಮಾರಾಟ ಇಲಾಖೆ)
ದೂರವಾಣಿ: (08484) 262212

ಮಾರುಕಟ್ಟೆ ಸಮಿತಿ, ಭಾಲ್ಕಿ-585328

...UCE MARKET COMMITTEE, BHALKI-585328
(ರಾಜ್ಯ ಕೃಷಿ ಇಲಾಖೆ)

...ಸಿ)/ಆಪಾಸ/267/2015-16 ದಿನಾಂಕ: 24-03-2015

...ವಿವರ/	Construction of CC Roads and RCC Drain in APMC Main Market Yard Bhalki
...ಂದಾಜು	Rs. 300.00 Lakhs
...	KPWD-Class 1 & Above
...ಯ	Rs. 299.06 Lakhs
...ತಿಮ	26-10-2015
...	As Per E-Portal
...	28-10-2015
...	31-10-2015 3.00Pm
...	Secretary APMC Bhalki
...	e-procurment portal www.eproc.karnataka.gov.in

...ಾರ್ಯದರ್ಶಿ
...ಟ್ಟೆ ಮಾರುಕಟ್ಟೆ ಸಮಿತಿ,
...ಲ್ಕಿ

ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತ

CIN: U85110KA1997SGC001919

ಸಂಖ್ಯೆ: ಪಸ(ಇಆಕಟಿಪಿ)/ಪೈ.ಇ.ಎಲ್/440 Date: 04.09.2015

ಸಾರ್ವಜನಿಕ ಪ್ರಕಟಣೆ

ರಾಜ್ಯ ಮುಖ್ಯ ವಿದ್ಯುತ್ ಸರಬರಾಜು ಅಧಿಕಾರಿ, ನಿರ್ಧರಣಾ ಪ್ರಾಧಿಕಾರ-ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಯಂತ್ರಣ ಆಯೋಗ ನಿಯಮಗಳು, 2014 ದಿನಾಂಕ 01.09.2015 ರಲ್ಲಿ ಪ್ರಕಟಿಸಲಾದ ವಿದ್ಯುತ್ ಪೂರೈಕೆಯ ಪರವಾನಗಿ ಷರತ್ತುಗಳಂತೆ ಸರ್ವೆ ನಂ. 44(P), 45, 46, 47/1-2, 48, 56/1 to 9, 57, 58, 59, 60/1-2, 61, 62/1-2, 63, 64, 65, 66/1-2, 67 ಮತ್ತು ಇತರೆಯವುದು ಸರ್ವೆ ನಂ. 74, 25, 26(P), 28(P) ರಲ್ಲಿ 1x350 ±20% ಮೆ.ವ್ಯಾ ಸಾಮರ್ಥ್ಯದ ಜಲವಿದ್ಯುತ್ ಸ್ಥಾವರ ಮತ್ತು ಸ್ಥಾವರದ ಸ್ಥಾಪನೆಗೆ ಬಾಧಕ ಪರಿಸರಿಯನ್ನ ಅಧ್ಯಯನ ನಿಗದಿಪಡಿಸಿ, ಹೊಸ ಪರಿಸರ ಪ್ರಕಟಣೆ ರಾಜ್ಯ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿ (KSPCB)ಯಲ್ಲಿ ಒಪ್ಪಿಗೆ ಮತ್ತು ಇತ್ಯರ್ಥ ಪರಿಸರ ಪ್ರಕಟಣೆ ಪರಿಸರ ವಿಮೋಚನಾ ಮಂಡಳಿ (KSPCB)ಯಲ್ಲಿ ಒಪ್ಪಿಗೆ ಮತ್ತು ಇತ್ಯರ್ಥ ಪರಿಸರ ಪ್ರಕಟಣೆ ಪರಿಸರ ವಿಮೋಚನಾ ಮಂಡಳಿ ವೆಬ್‌ಸೈಟ್ https://seiaa.kar.nic.in ಅಥವಾ https://seiaa.karnataka.gov.in ಪರಿಸರ ಸಚಿವಾಲಯದಲ್ಲಿ ಪಡೆಯಲು ಪರವಾನಗಿ ಪಡೆಯಲು ಮುಖ್ಯ ಇಂಜಿನಿಯರ್ (ಇಆಕಟಿಪಿ), ಕಮಾ, 22/23, ನಿರ್ಮಾಣ ಕಾಲ್ಪನಿಕ ಮಹಡಿ, ಶೇಷಾದ್ರಿ ರಸ್ತೆ, ಬೆಂಗಳೂರು - 560 009, ಟೆಲಿಫ್ಯಾಕ್ಸ್:080-22259431.

ಕೃಷಿ ಉತ್ಪನ್ನ ಮಾರುಕಟ್ಟೆ ಸಮಿತಿ, ದೊಡ್ಡಬಳ್ಳಾಪುರ-561203

ದೊಡ್ಡಬಳ್ಳಾಪುರ ಪಟ್ಟಿ ದೂರವಾಣಿ: 27622114/ 27627112, ಇ-ಮೇಲ್: apmc.dbpur@gmail.com

ತಿದ್ದುಪಡಿ ಪ್ರಕಟಣೆ

ಕ್ರ.ಸಂ.ಕೃಉಮಾಸ(ದೊ)/387/2015-16 ದಿನಾಂಕ:28-08-2015

ಈ ಕಛೇರಿ ಸಂಕ್ಷಿಪ್ತ ಇ-ಟೆಂಡರ್ ಪ್ರಕಟಣೆ ಸಂ ಕೃಉಮಾಸ(ದೊ)/306/2015-16 ದಿನಾಂಕ:30-7-2015 ರಲ್ಲಿ ದೊಡ್ಡಬಳ್ಳಾಪುರ ಕೃಷಿ ಉತ್ಪನ್ನ ಮಾರುಕಟ್ಟೆ ಸಮಿತಿ ವತಿಯಿಂದ 2015-16 ನೇ ಸಾಲಿನ ಮಾರ್ಕೆಟ್ ಕ್ರಿಯಾ ಯೋಜನೆಯಲ್ಲಿ ಹೊಸದಾಗಿ ಶೌಚಾಲಯ ಮತ್ತು ಚಾವಣಿ ಸಹಿತ ಸಿಸಿ ರಸ್ತೆ ಕಾಮಗಾರಿ ನಿರ್ವಹಿಸುವ ಟೆಂಡರ್ ಸಲ್ಲಿಸುವ ಹಾಗೂ ಟೆಂಡರ್ ತೆರೆಯುವ ದಿನಾಂಕವನ್ನು ಈ ಕೆಳಕಂಡಂತೆ ಕಿದ್ದುಪಡಿ ಮಾಡಿ ನಿಗದಿಪಡಿಸಲಾಗಿದೆ.

(1) ಮೆ ಸೈಟಿನಲ್ಲಿ ಟೆಂಡರ್ ಸಲ್ಲಿಸಲು ಕೊನೆಯ ದಿನಾಂಕ: 05-09-2015 ರಂದು ಸಂಜೆ 4.00 ಗಂಟೆ ವರೆಗೂ (1) 11-9-2015 ಸಂಜೆ 4.00 ಗಂಟೆ (2) ಟೆಂಡರ್ ತೆರೆಯಲಾಗುವುದು ದಿನಾಂಕ:07-09-2015 ರಂದು ಸಂಜೆ 4.00 ಗಂಟೆ ಬದಲಾಗಿ 14-9-2015 ಸಂಜೆ 4.30 ಗಂಟೆ

ಸಹಿ/-, ಕಾರ್ಯದರ್ಶಿ
ಕೃಉಮಾಸ, ದೊಡ್ಡಬಳ್ಳಾಪುರ

Annexure-R-12

ಫ್ಯಾಕ್ಸ್ / Fax : 080-25586321
ಈಮೇಲ್ / E-mail : ho@kspcb.gov.in
ವೆಬ್‌ಸೈಟ್ / Website : http://kspcb.gov.in

25581383, 25589112
25588151, 25588270
25588142, 25586520

ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿ
Karnataka State Pollution Control Board

"ಪರಿಸರಭವನ", 1 ರಿಂದ 5ನೇ ಮಹಡಿಗಳು, ನಂ.49, ಚರ್ಚ್‌ಸ್ಟ್ರೀಟ್, ಬೆಂಗಳೂರು - 560 001, ಕರ್ನಾಟಕ, ಭಾರತ
"Parisara Bhavana", 1st to 5th Floor, # 49, Church Street, Bengaluru - 560 001, Karnataka, INDIA

//BYRPAD//

NO. KSPCB/CFE/CEO/KPCL/2015-16/ H1033

DATED: - 2 NOV 2015

To:
The Chief Engineer,
M/s. Karnataka Power Corporation Limited (Yelahanka Combined Cycle Power Plant),
Yelahanka Combined Cycle Power Plant (YCCPP),
Sy. No. 44(P),45,46,47/1-2,48,56/1 to 9,57,58,59,60/1-2,61,
62/1-2,63,64,65,66/1-2,67 of Puttenahalli village,
24,25,26-P,28P of Kenchanahalli village,
Yelahanka, Bengaluru.

Office of The CE(GSW) KPCL, Yelahanka, Bangalore - 64.		
Inw No: 4492		
Date : 04.11.2015		
OM	EE	CE

Sir,

Sub: Issue of CFE for establishment of new Gas Based Combined Cycle Power Plant at Sy. No. 44(P),45,46,47/1-2,48,56/1 to 9,57,58,59,60/1-2,61,62/1-2,63,64,65,66/1-2,67 of Puttenahalli village, 24,25,26-P,28P of Kenchanahalli village, Yelahanka, Bengaluru, by M/s. Karnataka Power Corporation Limited (Yelahanka Combined Cycle Power Plant).

Ref:

1. Your consent for establishment application Reg. No. 98682 received at Board Office on 23.09.2015.
2. Inspection of Regional Officer, Byatarayanapura (Yelahanka) on 04.09.2015 and the inspection report dated: 22.09.2015.
3. Proceeding of the Consent Committee meeting held on 01.10.2015.
4. SEIA-Karnataka EC Clearance letter dated: 19.01.2015.

*****

With reference to the above, it is to be informed that, the Board hereby accords consent for establishment under the Water (Prevention & Control of Pollution) Act 1974, and the Air (Prevention & Control of Pollution) Act 1981, for establishment of New Gas Based Power Generation Plant of capacity 350 MW. Yelahanka Combined Cycle Power Plant (YCCPP), Sy. No. 44(P),45,46,47/1-2,48,56/1 to 9,57,58,59,60/1-2,61,62/1-2,63,64,65,66/1-2,67 of Puttenahalli village, 24,25,26-P,28P of Kenchanahalli village, Yelahanka, Bengaluru, M/s. Karnataka Power Corporation Limited (Yelahanka Combined Cycle Power Plant), subject to the following conditions:

1. This consent for establishment is valid for a period of Five years from the date of issue.
2. The applicant shall renew the CFE in case the Plant is not established within a period of 5 Years.

CHIEF ENVIRONMENTAL OFFICER

"ಪ್ಲಾಸ್ಟಿಕ್ ಬಳಕೆ ಬೇಡ, ಪರಿಸರ ಉಳಿಸಿ" AVOID USE OF PLASTICS, BE ECO FRIENDLY

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3. The applicant shall not undertake expansion/diversification without the prior consent of the Board.

4. The applicant shall obtain necessary license/clearance from other relevant statutory agencies before taking up construction.

5. There shall not be any complaints against the industry from the surrounding public in respect of Water, Air or Noise/solid waste generation.

I. WATER CONSUMPTION:

1. The source of water shall be from Bore Well and total fresh water consumption shall be as below.

Sl.No.	Particulars	Water Consumption
1.	Domestic	120 KLD
2.	Gardening	240 KLD
3.	Industrial Process	
a.	Washings	120 KLD
b.	Cooling	1260 KLD
c.	Boiler feed	360 KLD
d.	HVAC makeup & plant service water	360 KLD
e.	RO rejects & DM Backwash	480 KLD
4.	Fire water make-up	120 KLD

II. WATER POLLUTION CONTROL:

1. The total quantity of wastewater discharge & mode of treatment shall be as below.

Sl. No	Particulars	Wastewater discharged	Mode of Disposal
1.	Domestic	15 KLD	The domestic wastewater shall be disposed in septic tank & soak pit. No overflow from the soak pit is allowed. The septic tank and soak pit shall be designed as per IS 2470 Part – I and Part – II.
2.	Industrial Process		The trade effluent shall be treated in the ETP and finally disposed on land for gardening after conforming to the standards as per Annexure-I.
a.	Cooling	4200 KLD (CW Blow Down)	
b.	Boiler feed	180 KLD (HRSG Blow Down)	
c.	RO rejects & DM Backwash	480 KLD	

2. The applicant shall treat the tertiary treated water supplied from BWSSB in ETP consisting of Ultra Filtration (UF), RO1, RO2, Neutralizing pit. Permeate is collected in service water overhead tank and DM Water storage tank, and proposed to be utilized for High Volume Air Conditioner (HVAC) makeup, and Condenser hot well makeup, Chemical feed system and CW makeup respectively. The wastewater from UF and RO after neutralization, in neutralizing pit is collected in guard pond including HRSG blow down and CW blow down, and to be utilized for gardening, plant washing and fire protection.

CHIEF ENVIRONMENTAL OFFICER

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3. There shall be no bypass or discharge of effluents either within or outside the factory premises under any circumstances.

4. The applicant shall install integrated flow measuring/recording devices on the sewage line. A record of daily sewage discharge shall be maintained.

5. The applicant shall take suitable steps so that there will be reduction of the fresh water consumption as well as waste water generation from the industry.

6. The applicant shall not change or alter either the quality or the quantity or the rate of discharge or temperature or the route of discharge without the previous written permission of the Board.

7. The applicant shall not allow the discharge from the other premises to mix with the discharge from his premises. Storm water shall not be allowed to mix with the effluents on the upstream of the terminal manhole where the flow measuring devices are installed.

III. AIR POLLUTION CONTROL:

1. The discharge of emissions from the premises of the applicant shall pass through the air pollution control equipment and discharged through stacks/chimneys mentioned in Annexure-II where from the Board shall be free to collect, the samples at any time in accordance with the provisions of the Act and Rules made there under.

2. The industry shall upgrade/modify/replace the control equipments if they are found inadequate to meet the standards stipulated. Prior permission of the Board shall be obtained for the same.

3. Fugitive emission, if any has to be controlled by adopting advance technology. Progress made in this regard shall be furnished.

4. The applicant shall provide continuous online monitoring ans submit the report to the Board regularly.

5. If there is going to be any new air pollution sources in future, the project authorities shall apply and obtain consent for establishment for the same from the Board.

6. The industry shall ensure that the ambient air quality in its premises shall conform to the National Ambient Air Quality Standards specified in Environment (Protection) Rules.

IV. SOLID WASTE MANAGEMENT:

1. The applicant shall segregate solid waste from Hazardous Waste Municipal Solid Waste and store it properly till treatment/disposal without causing pollution to the surrounding Environment.

2. The solid waste generated shall be by scientific method without causing eye sores to the general public and to the surrounding environment.

V HAZARDOUS WASTES (MANAGEMENT, HANDLING & TRANSBOUNDRY MOVEMENT) RULES 2008:

1. The industry shall apply and obtain authorization under Hazardous Wastes (Management, Handling & Transboundry Movement) Rules 2008, and comply with the conditions of the authorization. The applicant shall comply with the terms and conditions stipulated in authorization.

CHIEF ENVIRONMENTAL OFFICER

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VI. GENERAL:

1. The industry shall transport and store the raw materials in a manner so as not to cause any damage to environment, life and property. The applicant shall be solely responsible for any damages to environment.
2. The industry shall not commission the proposed plant for trial or regular production unless necessary water & air pollution control equipments are installed to the satisfaction of the Board. The industry shall ensure that the control equipments are completed and commissioned simultaneously along with construction of the factory and erection of machineries.
3. The industry shall not change or alter (a) raw materials or manufacturing process, (b) change the products or product mix (c) the quality, quantity or rate of discharge/emissions and (d) install/replace/alter the water or air pollution control equipments without the prior approval of the Board.
4. The industry shall immediately report to the Board of any accident or unforeseen act or event resulting in release of discharge of effluents or emissions or solid wastes etc. in excess of the standards stipulated. And the industry shall immediately take appropriate corrective and preventive actions under intimation.
5. The industry is liable to reinstate or restore, damaged or destroyed elements of environment at his cost, failing which, the applicant/occupier as the case may be shall be liable to pay the entire cost of remediation or restoration in advance an amount equal to the cost estimated by Competent Agency or Committee.
6. The applicant shall comply with all the Rules and guidelines issued from time to time.
7. The Board reserves the right to review, impose additional condition or conditions, revoke, change or alter the terms and conditions.
8. The industry shall take measures to develop green belt in the periphery and shall have maximum greenery in the factory premises.
9. This CFE does not give any right to the Party/Project Authority/Industry to forego any legal requirement that is necessary for setting/operation of the plant.
10. This consent is issued without prejudice to any Court Cases pending in any Hon'ble Court.
11. The industry shall furnish point wise compliance to the conditions given under this consent for expansion within 30 days.

Please note that this is only consent for establishment issued to you to proceed with the formalities for establishment of new industry and does not give any right to proceed with trial /regular production. For this purpose, separate consents of the Board for discharge of liquid effluent and the emissions to the air shall have to be obtained by remitting prescribed consent fee. The application for consent has to be made 45 days in advance of commissioning for trial production of the plant. Issue of consent will be considered only after providing water and air pollution control measures / equipments as required.

The receipt of this letter may please be acknowledged.

FOR AND ON BEHALF OF KSPCB

CHIEF ENVIRONMENTAL OFFICER

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ANNEXURE-I
ON LAND FOR IRRIGATION

Sl. No.	Characteristics	Tolerance limits
1	pH	5.5 – 9.0
2	Total Suspended Solids, mg/l, max	200
3	Biochemical Oxygen Demand (BOD), mg/l, (5 days @ 20^0 C), max	100
4	Oil and grease, mg/l	10
5	Arsenic (as As), mg/l, max	0.2
6	Cyanide (as CN), mg/l, max	0.2
7	Total Dissolved Solids (Inorganic), mg/l, max	2100
8	Chloride (as Cl), mg/l, max	600

Note: All efforts should be made to remove colour and unpleasant odour as far as practicable

TABLE
HYDRAULIC LOADING APPLICABLE FOR DIFFERENT SOILS

Sl. No	Soil Texture	Loading rate in M^3/Hec/day
1	Sandy	225-280
2	Sandy Loam	170-225
3	Loam	110-170
4	Clay Loam	055-110
5	Clayey	035-055

CHIEF ENVIRONMENTAL OFFICER

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ANNEXURE – II

Chimney	Chimney Attached to	Minimum Chimney Height to be Provided	Constituents to be controlled in the emission	Tolerance limits Mg/NM3	Air Pollution Control equipment to be installed in addition to Chimney height as per Col (3)	Date of which air pollution Control equipments shall be provided to achieve the stipulated tolerance limits and chimney heights conforming to stipulated heights.	Remarks
1.	750 KVA (2 no's) DG Set	5 m ARL	--	--	with Acoustic enclosure	At all time	1. The emission rate of all chimneys shall be reported within 30 days. 2. Details of D.G. Sets if any like KVA rating fuel consumption in Kg/hr., Chimney height above roof level and dia to be furnished within 30 days. D.G. Sets and other noise generating machinery to be provided with Silencers/Mufflers to reduce the noise pollution. 3. There shall be no smell or odour nuisance from the industry. 4. There shall be no other sources of air pollution
2.	Natural Gas Combustion	45 m AGL gas turbine	--	--	With DLNx Burners	At all time	

CHIEF ENVIRONMENTAL OFFICER

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Annexure-R13

ಕರ್ನಾಟಕ ಸರ್ಕಾರ
(ಮೀನುಗಾರಿಕೆ ಇಲಾಖೆ)

ಸಂಖ್ಯೆ: ಮೀನಿ/17/ಆರ್.ಎಸ್.ಹೆಚ್/2014-15

ಮೀನುಗಾರಿಕೆ ನಿರ್ದೇಶನಾಲಯ,
3ನೇ ಮಹಡಿ, ಮೋಡಿಯಂ ಬ್ಲಾಕ್,
ವಿಶ್ವೇಶ್ವರಯ್ಯ ಕೇಂದ್ರ, ಡಾ:ಅಂಬೇಡ್ಕರ್ ವೀಧಿ,
ಬೆಂಗಳೂರು-1, ದಿನಾಂಕ:30-05-2015

ಇವರಿಗೆ:

The Chief Engineer (EI&TA)
Karnataka Powe Corporation Ltd.
"Sudarshan Complex" 2nd, Floor
No.27/3, Sheshadri Road,
Bangalore-560009.

ಮಾನ್ಯರೆ,

ವಿಷಯ:ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ (ನಿ). ರವರು ಯಲಹಂಕ ಇಲ್ಲಿ 350 ಮೆ.ವ್ಯಾ ಅನಿಲ ಆಧಾರಿತ ವಿದ್ಯುತ್ ಸ್ಥಾವರ ಸ್ಥಾಪಿಸಲು ಇಲಾಖೆಯಿಂದ ನಿರಾಕ್ಷೇಪಣಾ ಪತ್ರ ನೀಡುವ ಬಗ್ಗೆ.

ಉಲ್ಲೇಖ: ಮುಖ್ಯ ಇಂಜಿನೀಯರ್ (E.I& T.A) K.P.C.L ರವರ ಪತ್ರದ ಸಂಖ್ಯೆ:CE (GSW)/YELAHANKA/CCPP/CLS/661.dated;11/11/2014.

*****

ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ (ನಿ). ರವರು ಯಲಹಂಕ ಇಲ್ಲಿ 350 ಮೆ.ವ್ಯಾ ಅನಿಲ ಆಧಾರಿತ ವಿದ್ಯುತ್ ಸ್ಥಾವರವನ್ನು ಈ ಕೆಳಕಂಡ ಷರತ್ತುಗಳಿಗೆ ಒಳಪಟ್ಟು ಸ್ಥಾಪಿಸಲು ಮೀನುಗಾರಿಕೆ ಇಲಾಖೆಯು ಆಕ್ಷೇಪಣೆ ಇರುವುದಿಲ್ಲವೆಂದು ತಿಳಿಸಲಾಗಿದೆ.

1. ಸ್ಥಾವರದ ಮಶಿನರಿಯ ಕೂಲಿಂಗ್‌ನಿಂದ ಬರುವ ನೀರನ್ನು ಸ್ಥಳೀಯ ಕೆರೆಗಳಿಗೆ ಬಿಡುವುದರಿಂದ ಕೆರೆಯ ಮತ್ಸ್ಯಸಂಪತ್ತನ್ನು ವೃದ್ಧಿಸಲು ಇಲಾಖೆಯು ಸೂಚಿಸುವ ಸ್ಥಳೀಯ ಮತ್ತು ದೊಡ್ಡಗೊಂಡ ಜಾತಿಯ 50,000 ಮೀನುಮರಿಗಳನ್ನು ಹತ್ತಿರದ ಮಟ್ಟಿನ ಹಳ್ಳಿ, ಯಲಹಂಕ ಕೆರೆಗಳಿಗೆ ಮೀನುಗಾರಿಕೆ ಇಲಾಖೆಯಿಂದ ಪ್ರತಿ ವರ್ಷ ಬಿಡಿಗಿಸಿ ದಾಸ್ತಾನು ಮಾಡುವುದು.

2. ಸ್ಥಾವರ ನಿರ್ಮಾಣದ ಸಮಯದಲ್ಲಿ ಹಾಗೂ ತದನಂತರ ನಿರ್ಮಾಣದ ಹಾಗೂ ನಿರ್ವಹಣೆಯ ಸಮಯದಲ್ಲಿ ಯಾವುದೇ ತ್ಯಾಜ್ಯಗಳನ್ನು ಹೊಳೆ/ಕಾಲುವೆಗೆ ಹಾಗೂ ಸಮೀಪದ ಕೆರೆ, ಜಲಾಶಯಗಳಿಗೆ ಹಾಕದೆ ದೂರಕ್ಕೆ ದೂರ ಸಾಗಿಸುವುದು.

3. ಮುಂದಿನ ದಿನಗಳಲ್ಲಿ ಸಮೀಪದ ಕೆರೆಗಳಲ್ಲಿ ಮೀನುಗಾರಿಕೆ ಅಭಿವೃದ್ಧಿಗೆ ಯಾವುದೇ ಅಡಚಣೆ ಮಾಡಬಾರದು.

4. ಕಂಪನಿಯ EIA ಮತ್ತು EMP ವರದಿಯಲ್ಲಿ ಅಳವಡಿಸಿಕೊಂಡಿರುವ ಮೀನುಗಾರಿಕೆಗೆ ಸಂಬಂಧಿಸಿದ ಎಲ್ಲಾ ನಿಬಂಧನೆಗಳನ್ನು ಕಾಟುತಪ್ಪದೇ ಪಾಲಿಸತಕ್ಕದ್ದು.

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5. ಮೀನುಗಾರಿಕೆ ಇಲಾಖೆಯ ಅಧಿಕಾರಿಗಳು ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ಸ್ಥಳಕ್ಕೆ ಒಳಗೆ ಪ್ರವೇಶಿಸಿ ಮೇಲ್ಕಾಣಿಸಿದ ನಿಬಂಧನೆಗಳನ್ನು ಪಾಲಿಸಿರುವುದು ಪರಿಶೀಲಿಸುವ ಅಧಿಕಾರವನ್ನು ಹೊಂದಿರುತ್ತಾರೆ.

6. ಮೀನುಗಾರಿಕೆ ಹಿತದೃಷ್ಟಿಯಿಂದ ಮೀನುಗಾರಿಕೆ ಇಲಾಖೆಯು ಮುಂದೆ ವಿಧಿಸುವ ಯಾವುದೇ ಹೆಚ್ಚಿನ ಷರತ್ತು ಮತ್ತು ನಿಬಂಧನೆಗಳನ್ನು ವಿಧಿಸಿದ್ದಲ್ಲಿ ಅದಕ್ಕೆ ಬದ್ಧರಾಗಿರತಕ್ಕದ್ದು.

7. ಸ್ಥಾವರ ಸ್ಥಾಪಿಸಿದ ನಂತರ 10 ವರ್ಷಗಳ ಅವಧಿಯಪರ್ಯಂತ ಪ್ರತಿ 2 ವರ್ಷಕೊಮ್ಮೆ ಮೀನು ಸಂಕುಲದ ಮೇಲೆ ಉಂಟಾಗಿರುವ ಪರಿಣಾಮದ ಬಗ್ಗೆ ಅಧ್ಯಯನ ನಡೆಸಿ ವರದಿಯನ್ನು ಮೀನುಗಾರಿಕೆ ಇಲಾಖೆಗೆ ಸಲ್ಲಿಸುವುದು ಹಾಗೂ ಪರಿಣಾಮ ಬೀರಿದಲ್ಲಿ ಅದನ್ನು ತಪ್ಪಿಸಿಕೊಳ್ಳುವುದು.

8. ಈ ಮೇಲ್ಕಾಣಿಸಿದ ಯಾವುದೇ ಷರತ್ತು ಮತ್ತು ನಿಬಂಧನೆಗಳನ್ನು ಉಲ್ಲಂಘಿಸಿದ್ದಲ್ಲಿ ತಮಗೆ ನೀಡಿರುವ ನಿರಾಕ್ಷೇಪಣಾ ಪತ್ರವನ್ನು ರದ್ದುಗೊಳಿಸುವ ಅಧಿಕಾರವನ್ನು ಮೀನುಗಾರಿಕೆ ಇಲಾಖೆ ಕಾಯ್ದಿರಿಸಿ ಕೊಂಡಿರುತ್ತದೆ.

ತಮ್ಮ ವಿಶ್ವಾಸಿಯ

ಮೀನುಗಾರಿಕೆ ನಿರ್ದೇಶಕರು

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GOVERNMENT OF KARNATAKA
(Department of Fisheries)

No.Mini/17/R.S.H/2014-15

Directorate of Fisheries
3rd Floor, Podium Block
Visveswaraiah Centre,
Dr. Ambedkar Veedhi,
Bangalore-1, dated20-05-2015

To :

The Chief Engineer (EI&TA)
Karnataka Power Corporation Ltd,
"Sudarshan Complex" 2nd Floor,
No.22/23, Sheshadri Road,
Bangalore-560 009.

Sir,

Sub:- Issue of 'No Objection Certificate' by the Department for establishment of 350 MW gas based power plant by Karnataka Power Corporation (Ltd) at Yelahanka – regarding.

Ref:- Chief Engineer (E.I & T.A) K.P.C.L vide letter No.CE (GSW) Yelahanka/ACCPP/ CLS/661 dated 11-11-2014

Karnataka Power Corporation (Ltd) proposed to started 350 MW gas based power plant at Yelahanka and for which subject to the conditions hereunder the Fisheries Department having no any objection for the same.

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1. The water that may ooze from the machinery cooling of the plant will flow to the local lakes and in order to fish population in the lake the local and Doddagende breed 50,000 baby fishes as directed by the Department should be purchased every year from the fisheries department to the nearby Puttenahalli Yalahanka lakes.

2. During the course of construction of plant also on subsequent formation also during the course of maintenance the garbage that may generate should shift to a far away place without discharging the same to the river/canal also near by lake, reservoir.

3) In the future days it shall not cause any obstruction for development of fishes in the nearby lake.

4) In the EIA and EMP report of the company as adopted therein in connection with fisheries all the conditions should be complied strictly.

5) The officers of the Fisheries Department may enter into the unit at any point of time for inspection to know about the aforesaid conditions followed or not.

6) In the event of fisheries the more conditions that may be imposed in future should be prepared to follow the same.

7) After establishing the plant for the period up to 10 years once in 2 years the affect that may be taken in the fish a study is to be conducted, the said report is to be submitted to the Fisheries Department, if any such effect is taken it may be set-right.

8) In the event of violating all the aforesaid condition or any of the conditions stated above, the fisheries department reserves its rights to cancel the no objection certificate given to you.

Yours faithfully,
Sd/-
Director of Fisheries.

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भारतीय विमानपत्तन प्राधिकरण
AIRPORTS AUTHORITY OF INDIA

No. AAI/KIA/ATH/NOC/488-92 Date: 5/5/2016

Narendra Kumar

22/23 Sudharshan Complex KPCL Seshadri Road
Blore09

NO Objection Certificate for Height Clearance

This NOC is issued by Airports Authority of India (AAI) in pursuance of responsibility conferred by and as per the provisions of Govt. of India (Ministry of Civil Aviation) order SO84 (E) dated 14th Jan. 2010 for Safe and Regular Aircraft Operations.

1. References:

NOCID	JAKK/SOUTH/E/032615/107133
Applicant Letter	26/03/2015
AAI Reference	BL-139/2015

2. NOC Details for Height Clearance:

Applicant Name	Narendra Kumar
Type of Structure	Chimney
Site Address	Yelhanka DG Plant Karnataka Power Corporation Ltd ,SN Halli Post Yelhanka Bangalore 560064
Site Cordinates	13 7 4.281N -77 34 54.16E
Site Elevation AMSL in Mtrs	900.0 Mtrs Nine Zero Zero Decimal Zero Meters AMSL.
Permissible height above Ground Level in Mtrs	60.0 Mtrs Six Zero Decimal Zero Meters AGL.
Permissible Top Elevation AMSL in Mtrs	960.0 Mtrs Nine Six Zero Decimal Zero Meters AMSL.

3. This NOC is subject to the terms and conditions as given below:

a. The site-elevation and site coordinates provided by the applicant are taken for calculation of the permissible top elevation for the proposed structure. If, however, at any stage it is established that the actual data is different from the one, provided by the applicant, this NOC will be invalid.

b. The issue of the 'NOC' is further subject to the provisions of Section 9-A of the Indian Aircraft Act, 1934 and those of any notifications issued there under from time to time including the Aircraft(Demolition of Obstruction caused by buildings and trees etc.) Rules,1994.

c. No radio/TV Antenna, lighting arresters, staircase, Mumtee, Overhead water tank and attachments of fixtures of any kind shall project above the Permissible Top Elevation 960.0 Mtrs. indicated in para 2.

d. The use of oil fired or electric fired furnace is mandatory, within 8 KM of the Aerodrome Reference Point.

e. The certificate is valid for a period of 7 years from the date of its issue. If the building/structure/Chimney is not constructed & completed within the period, the applicant will be required to obtain a fresh 'NOC' from the Designated Officer of Airports Authority of India. The date of completion of Building/Structure/Chimney should be intimated to this office of AAI. Request for revalidation of NOC will not be entertained after the expiry of its validity period.

f. No light or a combination of lights which by reason of its intensity, configuration or colour may cause confusion with the aeronautical ground lights of the Airport shall be installed at the site at any time, during or after the construction of the building.

g. The applicant will not complain/claim compensation against aircraft noise, vibrations damages etc caused by aircraft operations at or in the vicinity of the airport.

h. Day markings & night lighting with secondary power supply shall be provided as per the guidelines specified in chapter 6 and appendix 6 of Civil Aviation Requirement Series 'B' Part I Section 4, available on DGCA India website: www.dgca.nic.in

i. The applicant is responsible to obtain all other statutory clearances from the concerned authorities including the approval of building plans as this NOC for height is for the purpose of 'to ensure the safe and regular aircraft operations' and shall not be used as document for any other purpose/claim whatsoever, including ownership of land etc.

j. This NOC has been issued w.r.t. the Civil Airportsas notified in S0 84(E). Applicant needs to seek separate NOC from Defence, if the site lies within jurisdiction of Defence Airport.

This certificate is issued for "HEIGHT CLEARANCE ONLY" with the approval of Competent Authority for Permissible Top Elevation 960.0 Mtrs

M.MUTHU
GENERAL MANAGER (ATM)
Airports Authority Of India

Copy to :

1. The Executive Director(ATM), AAI, Rajiv Gandhi Bhavan, Safdarjung Airport, New Delhi-110003
2. GM(NOC)/Airport Director(Bundle).
3. Guard File
4. Regional Executive Director(Southern Region),AAI,Chennai Airport,Chennai-600027.
5. Member Secretary,BIAAPA,Devanahalli/Commissioner,BBMP,Bangalore.
6. Director Operations,BIAL.
7. The Director I/C, Govt.Flying Training School, Jakkur Aerodrome,Yelahanka Post,Bangalore-64.

Office of The CE(GSW)
KPC Ltd., Yelahanka, Bangalore - 64.
Inw. No. : 704
Date : 25.11.2015

ಕರ್ನಾಟಕ ಸರ್ಕಾರ
ಆರೋಗ್ಯ ಮತ್ತು ಕುಟುಂಬ ಕಲ್ಯಾಣ ಸೇವೆಗಳ ನಿರ್ದೇಶನಾಲಯ
ಆನಂದ ರಾವ್ ವೃತ್ತ, ಬೆಂಗಳೂರು-560020

ಸಂಖ್ಯೆ:ಹೆಚ್ಇಕ್ಯೂ(ಹೆಚ್): 174:2014-15 ದಿನಾಂಕ: 28:10:2015

CEED | SE-1 | SE-2 | SE-CSD
EE-1 | OFFICE OF CEED K.P.C.LTD. BANGALORE | EE-11
EE-2 | 23 NOV 2015 | EE-10
EE-3 | No. | EE-9
EE-5 | EE-7 | EE-8

ವಿಷಯ: ನಿರಾಪೇಕ್ಷಣಾ ಪ್ರಮಾಣ ಪತ್ರ

ಯಲಹಂಕಾ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ 350 ಮೆಗಾವ್ಯಾಟ್ ನ್ಯಾಚುರಲ್ ಗ್ಯಾಸ್ ಪವರ್ ಪ್ಲಾಂಟ್ ಪ್ರಾರಂಭಿಸಲು ನಿರಾಪೇಕ್ಷಣಾ ಪತ್ರ ನೀಡಿದ್ದು ನ್ಯಾಚುರಲ್ ಗ್ಯಾಸ್ ಬದಲಿಗೆ ಬಯೋಗ್ಯಾಸ್ ಎಂದು ನೀಡಿರುವುದನ್ನು ತಿದ್ದುಪಡಿಮಾಡಿ ನಿರಾಪೇಕ್ಷಣಾ ಪ್ರಮಾಣ ಪತ್ರ ನೀಡುತ್ತಿರುವ ಕುರಿತು.

1. ತಮ್ಮ ಕಛೇರಿ ಪತ್ರ ಸಂಖ್ಯೆ :ಸಿಇ(ಜಿಎಸ್ಡಬ್ಲ್ಯು)ಯಲಹಂಕ ಸಿಸಿಪಿಪಿ /ಸಿಎಲ್ಎಸ್/662/ದಿನಾಂಕ:11.12/11/2014
2. ಆರೋಗ್ಯ ಮತ್ತು ಕು ಕ ಅಧಿಕಾರಿಗಳು ಬೆಂಗಳೂರು ನಗರ ಇವರು ಭೇಟಿ ನೀಡಿ ನೀಡಿರುವ ವರದಿಯ ಮೇರೆಗೆ
3. ಈ ಮೊದಲು ನೀಡಿರುವ ನಿರಾಕ್ಷೇಪಣಾ ಪತ್ರ ದಿನಾಂಕ:31/03/2015
4. ತಮ್ಮ ಕಛೇರಿ ಪತ್ರ ಸಂಖ್ಯೆ:ಸಿ.ಇ.(ಜಿ.ಎಸ್.ಡಬ್ಲ್ಯೂ.)ಪ್ರೈ.ಸಿ.ಸಿ.ಪಿ.ಪಿ./501 ದಿನಾಂಕ:23/07/2015

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ಮೇಲ್ಕಂಡ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ಹಾಗೂ ಉಲ್ಲೇಖದ ಪತ್ರ 1 ರಲ್ಲಿ ಕೋರಿದಂತೆ ಯಲಹಂಕಾ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ 350 ಮೆಗಾವ್ಯಾಟ್ ನ್ಯಾಚುರಲ್ ಗ್ಯಾಸ್ ಪವರ್ ಪ್ಲಾಂಟ್ನ್ನು ಅಳವಡಿಸಿ ಪ್ರಾರಂಭಿಸಲು ನಿರಾಪೇಕ್ಷಣಾ ಪ್ರಮಾಣ ಪತ್ರ ನೀಡಲು ಕೋರಲಾಗಿದೆ.

ಉಲ್ಲೇಖ ಪತ್ರ 1 ರಂತೆ ನಿರಪೇಕ್ಷಣಾ ಪತ್ರವನ್ನು ಉಲ್ಲೇಖ 3 ಇದೆ ಪತ್ರ ಸಮಸಂಖ್ಯೆ ದಿನಾಂಕ:31/03/2015 ರಂದು ನೀಡಲಾಗಿದ್ದು. ಅದರಲ್ಲಿ 350 ಮೆಗಾವ್ಯಾಟ್ ನ್ಯಾಚುರಲ್ ಗ್ಯಾಸ್ ಬದಲಿಗೆ 350 ಮೆಗಾವ್ಯಾಟ್ ಬಯೋಗ್ಯಾಸ್ ಎಂದು ನೀಲಾಗಿದ್ದನ್ನು 350 ಮೆಗಾವ್ಯಾಟ್ ನ್ಯಾಚುರಲ್ ಗ್ಯಾಸ್ ಎಂದು ತಿದ್ದುಪಡಿ ಮಾಡಿ ಮತ್ತೊಮ್ಮೆ ನಿರಾಪೇಕ್ಷಣಾ ಪತ್ರ ನೀಡಲು ಉಲ್ಲೇಖ 4 ರಲ್ಲಿ ಕೋರಿರುವುದರಿಂದ.

ಸದರಿ ಪ್ರದೇಶಕ್ಕೆ ಸಂಬಂಧಪಟ್ಟ ಆರೋಗ್ಯ ಮತ್ತು ಕು ಕ ಅಧಿಕಾರಿಗಳು ಬೆಂಗಳೂರು ನಗರ ಇವರು ಭೇಟಿ ನೀಡಿ ನೀಡಿರುವ ವರದಿಯಂತೆ

ಬೆಂಗಳೂರು ಉತ್ತರ ತಾಲ್ಲೂಕು, ಯಲಹಂಕ ಸಮೀಪದ ರಾಜ್ಯದ ಹೆದ್ದಾರಿ ಯಲಹಂಕ – ದೊಡ್ಡಬಳ್ಳಾಪುರ ರಸ್ತೆಯ ಸುಮಾರು ಯಲಹಂಕದಿಂದ 2-3 ಕಿ.ಮೀ. ದೂರದಲ್ಲಿ ಕೆ.ಪಿ.ಸಿ.ಎಲ್ ಕೆಛೇರಿಯ ಆಧಿನದಲ್ಲಿರುವ ಡಿ.ಜಿ. ಪ್ಲ್ಯಾಂಟ್ ನ ಆವರಣದಲ್ಲಿ ಹೊಸದಾಗಿ 350 ಮೆಗಾವ್ಯಾಟ್ ನ್ಯಾಚುರಲ್ ಗ್ಯಾಸ್ ಪವರ್ ಪ್ಲಾಂಟ್ ಪ್ರಾರಂಬಿಸಲು ಗುರುತಿಸಲಾಗಿದ್ದ ಪ್ರದೇಶದ ಚಕ್ಕುಬಂದಿಯು ಈ ಕೆಳಕಂಡಂತೆ ಇರುತ್ತದೆ.

ಪೂರ್ವಕ್ಕೆ :- ಬೆಂಗಳೂರು ದೊಡ್ಡಬಳ್ಳಾಪುರ ರಾಜ್ಯ ಹೆದ್ದಾರಿ
ಪಶ್ಚಿಮಕ್ಕೆ :- ಡಿ.ಜಿ.ಪ್ಲಾಂಟ್ ಪ್ರಾರಂಭಮಾಡುವ ಸ್ಥಳವನ್ನು ಒಳಗೊಂಡಂತೆ ಕಂಪೌಂಡ್ ಗೋಡೆ
ಉತ್ತರಕ್ಕೆ :- ಖಾಸಗಿ ಅಪಾರ್ಟಮೆಂಟ್

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ವಿಷಯಕ್ಕೆ :- ಸದರಿ ಸಂಸ್ಥೆಯವರ ಹಾಲಿ ಡಿ.ಜಿ.ಪ್ಲಾಂಟ್

ಸದರಿ ಚಕ್ಕುಬಂದಿಯ ಪ್ರಕಾರ ಹಾಲಿ ಪರಿಪೇಕ್ಷಣೆ ಮಾಡಿದ ದಿನದಂದು ಯಾವುದೇ ವಸತಿ ಪ್ರದೇಶಗಳು ಬಂದಿರುವುದಿಲ್ಲ. ಹಾಗೂ ಹಾಲಿ ಕೆ.ಪಿ.ಸಿ.ಎಲ್ ಕಛೇರಿಯ ಅಧಿಸೂಚನೆಯಲ್ಲಿರುವ ಕೆ.ಪಿ.ಸಿ.ಎಲ್ ಆಡಳಿತ ಕಛೇರಿ ಹಾಗೂ ಡಿ.ಜಿ. ಪ್ಲ್ಯಾಂಟ್ ನಲ್ಲಿ ಕರ್ತವ್ಯನಿರ್ವಹಿಸುತ್ತಿರುವ ಸಿಬ್ಬಂದಿ ವರ್ಗದವರು ಆರೋಗ್ಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ಅವಶ್ಯ ಮುನ್ನೆಚ್ಚರಿಕೆ ವಹಿಸಿದ್ದಲ್ಲಿ ಸ್ಥಾವರಜನಿಕರಿಗೆ ಮತ್ತು ಸಿಬ್ಬಂದಿ ವರ್ಗದವರಿಗೆ ಆರೋಗ್ಯಕ್ಕೆ ಯಾವುದೇ ರೀತಿಯ ಧಕ್ಕೆಯಾಗುವ ಸಂಭವವಿರುವುದಿಲ್ಲ.

ಈ ಹಿನ್ನೆಲೆಯಲ್ಲಿ ಯಲಹಂಕಾ ಸಮೀಪದಲ್ಲಿ 2x20 ಮೆಗಾವ್ಯಾಟ್ ನ್ಯಾಚುರಲ್ ಗ್ಯಾಸ್ ಪವರ್ ಪ್ಲಾಂಟ್‌ನ್ನು ಅಳವಡಿಸಿ ಪ್ರಾರಂಭಿಸಲು ಇತರೆ ಇಲಾಖೆಗಳಿಂದ ಅವಶ್ಯವಿರುವ ನಿರಾಪೇಕ್ಷಣಾ ಪ್ರಮಾಣ ಪತ್ರಗಳನ್ನು ಪಡೆಯಲು ಉದ್ದೇಶಿಸಲಾಗಿದೆ. ಈ ಇಲಾಖೆಯಿಂದ ನಿರಾಪೇಕ್ಷಣಾ ಪ್ರಮಾಣ ಪತ್ರವನ್ನು

01-33

ನಿರ್ದೇಶಕರು
ಆರೋಗ್ಯ ಮತ್ತು ಕ.ಕೆ.ಸೇವೆಗಳ ನಿರ್ದೇಶನಾಲಯ
ಬೆಂಗಳೂರು.

1) ಪ್ರತಿಯನ್ನು ಮುಖ್ಯ ಅಭಿಯಂತರರು (ಇವಿ&ಟಿಎ) ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತ ಶೇಷಾದ್ರಿ ರಸ್ತೆ ಬೆಂಗಳೂರು ಇವರಿಗೆ ಸಲ್ಲಿಸಿದೆ.
2) ಪ್ರತಿಯನ್ನು ಮುಖ್ಯ ಅಭಿಯಂತರರು (ಜವಿಸಿಡಬ್ಲ್ಯು) ಸಿಇಕೆ ಕಾಂಪ್ಲೆಕ್ಸ್ ಎರಡನೆ ಮಹಡಿ ಶೇಷಾದ್ರಿ ರಸ್ತೆ ಬೆಂಗಳೂರು ಇವರಿಗೆ ಸಲ್ಲಿಸಿದೆ.
3) ಕಛೇರಿ ಪ್ರತಿ.

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Government of Karnataka
DIRECTORATE OF HEALTH & FAMILY WELFARE SERVICES
Anandarao Circle, Bangalore-560 009

No.HEQ(H)174/2014-15 Date : 28-10-2015

NO OBJECTION CERTIFICATE

Sub:- No objection certificate given to commence 350 MW Natural Gas Power Plant within the limits of Yalahanka and instead of natural gas issue of amended No objection Certificate for Biogas – regarding.

Ref: 1) Your office letter No.CE(GSW) Yalahanka CCPP/CLS/662/dated 11.12/11/2014

2) Health & F.W. Officer, Bangalore City who visited and given report

3) The No objection Certificate earlier given on 31-03-2015

4) Your office letter No.CE(G.S.W.) Y.C.P.C.501 dated 23-07-2015

With reference to the above cited subject also the letter at Ref 1 above as sought for issued No objection Certificate for commencement of 350 M.W natural gas power plant.

As per the letter at Ref 1 above the No Objection Certificate vide Ref No.3 vide letter No. nil dated 31-03-2015 was given and in which it was given for 350 M.W Biogas instead of 350 MW natural gas and by amending

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the same it was sought once again for issue of No objection Certificate as 350 MW Natural Gas vide your letter at Ref:4 above.

In connection with the said area the Health & F.W. Officer, Bangalore City visited the spot and as per his report -

The area marked for commencement of 350 M.W natural gas power plant newly in the D.G. plant premises which is under the control of K.P.C.L office, 2-3 kms away from Yalahanka, Yalahanka-Doddaballapur Road, near Yalahanka National Hihway, Bangalore North Taluk, and the said are bounded on the;

East by : Bangalore Doddaballapura State Highway

West by : Compound wall including the interior area for commencement of D.G. Plant

North by : Private Apartment

South by : Present D.G. plant of the said company.

As bounded above now the spot inspection was conducted and there are no any residential area and further the present K.P.C.L office under which K.P.C.L Administrative office also D.G. Plant in which the staff

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working with regard to their health, if the precautionary measure is taken, there will be no health problem in any manner to the general public and the staff members.

On this background in order to install the 350 MW natural gas power plant and commence the same for which the no objection certificate required from other departments subject to the conditions to obtain the same, the no objection certificate is given by this department.

Sd/-
Director
Directorate of Health & F.W. Service
Bangalore.

1) Copy submitted to Chief Engineer (EI&TA) Karnataka Power Corporation Ltd, Seshadri Road, Bangalore.

2) Copy to Chief Engineer (JSW) Sudarshan Complex, 2nd floor, Seshadri Road, Bangalore.

3) Office copy

// True copy //

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No. 22(10)/2015-D (Coord)
Government of India
Ministry of Defence

R.No: 218, 'B' Wing, Sena Bhavan,
New Delhi, the 13th January, 2016.

OFFICE MEMORANDUM

Subject:- NOC for Chimney height restriction for 1x350 MW Gas based Combined Cycle Power plant (CCPP) at Yelahanka, Karnataka-issue of NOC-reg.

The undersigned is directed to refer to the Ministry of Power's O.M. No. 6/2/2015-S.Th. dated 21.07.2015 on the above subject and to state that Ministry of Defence has no objection to the construction of 1x350 MW Gas based Combined Cycle Power plant (CCPP) at Yelahanka, Karnataka by Karnataka Power Corporation Limited subject to the conditions as under:-

(a) The NOC cannot be treated as a document for claim of title of land on which the construction is proposed. No construction is to be undertaken on defence land or in its notified vicinity.

(b) The vertical extent (highest point) of the construction of Chimney and associated structures at Latitude: 13° 07' 04.28" N and Longitude 77° 34' 54.16" E shall not exceed 960 metres above mean sea level or 60 metres above ground level whichever is lower.

(c) Any extension or structure permanent or temporary (e.g. Cranes, Antennas, lightening arrester, etc.) shall not be permitted above the cleared height of the Chimney and any other associated structures.

(d) Applicant needs to abide by the understanding at Appendix 'D2' to use oil fired electric furnace or any other type of fuel in factory / industrial unit or at site that will not cause smoke hazards, violation of this shall render this NOC null and void.

(e) Standard obstruction markings and lightings as per IS 5613 notification and International Civil Aviation Organization(ICAO) standards as stipulated in ICAO-Annex-14 is to be provided by the company. The lights shall be kept 'ON' at all times. Provision shall be made for standby power supply to keep the lights 'ON' during power failure.

(f) Periodic maintenance of obstruction lights shall be carried out by the company at regular intervals to keep them in serviceable and visible condition.

(g) No light or combination of lights which by reasons of its intensity, configuration or colour may cause confusion with aeronautical ground lights

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of an airport shall be installed at the site at any time during or after construction of the chimney and associated structures.

(h) The commencement, completion of works inclusive of installation of obstruction lights shall to be intimated to the following:

(i) AOC, Air Force Station, Yelhanka.
(ii) CATCO, HQ TC IAF, JC Nagar Post, Bangalore-560006.

Failure to render these certificates within the stipulated time shall lead to cancellation of NOC.

(i) Required security clearance should be obtained through MHA/IB of the foreign Nationals/Indian representative employed/ to be employed by the company in India.

(j) NOC shall be obtained from AAI(Bengaluru) and Govt. Flying Training School, Jakkur, Bengaluru.

(k) The co-ordinates of the proposed location falls outside the area of jurisdiction considered for issuance of NOC by HAL, Bengaluru. However the other parts of proposed side if it falls within 20 Kms from HAL airport, the NOC shall be obtained from HAL.

(l) The Validity of this NOC is five years from the date of issue. If the construction for which NOC has been issued, does not complete within five years of issue or found to be in deviation from original proposal, or in case of non adherence to the above mentioned conditions, the NOC shall be deemed null and void. It will be the responsibility of the applicant to obtain fresh NOC for the proposal.

13/1/2016

(Arvind Kumar)
Under Secretary to the Govt. of India
Tele: 2301 2729

To,
Ministry of Power,
(Shri Kundan Kumar, Under Secretary)
Shram Shakti Bhavan,
Rafi Marg, New Delhi.

Copy to:- The Managing Director, Karnataka Power Corporation Ltd., 'Shakthi Bhavan', No. 82, Race Course Road, Bangalore-560 001

3/-

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Annexure-R14

KPCL
ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತ
KARNATAKA POWER CORPORATION LTD.
CIN-U51110 KA 1970 SGC 001919

CEGSW/ YCCPP/ Supply/ 1041/a -

Date : 03.11.2015

LETTER OF AWARD

(SUPPLY)

M/s Bharat Heavy Electricals Limited
Power Sector-Marketing
BHEL House, Siri-fort
New Delhi – 110 049

Dear Sir,

Sub: **1X370 MW, Yelahanka CCPP, Karnataka, India – Letter of Award for Design, Engineering, Manufacture, Inspection, Testing of Performance at works, Supply at Ex-works of Gas & Steam turbine generators & its auxiliaries, HRSG & its auxiliaries, agreed Balance of Plant (BOP) including associated Civil, Electrical and C&I works and Mandatory spares, etc.**

References: -

1. BHEL letter ref: MS-1-13-E-0030 dtd.21-05-2014 enclosing commercial EPC proposal for the installation of 370MW CCPP.
2. BHEL letter ref: MS-1-13-E-0030 dtd.11-06-2014 enclosing Technical EPC proposal for the installation of 370MW CCPP.
3. Discussions held between KPCL and BHEL on 4/5th Aug 2014 at KPCL Bangalore and at Yelahanka site regarding the technical scope, layout and the MOM finalised.
4. BHEL letter ref: MS-1-13-E-0030 dtd.28-08-2014 enclosing revised Technical proposal.
5. Minutes of meeting dated 09th and 10th Sept.2014 between KPCL and BHEL held at Yelahanka site of KPCL

Office of Chief Engineer (GSW), DG Plant Premises, S.N. Halli Post, Yelahanka, Bangalore-560 064
Tel. : 080-2856 2944 / 2846 0974 Fax 080-2846 0302
E-mail cegsw@karnatakapower.com / cegswkpcl@gmail.com Website www.karnatakapower.com

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6. BHEL Consolidated revised Techno commercial offer submitted by M/s BHEL dtd 13.11.2014.
7. BHEL letter ref: MS-1-13-E-0030 dtd 18-11-2014, enclosing the revised guarantee schedule (Re-2).
8. High level meeting held between KPCL and BHEL on 18th November 2014 at KPCL Bangalore regarding the contract price.
9. KPCL Email dtd 20.11.2014 and 22.11.2014 conveying the estimated BOQ for raw water reservoir.
10. BHEL Final offer ref: MS-1-13-E-0030 dtd.04-12-2014.
11. KPCL LOI (Supply) ref. CEGSW/YDG/gas/Supply/518. dtd 14.01.2015.
12. Minutes of Meeting dtd.20.02.2015 between KPCL and BHEL held at KPCL office Bangalore.
13. Minutes of meeting dated 15th and 16th Sept.2015 between KPCL and BHEL held at KPCL, Bangalore regarding finalization of commercial terms and conditions.

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1. We confirm having accepted BHEL's offer cited above at Sl.No.1 and subsequent correspondences/meetings ending with meeting referred under Sl.No.13 and are pleased to award the contract to BHEL for Design, Engineering, Manufacture, Inspection, Testing of performance at works, Supply at Ex-works including packing and forwarding of Gas Turbine Generator & Auxiliaries, Steam Turbine Generator & Auxiliaries, HRSG & Auxiliaries and agreed Balance of Plant (BOP) & Associated Civil works, Electrical and C&I works and Start-up & commissioning spares, Mandatory spares for the implementation of 1x370 MW Yelahanka CCPP on EPC basis subject to the terms and conditions detailed below.

2. SCOPE/SPECIFICATIONS

The scope of letter of Award is on the basis of CONTRACTOR'S single point responsibility covering the equipment mutually agreed. It will include the following but not limited to:

a) The scope of Supply, Terminal points and Exclusions shall be in line with BHEL original proposal dtd.21.05.2014 cited at Sl.No.1 above and read in conjunction with BHEL subsequent scope correspondence /Meeting cited from Sl.No.2 to Sl.No.5 above under reference.

b) The Final scope of Supply, Terminal points and Exclusions incorporating various scope changes as indicated at Sl. no. 2 (a) above is furnished in Vol. 1 of Techno commercial offer dtd.13.11.2014 submitted by M/s BHEL.

c) All Equipments/System/Items shall be Designed, Engineered, Manufactured, Supplied, as agreed vide Sl.No.11 of the MOM dtd.4/5th

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Aug 2014 and Sl.No.4 of the MOM dtd.9th and 10th Sept 2014 along with technical write-up, salient technical features, drawings furnished as part of revised techno commercial offer dtd 13.11 2014 submitted by M/s BHEL.

3. EQUIPMENT TO BE SUPPLIED BY THE CONTRACTOR

Gas turbine Generators & Auxiliaries, Steam Turbine Generator & auxiliaries, HRSG & auxiliaries, agreed BOP's and associated Electrical and C&I works shall include all the items detailed and mutually agreed as mentioned at Clause No.2 of this LOA. The scope of supply, terminal points and exclusions as specified at 2(b) for the project and mandatory spares shall be as per the agreed scope mentioned under ref above.

However, all the items which are essential for the completeness of system shall be included excepting those which are specifically deleted/ excluded as per agreed scope as cited above.

Any variation in the scope/ specifications mentioned as above shall be discussed and mutually agreed with additional price and delivery implications.

4. PRICES

4.1 The breakup of the FIRM price for the supply of Gas turbine Generator & auxiliaries, Steam Turbine Generator & auxiliaries, HRSG & auxiliaries, agreed BOP's and associated Electrical and C&I works as finalised at Sl.No.2 above on Ex-contractor's works / Sub-contractor's works /Port of entry in India including ED, CST/KST is as detailed below

Sl. No.	Particulars	INR(Million)
1	Supply of Main equipment including Mandatory spares (Ex-BHEL/ Sub Contractor's works/ Port of Entry in India basis) including Taxes/duties only on DD items.	8820.00
2	Taxes & Duties on Supply of Shop manufactured items including Site Fabrication items and away centre fabrication items. (Excise Duty @10%, Education cess @ 3% of Excise duty, Central Sales Tax @ 2% for dispatches from outside the state of Karnataka subject to issuance of C form and local Sales Tax @ 4% on the dispatches from within the state of Karnataka)	Included at Sl. No 1 above
3	Total of Supply including the Taxes & Duties / levies mentioned above	8820.00

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The CIF content included in the above prices is INR 3250.00 Million (for Supply) at the exchange rate of 1 USD=60.61 INR and 1 Euro=84.40 INR.

4.2 The prices indicated in para 4.1 above are firm and shall not be subject to price variation on account of materials and labour during contract period. However, in case of extension of the contract due to reasons not attributable to BHEL, prices shall be subject to revision, which shall be mutually discussed and agreed.

4.3 Taxes & Duties:

The prices indicated above include all applicable import duties at prevailing rates, under power certificate route Sl No.370 of customs notification 12/2012 and the amendments thereof.

Necessary documents including Essentiality Certificates required by BHEL to avail the above customs duty concessions shall be made available to BHEL by KPCL within seven days of receipt of the request from BHEL units. In case, the necessary documents including Essentiality Certificates are not made available to BHEL by KPCL or there is a delay in furnishing of these documents, the materials shall be got cleared from Customs Authorities by paying import duties on merit and the total implications arising there from shall be to KPCL's account.

Further, CIF value may increase beyond the value indicated above during contract stage depending upon import requirements of BHEL units which shall be intimated by BHEL units to KPCL during the course of the contract. KPCL will facilitate the issue of revised Essentiality Certificates to BHEL units. However the contract price shall not increase due to such increase in the CIF value.

4.4 Any variation in the rate of import duty under project import and / or impact on import duty due to the exchange rate variation along with corresponding implication on taxes and duties and there on shall be payable extra by KPCL on the total CIF value.

4.5 Further price quoted above also considers CD and ED exemption available for water treatment plant as per GOI notification 14/2004 –Cus. Dtd.08/01/2004 and 3/2004 -CE dtd.08.01.2004 respectively. Accordingly, KPCL shall provide exemption certificates to BHEL to enable claiming exemption from payment of custom duty, excise duty, Octroi etc. In case the exemption certificate is not issued or the Governing agencies do not recognise the exemption certificate(s), then such duties, taxes /levies etc. shall be paid by KPCL at actual on production of documentary proof.

4.6 Necessary "C" forms / any other local declaration forms as applicable shall be issued by KPCL to BHEL in time to enable to avail the concessional rate of sales tax as mentioned above. In the event of non-furnishing of requisite C

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forms/ other declarations forms as applicable, differential tax along with interest/ penalties as levied by statuary bodies shall be to KPCL account

Away- centre fabrication items shall be treated as shop manufactured items for taxation purpose and accordingly taxes/ duties shall be payable extra for the same.

All taxes, duties & levies other than those indicated above i.e Turnover tax, Entry tax, Exit tax, Octroi GST, (Goods and services tax) or any other local taxes and levies are excluded from above prices, which if leviable on BHEL during the execution of contract shall be payable extra at actuals by KPCL, based on BHEL's certification and furnishing necessary documents.

Further, in case any Taxes/Duties is levied by Government authorities on indirect transaction/invoicing for direct dispatchable items, same shall be payable extra at actuals by KPCL based on BHEL's certification and production of necessary documents.

BOCW is also not included in the above prices and same shall be reimbursed to BHEL extra at actuals, against production of necessary documents by BHEL/Sub-contractor.

4.7 The prices indicated above are subject to all statuary variations, which shall be to KPCL account. Any variation in taxes and duties on transaction between the Contractor and its Sub-vendors / Sub-Contractors/ Suppliers will however be to Contractor's account except for directly dis-patchable items to Site complete in all respects and be liable in the same shape.

5. TERMS OF PAYMENT FOR SUPPLY:

Payment of the Contract price will be regulated as per draw down schedule and against achievement of Milestones indicated in the Draw down schedule (DDS). The payment shall not exceed the amount indicated against each mile stone in the "Draw down Schedule" which is enclosed at Annexure-I.

Even though the payments will be made as per the Draw-Down Schedule (DDS), the following Terms of Payment shall be applicable for the purpose of billing:

i) 1st DDS payment: 10%

ii) Progressive payment: 75%

iii) Material receipt at site: 10%

iv) Last DDS payment: 5%

Statutory variation of Taxes and Duties shall be arrived on the basis of invoices raised by respective BHEL units, and settled regularly on mutually agreed basis.

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6. EFFECTIVE (ZERO) DATE OF CONTRACT:

The effective (Zero) date for the contract shall be reckoned as date of receipt of confirmed **Letter of Award.**

7. COMPLETION PERIOD & TAKING OVER

7.1 *Take over* of the plant shall be after the completion of all test procedures viz. Preliminary operation, Initial operation, Reliability tests, Unit characteristics tests & Performance Guarantee Test as set forth in the contract.

7.2 Takeover of the plant shall be achieved within 30 months from the zero date /Effective date. M/s BHEL will, however, make best efforts to complete the Preliminary operation, Initial operation, Reliability tests, Unit characteristics tests & Performance Guarantee Test within 28 months. However, for all contractual purposes, completion period shall be 30 months.

7.3 KPCL shall issue a Certificate of Taking Over to BHEL after the completion of Reliability test/ Trial Operation/PG tests in OCP mode as a proof of the final acceptance of the Plant. Guarantee period/latent defect period shall commence for the plant from such date.

7.4 In the event of Trial Operation, PG tests/ Take over getting delayed for reasons not attributable to BHEL, the scheduled date of completion of PG test/take over or date on which BHEL was ready for completion of such tests whichever is later, shall be deemed as date of taking over and obligations of either party like Handing over/ Taking over, Warrantee, Latent defect period, insurance obligations etc. will commence on such date.

However BHEL obligations for conductance of Trial operations/PG tests shall remain.

7.5 In such situations, all payments linked with trial operation/ PG tests shall be released on such dates against submission of BHEL's invoice and BG of equivalent amount valid for three (3) Months or up to the actual date of completion of Trial operation/PG tests, whichever is later. The BG shall be discharged by KPCL immediately on actual completion of Trial operation/PG tests

8. MODE OF PAYMENT

8.1 Unless otherwise agreed by the parties, payments by owner to contractor, shall be made in Indian Rupees as per draw down schedule by wire transfer or cheque to an account or accounts designated by BHEL and maintained by BHEL at a bank or banker in India in writing.

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8.2 KPCL shall pay the amount certified in each Interim Payment Certificate within 30 days from the date on which KPCL/ Owner's Representative received BHEL's invoices and supporting documents

9. PAYING AUTHORITY

The paying authority for supply shall be DGM (F)/HO, Karnataka Power Corporation Limited, Bangalore, Karnataka. All the documents with pre-receipted stamped invoices shall be sent to DGM (F)/HO, for arranging payment. However copies of documents shall be sent to the consignee, Chief Engineer (GSW), and Chief Engineer (Thermal Designs), KPCL, Bangalore for advance information.

10. CONSIGNEE:

The consignments/ material should be dispatched to F.O.R Yelahanka Combined Cycle Power Plant, freight prepaid duly insured, securely packed (wherever necessary) as per specification, so as to avoid damage during transit and consigned to Executive Engineer (Stores), Yelahanka Combined Cycle Power Plant, Karnataka Power Corporation Limited, Doddaballapura Road, Singanayakanahalli Post, Bangalore-560064, Karnataka.

11. LIQUIDATED DAMAGES

11.1 Liquidated Damages for Delay

11.1.1 If take over does not occur on or before the Guaranteed Completion Date of Plant as per clause no.7 of this LOA, Contractor shall pay liquidated damages to Owner for such delay for each and every day which elapses after the guaranteed completion date, until taking over of the plant as specified in the contract.

11.1.2 The liquidated damages payable by the Contractor to the Owner for the delay in achieving the Guaranteed Completion Date (taking over) shall be at the rate of **Rs.17.46 Million** (Rupees seventeen point four six million only) for each day of delay.

11.1.3 Notwithstanding the foregoing, no Delay Liquidated Damages shall be payable for period of delay in achieving takeover of the plant to the extent such delay is solely on account of Force Majeure Event and Contractor has been granted an extension of time pursuant to Clause no. 15.0 of this LOA with respect to such period.

11.2 Liquidated Damages for Performance Guarantees:

11.2.1 The Performance Liquidated Damages payable by the Contractor to the Owner in case the Contractor does not meet the Performance Guarantees as per following Schedule :

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(a) For decrease in Combined cycle plant gross output at the generator terminals

An amount of Rupees 1,00,000/- (Rupees One lakh only) per Kilowatt Shortfall in output.

(b) For increase in Combined cycle gross heat rate

An amount of Rupees 2,00,000/- (Rupees Two Lakhs only) per Kcal/Kwhr/MW.

(c) For increase in Auxiliary power consumption

An amount of Rupees of 17.5 Million (Rupees Seventeen point five Million only) per every 0.01% increase in auxiliary power consumption (measured in percentage (%) of Gross Output)

11.2.2 **Limitation of Liability:**

(a) Under no circumstance will Contractor's aggregate liability for

(i) Cumulative liquidated damages for delay in achieving taking over exceed 20% of the Contract Price and/ or

(ii) Cumulative liquidated damages for failure to achieve the Performance Guarantees exceed 20% of the Contract Price

(b) Furthermore, the total amount of Contractor's obligation to pay liquidated damages,

(i) For delay in achieving taking over and

(ii) For failure to achieve the Performance Guarantee shall not exceed an aggregate amount equal to 20% of the Contract Price.

11.2.3 The Contractor shall in no event be liable to the Owner, by way of indemnity or by reason of any breach of the Contract or in tort or otherwise, for loss of generation, loss of profit or loss of any Contract or for any indirect, special or consequential loss or generation loss or damage which may be suffered by the Owner in connection with the Contract

12. **DEFECT LIABILITY PERIOD AND LATENT DEFECT PERIOD.**

12.1 The Contractor guarantees shall survive for the term of the Guarantee Period which is twelve (12) months from the date of Take-over of Plant. Any Work having defects in the design, engineering, materials and workmanship of the Plant and Equipment supplied and of the work executed which is guaranteed and corrected by Contractor shall be further guaranteed by Contractor for a period ending twelve (12) months after the date such correction is effected and accepted by Owner / Owner's Representative, and to the extent such

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period ending twelve (12) months after the date such correction is effected and accepted by Owner / Owner's Representative, and to the extent such period extends beyond the Guarantee Period, the Guarantee period shall be extended for with respect to such corrected portion of the Work

12.2 Latent defect period shall be Five (5) years from the date of Take-over of the Plant. Any such latent defects during Latent Defect Period shall be corrected and made good by the Contractor at his sole cost. However whether the defect is latent defect or not shall be discussed and decided jointly by Owner and Contractor after detailed analysis.

13. PERFORMANCE SECURITY OR PERFORMANCE BANK GUARANTEE

The CONTRACTOR shall furnish performance security in the form of B.G to the extent of 10% value of Contract for the due and faithful performance of the Contract. Where BG is furnished, it shall be through a Nationalized Bank/ Scheduled Bank on Rs.200/- stamp paper. The BG shall be furnished strictly as per the pro-forma prescribed by the Corporation and the same shall be valid for the entire period of warranty and any extensions thereof plus claim period of six months. Performance Bank Guarantee will be discharged to the Contractor only after completion of warrantee period and any extensions thereof without interest.

Performance BANK GUARANTEE will be treated as to have been submitted only after the Bank Guarantee furnished by the CONTRACTOR is accepted by the Owner in writing.

14. CONTRACT AGREEMENT

An agreement shall be entered into between the CONTRACTOR and the Owner for the proper fulfillment of the contract. The agreement shall be executed by the CONTRACTOR on Rs.200/- stamp paper purchased in Karnataka State, in the form prescribed by the Corporation immediately after the order is received, but not later than 60 days.

The expense of completing and stamping the agreement shall be paid by the CONTRACTOR and the Owner shall be furnished free of charge with an executed stamped counter-part of the agreement together with 20 additional copies of the contract agreement. Each copy of the agreement, which shall comprise of the agreement together with all annexures shall be furnished duly bound. Further CONTRACTOR will furnish 15 copies of the agreement in soft copy in CD.

15. FORCE MAJEURE

Definition of Force Majeure. In this clause, 'force majeure' means an event beyond the control of the Owner and the Contractor, which makes it

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impossible or illegal for either party to perform whole or in part its obligations including but not limited to:

(a) act of God.

(b) an act of war, (whether declared or undeclared), invasion, armed conflict or an act of foreign enemies, blockage, embargo, revolution, riot, terrorist or military action, civil commotion or sabotage.

(c) contamination by radio-activity from any nuclear fuel, or form any nuclear waste from the combustion of nuclear fuel, radioactive toxic explosive, or other hazardous properties of any explosive nuclear assembly, or nuclear component of such assembly;

(d) riot, civil commotion, terrorism or disorder, unless solely restricted to employees of the Contractor or of his sub-contractors.

(e) any failure by a Governmental Instrumentality to grant any Applicable Permit within a reasonable time after application therefor having been duly made and the conditions for the issuance thereof having been duly satisfied.

(f) any change of law affecting the performance of the contract excluding those having mere financial implications.

(g) Accidents to any major critical equipment involving replacement.

16. **EXTENSION OF TIME FOR DELIVERY:**

In case contractor's performance is delayed due to any act of omission on the part of the Owner or his authorized agents or due to force majeure as detailed in Clause No.15.0 of this LOA, contractor shall be given due extension of time for the completion of the works. to the extent such omission on the part of the owner or due to force majeure has caused delay in the contractor's performance of the contract. Regarding reasonableness or otherwise of the extension of time, the same shall be mutually discussed and agreed between KPCL and BHEL.

17. **DESIGN & CONSTRUCTION DOCUMENTS/DRAWINGS**

In view of tight commissioning schedule, all design and construction documents including drawings and other documents will be submitted through soft copy only for review by KPCL. All drawings shall be approved by Owner within 15 days from the date of submission, failing which these shall be deemed to have been approved.

However for the speedy implementation of the project, KPCL and BHEL shall further discuss and mutually agree for time bound submission and resubmission of drawings before entering into contract agreement.

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18. REMOVAL OF EXCESS MATERIAL

After taking over of the plant, the contractor / his sub-contractor(s) shall have the right to remove all such excess materials outside the plant such as packing materials, temporary structures, erection equipments, scrap, surplus materials, commissioning spares etc., with the approval of the engineer which will not be unduly delayed. The contractor should keep the plant area clear as directed by the Engineer to avoid fire hazard and also injury to working personnel

19. SUIT OR PROCEEDINGS

Any suit or proceedings arising out of this contract shall be instituted in appropriate law courts at Bengaluru.

20. DISPUTES

20.1 All disputes, which cannot be settled amicably by mutual negotiations, shall be referred for arbitration in accordance with The Indian Arbitration and Conciliation Act 1996, or any statutory modification or enactment thereof for the time being in force.

20.2 The Contractor and the Owner will continue to perform their respective obligations under the Contract during the Arbitration proceedings unless such performance itself relates to the dispute referred to Arbitration pursuant to this sub-clause.

20.3 The Arbitrator Panel shall consist of 3 arbitrators, one to be appointed by Owner and Contractor respectively and a third one to be appointed by the two arbitrators so appointed by the Owner and the Contractor and the third arbitrator shall be appointed in accordance with the provisions of the Indian Arbitration and Conciliation Act, 1996. The arbitration shall be held in Bangalore and the Courts in Bangalore shall have jurisdiction on any matter connected with any arbitration under this Clause.

20.4 The award rendered in any Arbitration commenced hereunder shall be final and conclusive. The Owner and the Contractor hereby undertake to carry out the award without delay.

20.5 This Clause shall remain in full force and effect notwithstanding any lawful termination of the Contract where either Arbitration has already commenced or the liabilities between the Owner and the Contractor have not been fully determined

21. QUALITY PLANS

The contractor shall follow BHEL standard field quality plans as followed for the ongoing contracts between KPCL and BHEL during designing, manufacturing, testing inspection relating to various equipment to be supplied for the project and the same shall be submitted during contract stage and approved by KPCL on specific cases to be mutually discussed and agreed.

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Customer witness points/ hold points for inspection shall be as per those quality plans only.

No third party inspection is envisaged Inspection shall be carried out as per contractor / Sub-vendors / Collaborators of contractor standard quality plans. Details of the same shall be discussed and finalized during the contract stage

22. VENDOR LIST

All major bought out items /equipment's covered in BHEL scope shall be sourced from BHEL approved vendor's list However vendor's list for major bought out items shall be as followed in other ongoing contracts of KPCL and BHEL and same shall be approved within 15 days of submission by BHEL. In case of non-receipt of any approval/comments, vendor list submitted by BHEL shall be deemed to have been approved. Further disapproval of any vendor shall be supported with suitable reasoning and KPCL shall not restrict the approval to less than four vendors

BHEL shall submit their standard vendors list to KPCL within one month from date of acceptance of LOA However subsequent introduction of any new vendor, post submission of BHEL standard list shall be subject to prior approval of KPCL

23. GENERAL TERMS AND CONDITIONS

All other General terms & conditions applicable for the contract shall be in line with GCC of Bidadi which shall be mutually agreed before entering into contract agreement

24. Please acknowledge this letter of award sent in duplicate.

Yours faithfully,

For KARNATAKA POWER CORPORATION LIMITED

Chief Engineer (GSW)

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ANNEXURE-I

DRAW DOWN SCHEDULE FOR EPC CONTRACT- YELAHANKA CCPP 370 MW

SUPPLY : CONTRACT PRICE INR 8820.00 MILLION

MONTH	PHYSICAL MILESTONES	AMOUNT (%)	AMOUNT (INR in Million)
1	Acceptance of Letter of Award	0.00%	0.00
2	Release of first payment (within 15 days of Advance cum Performance BG submission)	10.00%	882.00
3		0.00%	0.00
4			0.00
5			0.00
6	Design & Engineering, submission of general layouts-schematics for major assemblies of STG/GTG	0.50%	44.10
6	Design & Engineering, submission of general layouts-schematics for major assemblies of HRSG	0.50%	44.10
7			0.00
8	Design & Engineering, Issue of approved foundation drawings for major assemblies of GTG	0.33%	29.10
8	Design & Engineering, Issue of approved foundation drawings for major assemblies of HRSG	0.33%	29.10
8	Design & Engineering, Issue of approved foundation drawings for major assemblies of STG	0.33%	29.10
9			0.00
10			0.00
11	Design & Engineering, Issue of approved drawings for major BOP's(Open Cycle)	0.50%	44.10
12	Design & Engineering, Issue of approved drawings for major BOP's(combined cycle)	0.50%	44.10
13			0.00
14			0.00
15		1.00%	88.20
16	Dispatch of GTG	3.00%	264.60
16		0.75%	66.20
17		0.25%	22.10
18		2.00%	176.40

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ANNEXURE-I

MONTH	PHYSICAL MILESTONES	AMOUNT (%)	AMOUNT (INR in Million)
18		3.00%	264.60
19		5.00%	441.00
20		3.00%	264.60
21		5.00%	441.00
22		5.00%	441.00
23		5.00%	441.00
23		5.00%	441.00
24	Completion of Supplies for Turbine box-up	4.00%	352.80
24		4.00%	352.80
25		5.00%	441.00
25		5.00%	441.00
25		5.00%	441.00
26		5.00%	441.00
26		4.00%	352.80
27	Combined Cycle operation and synchronization of STG	4.00%	352.80
28	Completion of Trial Operation of plant in CCPP mode	3.01%	265.50
29		5.00%	441.00
30	Completion of PG Test of plant in CCPP mode and Taking over	100.00%	8820.00
	TOTAL CONTRACT PRICE (SUPPLY)		

Note:

1. Above payment will be made progressively as per the Draw down Schedule indicated above.
2. The first 10% payment shall be released only after the submission of Advance cum contract performance bank guarantee for 10 % of the Contract value, which shall be as per KPCL format.
3. Detailed list of drawings to be covered for the achievement of the activity shall be mutually discussed and agreed during contract stage
4. Billing break-up (BBU) for various units of BHEL will be subject to KPCL's approval.

For KARNATAKA POWER CORPORATION LIMITED

Chief Engineer (GSW)
Chandrakanth B.
Chief Engineer (GSW)
Karnataka Power Corporation Ltd.
DG Plant Premises, SN Halli Post
Yelahanka, Bengaluru-560 064

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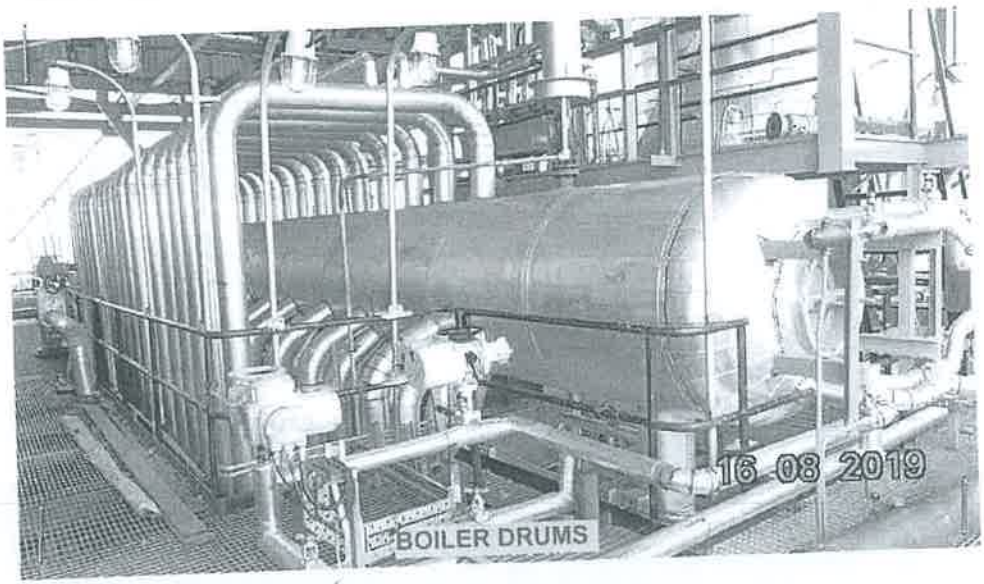
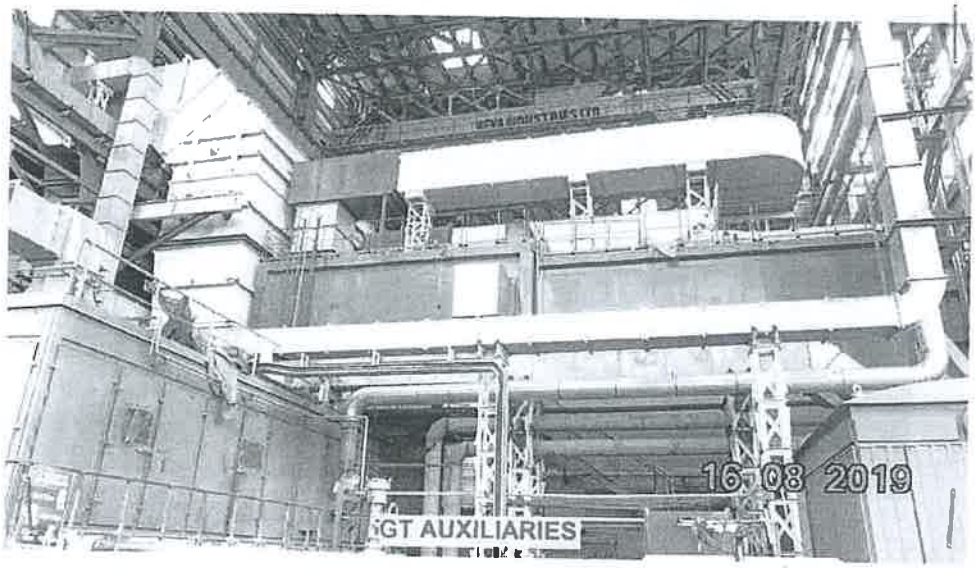
ANNEXURE -R15

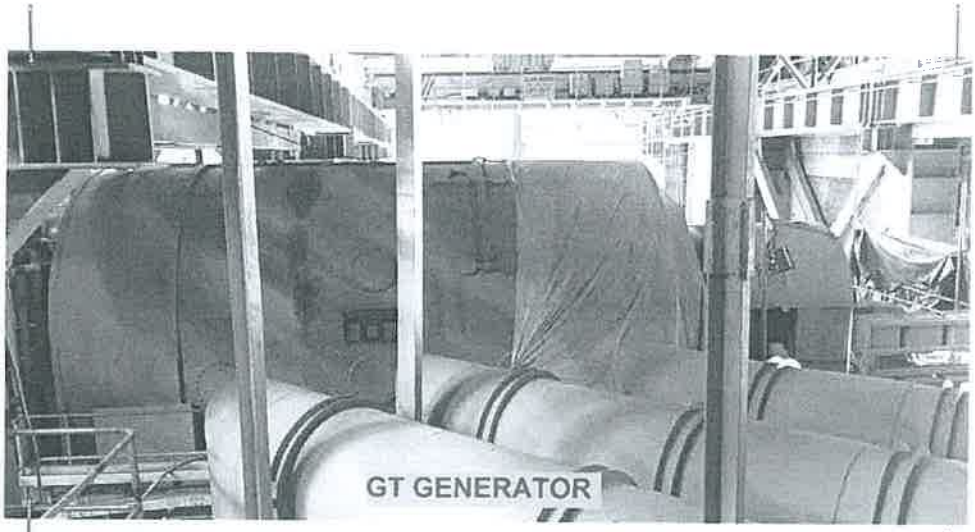


742

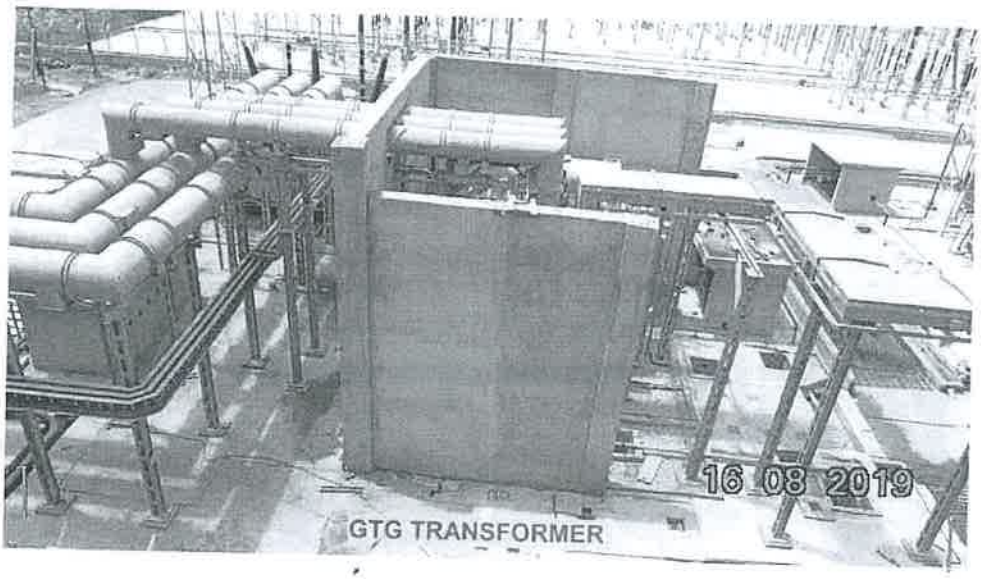
DANGER
Watch for falling material
16 08 2019
GAS TURBINE


16 08 2019
GT AUXILIARIES

743



744



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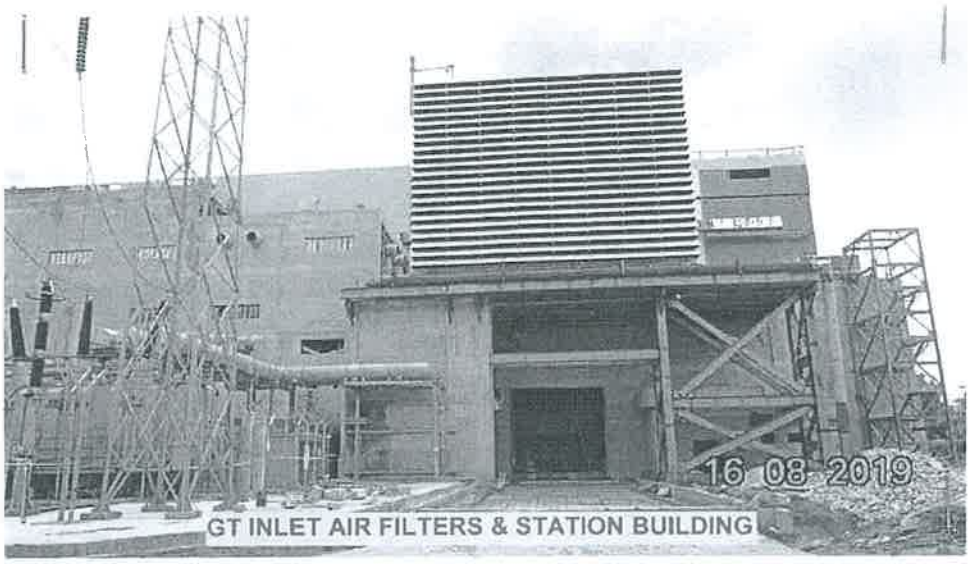
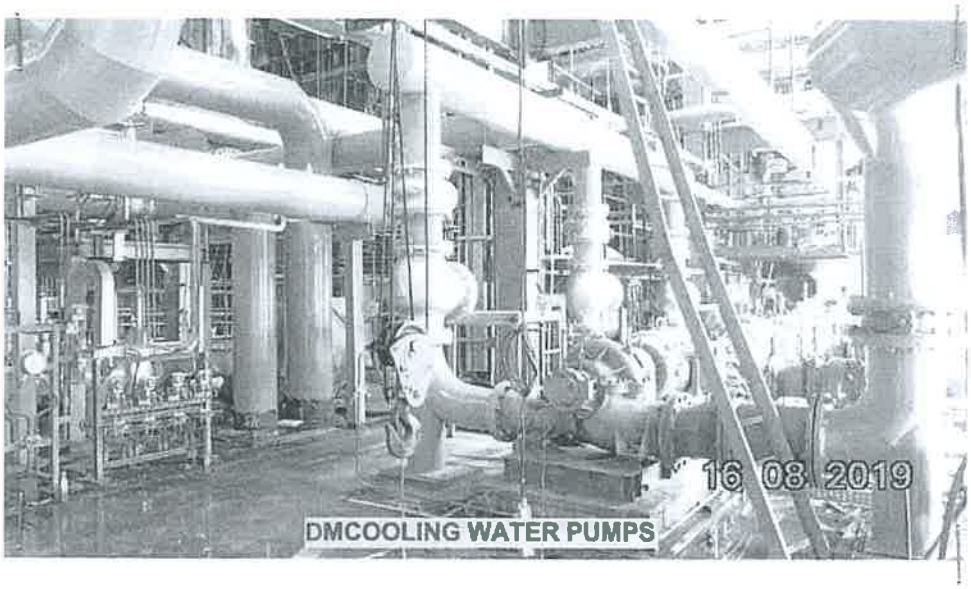
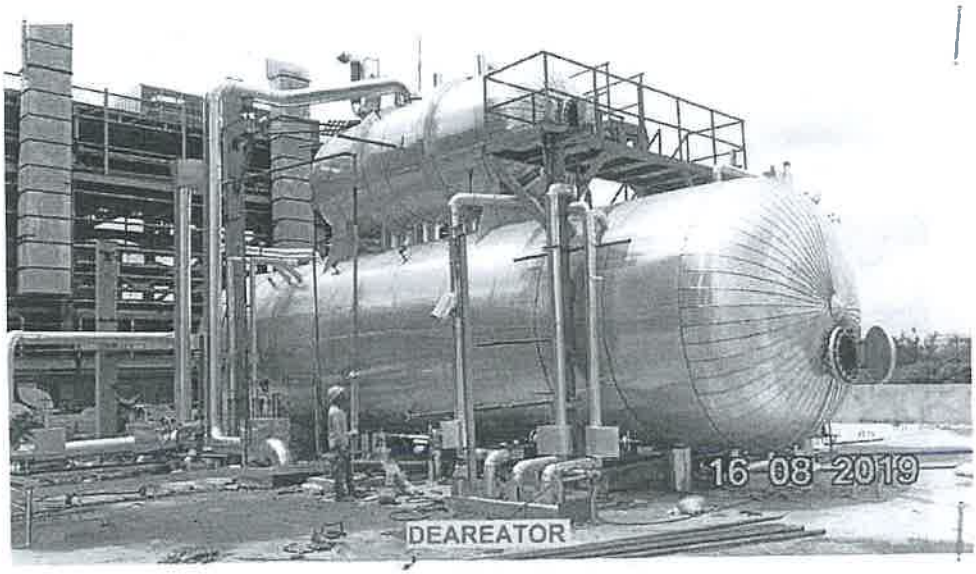

16 08 2019
GT INLET AIR FILTERS & STATION BUILDING

STEAM TURBINE AUX.

746





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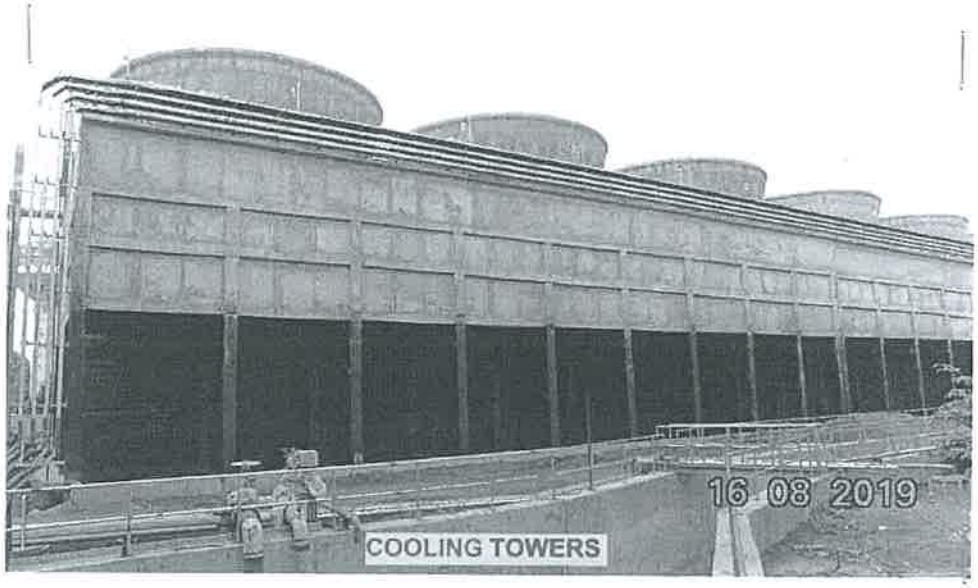

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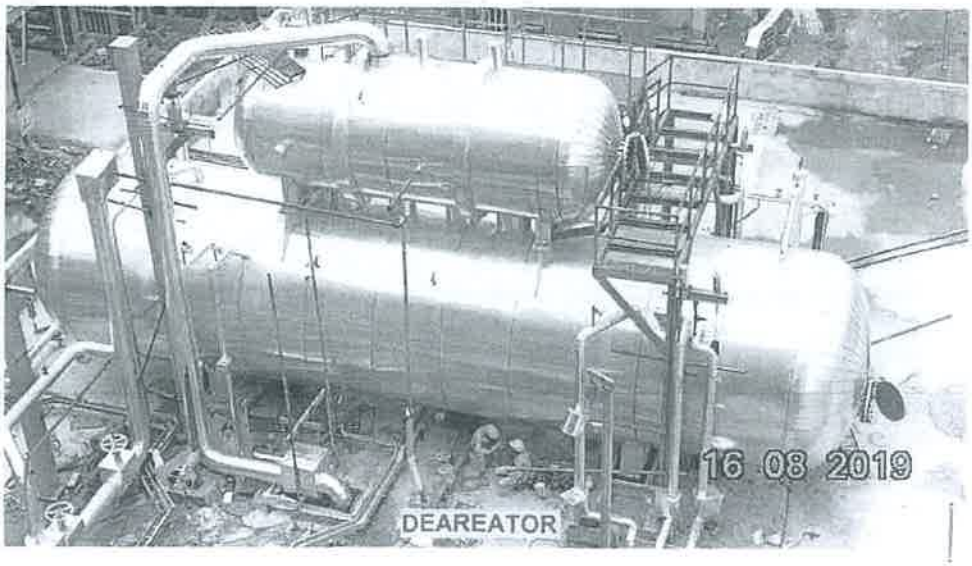
16 08 2019
HEAT RECOVERY STEAM GENERATOR & CHIMNEY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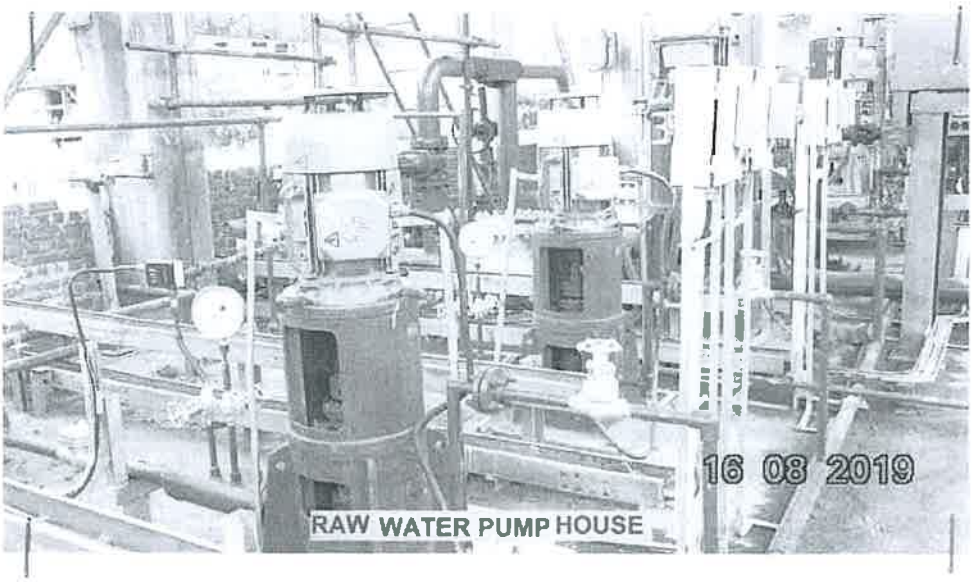
DEAREATOR

750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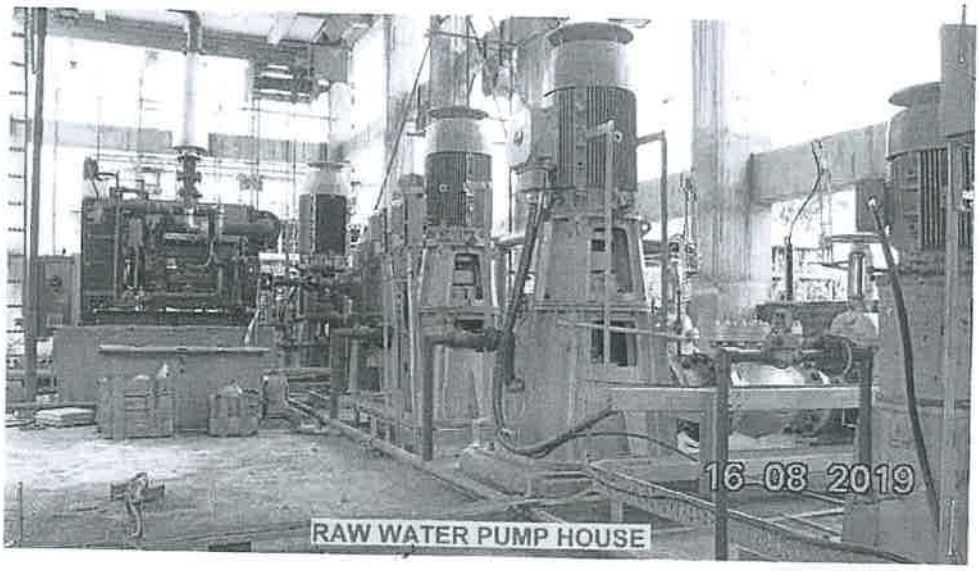
RAW WATER PUMP HOUSE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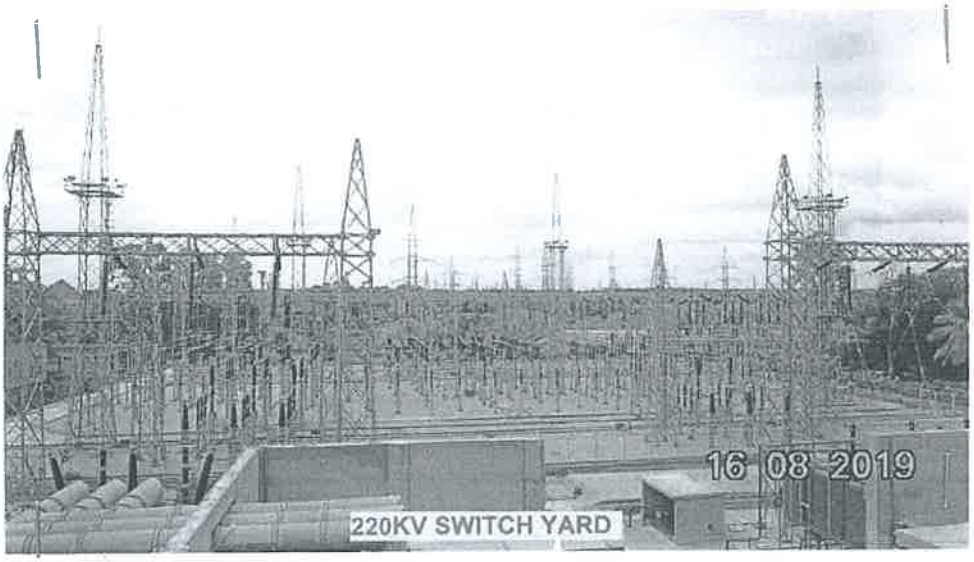
RAW WATER PUMP HOUSE

751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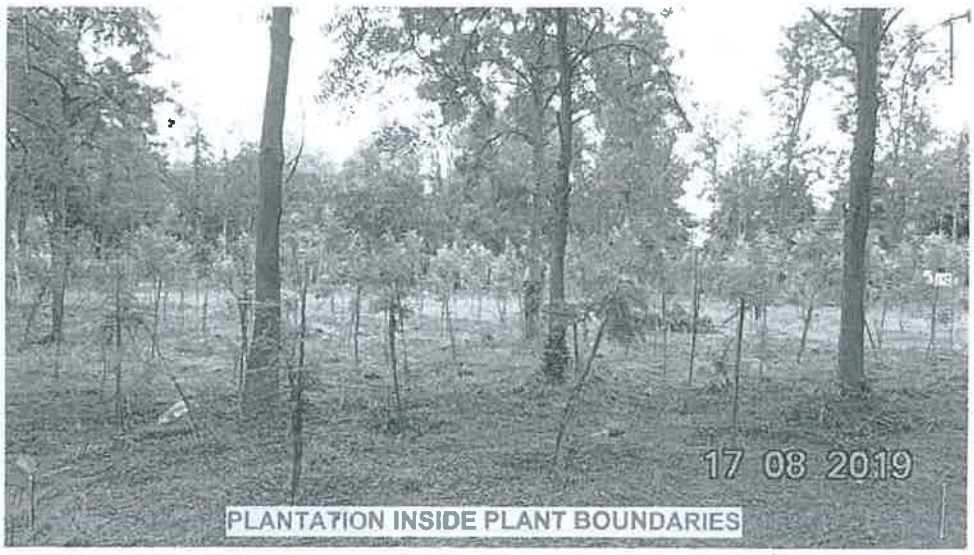
220KV SWITCH YARD

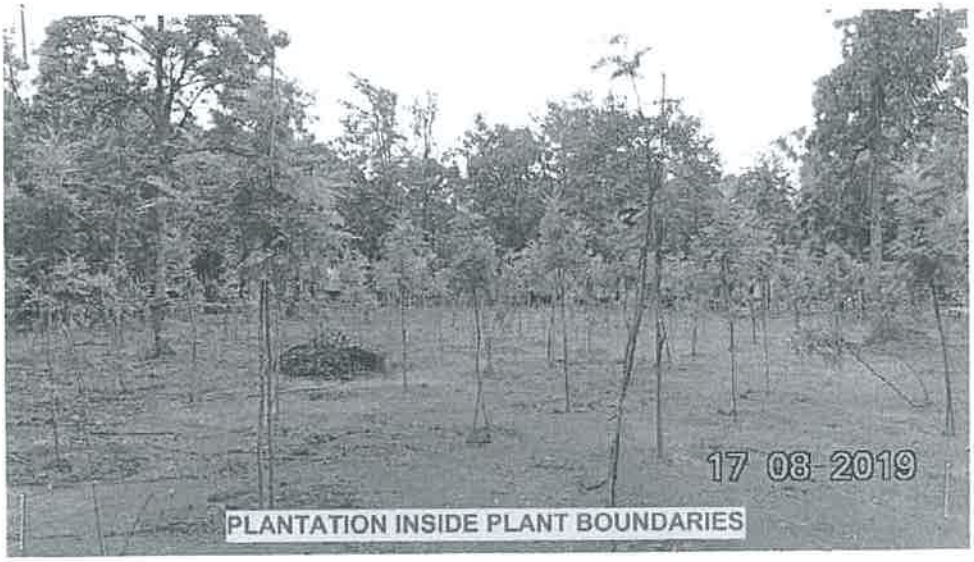

17 08 2019
PLANTATION INSIDE PLANT BOUNDARIES

752

17 08 2019
PLANTATION INSIDE PLANT BOUNDARIES

17 08 2019
PLANTATION ALONG PLANT BOUNDARIES

753


17 08 2019
PLANTATION INSIDE PLANT BOUNDARIES

17 08 2019
PLANTATION INSIDE PLANT BOUNDARIES

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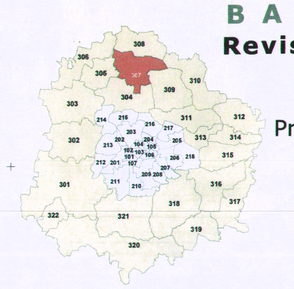
BANGALORE
Revised Master Plan 2015

Proposed Land Use Map

3.07 Yelahanka



306 | 308 | 310 | 305 | 309 | 304

ANNEXURE R16

Avalahalli | BMS Institute of Technology | Nagenahalli | Harohalli | KEB Layuout | Kenchanahalli | Hosahalli | Kattigenahalli | Technology Instit. | Ramagondanahalli | India Oil Ltd | KHB Colony (Puttenahalli) | Wheel and Axle Plant | Yelahanka | Yelahanka Village | Yelahanka New Town | Yelahanka Satellite Town | Nehru Nagar (Yenkatala) | Atturu Layout | Allalasandra | Judicial Colony | Tata Institute | Post Office | Police Station | Govt Hospital | Railway Station | Koeze India Pvt Ltd | Venkatala Post Office | Khodiji Layout | Agrahara kere | Jakkur kere | Thirumanahalli | Sampigehalli | Muhammad Sahib Palya | Vidyaranyapura 6th Block | Vidyaranyapura 5th Block | Gandiganahalli | Hunasemaranahalli

Peripheral Ring Road | Bellary Road (NH-7) | Bellary Road (NH-7) | Outer Ring Road | Outer Ring Road | Airport Road | Yeswanthpur Road | Yelahanka New Town Road | Attur Road | Amruthahalli Road | Jakkur Road | Thanisandra Main Road | Kempegowda Road | Kempegowda Road | Kempegowda

Annexure- R17

ಕರ್ನಾಟಕ ರಾಜ್ಯಪತ್ರ

ಅಧಿಕೃತವಾಗಿ ಪ್ರಕಟಿಸಲಾದುದು

ಸಂಪುಟ ೧೫೦ Volume 150	ಬೆಂಗಳೂರು, ಗುರುವಾರ, ಸೆಪ್ಟೆಂಬರ್ ೧೦, ೨೦೧೫ (ಭಾದ್ರಪದ ೧೯, ಶಕ ವರ್ಷ ೧೯೩೭) Bengaluru, Thursday, September 10, 2015 (Bhadrapada 19, Shaka Varsha 1937)	ಸಂಚಿಕೆ ೩೭ Issue 37

ಭಾಗ ೪ಎ

ರಾಜ್ಯದ ವಿಧೇಯಕಗಳ ಮತ್ತು ಅವುಗಳ ಮೇಲೆ ಪರಿಶೀಲನಾ ಸಮಿತಿಯ ವರದಿಗಳು, ರಾಜ್ಯದ ಅಧಿನಿಯಮಗಳು ಮತ್ತು ಅಧ್ಯಾದೇಶಗಳು, ಕೇಂದ್ರದ ಮತ್ತು ರಾಜ್ಯದ ಶಾಸನಗಳ ಮೇರೆಗೆ ರಾಜ್ಯ ಸರ್ಕಾರವು ಹೊರಡಿಸಿದ ಸಾಮಾನ್ಯ ಶಾಸನಬದ್ಧ ನಿಯಮಗಳು ಮತ್ತು ರಾಜ್ಯಾಂಗದ ಮೇರೆಗೆ ರಾಜ್ಯಪಾಲರು ಮಾಡಿದ ನಿಯಮಗಳು ಹಾಗೂ ಕರ್ನಾಟಕ ಉಚ್ಚ ನ್ಯಾಯಾಲಯವು ಮಾಡಿದ ನಿಯಮಗಳು

ಆರೋಗ್ಯ ಮತ್ತು ಕುಟುಂಬ ಕಲ್ಯಾಣ ಸಚಿವಾಲಯ.

ಅಧಿಸೂಚನೆ

ಸಂಖ್ಯೆ: ಆಕುಕ 161 ಸಿಜಿಇ 2015 ಬೆಂಗಳೂರು, ದಿನಾಂಕ: 01–07–2015

ಸರ್ಕಾರದ ಆದೇಶ ಸಂಖ್ಯೆ 319 ಸಿಜಿಇ 2007, ದಿನಾಂಕ: 18–01–2007ರ ಅನ್ವಯ ಹಾವೇರಿ ಜಿಲ್ಲೆಯ ಸವಣೂರು ತಾಲ್ಲೂಕು ಆರೋಗ್ಯ ರಕ್ಷಾ ಸಮಿತಿಗೆ ಈ ಕೆಳಕಂಡವರನ್ನು ಅಧಿಕಾರೇತರ ಸದಸ್ಯರನ್ನಾಗಿ ಕೂಡಲೇ ಜಾರಿಗೆ ಬರುವಂತೆ ಹಾಗೂ ಮುಂದಿನ ಆದೇಶದವರೆಗೆ ನಾಮ ನಿರ್ದೇಶನ ಮಾಡಿ ಆದೇಶಿಸಿದೆ.

ಕ್ರ.ಸಂ.	ಹೆಸರು ಮತ್ತು ವಿಳಾಸ	ವರ್ಗ
1	ಶ್ರೀ ಬಸವರಾಜು ಸಣ್ಣಧರ್ಮಣ್ಣ ವಡ್ಡರ ಸಾ: ಹೆಸರೂರ, ತಾ:ಸವಣೂರು	ಸದಸ್ಯರು (ಪರಿಶಿಷ್ಟ ಜಾತಿ)
2	ಶ್ರೀ ಬಸವರಾಜು ಈಶ್ವರಪ್ಪ ಗುಂಜಳ ಸಾ:ಯಲವಿಗಿ, ತಾ:ಸವಣೂರು	ಸದಸ್ಯರು (ಸಾಮಾನ್ಯ)
3	ಶ್ರೀ ಜ್ಯೋತಿಕಿರಣ ರಾಮಚಂದ್ರ ಕುಲಕರ್ಣಿ ಸಾ: ಹಿರೇಮಳ್ಳಿ, ತಾ: ಸವಣೂರು	ಸದಸ್ಯರು (ಸಾಮಾನ್ಯ)
4	ಶ್ರೀ ತಿರಕಪ್ಪ ದೊಡ್ಡಬಸಪ್ಪ ತಾಯಮ್ಮನವರ ಸಾ:ಹತ್ತಿಮತ್ತೂರು, ತಾ:ಸವಣೂರು	ಸದಸ್ಯರು (ಸಾಮಾನ್ಯ)
5	ಶ್ರೀ ಸಹದೇವಪ್ಪ. ಬಸವಣ್ಣೆಪ್ಪ ಇಟಗಿ ಸಾ:ಹೂವಿನಶಿಗ್ಲಿ, ತಾ:ಸವಣೂರು	ಸದಸ್ಯರು (ಸಾಮಾನ್ಯ)
6	ಶ್ರೀ ಬಸವಣ್ಣೆವ್ವ ರಾಮಪ್ಪ ಸವಣೂರು ಸಾ:ಮಂಟಗಣಿ, ತಾ:ಸವಣೂರು	ಸದಸ್ಯರು (ಮಹಿಳೆ)

ಈ ಆಸ್ಪತ್ರೆಯಲ್ಲಿ ಈ ಹಿಂದೆ ಇದ್ದ ಅಧಿಕಾರೇತರ ಸದಸ್ಯರುಗಳ ನಾಮನಿರ್ದೇಶನವು ತಂತಾನೆ ರದ್ದಾಗುತ್ತದೆ.

ಕರ್ನಾಟಕ ರಾಜ್ಯಪಾಲರ ಆಜ್ಞಾನುಸಾರ ಮತ್ತು ಅವರ ಹೆಸರಿನಲ್ಲಿ
ಎಸ್.ಎ. ಕಲಾವತಿ
ಸರ್ಕಾರದ ಅಧೀನ ಕಾರ್ಯದರ್ಶಿ,
ಆರೋಗ್ಯ ಮತ್ತು ಕುಟುಂಬ ಕಲ್ಯಾಣ ಇಲಾಖೆ.
(ಆರೋಗ್ಯ 1 ಮತ್ತು 2)

PR-477

BACKWARD CLASSES WELFARE SECRETARIAT

NOTIFICATION

NO: BCW 219 BET 2015 Bengaluru, Dated:30.06.2015.

In exercise of the powers conferred under clause (3) and (7) of rule II of the Rules and regulations of the Association of the Karnataka Residential Educational Institutions Society, the Governing council of the Karnataka Residential Educational Institutions Society with the approval of the Government of Karnataka communicated hereby, makes the following regulations, namely:-

(೧೩೪೫೫)

REGULATIONS

1. **Title and commencement:-** (1) These regulations may be called the Karnataka Residential Educational Institutions Society (Cadre and Recruitment) (Amendment) Regulations, 2011.

(2) They shall come into force on the date of registration of these regulations under sub-section (2) of section 10 of the Karnataka Societies Registrations Act, 1960 (Karnataka Act 17 of 1960)

2. **Amendment of the Schedule-I:** In Schedule- I of the Karnataka Residential Educational Institutions Society (Cadre & Recruitment) Regulations 2011,-

(1) In the entries relating to the category of posts of Music Teacher at serial number 33,-

(a) In column 2,- For the pay scale of Rs. 8000-14800, the pay scale of Rs. 17650-32000 shall be substituted.

By Order in the name of the Governor of Karnataka
N.R. EREKUPPI
Under Secretary to Government-1
Backward Classes Welfare Department

PR-478
SC-300

FOREST, ENVIRONMENT AND ECOLOGY SECRETARIAT

NOTIFICATION

No: FEE 389 FWL 2014 Bengaluru, dated: 29-04-2015.

Whereas the Government of Karnataka in exercise of the powers conferred by Section 36-A of the Wildlife (Protection) Act. 1972 (Amendment in 2006) (Central Act 53 of 1972) has considered the area. situation limits and extent of forest areas which are specified in the Schedule- I and are comprising only Government lands as shown in Schedule-II to declare as **"Puttenahalli Lake Birds Conservation Reserve".** as it is of ecological. faunal. floral and geomorphological importance and for the purpose of protecting. propagating and developing wildlife therein or its environment and to protect the important habitats like fresh water swamps, along with important species of birds like Darters. Painted storks. Black-crowned Night Herons. Purple Herons. Pond Herons. Egrets. Asian Open bill Storks. Eurasian Spoonbills. Spot-billed Pelican. Little Grebe. Little Cormorant Spot-billed Ducks. Purple Moorhen and other water-birds. The 'avifauna' of this lake also includes some of the endangered and migratory birds from the Northern Himalayas and Siberia. many species which are listed under threatened category of IUCN. Apart from this the Puttenahalli Lake also supports species like Acacia auriculiformis, Acacia nilotica, Albizia species. Anthocephalus chinensis Kadamba, Lagerstroemia flosreginae. Muntingia calabura. Pithecellobium dulce. Santalum album and clumps of Bamboo Dendrocalamus strictus. Bougainvillea illea species. Pongamia glabra. Phoenix sylvestrics, Santalum album and lantana. Reedbeds of Typha grow in several large patches within the tank.

And now, the Government of Karnataka consider its necessary to declare the area as a Conservation Reserve in view of the following aspects:-

i) Puttenahalli lake area. which is proposed for "Puttenahalli Bird Conservation Reserve" hosted 127 species of birds which included both wetland and waterfowl species of birds:

ii) further by virtue of their biological richness they are potentially of high value to human societies, help in maintaining the ecological stability of the area and are significant in conserving biological diversity. The uniqueness of the services they offer to human society is precious:

iii) due to biotic and climatic intervention, there is a threat of degradion of rich natural forest and to the wildlife of the area. Hence, there is a need to conserve this precious and irreplaceable unique wealth given by our nature;

The Puttenahalli Lake Birds Conservation Reserve does not include any private and Patta lands on the date of publication of this Notification. Puttenahalli Lake situated in Puttenahalli and Attur villages of Yelahanka Hobli has been in the custody of Karnataka Forest Department for the past 25 years. And, whereas all the rights within the boundaries of the Puttenahalli Lake to be constituted as "Puttenahalli Lake Birds Conservation Reserve" are vested with the State Government.

SCHEDULE-I

Name of the District	:	Bengaluru Urban.
Taluk	:	Bengaluru North.
Area	:	37 Acres or 14.98 ha.

SCHEDULE- II

Extent and Legal status of the lake

District	Taluk	Hoble	Village	Sy. No.	Extent		Status
					(A-g)	(ha.)	
Bengaluru Urban	Bengaluru North	Yelahanka	Puttenahalli	36	29A-14g	11.88	Tank
			Attur	49	7A-26g	3.10	Tank
Total Area :					37 Acres	14.98	Tank

Now. therefore. in exercise of the powers-conferred by Section 36-A of the Wildlife (Protection) Act, 1972 (Central Act, 53 of 1972) the Government of Karnataka hereby declares that the areas specified in the **Schedule-II** above whose boundary descriptions are mentioned in the **Annexure-I** below, shall be a Conservation Reserve and called as **"Puttenahalli Lake Birds Conservation Reserve"** with effect from the date of publication of this notification.

ANNEXURE-I

Boundary Description:

North : Starting from southwest corner of survey No. 50 of Attur village with co-ordinates (N -13°11'118". E - 77°57'275"), the boundary line runs East and north along its southern and eastern boundary till it meets the Attur and Puttenahalli village common boundary point at the southwest corner of survey No.37 of Puttenahalli village with co-ordinates (N-13°11'184", E -77°57'486"). Then the line runs along the eastern and southern boundaries of survey No.37. 38. 39 & 40 of Puttenahalli Village to the south corner of later surey No. Then the lines continuous along the north and eastern boundary of Survey No. 40 to reach its eastern most corner with co-ordinates (N -13°11'445". E - 77°57'903••). and further touches the western side of Doddaballapura - Bengaluru main road.

East : From the above point the boundary line runs along south and western side of Doddaballapura - Bengaluru main road till it meets north-eastern corner of survey No. 69 of Puttenahalli village with co-ordinates (N -13011'119", E - 77057'969").

South : Then the line passes in west direction along the northern boundary of survey No. 69 & 35 of Puttenahalli village till it meets the Puttenahalli and Attur village common Boundary point at the north-east corner of survey No. 48 of Attur village. Then further the line runs in west direction along the northern boundary of survey No. 48 and 47 of Attur village till it meets north-west corner of survey. No. 47 of Attur village.

West : From the above point the lines runs in north direction along the eastern boundary of survey No.51 of Attur village till it meets startiing point.

By Order and in the name of the Governor of Karnataka
S.P. PATIL
Under Secretary to Government
Forest, Environment and Ecology Department

PR-479
SC-600

HOME SECRETARIAT

NOTIFICATION

NO. : HD 38 PoSiLE 2014 Bengaluru, DATED: 15.04.2015

Whereas the draft of the Karnataka State Police (Disciplinary- Proceedings) (Amendment) Rules, 2014, was published as required by clause (a) of Sub-Section (2) of Section 3 of the Karnataka State Civil Services Act, 1978, (Karnataka Act 14 of 1990), in Notification No. HD 38 PoSiLi 2014, Bangalore, dated: 28.08.2014 in Part IV-A of the Karnataka Gazette (Extraordinary) dated: 01.01.2015 inviting objections of suggestions from all the persons likely to be affected thereby within fifteen days from the date of its publication in the Official Gazette.

Whereas, the said Gazette was made available to the public on 01.01.2015;

And whereas objections and suggestions were not received from any public;

Now, therefore, in exercise of the powers conferred by sub-section (1) of Section 3 read with section 8 of the Karnataka State Civil Services Act, 1978 (Karnataka Act No. 14 of 1990), the Government of Karnataka, hereby makes the following rules, namely;-

RULES

1. **Title and commencement:-** (1) These rules may be called the Karnataka State Police (Disciplinary Proceedings) (Amendment) Rules, 2015

(2) They shall come into force from the date of their publication in the Official Gazette.

2. **Amendment of rule 6:-** In the Karnataka State Police (Disciplinary Proceedings) Rules, 1965, in rule 6, in sub-rule (5)

(i) after the words "the Assistance of any other police officer', the words "or a retired Ministerial Staf of Police departrment shall be inserted;

(ii) in the proviso, after the words "the retired police officer", the words "or a retired Ministerial Staff of Police Department" shall be inserted.

By Order and in the name of the Governor of Karnataka
Devendrappa Kattimani
Under Secretary to Government
Home Department (Police Services-B)

PR-480
SC-500

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HOME SECRETARIAT

ADDENDUM TO NOTIFICATION

NO. ACS/HOME/16/CDR/2014 Bengaluru, DATED: 22.-06-2015

In exercise of the powers vested under Rule 2(d) and 4 of The Information Technology (Procedure and Safeguards for Interception, Monitoring and Decryption of Information) Rule 2009, the Government of Karnataka, in its notification dated 26/06/2014 had authorised the following officers of the Karnataka Forest Department to **receive Call Detail Records (CDR) from the service providers while discharging their duties** under The Karnataka Forest Act 1963 and Wildlife Protection Act 1972, for a period of **six months** from the date of issue and thereafter for another **six months** upto 30-06-2015.

The said authorisation is further **extended from 01-07-2015 upto 30-06-2016**. Other details remain unchanged.

Sl. No.	Designation of the Officer	NIC Mail ID
01	APCCF(WL)	Apccfwl @ aranya.gov.in
02	CF & Director,BRT,TR	dcfwlchm @ aranya.gov .in
03	CF & Director RGNP Hunsur	dcfhnswl @ aranya.gov .in

By Order and in the name of the Governor of Karnataka
PRAKASH Y.K
UNDER SECRETARY TO GOVERNMENT (I/C),
HOME DEPARTMENT (CRIMES)

PR-481
SC-300

HOME SECRETARIAT

NOTIFICATION

NO. HD 7 PND 2015 bengaluru, dated: 26.-06-2015.

In exercise of the powers conferred by clause (a) of Section 9 of the Prevention of Illicit Traffic in Narcotic Drugs and Psychotrophic Substances Act, 1988 (Central Act No.46 of 1988) and in supersession of Notification No.HD 01 PND 2009, dated: 06.04.2009, the Government of Kamataka hereby reconstitute the Advisory Board with immediate effect for the purpose of the said Act, consisting of the following namely:

(1) Hon'ble Shri Justice N.K. Patil, Judge, High Court of Karnataka, Bengaluru : Chairman

(2) Honble Shri Justice Anand Byrareddy, Judge, High Court of Karnataka, Bengaluru : Member

(3) Hon 'ble Shri Justice Aravind Kumar, Judge, High Court of Karnataka, Bengaluru : Member

By order and in the name of the Governor of Karnataka
DEVENDRAPPA KATTIMANI
Under Secretary to Government,
Home Department (Police Services-B)

PR-482
SC-20

HOME SECRETARIAT

NOTIFICATION

NO. HD 4 SCF 2015 BENGALURU, DATED: 26.-06-2015.

In exercise of the powers conferred by clause (a) of Section 8 of the Conservation of Foreign Exchange and Prevention of Smuggling Activities Act, 1974 (Central Act No.52 of 1974) and in supersession of Notification No.HD 16 SCF 2011, dated: 03-12-2013, the Government of Kamataka hereby reconstitute the Advisory Board with immediate effect for the purpose of the said Act, consisting of the following namely:

(1) Hon'ble Shri Justice H.Billappa Judge, High Court of Karnataka, Bengaluru. : Chairman

(2) Hon'ble Shri Justice A.N.Venugopala Gowda, Judge, High Court of Karnataka, Bengaluru : Member

(3) Hon'ble Shri Justice Aravind Kumar, Judge, High Court of Karnataka, Bengaluru : Member

By order and in the name of the Governor of Karnataka
N.R. EREKUPPI
Under Secretary to Government-1
Backward Classes Welfare Department

PR-483
SC-20

ಮುದ್ರಕರು ಹಾಗೂ ಪ್ರಕಾಶಕರು:– ಸಂಕಲನಾಧಿಕಾರಿಗಳು, ಕರ್ನಾಟಕ ರಾಜ್ಯಪತ್ರ, ಸರ್ಕಾರಿ ಕೇಂದ್ರ ಮುದ್ರಣಾಲಯ, ಬೆಂಗಳೂರು–59

(101)

Annexure-R18

Minutes of the meeting of KPCL and BBMP officers held at KPCL Board Room on 28.03.2015

Members Present:

KPCL:

Shriyuths:
1. M.Maheshwar Rao, M.D.
2. P.Bhaskar, T.D.
3. S.Mruthunjaya, CE(C)/Bidadi
4. Chandrakantha.Dhondiba, C.E.(GSW)
5. ChinnaSomaiah, CECD
6. Prakash.C.Bewoor, SE(C)/Bidadi
7. I.S.Haveri, EE(M)/Yelahanka
8. Ramachandra Nair V.M., TA to TD

BBMP:

Shriyuths:
1. M.Lakshmi Narayana, Commissioner
2. Ananth Swamy, CE,SWD
3. Somshekhar CE (MW)
4. K.T.Nagaraj, CE
5. Thippeswamy ADTP

ARCHITECT

Smt. Meghana,Datta
Studio Decode

MD, KPCL welcomed all the members present. The Architect, (from Studio Decode) for KPCL new office building under construction, made a presentation and explained about the clearances already obtained for construction i.e. up to 6 floors by BBMP and up to 8 floors from Fire Department etc., Also, briefed about the proposals from 6th floor onwards.

KPCL officers explained about the acquisition of KPCL land on Doddaballapura Road for widening of road. MD, KPCL suggested to submit a revised application to avail TDR, thereby seek permission for construction of 8 floors and a recreation room with light roof.

Commissioner, BBMP agreed for the proposals and directed the concerned to communicate, early approval on receipt of revised application from KPCL.

KPCL officers sought to consider more FAR, as is being done in NOIDA Corporation for the green buildings, for which BBMP officers informed that, presently it is not being considered in Bangalore and BDA is dealing with the planning portion.

The present proposal of 11 m set back was felt to be on higher side and BBMP commissioner suggested to leave 8 –9 m set back and utilize 2 m for parking.

KPCL explained about the proposed sky walk from Shakthi Bhavan to New KPCL bldg..(Khanija Bhavan). Commissioner, BBMP requested to make it useful for public also, to cross this busy road, there by contribute to CSR activity. The same was agreed by KPCL. However BBMP was requested to permit erecting supporting pillars/structures on the footpaths. BBMP gave consent for the same. Commissioner suggested KPCL to build the sky walk with 2 rows, one for KPCL

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(103)

officials and another one exclusively for the public. It was agreed to maintain the requisite height, and try to make this skywalk look like unique one, duly covering the sides. The architect from studio Decode agreed to comply in this regard

The proposal to construct/remodelling of storm water drain from Puttenahalli Lake to Bangalore Dharmavaram railway Track Bridge was discussed. Commissioner, BBMP informed that, he has already signed the proposal to hand over the reach to KPCL for improvement. He also suggested constructing a bund and diverting the storm water into the water body duly deepening the drain, so that the balance area on the sides of the drain can be developed into green area and using the water body for service water requirement etc., BBMP is willing to sign a MOU with KPCL to maintain the lake.

KPCL officers informed that regular payment of tax is being remitted to BBMP, however demand letter is sent showing arrears and interest over arrears to be paid. It was suggested to submit an appeal to reconsider the same and matter will be looked into favourably. The meeting concluded with the thanks giving by MD, KPCL.

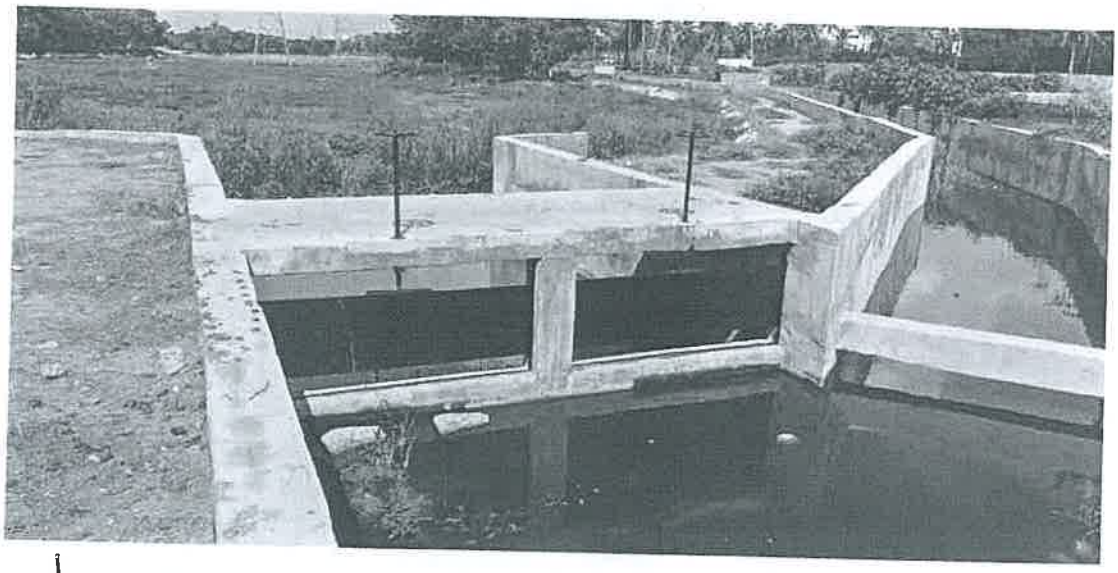
Managing Director,
KPCL, Bangalore

Managing Director
Karnataka Power Corporation Ltd.,
82, "Shakthi Bhavan", Race Course Road
Bangalore - 560 001

Commissioner,
BBMP, Bangalore
COMMISSIONER
Brihat Bangalore Mahanagara Palike

AEE(T)
c/fo: EE(M) Cycle
EE(M) DG.
24/4

Annexure-R 19



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Annexure-R20

KPCL
ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತ
KARNATAKA POWER CORPORATION LTD.,
(A premier power generating company of Government of Karnataka)
CIN U85110KA1970SGC001919

LETTER OF AWARD

No: KPCL/CETD/YCCPP/ZLD/1461 **Date: 30.10.2019**

To,

M/s. Arvind Envisol Limited
Arvind Mills Premises,
Naroda Road,
Ahmedabad-380025,
Gujarat, India.

Attn: Mr. Daksh Rajan
Head Business Development (Mega Projects)

Sir,

Sub: "Design, engineering, manufacture, Quality Surveillance, inspection & testing at supplier's works, packing & forwarding, transportation, supply, delivery F.O.R. YCCPP site, unloading, receipt & storage, handling at site, erection, trial operation, testing, commissioning, conducting performance guarantee tests including painting and handing over of ZLD Plant comprising of waste water pre-treatment plant with RO system of capacity 150m³/hr. and Evaporator/Crystallizer system of capacity 6m³/hr. with Mechanical vapour recompression forced circulation crystallizers and accessories with all civil, structural, mechanical, electrical, control & instrumentation works, integrating ZLD scheme with main power plant including insurance towards transit risk / storage / intra-site transportation and erection including O&M of Plant and Equipment for a period of Five years for 1 x 370MW of Yelahanka Combined Cycle Power Plant of KPCL, Yelahanka, Bengaluru- 560064, in the State of Karnataka, India". – **Letter of Award** – reg.,

Ref.: 1. Tender Notification no: KPCL/2018-19/PS/WORK_INDENT8374 dated 27/02/2019.
2. Pre-bid meeting held on 22.03.2019.
3. Your bid (letter No. AE/31/111/2019-20) dated 30.04.2019 uploaded to the e-portal of GoK.
4. Replies to Pre-bid queries dated 02.04.2019, Amendments – 2 to 5 to Pre-bid queries dated 15.04.2019, 25.04.2019, 29.04.2019, 10.05.2019 and Addendum dated 14.05.2019 Amendment-1 to 2 to PQR dated 01.04.2019, 24.04.2019, uploaded to the e-portal of GoK.
5. Corrigendum – 1 to 3 dated 01.04.2019, 15.04.2019, 02.05.2019
6. Meeting held on 02.08.2019 to discuss variations observed in the Price break-up.
7. Revised Price break-up for ZLD tender submitted on 03.08.2019.
8. MOM of Pre award meeting held on 30.10.2019.

-o0o-

We, the Karnataka Power Corporation Limited, hereinafter referred to as the 'Corporation / Owner' hereby place the Letter of Award on you in

ಮುಖ್ಯ ಅಭಿಯಂತರು (ಶಾಖೋತ್ಪನ್ನ ವಿನ್ಯಾಸ) ರವರ ಕಛೇರಿ, 'ಸುದರ್ಶನ್ ಕಾಂಪ್ಲೆಕ್ಸ್', ೨ನೇ ಮಹಡಿ, ನಂ. ೨೨/೨೩, ಶೇಷಾದ್ರಿ ರಸ್ತೆ, ಬೆಂಗಳೂರು-೫೬೦ ೦೦೯.
Office of the Chief Engineer (Thermal Designs), 'Sudarshan Complex', 2nd Floor, No. 22/23, Sheshadri Road, Bengaluru-560 009.
Tel. : 080-2220 6223 EPABX : 2220 2950-54 Fax : 080-2238 6517
E-mail : cetd@karnatakapower.com / kpclcetd@gmail.com Website : www.karnatakapower.com

accordance with the terms and conditions of the specifications in the Bid document, your offer in response to our tender, pre bid queries along with amendments, addendum and subsequent correspondences ending with minutes of Pre award meeting under ref (8).

1.0 SCOPE OF WORK:

1.1 The scope of work is detailed below:
"Design, engineering, manufacture, Quality Surveillance, inspection & testing at supplier's works, packing & forwarding, transportation, supply, delivery F.O.R. YCCPP site, unloading, receipt & storage, handling at site, erection, trial operation, testing, commissioning, conducting performance guarantee tests including painting and handing over of ZLD Plant comprising of waste water pre-treatment plant with RO system and Crystallizer system with Mechanical vapour Recompression forced circulation crystallizers and accessories with all civil, structural, mechanical, electrical, control & instrumentation works, integrating ZLD scheme with main power plant including insurance towards transit risk / storage / intra-site transportation and erection including O&M of Plant and Equipment for a period of Five years for 1 x 370MW of Yelahanka Combined Cycle Power Plant of KPCL, Yelahanka, Bengaluru- 560064, in the State of Karnataka, India.

Brief details of work to be executed is as indicated in the following table.

Sl. No.	Particulars
I	**MECHANICAL WORKS**
1.	Pressure sand filters for bypass stream of 80m3/hr.
2.	Pre-treatment system-150m3/hr. + feed from Common backwash collection tank.
3.	Sludge handling system.
4.	Ultra-filtration system-150m3/hr. @ outlet.
5.	Reverse Osmosis system-150m3/hr. @ Inlet.
6.	Evaporator/Crystallizer system-6m3/hr.
7.	Salt centrifuge system.
II	**ELECTRICAL WORKS**
1.	Complete Electrical System for the scope of work.
III	**CONTROL & INSTRUMENTATION WORKS**
1.	PLC based controls.
2.	Monitoring Instruments, measuring and control equipment.
IV	**CIVIL WORKS**
1.	Buildings, Tanks, Facilities & Architectural works etc.

Scope of work given is only indicative. Detailed scope of works has been described in the bid document which is binding on the contractor.

The scope of work read in conjunction with your proposals, letters under this contract as briefly outlined above shall also include all such equipment, services and materials which are not specifically mentioned in the Bid

documents but required to complete the system, as well as for the successful, efficient, safe and reliable operation of the equipment / systems.

2.0 CONTRACT PRICE:

2.1 The Total Contract price consists of Main contract price and O&M contract price.

The Main contract includes, Sum of lumpsum price for Supply, Erection, Civil works and Freight (inclusive of GST and any other taxes / duties) indicated under Price break-up for quoted lumpsum Price.

Whereas, O&M contract includes lumpsum price for O&M (inclusive of GST and any other taxes / duties) indicated under Price break-up for quoted lumpsum Price.

(Refer Annexure-1 for Main contract and O&M contract Prices).

2.2 The Lump sum and FIRM contract price for the entire scope of work covered under this contract including O&M for a period of Five years shall be **Rs. 69,98,90,295/-** (Rupees Sixty Nine crores Ninety Eight lakhs Ninety thousand Two hundred and Ninety Five only) inclusive of all taxes.

2.3 SCHEDULE OF PRICES:

SL. NO	DESCRIPTION AS PER SPECIFICATION	LUMPSUM PRICE for Item No. 1 to 6 in Rs.
1.0	**LUMPSUM PRICE FOR SUPPLY** : Lump sum firm price for "Design, engineering, manufacture, Quality Surveillance, inspection & testing at supplier's works, packing & forwarding, transportation, supply, delivery Ex-works of ZLD Plant comprising of waste water pre-treatment plant with RO system and Crystallizer system with Mechanical vapour Recompression, forced circulation crystallizers and accessories with all civil, structural, mechanical, electrical, control & instrumentation works, integrating with existing BHEL supplied main power plant excluding Custom Duty / IGST / GST & any other taxes which are applicable for such contracts in the State of Karnataka as on the date of submission of price bid.	**69,98,90,295/-**
1.1	Customs Duty on Imported Equipment.	
1.2	IGST, **HSN CODE-84219900**	
1.3	GST along with HSN code	

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2.0	**LUMPSUM PRICE FOR ERECTION:** Lump sum and firm price for " unloading, receipt & storage, handling at site, Erection, trial operation, testing, commissioning, conducting performance guarantee tests including painting and handing over of ZLD Plant comprising of waste water pre-treatment plant with RO system and Crystallizer system with Mechanical vapour Recompression forced circulation crystallizers and accessories with all civil, structural, mechanical, electrical, control & instrumentation works, & integrating ZLD scheme with existing BHEL supplied main power plant including insurance towards storage / intra-site transportation and erection excluding GST & any other taxes which are applicable for such contracts in the State of Karnataka as on the date of submission of price bid and Cess (on erection part).	
2.1	GST , **SAC CODE-9954**	
2.2	Marine cum erection insurance on lump sum and firm price basis including GST.	
3.0	**LUMPSUM PRICE FOR CIVIL WORKS:** Lumpsum firm price for Civil Works including, supplies such as cement, reinforcement steel, structural steel, all construction materials, all foundation bolts etc. required for subject work including Design, Engineering and Construction of entire Civil works excluding GST and any other taxes.	
3.1	GST, **SAC Code-995421**	
4.0	**LUMPSUM PRICE FOR FREIGHT:** Lumpsum firm price for Freight from Ex Manufacturer works / vendor works including insurance towards transit risk to F.O.R YCCPP site excluding GST and any other taxes.	
4.1	GST, **HSN Code-8704**	
5.0	**LUMPSUM PRICE FOR O&M:** Lumpsum firm price of O&M for a period of **Five years** from the date of takeover inclusive of spares, consumables and speciality chemicals.	
5.1	GST, **SAC CODE-9987**	
6.0	**LUMPSUM PRICE for Others, if any**	

Note:

i. Break for Schedule of Prices shall be as per Annexure-1.

ii. Broad billing break-up and Detailed billing break-up (BBU) for Supply, Erection and commissioning and Civil works under the various heads

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indicated as per Schedule of Milestone – F2 shall be furnished for customer approval before raising the invoice for payment.

2.4 The above referred contract price is Lump sum and FIRM and on F.O.R. YCCPP site basis as per Schedule of Prices above.

2.5 The Contract Price shall remain firm during the bidder's performance of the contract and not subject to any variation on any account.

2.6 The Contract price shall not be adjusted for changes in the cost of labor, materials, equipment, systems, software or other matters.

2.7 Any Indian custom duties or levies including stamp duties and import license fee, if any, levied by the Govt. of India or any State Govt. in India on equipment, materials and spare parts covered in the work under the contract to be imported to India rests with contractor only.

2.8 The contractor has to arrange for importing all goods that are required for the project (comprehensive list to be submitted) work duly observing all statutory provisions read with foreign trade laws and other issues that are applicable for getting import of materials for smooth functioning of construction activities on behalf of the owner (KPCL).

2.9 Any variations in/new duties & taxes, subsequent to last date of submission of Bid and during the contract period are to the Owner's account.

2.10 As regards Indian Income tax, surcharge on Income tax and any other corporate tax, the Owner shall not bear any tax liability whatsoever, irrespective of mode of contracting. The bidder shall be liable and responsible for payment of all such tax if attracted under the provisions of the law.

3.0 TAXES AND DUTIES:

The taxes, cess, duties & levies shall be as per clause no. 3.18 of bid document.

Owner will provide all necessary documents for obtaining Project authority Certificate/Project essentiality certificate addressed to authority concerned for availing concession in custom / excise duties. Contractor shall take up necessary Liasoning with authorities concerned/ departments for availing the benefits. The benefit obtained beyond what is considered in bid submission shall be passed on to owner.

4.0 TERMS OF PAYMENT:

The terms of payment shall be as follows:

4.1 FOR SUPPLIES FROM CONTRACTOR / SUB-VENDOR

i. **10%** of total contract price for supply (excluding GST & Duties/levies/cesses) with interest of SBI -1 year MCLR + 6.15% per year as initial advance (if required by the bidder) after issue of Letter of Award (LOA) against Bank Guarantee of the same value and Performance Bank Guarantee of 10% of

contract value. The bank guarantee furnished towards advance will be released only after complete advance and interest are adjusted / recovered.

ii. **55%** (65% if advance not taken) of contract price for supply (including GST & Duties/levies/cesses) on pro-rata basis progressively against joint inspection report at site. The interest will be recovered at SBI 1 year MCLR + 6.15% per year on 10% of invoice value (advance paid) from each bill till complete advance is adjusted.

iii. **25%** of contract price (including GST & Duties/levies/cesses) for supply will be released after completion of supply for each mile stone activity.

iv. **10%** of contract price (including GST & Duties/levies/cesses) for supply on completion of PG test of the plant.

4.2 **ERECTION:**

i. **10%** of total contract price for Erection (including GST & Duties/levies/cesses) with interest of SBI 1 year MCLR + 6.15% per year per year as initial advance (if required by the bidder) after issue of Letter of Award (LOA) against the Bank Guarantee of the same value and Performance Bank Guarantee of 10% of contract value. The bank guarantee furnished towards advance will be released only after complete advance and interest are adjusted / recovered.

ii. **55%** (65% if advance not taken) of contract price for Erection (including GST & Duties/levies/cesses) on pro-rata basis progressively against joint inspection report at site. The interest will be recovered @ SBI 1 year MCLR + 6.15% per year on 10% of invoice value (advance paid) from each bill till complete advance is adjusted.

iii. **25%** of contract price for Erection (including GST & Duties/levies/cesses) will be released after completion of Erection of each mile stone activity.

iv. **10%** of contract price for Erection (including GST & Duties/levies/cesses) on completion of PG test of the plant.

4.3 **FREIGHT:**

i. **10%** of total contract price for Freight portion (including GST & Duties/levies/cesses) with interest of SBI 1year MCLR + 6.15% (or prevailing rate of KPCL) per year as initial advance (if required by the bidder) after issue of Letter of Award (LOA) against the Bank Guarantee for an equivalent amount and Performance Bank Guarantee of 10% of contract value. The bank guarantee furnished towards advance will be released only after complete advance and interest are adjusted / recovered.

ii. **55%** (65% if advance not taken) of contract price for Freight portion (including GST & Duties/levies/cesses) on pro-rata basis progressively against joint inspection report at site. The interest will be recovered @ SBI 1year MCLR + 6.15% (or prevailing rate of KPCL) per year on 10% of invoice value (advance paid) from each bill till complete advance is adjusted.

iii. **25%** of contract price (including GST & Duties/levies/cesses) for Freight will be released after completion of supply of each mile stone activity.

iv. **10%** of contract price for Freight portion (including GST & Duties/levies/cesses) on completion of PG test of the plant.

4.4 **CIVIL WORKS**

i. **10%** of total contract price for civil works (including GST & Duties/levies/cesses) with interest of SBI 1 year MCLR + 6.15% per year as initial advance (if required by the bidder) after issue of Letter of Award (LOA) against the Bank Guarantee of the same value and Performance Bank Guarantee of 10% of contract value. The bank guarantee furnished towards advance will be released only after complete advance and interest are adjusted / recovered.

ii. **55%** (65% if advance not taken) of contract price for civil works (including GST & Duties/levies/cesses) on pro-rata basis progressively against joint inspection report at site. The interest will be recovered @ SBI 1 year MCLR + 6.15% per year on 10% of invoice value (advance paid) from each bill till complete advance is adjusted.

iii. **25%** of contract price for civil works (including GST & Duties/levies/cesses) will be released after completion of Civil works of each mile stone activity.

iv. **10%** of contract price for civil works (including GST & Duties/levies/cesses) on completion of PG test of the plant.

5.0 **INSURANCE :**

Contractor shall at their sole cost, in the joint names of Owner, Contractor, and the sub-contractors, take insurance cover for full replacement value for the following:

5.1 "Material Damage Insurance" (Storage-cum-Erection Insurance) on an "All Risk" basis (including terrorists act, SRCC) of loss or of damage arising during period of Insurance coverage to any part of the Contract works, material and supplies including any transit and off-site storage, and anywhere in India for ex-works Indian factory and foreign supplies, materials, etc.,

5.2 Contractor shall bear the risk of loss and all deductibles and also for the difference of the amount of claims settled and loss suffered shall be the responsibility of the Contractor.

5.3 Such insurance shall be administered and managed by the Contractor and shall be effected from the Commencement date of Contract and thereafter shall operate from the time the relevant property leaves the premises of the manufacturers in the country of origin, and shall continue during the ordinary course of transit and during storage on or off the plant site, if any, and during erection and commissioning until the date on which Owner takes over the care, custody and control of the Plant.

6.0 **MODE OF PAYMENT:**

All payments shall be released to Contractor directly through cheques / electronic transfer within 30 days of submission of invoices/ bills along with

requisite documents. No interest for delayed payment shall be payable by KPCL.

7.0 EFFECTIVE (ZERO) DATE OF CONTRACT:

The effective (Zero) date of the contract shall be deemed to have come into force and effect from the date of issue of Letter of Award by the owner to the contractor.

8.0 COMPLETION PERIOD:

MAIN CONTRACT

Fourteen (14) calendar months including monsoon period commencing from the date of issue of Letter of Award.

9.0 CONTRACT PERIOD:

i. **MAIN CONTRACT:**
Twenty Six (26) calendar months commencing from date of issue of Letter of Award comprising Fourteen (14) calendar months of completion period or to the extent of valid extension permitted by the Owner and 12 calendar months of Guarantee Period thereafter, during which the contract shall be executed as agreed between the owner and the contractor.

ii. **O&M CONTRACT**
Five years after handing over of the ZLD plant / issue of Notice to Proceed (NTP) as the case may be.

10.0 OPERATION & MAINTENANCE OF ZLD:

10.1 SCOPE:

The contractor shall be responsible for the Operation & Maintenance (O&M) for ZLD Plant comprising of waste water pre-treatment plant with RO system and Crystallizer system with Mechanical vapour Recompression forced circulation crystallizers and accessories and shall perform all necessary services in a prudent & efficient manner.

10.2 PERIOD OF OPERATION & MAINTENANCE:

The contractor shall be responsible for Operation & Maintenance of plant and equipment on 24x7 basis for a period of Five years after handing over / issue of Notice to Proceed (NTP) as the case may be. Spares, Speciality chemicals, Consumables are in the scope of bidder during O&M period. However, bulk chemicals shall be in KPCL scope.

10.3 **TERMS OF PAYMENT FOR OPERATION & MAINTENANCE:**

i. The Contractor shall raise invoice/s for the preceding calendar month for O&M services rendered for the subject month or part thereof.

ii. 100% payment, after statutory deductions and any other recoveries of the monthly running bills shall be made within 30 days after the submission of invoice, after satisfactory completion of work done and certified by Engineer in charge of KPCL.

iii. Invoice value shall be based on the O&M Price break-up furnished by the contractor as part of the tender documents. The price for each year of O&M contract shall be prorated for arriving at monthly billing value.

iv. No interest for delayed payment shall be payable by KPCL.

11.0 **PAYING AUTHORITY:**

The paying authority is Assistant General Manager (Finance)-Y, YCCPP, KPC Gas Power Corporation Limited, Bangalore, Karnataka. All the documents with pre-receipted stamped invoices shall be sent to Paying authority for arranging payments. However, copies of documents shall be sent to the consignee, Chief Engineer (Gas, Solar & Wind) for electro-mechanical items and Chief Engineer (Civil)-YCCPP for civil works and Chief Engineer (Thermal Designs) KPCL, Bangalore for advance information.

12.0 **CONSIGNEE:**

The consignments/ material shall be dispatched to F.O.R Yelahanka Combined Cycle Power Plant / YCCPP, freight prepaid duly insured, securely packed (wherever necessary) as per specification, so as to avoid damage during transit and consigned to Executive Engineer (Stores), KPCL Gas Power Corporation Limited, Yelahanka Combined Cycle Power Plant, Doddaballapur Road, S N Halli post, Near Puttenehalli, Yelahanka, Bangalore.-560064, Bangalore Dist, Karnataka state.

13.0 **LIQUIDATED DAMAGES FOR DELAY**

13.1.1 If Performance Acceptance does not occur on or before the Completion Date of Plant (14 months), Contractor shall pay liquidated damages to Owner for such delay for each and every day which elapses after the guaranteed completion date for Plant until the earlier of Performance Acceptance or the day on which Contractor has paid to the Owner the maximum amount of liquidated damages for delay pursuant to the Contract conditions.

13.1.2 The Liquidated damages payable by the Contractor to the Owner for delay in

Supply and "Erection including achieving Performance acceptance after the Completion Date of the Plant (14 months) shall be at the rate of Half (0.5) percent of Main contract value per week or part thereof of delay.

13.1.3 Notwithstanding the foregoing, no Delay Liquidated Damages shall be payable for period of delay in achieving performance Acceptance Guaranteed Completion Date of Plant to the extent such delay is solely on account of Force Majeure Event and Contractor has been granted an extension of time pursuant to clause no. 20.0 of these Conditions of Contract with respect to such period.

13.2 The Liquidated Damages for Failure to meet Performance Guarantees: As per revised Schedule of Guaranteed Parameters – F3.

14.0 LIMITATION OF LIABILITY:

Under no circumstances that the Contractor's aggregate liability for:

(a) Cumulative liquidated damages for delay (calculated as per clause no. 11.1.2 above)

and/or

(b) Cumulative Liquidated Damages for failure to achieve the Performance Guarantees (As per revised Schedule of guaranteed parameters – F3)

and/or

(c) Penalty towards guaranteed power consumption (As per revised Schedule of guaranteed power consumption – F4)

and/or

(d) Penalty towards guaranteed chemical consumption (As per revised Schedule of guaranteed chemical consumption – F14)

shall exceed 15% of the Main Contract Price.

15.0 GUARANTEE:

The Contractor Guarantees shall survive for the term of the Guarantee Period which is twelve (12) months from date of Take-over of Plant. Any work having defects which is guaranteed and corrected by Contractor shall be further guaranteed by Contractor for a period ending twelve (12) months after the date such correction is effected and accepted by Owner / Owner's Representative, and to the extent such period extends beyond the Guarantee Period, the Guarantee period shall be extended for with respect to such corrected portion of the Work.

16.0 **CONTRACT PERFORMANCE GAURANTEE (SECURITY DEPOSIT):**

16.1 The contractor shall furnish Bank guarantee from a Nationalized/Scheduled bank towards contract performance, equivalent to 10% (Ten percent) of the Main Contract (execution of plant) value for due and faithful performance of the contract, valid for the entire period of the contract till the end of guarantee period and any extensions thereof, at the time of entering into contract agreement. The B.G. furnished shall be through a Nationalized/Scheduled Bank on Rs.200/- stamp paper as per KPCL format.

The contractor shall enter into a separate agreement after successfully taking over of plant/issue of NTP as the case may be towards O&M contract and submit SD @ 10% of the O&M contract value before commencement of O&M contract.

The performance guarantee (Security deposit @ 10% of the main contract) will be returned to the contractor after successful completion of Guarantee period. For this, contractor should have successfully entered into O&M contract agreement by furnishing BG @ 10% of O&M contract value.
The SDBG for O&M contract will be returned after successful completion of O&M contract and any extensions thereof.

No interest is payable on the contract performance guarantee.

17.0 **CONTRACT AGREEMENT:**

17.1 The contractor shall sign the contract agreement within 30 days from the date of issue of letter of award, on Non Judicial stamp paper purchased in Karnataka of value Rs. 100 where the amount or consideration in the agreement does not exceed Rupees Ten lakhs and where the amount or consideration in the agreement exceeds Rupees Ten lakhs 'Rupees one hundred and in addition Rupees one hundred for every Rupees Ten lakhs or part thereof in excess of Rupees Ten lakhs subject to maximum of Rupees five lakhs.
The agreement shall be strictly in the KPCL format (will be furnished to the contractor) for due fulfilment of the contract, failing which Bid Security (EMD) shall be forfeited.

17.2 Agreement shall be signed in one original only. Original would be kept with the corporation and certified copy given to the contractor.

17.3 Subsequent to signing of the contract, the contractor shall provide KPCL with 14 hard copies duly bound and soft copies in CDs of the contract agreement.

18.0 **FORCE MAJEURE:**

Force majeure is herein defined as an event beyond the control of the Owner and the Contractor, which makes it impossible or illegal for either party to perform whole or in part its obligations, including but not limited to:

(a) Act of God;

(b) An act of war, (whether declared or undeclared), invasion, armed conflict or an act of foreign enemies, blockage, embargo, revolution, riot, terrorist or military action, civil commotion or sabotage;

(c) Contamination by radio-activity from any nuclear fuel, or form of any nuclear waste from the combustion of nuclear fuel, radioactive toxic explosive, or other hazardous properties of any explosive nuclear assembly or nuclear component of such assembly;

(d) Riot, civil commotion, terrorism or disorder, unless solely restricted to employees of the Contractor or of his Sub Contractors;

(e) Any failure by a Governmental Instrumentality to grant any Applicable Permit within a reasonable time after application therefor having been duly made and the conditions for the issuance thereof having been duly satisfied.

19.0 **DELIVERY:**

The delivery for supply of equipment/materials shall be in sequential manner to suit the erection and commissioning schedule of ZLD Plant.

The commissioning schedule shall further be subject to release of all inputs by KPCL as per schedule, to be mutually discussed and agreed.

20.0 **EXTENSION OF TIME FOR DELIVERY:**

Neither the owner nor the contractor shall be considered in default or in contractual breach to the extent that performance of obligations is prevented by a force majeure event which arises after the Effective Date. Except as otherwise provided in a change order on extension of time shall be granted to contractor only to the extent contractor proves to owner;

(a) The performance of the Work is actually and necessarily delayed by an event of Force Majeure and

(b) The effect of such Force Majeure could not have been prevented or avoided or removed despite exercise of reasonable due diligence whether before, after or during the event of Force Majeure.

21.0 **CONTRACTOR's DRAWINGS:**

The bidder has to upload drawings / documents, QAP and vendor list for approval from KPCL on a dedicated software for this project. KPCL will review

the drawings / documents and will provide comment / approval through this mode. Inspection call will also be raised through this mode any other web based system/letter as applicable. (as per Sec C12-Contract Co-ordination Procedure).

In addition, the Contractor shall furnish 2 sets of hard copies of all basic drawings and all other drawings / documents within the time specified in the time schedule chart.

Within 30 days of receipt of this L.O.A., the Contractor shall submit MDL "Master Drawing List" of all drawings/ documents / manuals identifying each by a serial number and descriptive title and giving the expected date of submission. Contractor shall also submit the documents/ drawings/ logics of schemes for which approval is required from purchaser. This list shall be revised and extended, as necessary, during the progress of work.

22.0 ARBITRATION

Any dispute or difference of claim arising out of or in connection with, or relating to the present contract or the breach, termination or invalidity thereof shall be referred and settled under the Arbitrations Centre – Karnataka (Domestic and International) Rules 2012 by one or more Arbitrators appointed in accordance with its rule.

23.0 SUIT OR PROCEEDINGS:

Any suit or proceedings arising out of this contract shall be instituted in appropriate law courts at Bengaluru, Karnataka State.

24.0 SETTLEMENT OF DISPUTES:

The appellate authority shall be energy secretary Department of Energy, GOK

If any dispute of difference of any kind whatsoever is to arise between the Owner and the Contractor on the following matters viz.

i) The meaning of the specification, designs, drawings and instructions.
ii) The quality of workmanship or materials used.
iii) Any other question, claim, right, matter , thing whatsoever in anyway arising out of or relating to the contract, estimates, orders or those conditions or failure to execute the same whether arising during the progress of the work or after the completion, termination or abandonment thereof, the dispute shall be referred to the concerned Chief Engineer.

The Chief Engineer shall within a period of 30 days from the date of being requested by the Contractor to do so, give written notice of his decision to the Contractor.

Subject to other form of settlement hereafter provided, the Chief Engineer's decision in respect of every dispute or difference so referred shall be final and binding upon the Contractor. The said decision shall forthwith be given effect to and Contractor shall proceed with the execution of the work with all due diligence.

In case the decision of the Chief Engineer is not acceptable to the Contractor, the Contractor will request to convene the meeting of MD KPCL, The owner and CEO of the Contractor for amicable settlement of the dispute.

25.0 **OTHER TERMS AND CONDITIONS:**

All other general terms and conditions applicable for the contract shall be in line with the GCC and other bid documents of the tender. Tender document and replies to pre-bid queries, record of pre award meeting shall form a part of this Contract.

Please acknowledge the receipt of this letter of award sent in duplicate and send one copy of LOA duly signed and stamped on each page for having accepted the same.

Yours faithfully,
For Karnataka Power Corporation Ltd.,

Chief Engineer (Thermal Designs)

Encl: Proforma of:

i) Break-up for Schedule of Prices – Annexure-1
ii) Format for agreement - Annexure-2
iii) Format for Performance Security or Performance BG - Annexure-3

777 777

No: KPCL/CETD/YCCPP/ZLD/1461 **Date: 30.10.2019**

ANNEXURES TO LOA – ZERO LIQUID DISCHARGE SYSTEM

(Tender Notification no: KPCL/2018-19/PS/WORK_INDENT8374 dated 27/02/2019).

ANNEXURE-1

BREAK-UP FOR SCHEDULE OF PRICES:

SL. NO.	DESCRIPTION AS PER SPECIFICATION	PRICE IN Rs.
1.0	**LUMPSUM PRICE FOR SUPPLY** : Lump sum firm price for "Design, engineering, manufacture, Quality Surveillance, inspection & testing at supplier's works, packing & forwarding, transportation, supply, delivery Ex-works of ZLD Plant comprising of waste water pre-treatment plant with RO system and Crystallizer system with Mechanical vapour Recompression, forced circulation crystallizers and accessories with all civil, structural, mechanical, electrical, control & instrumentation works, integrating with existing BHEL supplied main power plant excluding Custom Duty / IGST / GST & any other taxes which are applicable for such contracts in the State of Karnataka as on the date of submission of price bid.	**45,15,02,560/-**
1.1	Customs Duty on Imported Equipment.	**3,53,808/-**
1.2	IGST, **HSN CODE-84219900**	**8,13,34,146/-**
1.3	GST along with HSN code	**NIL**
2.0	**LUMPSUM PRICE FOR ERECTION:** Lump sum and firm price for " unloading, receipt & storage, handling at site, Erection, trial operation, testing, commissioning, conducting performance guarantee tests including painting and handing over of ZLD Plant comprising of waste water pre-treatment plant with RO system and Crystallizer system with Mechanical vapour Recompression forced circulation crystallizers and accessories with all civil, structural, mechanical, electrical, control & instrumentation works, & integrating ZLD scheme with existing BHEL supplied main power plant including insurance towards storage / intra-site transportation and erection excluding GST & any other taxes which are applicable for such contracts in the State of Karnataka as on the date of submission of price bid and Cess (on erection part).	**2,11,86,500/-**
2.1	GST , **SAC CODE-9954**	**38,13,570/-**
2.2	Marine cum erection insurance on lump sum and firm price basis including GST.	**Included in Sl. No.2**

3.0	**LUMPSUM PRICE FOR CIVIL WORKS:** Lumpsum firm price for Civil Works including, supplies such as cement, reinforcement steel, structural steel, all construction materials, all foundation bolts etc. required for subject work including Design, Engineering and Construction of entire Civil works excluding GST and any other taxes.	**5,50,85,000/-**
3.1	GST, **SAC Code-995421**	**99,15,300/-**
4.0	**LUMPSUM PRICE FOR FREIGHT:** Lumpsum firm price for Freight from Ex Manufacturer works / vendor works including insurance towards transit risk to F.O.R YCCPP site excluding GST and any other taxes.	**14,40,000/-**
4.1	GST, **HSN Code-8704**	**2,59,200/-**
5.0	**LUMPSUM PRICE FOR O&M:** Lumpsum firm price of O&M for a period of **Five years** from the date of takeover inclusive of spares, consumables and speciality chemicals.	**6,35,59,500/-**
5.1	GST, **SAC CODE-9987**	**1,14,40,710/-**
6.0	**LUMPSUM PRICE for Others, if any**	**NIL**
	Total price	**69,98,90,295/-**

Main Contract Price inclusive of GST and any other taxes / duties: (Sum of lumpsum prices for Supply, Erection, Civil works and Freight): Rs. 62,48,90,085/-

O&M Contract Price inclusive of GST and any other taxes / duties: (lumpsum price for O&M): Rs. 7,50,00,210/-

ANNEXURE-R21

C GAS POWER CORPORATION LIMITED

(SUBSIDIARY of KPCL)

Regd. Office : 'Trade Centre', 2nd Floor, No. 116/2, Race Course Road, Bengaluru-560 001.

CIN : U40102KA1996SGC020337

No: CEC/Bidadi/YCCPP/ Afforestation/277 Date:05.08.2017

To

Sri.Yella Reddy Y N,
Asha Nilaya
Raghavendra colony
WARD No:7
Kudathini-583115
BELLARY DISTRICT

// LETTER OF AWARD //

Sir,

Sub : Development and maintenance of tree plantation for a period of two years at YCCP Plant premises under Phase-I-Letter of award - Reg.

Ref : 1] KPCL Bid Notification No: KPCL/YCCPP/EEC-2/Afforestation/NIT/ 2017-18/27 dtd 27.03.17
2] Bid notification No. KPCL/YCCPP/EEC-2/Afforestation/NIT/2017-18/12 dtd: 02/05/2017
3] Tender No : KPCL /2016-17/OW /WORK-INDENT/5667/CALL-2
4] Your bid submitted in e-portal GOK dtd. 02.06.2017.

We are pleased to accept your offer submitted vide reference (4) above for the work of "Development and maintenance of tree plantation for a period of two years at YCCP Plant premises under Phase I" at a quoted cost of Rs.11,89,227.40 (inclusive of all taxes) (Rupees Eleven Lakhs Eighty nine thousand two hundred twenty-seven and paise forty only), which is (-) 3.03 % below the estimated cost of Rs. 12,26,411.21 subject to the following conditions:-

1. You Shall enter into an agreement on a Non-Judicial Stamp Paper of Value Rs.200/- with the Executive Engineer (Civil)-2,YCCPP, Yelahanka within 20 days from the date of issue of this letter of award along with Bank Guarantee towards performance Guarantee.
2. The date of handing over of site shall be considered as the date of commencement of work for reckoning the period of completion and contract.
3. The work shall be completed in all respects within 24 (twenty four) calendar months including monsoon period from the date of handing over of site. During the execution of work you shall adhere to the construction schedule.
4. You shall commence the work at site immediately after the site is handed over and complete the work as per the construction schedule jointly drawn up and shall

Mailing Address : Chief Engineer (Civil) / Bidadi
116/2, 'Trade Centre', 2nd Floor, Race Course Road, Bengaluru-560 001.
Tel. : 080-2228 6383 Telefax : 080-22285501 E-mail : cecbidadi789@gmail.com

ANNEXURE-R22

KPC GAS POWER CORPORATION LIMITED

(SUBSIDIARY of KPCL)

Regd. Office : 'Trade Centre', 2nd Floor, No. 116/2, Race Course Road, Bangalore 560 001

CIN : U40102KA1998SGC025137

NO.CEC/Bidadi/YCCP/Afforestation/LOA/ 102 Date: 29.05.2019

To.

Sri.SaiPavan Enterprises.
No.26/1, 5th cross,
Muneshwara Layout,
Yelahanka, Bangalore

//LETTER OF AWARD//

Sir,

Sub:-"Development and Maintenance of tree plantation for a period of two years at YCCP plant premises under phase-II - Letter of Award - reg..

Ref:- e-tender Notification No.KPCGPCL/YCCPP/EEC-2/ Housekeeping/NIT/ 2018-19/2019 Dated 28.02.2019

Inviting reference to the above, we are pleased to award the work of "Development and Maintenance of tree plantation for a period of two years at YCCP plant premises under phase-II" at a quoted cost of Rs.10,86,984.00 (Rupees Ten Lakhs Eighty six thousand nine hundred and eighty four only) (Inclusive of all applicable taxes) which is(-)23.43% below the estimated cost of Rs.14,19,622.29 is acceptable to the Corporation subject to the following conditions:

1) You shall enter into an agreement on a non-judicial stamp paper of value Rs.200/- with the Executive Engineer(Civil-2)YCCPP, Yelahanka within 15 days from the date of this letter of award.
2) The date of commencement of contract will be from 01.06.2019.
3) The contract period will be upto 31.05.2021 including monsoon period from 01.06.2019. During the execution of work you shall adhere to the maintenance norms stipulated in NIT/Agreement.

4) You shall commence the work at site immediately and mobilize required men, materials etc., so as to execute the work satisfactorily throughout the contract period as directed by Engineer-in-charge

5) Before entering into an agreement with the corporation you are requested to furnish the Contract performance guarantee for Rs.54,350.00 being 5% of the total contract amount in the form of FDR/TDR/DD/BG from any schedule bank acceptable to the corporation in the prescribed format before entering into agreement and valid throughout the contract period. CPG shall be furnished within 15 days from the date of issue of this letter of award. The validity shall be extended at a later date if necessary

6) All other conditions as stipulated in the tender form shall be adhered to.

7) You shall have an undertaking at the time of execution of the agreement towards the requirementunder EPF & MP Act 1952 and make necessary remittances towards contributions as per the procedure in vogue in the Corporation.

8) The following documents shall also form a part of the agreement. viz..

   a) Notice inviting tender (NIT)
   b) Your Tender document along with all relevant enclosures uploaded by you to the e-procurement portal
   c) Contract performance Guarantee for Rs.54,350.00
   d) This Letter of Award (LoA)
   e) Schedule-B indicating the Quantity and rates
   f) Your letter of acceptance

9) The receipt of this Letter of Award may please be acknowledged and the acceptance of the LoA may be communicated to this office within 7 days from the date of issue of LoA.

Thanking you,

Your's faithfully,

for KPC GAS POWER CORPORATION LTD.,

Chief Engineer (Civil)/Bidadi

C/c:CE(GSW) for information
: SE(C)/Y for information
: EE(C-2)/Y for information and necessary action
: AGM(F)/Y for information

Annexure-R23

783

784

Annexure-R24

KPCL
ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತ
KARNATAKA POWER CORPORATION LTD.,
(A premier power generating company of Government of Karnataka)
CIN U85110KA1970SGC001919

LETTER OF AWARD

No: KPCL / YCCPP / Mobile RO / 1176 Date: 06.09.2019

To,

M/s. SUEZ Water Technologies & Solutions (I) Private Limited.
No.302. Campus 2A.
3rd Floor RMZ NXT Building.
Whitefield Road. Sonnenahalli.
Bengaluru – 560 066
Karnataka. India

Dear Sirs.

Sub: Supply. Erection & Commissioning of skid mounted (Containerized) mobile RO units of total capacity 180 m^3/hr. on hire basis including O&M for 9 months period for 1x370MW Yelahanka Combined Cycle Power Plant (YCCPP). Yelahanka. Bengaluru. 560064 in the State of Karnataka. India.- Issue of LOA - Reg.

Ref:

1. Your offer dated 11.04.2019
2. Our e-mails dated 25.04.2019. 03.05.2019. 17.05.2019. 20.05.2019. 24.05.2019. 28.05.2019. 13.07.2019.
3. Your final offer No. 363973 (Rev-6) dated 10.06.2019 & e-mail dated 19.7.2019. 04.9.2019 & 05.9.2019.
4. MOM of Pre-Award meeting held on 15.07.2019.

-o0o-

With reference to your offer for the subject work cited under ref.(1). subsequent correspondences and your final offer dated 10.06.2019 and e-mails cited under ref.(3). for providing mobile RO units of total feed capacity 180 m3 / hr on hire basis including O&M for 9 months period to treat the effluent water generated from the 1x370 MW Yelahanka Combined Cycle Power Plant (YCCPP). we are happy to inform that your final offer has been accepted by KPCL and we hereby place the **Letter of Award (LOA)** for the subject work in accordance with your final offer. e-mails cited under ref.(3) and pre-award meeting MOM cited under ref.(4).

The brief description of the work and terms & conditions of the contract are detailed below:

1. SCOPE OF AWARD:

Scope of work includes. "Preparation of the RO units at SUEZ Service centre, packing & forwarding, transportation & delivery F.O.R. YCCPP site. unloading, receipt & storage, handling at site, erection. trial operation. testing. commissioning. O&M (including Man power. Chemicals & Consumables) for a

ಮುಖ್ಯ ಅಭಿಯಂತರು (ಶಾಖೋತ್ಪನ್ನ ವಿನ್ಯಾಸ) ರವರ ಕಛೇರಿ, 'ಸುದರ್ಶನ ಕಾಂಪ್ಲೆಕ್ಸ್', 2ನೇ ಮಹಡಿ, ನಂ. 22/23, ಶೇಷಾದ್ರಿ ರಸ್ತೆ, ಬೆಂಗಳೂರು-560 009.
Office of the Chief Engineer (Thermal Designs), 'Sudarshan Complex', 2nd Floor, No. 22/23, Sheshadri Road, Bengaluru-560 009.
Tel. : 080-2220 6223 EPABX : 2220 2950-54 Fax : 080-2235 6510
E-mail : cetd@karnatakapower.com / kpclcetd@gmail.com Website : www.karnatakapower.com

period of 9 months, de-commissioning, removal of units from site and return transportation including insurance towards transit risk / storage / intra-site transportation of mobile RO units and to maintain Commercial General Liability Insurance".

This scope of award shall be read in conjunction with all documents referred to above.

2. CONTRACT PRICES: Pricing for the proposed equipment and services is summarized in the table below:

A. Equipment Rental charges:

All prices in INR only (Exclusive of GST)

Sl. No.	Description	No. of Days	Charges / Day. Rs.	Total Charges. Rs.	Remarks
1	Equipment Rental Charges in Transit Journey from SUEZ service centre to YCCPP site.	50	1,72,482 / -	86,24,110/ -	For details, see clause No. 6.2
2	Onward Freight Charges.			25,90,000/-	For details, see clause No. 6.3
3	Installation. Commissioning & De-Commissioning.			8,75,000/-	For details, see clause No. 6.4
4	Import Duty & Custom Clearance.			40,35,994/-	For details, see clause No. 6.5
5	Equipment Daily Rental Charges.	309	2,61,337/-	8,07,53,029/-	For details, see clause No. 6.6
6	Return Freight Charges			25,90,000/-	For details, see clause No. 6.7
7	Total			9,94,68,133/-	

B. Operation & Maintenance Charges:

All prices in INR only (Exclusive of GST)

Sl. No.	Description	No. of Months	Charges / Month. Rs.	Total Charges. Rs.	Remarks
1	Fixed Monthly O&M Charges.	9	14,00,000/-	1,26,00,000/-	For details, see clause No. 6.8
2	Variable Monthly O&M Charges.	9	8,00,000/-	72,00,000/-	
3	Total			1,98,00,000/-	

Grand Total: A+B = Rs. 9,94,68,133 + Rs. 1,98,00,000 = Rs. 11,92,68,133/- (Excl. of GST).

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3. TAXES & DUTIES

GST shall be payable extra for applicable items at prevailing rates. Any variation in taxes & duties during the contract period shall be to KPCL account.

4. SYSTEM COMPONENTS:

The System under the scope of SUEZ broadly consists of:

a) Mobile Flow Filter Container	:	2 Nos.
b) Mobile Reverse Osmosis Container	:	3 Nos.
c) Dosing System (NaOCl, $FeCl_3$, Antiscalant, SMBS, HCl, NaOH, Biocide)	:	7 Nos.
d) CIP Skid	:	1 No.
e) Bulk Chemical Tank for Acid & Caustic	:	2 No.
f) Bulk Transfer Pump for Acid & Caustic	:	Each chemical one pump

and all other accessories required for the successful functioning of the system covered under SUEZ's scope.

5. CONTRACT SCHEDULE:

i. **ZERO DATE OF CONTRACT:** The Zero Date of the contract shall be 16.9.2019.

ii. **EQUIPMENT PREPEARTION PERIOD** (at SUEZ service centre): 2-3 weeks from the Zero Date.

iii. **DELIVERY PERIOD:** 12-14 weeks from the Zero Date.

iv. **ONWARD TRANSIT PERIOD:** 50 days from the date of despatch. (from SUEZ service centre to YCCPP site)

v. **INSTALLATION & COMMISSIONING:** Shall be 21 days from the day all equipment listed under clause no.4 arrives at site.

vi. **O&M PERIOD:** The O&M period is 274 days (9 months) from the date of commissioning of all the equipment.

vii. **DE-COMMISSIONING PERIOD:** 14 days after completion of O&M period with extensions if any.

The contract shall be deemed to be completed after successful de-commissioning as per KPCL's written instructions.

The equipment shall be removed from YCCPP site by SUEZ within a maximum of 90 days (plus 30 days grace period) after de-commissioning failing which KPCL shall have the right to levy penalty @ 0.1 % per week to maximum of 1% of the total rental charges value.

6. TERMS OF PAYMENT:

6.1 **Advance Payment:** Interest free advance @10% of contract basic value excl. of GST shall be paid by KPCL against advance Bank Guarantee after the Zero Date. The advance amount shall be adjusted / recovered from SUEZ's monthly bills in the first 4 months. BG validity shall be 8 months from the Zero Date. BG shall be released only after all recoveries are completed.

6.2 **Transit Rental Charges:** The Equipment Rental Charges in Transit (Onward Journey+Customs Clearance+Land Transport) shall be payable to SUEZ for the actual number of days of transit limited to a maximum of 50 days. Invoice shall be raised after all equipment is delivered at site.

Rental charges for transit period from SUEZ service centre to YCCPP site shall be restricted to a maximum of 50 days irrespective of the actual time consumed. If customs clearance takes more than 15 days from the date of arrival of all equipment at port in India due to reasons attributable to KPCL, then rental charges for the extra days consumed for customs clearance in excess of 15 days shall also be payable by KPCL.

6.3 **Onward Freight Charges:** SUEZ shall be responsible for booking the equipment from SUEZ service centre and deliver upto YCCPP site. Freight shall be chargeable from SUEZ service centre to YCCPP site. Onward freight charges shall be paid at actuals or Rs. 25,90,000 / - whichever is lower. Terms shall be as per Incoterms-2010- DDP (Delivery Duty Paid). Invoice shall be raised after all equipment is delivered at site.

6.4 **Installation, Commissioning & De-commissioning Charges:** SUEZ shall install, commission and de-commission the RO plant.

Installation & Commissioning Charges: **Rs. 5,25,000/-**. Invoice shall be raised after installation& commissioning.

De-commissioning Charges: **Rs.3,50,000/-** Invoice shall be raised after de-commissioning.

6.5 **Importation Period & Customs Duty:** The importation period for the mobile RO plant is considered as <18 months for availing concessional customs duty against BG (to be furnished by SUEZ). If the importation period exceeds 18 months due to contract extension by KPCL, then additional customs duty of approx. Rs.60 Lakh shall be borne by KPCL at actuals against proof of such payment.

6.6 **Equipment Daily Rental Charges:** Equipment rental charges shall be payable for 309 days (21 days for Commissioning + 274 days of O&M + 14 days for De-Commissioning). Actual no. of days taken for Commissioning and De-Commissioning only shall be considered for this purpose. The Monthly Rental Charges shall be invoiced after completion of each calendar month.

Daily Rental Charges shall commence from the delivery date i.e. after 12 weeks from the Zero Date. In case the equipment arrives earlier than 12 weeks and if

KPCL is also ready to use the RO plant, then only Daily Rental Charges shall be payable from the date of arrival.

6.7 **Return Freight:** SUEZ shall be responsible for booking the equipment from YCCPP site and deliver upto SUEZ service centre after completion of De-commissioning and issue of Despatch Clearance by Chief Engineer(GSW). Freight shall be chargeable from YCCPP site to SUEZ service centre. Return freight charges shall be paid at actuals or Rs.25,90,000/- whichever is lower. Terms shall be as per Incoterms-2010- DDP (Delivery Duty Paid). Invoice shall be raised after all equipment is booked for return transit.

6.8 **O&M Charges:** The O&M charges commence from the date of commissioning of mobile RO Plant in complete manner. The monthly O&M Charges (Fixed & Variable Charges) shall be invoiced after completion of each calendar month.

(i) **Fixed monthly O&M Charges:** Lump sum @ Rs. 14,00,000 / - per month.

(ii) **Variable monthly Charges:** Shall be based on feed quality and quantity as indicated below:

a) **Quality of feed water:** In case feed water quality is within +10% of feed design limits, the monthly variable charges shall be paid as agreed and no documents are required in support of consumption of Chemicals & Consumables. When feed water quality exceeds 10% of design values, then for claiming extra variable charges, SUEZ shall furnish consumption details of additional Chemicals & Consumables for the subject month along with the invoice which shall be admitted only after due verification by KPCL.

b) **Quantity of feed water:** The monthly variable charges shall be charged on pro rata basis on the feed flow quantity in that month.

The flow meters shall be calibrated as per international standards by reputed agencies with a validity covering the entire contract period.

(iii) No Variable Charges shall be admissible if mobile RO Plant could not be commissioned due to non-availability of effluent. In this case, KPCL shall pay monthly equipment rental charges and O&M Fixed Charges only to SUEZ from the date of readiness of the plant till plant is commissioned.

7. PRICE VARIATION:

7.1 The offered prices shall be firm during the Contract Period.

7.2 In case the contract is extended beyond the original Contract Period by KPCL, contract price shall be revised on mutually agreed terms & conditions. Such requirement of extension shall be intimated to SUEZ one month prior to the expiry of the contract.

7.3 Any changes in influent water quality beyond the design values, Environmental, Health & Safety conditions which warrants for changes in Price, Warranties and

Specifications or Terms & Conditions, then the same may lead to changes after mutual discussions and agreement by KPCL.

8. MODE OF PAYMENT:

All payments shall be released to SUEZ directly through cheque / electronic transfer within 15 days after submission of invoices / bills along with requisite documents. However, no interest shall be payable for delayed payments.

9. PAYING AUTHORITY:

All invoices shall be raised on Chief Engineer (GSW), YCCPP, S.N.Halli Post, Anantapura Gate, Doddballpur Road, Yelahanka, Bengaluru, 560 064.

10. CONTRACT AGREEMENT:

a) SUEZ shall sign the contract agreement within 10 days from the Zero Date as per KPCL format. SUEZ after the receipt and acceptance of the 'Letter of Award' shall send draft contract agreement to KPCL for the scrutiny and approval. The agreement shall be signed on a stamp paper (purchased in Karnataka State) on date and time to be mutually agreed within the specified period. The stamp paper shall be of value as per Article 5(i-d), section-3 of Karnataka stamp Act 1957. SUEZ representative shall be present for signing the Contract Agreement with "Contract Performance Bank Guarantee / Security Deposit BG" and other requisite material.

b) The agreement shall be signed in two original sets. SUEZ and KPCL shall retain each signed original contract agreement.

c) Subsequent to signing of the contract, the SUEZ at their own cost shall provide KPCL with at least 08 (Eight) duly bound copies of the agreement and soft copies within 7 days of signing the contract.

11. CONTRACT PERFORMANCE BANK GUARANTEE-CPBG (SECURITY DEPOSIT):

As a part of security and performance of the contract in connection with this assignment for faithful fulfillment of contract, SUEZ shall provide KPCL a Bank Guarantee to an extent of 10% (Ten percent) of the contract value (incl. of GST) at the time of signing the Agreement.

The Bank Guarantee shall remain valid for the entire contract period, i.e. 13 months from Zero Date. The above Bank Guarantee shall be furnished through a Nationalized /Scheduled Bank on Rs.200/- stamp paper as per the proforma furnished. The Contract Performance Bank Guarantee / Security Deposit shall be treated as to have been paid only after the said BG furnished by SUEZ is accepted by KPCL in writing.

In case of contract extension by KPCL, BG validity shall be extended by SUEZ suitably.

Contract Performance BG shall be returned to SUEZ after successful de-commissioning and removal of equipment from site.

12. OPERATIONAL BASIS:

Operation Hours per day = Productive Operation Hours of 22 hours+ 2 hours down time.

(2 hrs downtime allowed for process related maintenance such as membrane cleaning, cartridge filter change outs, backwash of the System etc.)

13. LIQUIDATED DAMAGES (LD):

1. AVAILABILITY:

(i) Availability 75% & above: LD is not applicable.

(ii) Availability < 75%:

(a) LD @ 1.33% of monthly rental charges shall be applicable for every 1% decrease in availability.

(b) Variable Charges shall be limited to the actual cost of Chemicals consumed in that month.

However the lowest allowable availability in a month shall be 50%. In case the availability is < 50 % in a month, KPCL shall serve a notice to SUEZ for restoring the availability to ≥50% within 30 days from the date of notice failing which the same shall be treated as termination notice and contract shall be liable for termination on the 31st day from the date of notice. In this case, no payment shall be made by KPCL for the balance period after termination and the CPBG shall be encashed.

Availability shall be calculated as per below formula:

Total Availability Percentage = 100-{(A+B) / (22 x No. of days of the month)}*100

A : Non-availability hours based on critical equipment:

No. of hours the critical equipment is under breakdown maintenance in that month shall be considered as non-availability hours. (Critical equipment are the equipment which don't have redundancy and affects the treatment capacity).

Non availability hours of RO plant due to any reason attributable to SUEZ shall also be added to above.

Hours lost for CIP, backwash, cartridge filter & membrane change outs and for reasons attributable to KPCL like Power failure, feed water non-availability etc. shall not be considered as non- availability.

B : Non-availability hours based on Recovery:

Monthly reject generation quantity shall be calculated by subtracting monthly RO permeate quantity from monthly RO feed flow quantity. Reject quantity generated over and above the quantity corresponding to 70% recovery shall be converted to no. of hours of non-availability on pro-rata basis. (taking base as 54 m3 = 1 hr. of non-availability).

No credit shall be given for achieving recoveries higher than 70%.

However, if the recovery decreases below 70% due to influent water quality exceeding the design value, or due to influence of chemicals dosed to the influent water circuits by KPCL, no penalty shall be applicable. Justification with valid reasons shall be furnished by SUEZ in the events of lesser recoveries for KPCL's verification.

2. OUTLET QUALITY:

Liquidated Damages (LD) shall not be applicable if monthly average RO permeate TDS <150 ppm @ 28 Deg.C. For every 10 ppm increase in the permeate average TDS value, LD @ 3% of O&M Fixed Charges shall be applicable.

The temperature correction factor shall be considered for the permeate TDS value as per the table shown below.

Temperature in deg C	RO permeate TDS in PPM
25	145
28	150
31	160
33	166
35	175

If RO permeate average TDS >200 ppm in a month, KPCL shall serve a notice to SUEZ for restoring the quality to <200ppm within 30 days from the date of notice failing which the same shall be treated as termination notice and contract shall be liable for termination on the 31st day from the date of notice. In this case, no payment shall be made by KPCL for the balance period after termination and the CPBG shall be encashed.

14. Liquidated Damage shall be sole and exclusive remedy. Total aggregate Liquidated Damages shall not exceed 15% of the contract value.

15. TERMINATION:

Without Cause: KPCL may terminate this contract after giving one month notice at any point of time during the Contract Period, provided that the full rental along with transit charges and fixed O&M costs are paid by KPCL to SUEZ for the balance period along with return freight charges from the date of Termination.

Breach: Either party (the "Non-Defaulting Party") may terminate if defaulting party commits a material breach of this contract and fails to cure the breach within thirty (30) days of notice from the Non-Defaulting Party, or fails to commence to cure the breach and diligently proceed with the cure if it is not possible to cure within thirty (30) days of such notice.

If the termination is due to any reason not attributable to SUEZ, KPCL shall release rental and fixed O&M costs for the balance period after termination along with return freight charges.

If termination is due to material breach by SUEZ (which is not cured as per above), KPCL shall not make any payment from the date of termination. CPBG shall be encashed by KPCL due to non-performance of the SUEZ. However KPCL shall pay SUEZ for all services offered as per the contract before the date of termination.

Upon expiration or termination of the Service Period, KPCL shall permit SUEZ to disconnect and take back the equipment and any other SUEZ supplied parts, inventory and other assets in accordance with SUEZ's written request.

16. INSURANCE:

16.1 SUEZ shall provide and maintain in full force Commercial General Liability policy with a combined single limit of USD 2,000,000 with an excess liability policy of USD 3,000,000 additional coverage. The Parties expressly agree that SUEZ may self-insure any or all portions of the insurance mentioned in this or any portion of this Agreement.

16.2 SUEZ

(i) shall provide KPCL, upon request, with certificates of insurance showing policy coverage and limits for policies required under this Article;

(ii) shall not terminate the insurance coverage required under this Article without giving thirty (30) days prior written notice to KPCL, and the policies shall provide for such written notice; and

(iii) shall not materially modify the insurance coverage required under this Article without giving thirty (30) days prior written notice to KPCL.

17. CONTRACT CO-ORDINATION PROCEDURE:

SUEZ shall prepare and finalize in consultation with KPCL a detailed contract co-ordination procedure for KPCL's review.

The Controlling Officer for Control & Coordination of the subject work shall be **Chief Engineer (Gas, Solar, Wind)- CE(GSW), YCCPP,** KPC Gas Power Corporation Ltd. Yelahanka. Bengaluru.

18. DRAWINGS & DOCUMENTS:

The Process Flow Diagram, Layout drawing, Civil Foundation drawings indicating the dimensions and loading details have to be submitted after issue of LOA before dispatching the equipment.

Calculations for Chemical dosage values for design influent water quality shall be furnished.

Monthly Reports shall be submitted to CE(GSW) in mutually agreed formats.

19. CONSIGNEE:

The Consignment / materials should be dispatched to F.O.R., YCCPP, as per Incoterms-2010 DDP, freight pre-paid, duly insured, securely packed (wherever necessary) as per SUEZ standard specification, so as to avoid damage during transit and consigned to:

Chief Engineer (GSW),YCCPP,
KPC Gas Power Corporation Ltd.
S.N.Halli Post. Anantapura Gate.
Doddballpur Road.
Yelahanka. Bengaluru. 560 064. Karnataka State.

20. FORCE MAJEURE:

In the event that either party is prevented, wholly or in part by any force majeure clause, as defined herein after, from performing or accepting performance by the other party under this agreement, it is agreed that either party shall have the right to terminate the agreement immediately, upon giving notice and full particulars of such act of force majeure in writing to the other party as soon as possible after the cause relied on, as in such an event, SUEZ shall be entitled to the amount due to him as on that date, under this agreement. Force majeure is herein defined as:

a) Act of God:
b) An act of war, (whether declared or undeclared), invasion, armed conflict or an act of foreign enemies, embargo, revolution, riot, terrorist or military action, civil commotion or sabotage.
c) Contamination by radio-activity from any nuclear fuel, or form any nuclear waste from the combustion of nuclear fuel, radioactive toxic explosive, or other hazardous properties of any explosive nuclear assembly or nuclear component of such assembly.
d) Disorder, unless solely restricted to employees of SUEZ or of their sub-contractors.
e) Any failure by a Governmental Instrumentality to grant any applicable permit within a reasonable time after application therefor having been duly made and the conditions for the issuance thereof having been duly satisfied.

21. SETTLEMENT OF DISPUTES:

21.1 If any dispute or difference of any kind whatsoever is to arise between KPCL and SUEZ on the following matters viz.

i) The meaning of the specification, designs, drawings and instructions.

ii) Any other question, claim, right, matter, thing whatsoever in anyway arising out of or relating to the contract, estimates, orders or those conditions or failure to execute the same whether arising during the progress of the work or after the completion, termination or abandonment thereof, the dispute shall be referred to Chief Engineer(GSW) / Chief Engineer(Thermal Designs).

CE(GSW) / CE(TD) shall within a period of 30 days from the date of being requested by SUEZ to do so, give written notice of his decision to SUEZ.

21.2 Subject to other form of settlement hereafter provided, the CE(GSW) / CE(TD)'s decision in respect of every dispute or difference so referred shall be final and binding upon SUEZ. The said decision shall forthwith be given effect to and SUEZ shall proceed with the execution of the work with all due diligence.

21.3 In case the decision of the CE(GSW) / CE(TD) is not acceptable to SUEZ. SUEZ shall request to convene a meeting of Managing Director. KPCL and the Owner / CEO of SUEZ for amicable settlement of the dispute.

22. The appellate authority shall be Additional Chief Secretary Dept. of Energy. Govt. of Karnataka.

TERMINATION :

23. ARBITRATION

Any dispute or difference of claim arising out of or in connection with. or relating to the present contract or the breach. termination or invalidity thereof shall be referred and settled under the Arbitrations Centre -- Karnataka (Domestic and International) Rules 2012 by one or more Arbitrators appointed in accordance with its rule.

24. SUIT or PROCEEDINGS:

Any suit or proceedings arising out of this contract shall be instituted in appropriate courts of Law at Bengaluru.

OTHER TERMS AND CONDITIONS:

25.

All other terms and conditions not mentioned above shall be as per SUEZ offer No. 363973 (Rev-06) dated 10.06.2019 and MOM of Pre-award meeting dated 15.7.2019.

Please acknowledge the receipt of this Letter of Award sent in duplicate and send one copy of LOA duly signed and stamped on each page for having accepted the same within 10 days from the date of LOA.

Yours faithfully.
for Karnataka Power Corporation Limited

Chief Engineer (Thermal Designs)