

**BEFORE THE NATIONAL GREEN TRIBUNAL
SOUTHERN ZONE, CHENNAI**

ORIGINAL APPLICATION NO. 183 OF 2025

IN THE MATTER OF:

K. Saravanan

...Applicant

Versus

The Union of India

Rep. by its Secretary to Government

Ministry of Environment & Forests & Climate Change and 3 others

...Respondents

TYPEDSET OF DOCUMENTS FILED ON BEHALF OF THE 4TH RESPONDENT

S.No.	Date	Particular	Pg No.
1.	24.02.2026	Reply statement filed on behalf of the 3 rd respondent	1
TYPEDSET			
2.	25.05.2005	Environmental Impact Assessment of TNEB-NTPC JVC 2 x 500 MW Vallur Thermal Power Project	10
2.	18.04.2007	Environment Clearance issued by Director of Ministry of Environment & Forests for two 500 MW Vallur Thermal Power Project	210
3.	03.09.2009	Environment Clearance issued by Director of Ministry of Environment & Forests for one 500 MW Vallur Thermal Power Project	215
4.	28.06.2022	Renewal of Consent issued by Tamil Nadu Pollution Control Board under Section 25 of the Water (Prevention and Control of Pollution) Act, 1974	221
5.	28.06.2022	Renewal of Consent issued by Tamil Nadu Pollution Control Board under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981	226
6.	April 2015-April 2025	Emission data of plant of 3 rd respondent	230

Certified that the above documents filed in the typed set are true copy of the original

Dated at Chennai on this 12th day of March 2026



ADVOCATES FOR 3RD RESPONDENT

**BEFORE THE NATIONAL GREEN TRIBUNAL
SOUTHERN ZONE, CHENNAI**

ORIGINAL APPLICATION NO. 183 OF 2025

IN THE MATTER OF:

K. Saravanan
Son of Kasinathan,
Aged about 37 years,
No. 30, Urur Kuppam, Besant Nagar,
Chennai - 90.
Ph: 9566254546
Email: yogeshwaranadv@gmail.com

...Applicant

Versus

1. The Union of India
Rep. by its Secretary to Government
Ministry of Environment & Forests & Climate Change
Indira Paryavaran Bhavan, Jor Bagh, New Delhi - 110 003
Email : secy-moef@nic.in,
Ph No.: 011- 24695262
2. North Chennai Thermal Power Station
Rep by its Chief Engineer,
Athipattu, Chennai, Thiruvallur (District), 600 120
Phone No. 044 - 27950061
E-mail : cenctps@tnebnet.org
3. NTPC Tamilnadu Energy Company Limited
Rep by it Chief Executive Officer,
Vallur Thermal Power Project,
S.F No. 1556 etc. Vallur Village,
Ponneri Taluk, Thiruvallur Dstrict, Tamil Nadu - 600 103
Email : hopntecl@ntpc.co.in
Phone: 094450 30125
4. The Tamil Nadu Pollution Control Board,
Rep by its Member Secretary,
No. 76, Mount Salai, Chennai - 600 032
Tel: 044-22353134 - 139
Email-ID : tnpcb-chn@gov.in
5. Tamil Nadu Power Generation Corporation Limited (TNPGL)
Rep by its Managing Director
7th Floor, NPKRR Maaligai, Anna Salai, Anna Salai,
Chennai, Tamil Nadu, 600 002
Email : Not known
Phone : 044-25670193

...Respondents



**Dr. PRADEEP. M
Manager (EMG)**

NTPC Tamilnadu Energy Company Ltd.
Vallur Thermal Power Station
P.O.: Vellivoyal Chavadi, Chennai-600 103.

REPLY STATEMENT FILED ON BEHALF OF THE 3RD RESPONDENT

It is submitted as follows:

The address for service of all notices and processes on the 3rd respondent is that of its advocates M/s. King & Partridge, "Catholic Centre", 108, Armenian Street, Chennai - 600 001.

1. The 3rd respondent, NTPC Tamil Nadu Energy Company Ltd, (NTECL), is a joint venture company of NTPC Ltd., (Central Public Sector Undertaking) & Tamil Nadu Generation and Distribution Corporation Ltd., (Tamil Nadu State Government Undertaking). It has established a power project in the State of Tamil Nadu for generating 1500 MW of electricity at Vallur, Vellivoyal Chavadi, Ponneri Taluk, Thiruvallur District, Chennai. All the Southern States are beneficiaries of the power produced by this plant and State of Tamil Nadu is the major beneficiary of this project with 71.24% of power generated has been allocated to Tamil Nadu.
2. At the outset, the 3rd Respondent denies all the averments, allegations, and contentions raised by the Applicant in the Original Application, except those that are specifically admitted herein. The Application is based on misconceptions of law and fact, speculative assertions, and a fundamental misunderstanding of the regulatory regime governing Thermal Power Plants (TPPs) in India.
3. The averments made in the Para 2 are denied insofar as they relate to the 3rd Respondent. The allegation that the 3rd Respondent's thermal power plant at Vallur has been emitting pollutants such as PM (SPM, RSPM/PM₁₀ & PM_{2.5}), SO₂ and NO_x "far in excess" of permissible limits is false, baseless, and unsupported by any regulatory finding or credible monitoring data. The plant has at all material times operated in compliance with the emission limits prescribed under the Environment (Protection) Act, 1986, the Environment (Protection) Rules, 1986, the conditions stipulated in the Environmental Clearance granted by the 1st Respondent, and the Consent to Operate issued by the State Pollution Control Board. Continuous Emission Monitoring Systems (CEMS) are installed and operated, and emissions are routinely monitored and reported to the statutory authorities.
4. With regard to the averments made in the Para 2 (a), it is specifically denied that the 3rd Respondent has exceeded the maximum emission levels



Dr. PRADEEP. M
Manager (EMG)

NTPC Tamilnadu Energy Company Ltd.
Vallur Thermal Power Station
P.O.: Vellivoyal Chavadi, Chennai-600 103.

expressed as concentration ($\mu\text{g}/\text{m}^3$) mandated under the Environment (Protection) Rules. No inspection report, show cause notice, or adjudication by the competent authority has recorded any such exceedance. The Applicant's characterisation of the alleged exceedance as an "unforgivable environmental crime" is rhetorical and devoid of factual or legal foundation.

5. With regard to the averments made in the Para 2(b), It is denied that the actual emission rates of the 3rd Respondent have exceeded the emission rates adopted for air dispersion modelling in the EIA. The emission rates used in the EIA were based on plant design parameters, fuel characteristics, pollution control technology, and applicable emission norms, and were duly examined and accepted by the Expert Appraisal Committee prior to the grant of Environmental Clearance. The Applicant has failed to demonstrate any causal nexus between the alleged emissions and any breach of ambient air quality standards attributable to the 3rd Respondent. Neither the EIA nor the Environmental Clearance has been shown to be vitiated by incorrect data, suppression of material facts, or post-clearance non-compliance. The bald assertion that the Environmental Clearance granted to the 3rd Respondent stands violated is denied. In the absence of any proven exceedance of permitted emission limits, regulatory non-compliance, or adverse finding by the competent authorities, the allegations in paragraph 2 are speculative, misleading, and liable to be rejected.

6. With regard to the averments made in the Para 3, it is submitted that the contention that the EIA and clearance process are rendered "nugatory" or that a "fraud" has been committed on the process is misconceived and untenable. The Environmental Clearance granted to the project is based on comprehensive Environmental Impact Assessment (EIA) studies conducted in accordance with the applicable statutory framework, guidelines of the Ministry of Environment, Forest and Climate Change (MoEF&CC), and appraisal by the competent authorities. It is further submitted that the 3rd Respondent operates its thermal power plant strictly in compliance with the emission standards and conditions stipulated under the Environmental Clearance (EC), Consent to Operate (CTO), and other applicable statutory approvals. Emission limits prescribed by the CPCB and SPCB are dynamic regulatory standards, and compliance with such standards is continuously monitored and enforced by the competent authorities through CEMS, inspections, and statutory reporting. Any temporary


Dr. PRADEEP. M
Manager (EMG)

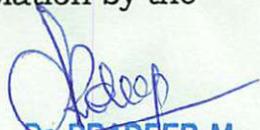
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Vallur Thermal Power Station
P.O.: Vellivoyal Chavadi, Chennai-600 103.

operational variation, where applicable, is addressed within the regulatory framework through permissions, extensions, or directions issued by the competent authorities and does not invalidate the EIA or EC process. The EIA study assesses potential impacts based on approved plant configuration, capacity, and prevailing regulatory standards, and the clearance is granted after due consideration of these factors. Therefore, it is incorrect to suggest that the EIA process is rendered nugatory. The 3rd Respondent remains fully committed to environmental compliance and operates under continuous regulatory oversight.

7. With regard to the averments made in Para 4, it is submitted that the EIA Notification, 2006 was indeed issued to strengthen the regulatory framework. However, even prior to the EIA Notification, 2006, the establishment of thermal power plants was subject to environmental scrutiny under the then-prevailing legal regime, including the EIA Notification, 1994. Environmental appraisal and clearance for thermal power projects is a continuous and evolving regulatory process. The 3rd Respondent has acted in compliance with the applicable environmental laws and obtained requisite approvals in accordance with the procedures prevailing at the relevant time. The transition from the 1994 Notification to the 2006 Notification represents a progressive refinement of the regime, not a retrospective invalidation of prior lawful clearances. The contentions seeking to draw an adverse inference against the 3rd Respondent based on the evolution of the EIA framework are misconceived and liable to be rejected.

8. With regard to the averments made in Para 5, it is submitted that the 3rd Respondent submits that the proposed activity was subjected to the prescribed environmental appraisal process, including assessment of potential impacts, examination by the competent authority, and grant of environmental clearance in conformity with the legal regime then in force. An informed decision to permit the activity was taken by the statutory authority after due consideration of relevant environmental parameters. The Applicant has not demonstrated any deviation from the prescribed procedure nor established that the decision-making process suffered from illegality or non-application of mind.

9. With regard to the averments made in Para 6, the 3rd Respondent submits that the EIA framework is intended to enable an informed decision-making process. However, this assessment is not undertaken in isolation by the


Dr. PRADEEP. M
Manager (EMG)
NTPC Tamilnadu Energy Company Ltd.
Vallur Thermal Power Station
P.O.: Vellivoyal Chavadi, Chennai-600 103.

project proponent but is carried out by the statutory authority through a structured appraisal mechanism involving expert bodies. In the present case, the proposed activity was subjected to comprehensive environmental appraisal by the competent authority, which examined the projected pollution load, carrying capacity, anticipated impacts, and proposed mitigation measures. The EIA Notification does not mandate a "zero-impact" standard nor prohibit development per se, but seeks to balance environmental protection with developmental needs. The clearance granted to the 3rd Respondent reflects such a balance and cannot be faulted merely on the basis of abstract or generalized assertions regarding environmental desirability.

10. With regard to the averments made in the Para 7, the 3rd Respondent submits that the procedural steps outlined by the Applicant are broadly reflective of the statutory EIA framework. The 3rd Respondent has rigorously followed this process:

- a) Baseline environmental data (air, water, noise, etc.) was duly collected as per the approved Terms of Reference.
- b) The nature of the activity, raw materials, fuel usage, and anticipated emissions were fully disclosed.
- c) Anticipated impacts were quantified using accepted scientific methodologies and predictive modelling.
- d) Cumulative impact assessment, including existing environmental load, was carried out in accordance with applicable guidelines.
- e) The EIA report was placed in the public domain and public consultation was conducted, enabling stakeholders to express views which were duly recorded.
- f) The EIA report and data were appraised by the Expert Appraisal Committee, and the decision to grant clearance was taken by the competent authority after due application of mind.

Therefore, the project has undergone the complete statutory EIA process, and the Applicant's narration does not disclose any procedural lapse or illegality.


Dr. PRADEEP. M
Manager (EMG)
NTPC Tamilnadu Energy Company Ltd.
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11. With regard to the averments made in the Para 8 to 18, it is submitted that the averments contained in these paragraphs do not pertain to the answering 3rd Respondent and appear to relate to other Respondents or general theoretical arguments. The 3rd Respondent reserves its right to respond specifically if any direct allegation is substantiated against it.

12. With regard to the averments made in the Para 19, it is submitted that the compliance with prescribed emission standards is a mandatory statutory requirement and a legally relevant benchmark for determining regulatory compliance. The 3rd Respondent denies that it seeks to justify operations merely on this basis; rather, the project employs best available technology and continuous monitoring to minimise emissions. Emission standards under the Environment (Protection) Rules represent enforceable limits framed after scientific assessment of carrying capacity and public health considerations. Compliance with such standards constitutes lawful operation. The sweeping allegation that areas with thermal power plants are "invariably severely polluted" is denied as unsubstantiated. Air quality monitoring demonstrates that ambient air quality levels remain within the National Ambient Air Quality Standards (NAAQS) and the project's incremental contribution is within permissible limits. The EIA regime mandates regulated development, not zero-emission.

13. The averments made in the Para 20 are denied as speculative and contrary to the record. The emission rates adopted for air quality modelling in the EIA were neither arbitrary nor understated but were based on plant design parameters, fuel characteristics, and applicable emission norms. The EIA Notification does not mandate modelling based on theoretical maximum permissible emissions but requires realistic, project-specific emission scenarios. In the present case, scientifically accepted dispersion models were used with conservative inputs. The modelling results, combined with baseline data, demonstrated that the incremental contribution would remain within NAAQS. The allegation that higher emission rates were avoided to conceal non-compliance is denied. The Competent Authority granted clearance only after being satisfied with the scientific validity of the modelling.

14. The averments made in the Para 21 are not relevant to the 3rd Respondent and are denied.



Dr. PRADEEP. M
Manager (EMG)

NTPC Tamilnadu Energy Company Ltd.
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15. With regard to the averments made in the Para 22, the averments suggesting that the National Ambient Air Quality Standards (NAAQS), 2009 are inadequate are denied. The NAAQS are notified under the Environment (Protection) Act, 1986 after due consideration of scientific evidence, national conditions, and technical feasibility, and constitute binding statutory standards. The WHO guidelines are recommendatory and non-binding. The mere existence of different international guidelines does not render Indian statutory standards arbitrary. The EIA process ensures compliance with national standards (NAAQS). Since both baseline and post-project assessments demonstrate compliance with NAAQS, no violation is established. The contention that compliance with NAAQS permits harmful exposure is a generalized assertion unsupported by site-specific evidence.

16. With regard to the averments made in the Para 23, the 3rd Respondent denies the contention that NAAQS are merely "politically fixed". They are legally binding standards framed based on epidemiological evidence and policy considerations. The regulatory framework applies uniformly to all persons. The EIA regime operates within this framework, and compliance with NAAQS remains the determinative criterion. In the absence of a statutory mandate to apply non-binding international guidelines, the allegations are untenable.

17. The averments made in the Para 24 are denied as misconceived. The 3rd Respondent has at no point emitted pollutants in excess of the emission limits prescribed under the Environment (Protection) Act, 1986 or the EC/CTO conditions. It is incorrect to suggest that compliance with NAAQS is relied upon to "ignore excess emissions". Emission compliance and ambient air quality compliance are distinct but complementary regulatory controls; the 3rd Respondent complies with both. The assertion that emissions have exceeded forecasted levels is denied. The Applicant has not produced any data establishing that actual emissions exceeded permitted limits.

18. With regard to the averments made in the Para 25 to 33, the 3rd Respondent denies the allegations of non-compliance. With specific reference to the data tables presented in the Application (purportedly showing exceedances), it is submitted that any alleged "data gaps" or "exceedances" in the CARE AIR data are attributable to technical glitches, maintenance periods, or unit shutdowns, and do not reflect actual continuous operational violations. The 3rd Respondent strictly adheres to the statutory reporting regime and takes



Dr. PRADEEP. M
Manager (EMG)

immediate corrective action in the rare event of any deviation. The 3rd Respondent operates a critical infrastructure project essential for energy security within the four corners of the law.

19. It is submitted that the instances of no or unreliable online data were solely attributable to planned unit shutdowns, routine maintenance activities, and intermittent software or data-upload related issues, which are technical in nature and beyond operational emission control. During all such periods: Actual plant operations remained compliant, and The daily average emission values, wherever the units were in operation, were well within the stipulated emission limits prescribed by MoEF&CC, CPCB, and TNPCB. Further, it is respectfully submitted that, the monthly average emission values did not exceed the prescribed standards, and the annual average emission values were also well within the applicable emission limits, fully complying with the Environmental Clearance conditions and statutory norms. The absence or unreliability of online data during the stated periods does not indicate exceedance of emission standards, and compliance with environmental norms has been consistently maintained.

20. Each Unit is connected to a highly efficient Electrostatic precipitator (99.969 % efficiency) that maintains the Particulate Matter emissions from stack within 50 mg/Nm³. Stacks for height 275 m are provided for wide dispersion of emissions into the atmosphere. In order to meet NO_x emission limit of 450 mg/Nm³, NTECL has completed Combustion Modification in Unit 1 in December 2020, Unit 2 in September 2021, Unit 3 in August 2022. NO_x standards are achieved at NTECL well within the timeline stipulated by MoEF&CC.

21. NTECL had taken effort for compliance of MoEF order for the installation of FGD (Flue Gas Desulphurization). FGD for Unit 1 trial operation commenced from August 2025 and successfully commissioned in January 2026, Unit 3 hot gas in-cum trial taken in November 2025 and Unit 2 erection in advanced stages of completion and shall be commissioned within deadline of MoEF. NTECL installed four AAQMS stations and two EQMS, all are connected to Online Continuous Effluent/Emission Monitoring System(OCEMS) and made online. AAQMS stations are located in Athipattu, Kathivakkam, Kondakarai & Vichoor and continuously monitored.



Dr. PRADEEP. M
Manager (EMG)
NTPC Tamilnadu Energy Company Ltd.
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22. This respondent remains fully committed to environmental protection, regulatory compliance, and transparent operations in line with national environmental legislation and public sector accountability standards.

In view of the above, it is most respectfully prayed that this Hon'ble Tribunal may be pleased to dismiss the Application against the 3rd Respondent with costs and pass such further or other orders as this Hon'ble Tribunal may deem fit and proper in the circumstances of the case.

Dated at Chennai on this the 24th day of February, 2025.

ADVOCATES FOR 3RD RESPONDENT

Dr. PRADEEP. M
Manager (EMG)
 NTPC Tamilnadu Energy Company Ltd.
 Vallur Thermal Power Station
 P.O.: Vellivoyal Chavadi, Chennai-600 103.

3RD RESPONDENT

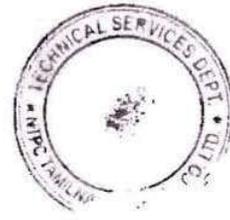
VERIFICATION

I, Dr. Pradeep M, the Manager (EMG) of the 3rd Respondent Company, do hereby verify that the contents of the above Counter Statement are true to the best of my knowledge derived from the official records of the Company, and legal submissions are based on advice received.

Verified at Chennai on this the 24th day of February, 2026.

Dr. PRADEEP. M
Manager (EMG)
 NTPC Tamilnadu Energy Company Ltd.
 Vallur Thermal Power Station
 P.O.: Vellivoyal Chavadi, Chennai-600 103.

DEPONENT



ENVIRONMENTAL IMPACT ASSESSMENT
(Comprehensive Report)
of
TNEB-NTPC JVC THERMAL POWER PROJECT
2 x 500 MW
ENNORE, CHENNAI

Doc. No.: 0260/999/GEG/S/001
Rev. No.: 0

A Joint Venture Project
Between



NATIONAL THERMAL POWER CORPORATION LTD.
(A Government of India Enterprise)
New Delhi

And



TAMIL NADU ELECTRICITY BOARD
CHENNAI, TAMIL NADU



MANTEC CONSULTANTS PRIVATE LIMITED
805, Vishal Bhawan, 95, Nehru Place, New Delhi-110 019

May 2006

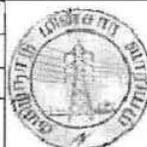
	Comprehensive Environmental Impact Assessment for TNEB - NTPC JVC Thermal Power Project (2 x 500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: i	

CONTENTS

Content	Page No.
1 INTRODUCTION	01
1.1 Background	01
1.2 Demand Analysis and Justification	02
1.2.1 Demand Supply	02
1.2.2 Alternative Locations	03
1.2.3 Location and Approach	05
1.3 Administrative and Legislative Frame Work	05
1.4 Scope of the Study	06
2 PROJECT PROFILE	08
2.1 Project Component	08
2.1.1 Land	08
2.1.2 Coal	08
2.1.3 Water	09
2.1.4 Construction Power	12
2.2 General Layout Plan	12
2.2.1 Plant Design	12
2.3 Thermal Power Generation Process	12
2.4 Pollution Control/Environmental Components	14
2.4.1 Air Pollution Control Systems	14
2.4.2 Water Pollution Control Systems	15
2.4.3 Noise Pollution Control Systems	19
2.4.4 Ash Management Systems	19
2.4.5 Green Belt Development Plan	22
2.4.6 Rehabilitation and Resettlement Plan	22
2.5 Fire Detection and Protection Systems	23
3 BASELINE DATA	25
3.1 EIA Methodology	25
3.1.1 Project Setting and Description	25
3.1.2 Identification of Impacts	25
3.1.3 Baseline Data Collection /Reconnaissance Survey	25
3.1.4 Environmental Impact Prediction & Evaluation	27
3.1.5 Environmental Management Plan (EMP)	27
3.1.6 Occupational Health & Safety	27
3.1.7 Disaster Management Plan	27
3.2 Description of Site and Surrounding	27
3.3 Land Use	28
3.3.1 Objectives of the Study	28

	Comprehensive Environmental Impact Assessment for TNEB - NTPC JVC Thermal Power Project (2 x 500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: ii	

Content	Page No.
3.3.2 Methodology	28
3.3.3 Land Use Classification Based on Satellite Data	29
3.3.4 Land Use Classification Based on Census Data	31
3.3.5 Sensitive Area	33
3.4 Water Use	33
3.4.1 Sources of Water	33
3.4.2 Trends of Surface and Ground Water Use	33
3.5 Demography and Socioeconomic	34
3.5.1 Demographic Profile of the Study Area based on 1991 Data	36
3.5.2 Demographic Profile of the Study Area based on 2001 Data	36
3.5.3 Evolution of Demographic Profile of the Study Area During 1991-2001 Decade	37
3.5.4 Socio Economic Profile of the Study Area based on 1991 Census Record	38
3.5.5 Socio Economic Profile of the Study Area based on 2001 Census Record	40
3.5.6 Evolution of Demographic Profile of the Study Area During 1991-2001 Decade	41
3.5.7 Availability of Infrastructural Facilities & Amenities	42
3.5.8 Conclusion	44
3.6 Geology	45
3.7 Soils	46
3.7.1 Selection of Sampling Locations	46
3.7.2 Methodology	46
3.7.3 Physicochemical Characterization of Soil	47
3.8 Hydrology	50
3.8.1 Depth of Ground Water Table	50
3.9 Water Quality	54
3.9.1 Selection of Sampling Locations	54
3.9.2 Methodology	55
3.9.3 Surface Water Quality	55
3.9.4 Ground Water Quality	55
3.10 Meteorology	69
3.10.1 Climatological Data	69
3.10.2 Meteorological Observation at Kathivakkam	75
3.11 Sediment Quality	85
3.11.1 Metal	85
3.11.2 Pesticides	86
3.12 Ambient Air Quality	87
3.12.1 Selection of Sampling Stations	88
3.12.2 Monitoring Parameters, Frequency and Methodology	88
3.12.3 Analysis and Interpretation Data	91

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2 x 500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: iii	

Content	Page No.
3.13 Ecology	96
3.13.1 Terrestrial Ecology	96
3.13.2 Aquatic Ecology	102
3.13.3 Rare and Endangered Species	109
3.13.4 Ecologically Sensitive Area	109
3.14 Noise	109
3.14.1 Methodology	109
3.14.2 Type of Sound Fields	110
3.14.3 Sampling Locations	111
3.14.4 Ambient Noise Standards	113
3.14.5 Results and Discussions	113
3.14.6 Conclusion	116
3.15 Potential of Ash Utilization	116
4 IMPACTS	118
4.1 Land Use	118
4.1.1 Impacts During Construction and Operation Phases	118
4.2 Water Use	119
4.2.1 Water Budget of the Study Area	119
4.2.2 Impacts During Operation Phase	120
4.3 Demography and Socioeconomic	121
4.3.1 Impacts during Construction Phase	121
4.3.2 Impacts during Operation Phase	123
4.4 Soils	124
4.4.1 Impacts during Construction Phase	124
4.4.2 Impacts during Operation Phase	124
4.5 Hydrology	125
4.5.1 Impacts on Surface Water	125
4.5.2 Impacts on Ground Water	125
4.6 Water Quality	125
4.6.1 Impacts During Construction Phase	125
4.6.2 Impacts on Surface Water Quality During Operation Phase	125
4.6.3 Impacts on Ground Water Quality During Operation Phase	126
4.7 Air Quality	127
4.7.1 Impacts During Construction Phase	127
4.7.2 Impacts During Operation Phase	127
4.7.2.1 Meteorological Data	128
4.7.2.2 Determination of Atmospheric Stability	128
4.7.2.3 Mixing Depth	129
4.7.2.4 Application of ISCST3 Model	130
4.7.2.5 Presentation of Results	131

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2 x 500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: iv	

Content	Page No.
4.7.2.6 Result Concentrations after Commissioning of the Project	132
4.8 Noise Environment	137
4.8.1 Impact During Construction Phase	137
4.8.2 Impact During Operation Phase	137
4.9 Terrestrial Ecology	140
4.9.1 Impact During Construction Phase	140
4.9.2 Impact During Operation Phase	141
4.10 Aquatic Ecology	142
4.10.1 Impact During Construction Phase	142
4.10.2 Impact During Operation Phase	142
5 ENVIRONMENTAL MANAGEMENT PLAN	143
5.1 Environmental Management for Construction Phase	143
5.2 Environmental Management for Operation Phase	144
5.2.1 Env. Management Measures for Socioeconomic Environment	145
5.3 Green Belt Development	145
5.3.1 Green Belt Design	145
5.3.2 Green Belt Design Methodology and Approach	146
5.3.2.1 Preparation of Plantation Area	146
5.3.2.2 Preparation of Pits and Sapling Transplantation	146
5.3.2.3 Time of Plantation	147
5.3.2.4 Protection of Green Belt	147
5.3.3 Selection of Tree Species	147
5.3.4 Plantation for Noise Pollution Control	148
5.4 Environmental Monitoring Programme	148
5.5 Institutional Set-up for Environmental Management	149
5.5.1 Institutional Set-up at TNEB-NTPC JVC TPP	150
5.5.2 Functions of Env. Groups	151
5.5.3 Environmental Laboratory	152
5.5.4 Cost Provision for Environmental Measures	152
5.6 Ash Utilization	153
5.6.1 Use of Fly Ash in Agriculture	154
5.6.2 The use of Fly Ash for FAL-G Bricks	154
5.6.3 FAL-G for Coarse Aggregate	155
5.6.4 FAL-G as Cement	155
6 OCCUPATIONAL HEALTH & SAFETY PLAN	156
6.1 Occupational Health	156
6.1.1 Construction & Erection Phase	156
6.1.2 Operation & Maintenance Phase	157
6.2 Electrocution	158
6.3 Housekeeping	158
6.4 Safety & Emergency Plan	159
6.4.1 Safety Organization	160

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2 x 500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: v	

Content	Page No.
6.4.2 Safety Circle	160
6.4.3 Safety Awareness Among Workers/Employees	161
6.5 Accident Reporting	164
6.6 Safety Review Check List	164
6.7 Medical Facilities	164
6.7.1 First Aid Center	164
6.8 Fire Fighting Arrangement	165
6.8.1 Fire Detection System	165
6.8.2 Fire Protection System	165
6.8.3 Automatic Hydrant System	166
6.8.4 Automatic High Velocity Water Spray System	166
6.8.5 Automatic Medium Velocity Spray System	166
6.8.6 Automatic Medium Velocity Water Spray System	166
6.8.7 Halon 1301/Extinguishin System	167
6.8.8 Foam Injection System	167
6.8.9 Manual Medium Velocity Spray System	167
6.8.10 Fire Detection System	167
6.8.11 Portable and Mobile Fire Extinguishers	167
6.8.12 Chlorine Detection Kit	168
6.8.13 Blow Down of Circulating Water System	168
6.8.14 Inert Gas Extinguishing System	168
6.9 Protective Equipment	168
7 DISASTER MANAGEMENT PLAN	170
7.1 Introduction	170
7.2 Purpose and Scope of the Disaster Management Plan	170
7.3 Disaster Control Philosophy	171
7.4 Vulnerable Units	171
7.4.1 Analysis of Vulnerable Zones	171
7.5 Preventive Measures and Plans	172
7.6 Loading and Unloading Facilities	172
7.7 Preventive Measure	173
7.8 Disaster Control Measures	174
7.8.1 On-site Emergency Planning	174
7.8.2 Off-site Emergency Planning	174
7.9 Site Emergency Planning	175
7.9.1 Control Requirement of an On-site Emergency Plan	175
7.9.2 Alarm and Communication Mechanism	175
7.9.3 Control Center	175
7.9.4 Roles and Responsibilities (Proposed)	176
7.9.5 Emergency Response Facilities (Proposed)	176
7.9.6 Outline of Key Emergency Actions	177
7.9.7 Conducting Evacuation	178

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2 x 500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: vi	

Content	Page No.
7.9.8 Evacuation Tasks	178
7.9.9 Security in Evacuated Areas	179
7.9.10 Re-Entry into Evacuated Areas	179
7.9.11 Updating of On-Site Plan	179
7.9.12 Mock Drill for Rehearsing On-site Plan	179
7.9.13 Transport	179
7.10 Off-Site Plan	179

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2 x 500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: vii	

LIST OF TABLE

Table No.	Title	Page No.
Table 2.4.1	Details of Stack Emissions	15
Table 2.4.2	Quantity of Waste water Streams Routed to CMB	18
Table 2.4.3	Expected Quality of Wastewater Treatment and Disposal	18
Table 2.4.4	Noise Generating Sources	20
Table 3.1.1	Details of Baseline Data Collection Schedule	26
Table 3.3.1	Land Use/Land Cover Classification System	29
Table 3.3.2	Land Use Pattern of the Study Area Based On Satellite Imagery, Year-1997	31
Table 3.3.3	Land Use Pattern of the Villages in the Study Area Based On Census Data	32
Table 3.3.4	Major Sensitive Area within 25 Km of the Study Area	33
Table 3.4.1	Water Use Pattern within the Study Area	34
Table 3.5.1	Comparison of Demographic Profile of Study Area over One Decade	37
Table 3.5.2	Comparison of Socioeconomic Profile of the Study Area over One Deacade	42
Table 3.5.3.1	Educational Facilities Within the Study Area	42
Table 3.5.3.2	Medical Facilities Within the Study Area	43
Table 3.5.3.3	Drinking Water Facility in the Study Area	43
Table 3.5.3.4	Electricity Facilities in the Study Area	43
Table 3.5.3.5	Post And Telegraph Facility in the Study Area	44
Table 3.5.3.6	Transportation Facility in the Study Area	44
Table 3.7.1	Soil Sampling Locations of the Study Area	46
Table 3.7.2	Physical Characteristics of the Soil in the Study Area (Pre Monsoon)	47
Table 3.7.2/A	Physical Characteristics of the Soil in the Study Area (Post Monsoon)	47
Table 3.7.3	Chemical Characteristics of Soil in the Study Area (Pre Monsoon)	48
Table 3.7.3/A	Chemical Characteristics of Soil in the Study Area (Post Monsoon)	50
Table 3.8.1	Ground water table measured at 3 wells around the Project site	50
Table 3.8.2	Pump test results	51
Table 3.9.1	Water Quality Sampling Location of the Study Area	55
Table 3.9.2-7	Surface & Ground Water Quality Data of the Study Area	57-68
Table 3.10.1	Climatological Data From IMD	71
Table 3.10.2	Instruments, Parameters And Frequency of Meteorological Monitoring At Site	75

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2 x 500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: viii	

Table 3.10.3	Recorded Meteorological Data At Site (July, 2003 – June 2004)	76
Table 3.11.1	Concentration of Metals in Sediments	86
Table 3.11.2	Concentration of Pesticides in Sediments	86
Table 3.11.3	Benthos Organism's Composition and Biomass	87
Table 3.12.1	Ambient Air Quality Monitoring Stations Within the Study Area	88
Table 3.12.2	Ambient Air Quality Status With Respect To RPM	91
Table 3.12.3	Ambient Air Quality Status With Respect To SPM	92
Table 3.12.4	Ambient Air Quality Status With Respect To SO ₂	92
Table 3.12.5	Ambient Air Quality Status With Respect To NOx	93
Table 3.13.1	Location of Terrestrial Ecological Study	97
Table 3.13.2	List of Important Flora Found in the Study Area	100
Table 3.13.3	List of Domestic Fauna in the Study Area	101
Table 3.13.4	List of the Wild Fauna in the Study Area	101
Table 3.13.5a	List of Zooplankton Identified within the Study Area (Pre-Monsoon)	102
Table 3.13.5b	List of Zooplankton Identified within the Study Area (Post-Monsoon)	103
Table 3.13.6a	List of Phytoplankton Identified within the Study Area (Pre-Monsoon)	104
Table 3.13.6b	List of Phytoplankton Identified within the Study Area (Post-Monsoon)	105
Table 3.13.7a	Aquatic Fauna Identified, Economic Varieties And Vulnerability as Provided by Thiruvallur District Office (Pre-Monsoon)	107
Table 3.13.7b	Aquatic Fauna Identified, Economic Varieties And Vulnerability as Provided by Thiruvallur District Office (Post-Monsoon)	108
Table 3.13.8	Rare and Threatened Species	109
Table 3.14.1	Noise Level Monitoring Stations in the Study Area	111
Table 3.14.2	Ambient air Quality Standards in respect of Noise	113
Table 3.14.3-3.14.6	L10, L50, L90 And Leq of Ambient Noise Level in the Study Area	114-115
Table 3.15.1	Expected Potential Ash Utilizer in the Study Area	116
Table 4.2.1	Input Data for Computing Annual Water Budget of the Study Area	119
Table 4.2.2	Annual Surface Water Budget of the Study Area	120
Table 4.7.1	Stack And Emission Characteristics for the Proposed Thermal Power Plant	128
Table 4.7.2	Key To Solar Radiation Delta T Method for Estimating P-G Stability Categories	129
Table 4.7.3	Mixing Height Considered for Dispersion Modeling (North East Monsoon)	129
Table 4.7.4	First 10 Maximum 24 Hourly Short Tem Incremental	132

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2 x 500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: ix	

	Concentrations	
Table 4.7.5	Resultant Maximum GLC After Commissioning of Thermal Power Project	132
Table 4.7.6	Resultant Maximum GLC After Commissioning of Proposed TPP At the Ambient Air Quality Monitoring Stations	133
Table 4.8.1	Likely Noise Level in NTPC TNEB TPP	139
Table 4.8.2	Predicted Noise Level	139
Table 4.8.3	Permissible Exposure in Cases of Continues Noise	139
Table 5.3.1	List of Tree Species for Green Belt Plantation	147
Table 5.4.1	Environmental Monitoring Programme	149
Table 5.5.1	Organizational Structure of NTPC for Environmental Management	150
Table 5.6.1	Uses of Fly Ash From Coal Based Thermal Power Plant	153
Table 6.4.1	Suggested List of Training Courses	161
Table 6.4.2	Institutions Offering Courses on Industrial Safety	162
Table 6.9.1	Safety Equipment	168
Table 6.9.2	Fire Fighting Safety Equipment	169

	Comprehensive Environmental Impact Assessment for TNEB - NTPC JVC Thermal Power Project (2 x 500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: x	

LIST OF FIGURES

Figure No.	Title	Page No.
Figure 1.1	Vicinity Map for TNEB-NTPC Thermal Power Project	07
Figure 2.2.1	Water Balance for the Proposed Power Plant	11
Figure 3.3.1	Land Use Classification Based On Satellite Imagery	30
Figure 3.5.1	Rural/Urban Settlement Under the Study Area	35
Figure 3.5.2	Occupational Structure of the Study Area on 1991 Census Record	39
Figure 3.5.3	Occupational Structure of the Study Area in the Year 2001	41
Figure 3.7.1	Soil Quality Monitoring Stations	49
Figure 3.8.1	Soil Profile (Borewell No.1)	52
Figure 3.8.2	Soil Profile (Borewell No. 2)	53
Figure 3.8.3	Soil Profile (Borewell No. 3)	54
Figure 3.9.1	Water Quality Monitoring Stations	56
Figure 3.10.1	Annual Windrose Diagram at Nungambakkar Based on IMD Data (1992-2000)	73
Figure 3.10.2	Diurnal Variations on the Wind Direction	74
Figure 3.10.3	Annual Windrose (July 2003-June 2004)	78
Figure 3.10.4	Monthly Wind Rose – July	78
Figure 3.10.5	Monthly Wind Rose – August	79
Figure 3.10.6	Monthly Wind Rose – September	79
Figure 3.10.7	Monthly Wind Rose – October	80
Figure 3.10.8	Monthly Wind Rose – November	80
Figure 3.10.9	Monthly Wind Rose – December	81
Figure 3.10.10	Monthly Wind Rose – January	81
Figure 3.10.11	Monthly Wind Rose – February	82
Figure 3.10.12	Monthly Wind Rose – March	82
Figure 3.10.13	Monthly Wind Rose – April	83
Figure 3.10.14	Monthly Wind Rose – May	83
Figure 3.10.15	Monthly Wind Rose – June	84
Figure 3.12.1	Ambient Air Quality Monitoring Stations	89
Figure 3.12.2	Variation in Ambient Air Quality Status with Respect to RPM	94
Figure 3.12.3	Variation in Ambient Air Quality Status with Respect to SPM	94
Figure 3.12.4	Variation in Ambient Air Quality Status with Respect to SO ₂	95

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2 x 500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: xi	

Figure 3.12.5	Variation in Ambient Air Quality Status with Respect to NOx	95
Figure 3.13.1	Ecological Monitoring Stations	99
Figure 3.14.1	Noise Level Monitoring Stations	112
Figure 4.7.1	Hourly Maximum GLC of Sulphur dioxide	134
Figure 4.7.2	Hourly Maximum GLC of Nitrogen Dioxide	135
Figure 4.7.1	Hourly Maximum GLC of SPM	136

ANNEXURE

CHAPTER-1
INTRODUCTION

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: Page 1 of 179	

1.0 INTRODUCTION

1.1 BACKGROUND

Power generation is the key Infrastructural requirement for economic growth of the country. In recent years, power development has assumed paramount importance in view of its role in rapid development of industry, agriculture and service sector in the country. Since independence, the development of power sector in the country has predominantly been through state electricity boards and NTPC. In order to supplement the efforts of various states in accelerating power development and its promotion on regional basis enabling optimum utilization of energy resources, the Government of India decided to take up the program for establishment of super thermal power stations with the objective of planning, promoting and organizing integrated development of thermal power in the country. The National Thermal Power Corporation Ltd. (NTPC) has started forming joint venture company with different organizations.

A memorandum of understanding was signed on 12th July 2002 between NTPC and Tamil Nadu Electricity Board with intent to establish and operate 1000 MW coal based Thermal Power Project at Ennore in Tamil Nadu. Subsequently, a joint venture company between NTPC and TNEB, each acquiring 50 % share, under the name NTPC TAMIL NADU ENERGY COMPANY LTD (NTECL) was incorporated on 23rd May 2003.

The proposed power project of NTPC TAMIL NADU ENERGY COMPANY LTD (NTECL) shall be located between Ennore creek and Pulludivakkam Village of Ponneri Taluk of Thiruvallur district in Tamil Nadu at a latitude 13^o 13' 45" N and Longitude 80^o 18' 05 " E respectively. It is located at a distance of about 20 Kms from Chennai City. The nearest railhead, Kathivakkam is at a distance of 1 km on trunk route section of Southern Railway from the project site. The National Highway exists at a distance of about 14 kms from project site. The nearest airport, Meenambakkam , is about 36 kms from the project site.

NTECL intends to implement 1000 MW (2x500 MW) coal based thermal power project near Ennore in the vicinity of TNEBs existing power stations i.e. North Chennai TPS (NCTPS) and Ennore TPS (ETPS). Coal requirement for the project is estimated as 4.4 million tonnes/ annum, considering GCV of washed coal as 3900 Kcal/kg and 80% PLF. A total land of 1184 acres have been identified for the project.

Mahanadi Coal fields Ltd vide letter dated 13.06.03, in-principle agreed to supply 5.0 MT/annum of coal from Talcher / IB valley coalfields of MCL. Further, long term coal linkage for the project was considered by SLC (LT) in its various meetings. However, firm linkage is still awaited.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: Page 2 of 179	

Parallely, NTPC-TNEB JV company has applied for location of the Nuggaon Talisahi coal block of Talcher Coal Fields. MOP vide letter dated 15.12.05 has forwarded their recommendation to MOC for location of the Nuggaon Talisahi coal block to JV company.

Desalinated seawater for sweet water make-up and cooling by seawater have been envisaged.

Power generated from the proposed units shall be stepped upto 400 KV and will be evacuated through Associated Transmission System (ATS). The ATS of the project will be implemented by Power Grid Corporation of India Limited.

In order to assess the potential environmental impacts due to the proposed coal based power project, M/s National Thermal Power Corporation Ltd. retained M/s Mantec Consultants Pvt. Ltd., New Delhi to undertake comprehensive Environmental Impact Assessment study incorporating baseline data for various environment components viz. air, meteorology, noise, water, land and biological along with the socio-economic parameters of human interest, to assess the potential impact and to prepare Environmental Management Plan for mitigating/minimizing adverse impact including occupational health and safety and disaster management plan, delineation of post project environmental monitoring programme. The report is based on data generated at the proposed site for one year from August 2003 to July 2004.

1.2 DEMAND ANALYSIS AND JUSTIFICATION

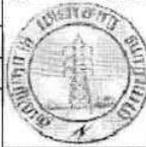
1.2.1 Demand Supply

The project is expected to start yielding benefits during the end of 11th Plan period. Power from this project is envisaged to be supplied to the beneficiaries of the Southern Region, with major share proposed for Tamil Nadu.

The power supply position in Southern Region during 2001-02, 2002-03, 2003-04 and 2004-2005 are as follows: -

POWER SUPPLY POSITION IN SOUTHERN REGION

Description	Unit	2001-02	2002-03	2003-04	2004-05
Peak Demand	(MW)	22757	22419	23183	23075
Peak Availability	(MW)	19201	20428	21928	22364
Deficit	(MW) (%)	3556 (15.6%)	1991 (8.9%)	1255 (5.4%)	711 (3.1%)
Energy Requirement	MU	140516	140316	144372	147672

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: Page 3 of 179	

Energy Availability	MU	128095	130229	136844	145395
Deficit	MU (%)	12421 (8.8%)	10087 (7.2%)	7528 (5.2%)	2277 (1.5%)

As observed from the above table, Southern Region has been experiencing power shortages (both in term of peak demand as well as energy requirement) during the last four years.

As per the assessment made by CEA in November 2004 for Draft National Electricity Plan, based on the demand projected in 16th EPS and considering likely capacity addition of 39920 MW during 10th Plan (against the original 41110 MW capacity addition target), Southern Region is envisaged to experience a Peaking Shortage of 3469 MW (11.2%) and Energy Shortage of 16439 MU (8.5%) during 2006-07 (terminal year of 10th Plan) as per the details given below: -

PEAK DEMAND AND ENERGY SHORTAGE IN THE SOUTHERN REGION

Particulars	End of the 10 th Plan (2006-07)
Peak Demand (MW)	31017
Peak Availability (MW)	27548
Deficit (MW)	3469
Deficit%	11.2
Energy Requirement MU	194102
Energy Availability MU	177663
Deficit MU	16439
Deficit %	8.5

As observed from the above table, Southern Region is expected to continue to face the peaking shortage and the energy shortage upto the end of X plan/beginning of XI plan.

The project is, therefore, considered justified from Demand-Supply considerations.

1.2.2 Alternative Locations

The present site of the power plant was selected after examining various suitable alternative location based on the following criteria.

- Availability of suitable and adequate land
- Availability of water
- Availability of infrastructural facilities.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: Page 4 of 179	

Environmental aspects
Road and railway access

A site selection team comprising of NTPC and TNEB officials inspected various sites and finally considered four alternatives for selection of the final site. The details of the alternative sites are as follows:-

Alternative-I

This site is located in Tamil Nadu Industrial Development Corp. Ltd. (TIDCO) area in Kattupalli village of Thiruvallur district. TNPCB has given clearance only for LNG terminal. The site requires clearance under CRZ regulation. This site has not been considered further for the proposed thermal power plant.

Alternative-II

The site is located near SPIC Aromatic site in Manali area about 25 km from Ennore port. The ownership of the land was under litigation. Land acquisition will be troublesome and time-consuming process. This site has not been considered further.

Alternative Site-III

Videocon Site:

The proposed site is located within the premises of existing North Chennai Power Project of TNEB. The land availability is very limited. This site has not been considered further for the proposed thermal power project.

Alternative Site-IV

This site is located near Kurivimedu village in Ponneri Taluk of Thiruvallur district. About 1102 acres of saltpan area is available. Approx 990 acres of land clear of CRZ boundary could be utilized for development of power project i.e. plant and ash disposal area after considering land under CRZ provision. The area is low lying and is slightly sloping towards creek. For development of the land, ash from ETPS is proposed to be used to a large extent, which is available very close to the proposed plant site. The site is situated near to the Ennore port, which has a dedicated berth for receiving coal, both from other Indian ports and imported coal. The site can be easily connected to the port through a coal conveyer system for receiving coal. For setting up the desalination plant, the intake point of water is available very near to the proposed site.

In view of above available facilities, alternative-IV location is proposed for locating the power plant.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: Page 5 of 179	

1.2.3 Location and Approach

Location of the project site, nearest airport, railway station, highways etc. are given below:-

Project location	:	District : Thiruvallur State : Tamil Nadu
Latitude	:	13 ⁰ 12' 45" N to 13 ⁰ 14'30" N
Longitude	:	80 ⁰ 17'0" E to 80 ⁰ 18'50" E
Nearest railway station	:	Kathivakkam
Distance of project site from the railway station	:	1 km.
Rail region / zone	:	Southern Railway
Nearest municipal town	:	Chennai
Distance of the municipal town from the Project site	:	20 kms (Approx.)
Nearest commercial airport	:	Meenabakkam - chennai
Distance of airport from the project site	:	36 kms (Approx.)
Nearest highway	:	NH-5
Distance from nearest Highway point to the site	:	4 kms. (Approx.)

The project site is on the western side of the Ennore Creek in Ponneri Taluk of Thiruvallur district. River Korattalayar surrounds the proposed project site from three sides . The Vicinity Plan indicating the location of the plant, ash disposal area, colony etc. is placed at **Figure 1.1**.

1.3 ADMINISTRATIVE AND LEGISLATIVE FRAMEWORK

It is mandatory on part of the joint venture company NTECL, to obtain the clearance and approval for the coal based thermal power plant under the legislative enactment of the Environment (Protection) Act, 1986 and Rules and Notification and Guidelines issued thereunder including notification on Environmental Impact Assessment (EIA) of development projects dated January 27, 1994.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: Page 6 of 179	

Tamil Nadu State Pollution Control Board (SPCB) and Ministry of Environment and Forest (MOEF) will be approached for obtaining No Objection Certificate (NOC) and Environmental Clearance (EC), respectively. This will be in accordance with the procedure laid down in the EIA Notification of January 1994 and its amendments including Public Hearing Notification.

1.4 SCOPE OF THE STUDY

The major scopes of the Environmental Impact Assessment study are listed below: -

- ❖ A detailed characterization of the existing environment within the area of 7 km radius from the project site for environmental components viz. air, noise, water, land, soil, biological and socioeconomic aspects.
- ❖ A brief description of the project.
- ❖ Prediction and evaluation of positive and negative impacts that may result from proposed power plant project.
- ❖ Delineation of environmental management plan to eliminate or minimize the adverse impacts of the project on the surrounding environment.
- ❖ To propose plans for post project monitoring.
- ❖ Developing occupational health and safety as well as Disaster Management Plan to minimize any accident or emergency situation.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: Page 7 of 179	

Figure 1. 1: Vicinity Map for TNEB – NTPC Thermal Power Project

CHAPTER-2
PROJECT PROFILE

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 8 of 179	

2.0 PROJECT PROFILE

2.1 PROJECT COMPONENTS

2.1.1 Land

The project is planned within 1184 acres of total identified land out of which about 1103.82 acres consists of Salt Pan area which includes 1.65 acres of land situated across the Ennore Creek.

Detail of land breakup is as follows:-

Plant area including green belt	:	415 acres
Ash disposal area	:	500 acres
Ash based Units	:	75 acres
Township	:	45 acres
Corridors	:	35 acres
Others (Land area under CRZ)	:	114 acres

Total Land	:	1184 acres
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2.1.2 Coal

The annual washed coal requirement for the project will be 4.4 MT considering GCV of coal as 3900 kcal/kg and 80% PLF and about 5.5 MT at 100% PLF.

The peak daily coal requirement shall be about 15076 tonnes based on gross calorific value of 3900 kcal/kg, 100% plant load factor and 2450-kcal/kg unit heat rate for a 500 MW plant capacity based on washed coal.

Mahanadi Coalfields Ltd. vide letter dated 13.06.03 in principle agreed to supply 5.0 MT/annum coal from Talcher/IB Valley coalfields of MCL. Further, long term coal linkage for the project was considered by SLC (LT) in its various meetings; however, firm linkage is still awaited.

Parallely, NTPC-TNEB JV company has applied for location of the Nuggaon Talisahi coal block of Talcher Coal Fields. MOP vide letter dated 15.12.05 has forwarded their recommendation to MOC for location of the Nuggaon Talisahi coal block to JV company.

Coal Transportation

The envisaged mode of coal transportation from the coalmines to the power plant is by Indian Railways rakes in BOBR/BOX-N wagons upto the port, thereafter by ships upto Ennore Port and from Ennore Port to the main plant by conveyor system.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 9 of 179	

Coal Quality

Proximate analysis (as received basis)

	Raw Coal (F Grade)	Washed Coal
Total moisture	12-15%	15-18%
Ash	36-46%	34+/-2%
GCV (kcal/kg)	3200-3600	3800-4000

2.1.3 Water

Source of Water:

Seawater is proposed to be used for meeting complete water requirement of the project. Present environmental regulation permit installation of once through circulating water system for coastal Thermal Power Stations with a stipulation that the temperature of receiving water does not exceed 7°C over and above the ambient temperature of the receiving water bodies. Various options regarding location of drawl of sea water and type of Circulating Water (CW) System i.e. once through system and open re-circulating type CW System (with Natural Draft Cooling Towers) have been studied for this project. Based on the study, re-circulating type CW system with makeup water from the intake channel of North Chennai Thermal Power Station is found to be an optimum choice. Makeup water for the project shall be drawn at a suitable location from the intake channel of North Chennai Thermal Power Station. CW system and ash handling plant shall utilize seawater. Sweet water required for meeting the potable water, plant service water, power cycle makeup (DM water) etc. shall be produced through Desalination Process from seawater.

Water Requirement

The water requirement for the project shall depend on two factors- a) Type of desalination system (Reverse Osmosis or Thermal desalination) and b) Type of ash water system (Once through or ash water recirculation system). The water balance diagram shown in **Figure 2.2.1** shows all possible scenarios. In brief the water requirements may be summarised as –

Type of Desalination System	Water Requirements (m ³ /hr)	
	With Once through ash water System	With ash water recirculation system
Reverse Osmosis	8720	9720
Thermal Desalination	10920	11920

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 10 of 179	

Circulating Water System

Seawater makeup shall be supplied to the cold water channel of CW system. Water from cold water channel will enter into the CW pump house through stoplog gates and trash racks at low velocity. The total water requirement for the condenser and auxiliary cooling is estimated to be about 60000 Cu.m./hr per unit. Considering various aspects it has been envisaged to adopt Natural Draft Cooling Towers. It is proposed to operate CW system at about 1.5 Cycle of Concentration (COC).

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 11 of 179	

Figure-2.2.1: Water Balance for the Proposed Power Plant



	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 12 of 179	

2.1.4 Construction Power

The requirement of the construction power supply for the project would be met from TNEBs existing source near NCTPS at 33/11 KV level. Necessary overhead lines, 33/11 KV substation/transformers and 11 KV ring main/LT sub-station shall be provided as per requirement.

2.2 GENERAL LAYOUT PLAN

The general layout plan for the project is presented in **Annexure-I**. The layout has been planned for 2 x 500 MW along with space for FGD. Average 100-m wide green belt has been provided around the plant boundary except towards switch yard side.

2.2.1 Plant Design

Boiler, Air pre-heaters, ID/FD/PA fans, ESP, mills and chimney with tentative dimensions are indicated in layout drawing. Vertical Mills have been located on the rear of the Boiler. Space has been provided at the center of unit to route the flue gas duct from Air-Pre heaters to ESP.

The boiler will be radiant, dry bottom type with tangential or opposed wall firing and enclosed by water-cooled and all welded membrane walls. The furnace bottom shall be suitable for installation of a water impounded bottom ash hopper.

The coal burning system will comprise of coal mills of vertical spindle type which include (a) bowl mills (XRP type), (b) roller mills (MPS type) and (c) balls and race mills (E-type).

2.3 THERMAL POWER GENERATION PROCESS

In a thermal power plant, the chemical energy of the fuel (coal) is first converted into thermal energy (during combustion), which is then converted into mechanical energy (through a turbine) and finally into electrical energy (through a generator).

- (1) The coal is transferred from the coal handling plant by conveyor belt to the coalbunkers, from where it is fed to the pulverizing mills, which grind it to fine powder. The finely powdered coal, mixed with air is then blown into the boiler by a fan where it burns like a gas.
- (2) The process of combustion releases the thermal energy from coal. The boiler walls are lined with boiler tubes containing high quality demineralized water (known as boiler feed water). The combustion

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 13 of 179	

heat is absorbed by the boiler tubes and the heat converts the boiler feed water into steam at high pressure and temperature. The steam, discharged through nozzles on the turbine blades, makes the turbine to rotate, which in turn rotates the generator coupled to the end of the turbine. Rotation of generator produces electricity, which is passed to the step-up transformer to increase its voltage so that it can be transmitted efficiently. The power is evacuated via switchyard through a Transmission System.

- (3) During combustion, the non-combustible part of coal is converted into ash. A small part of ash (about 20%) binds together to form lumps, which fall into the ash pits at the bottom of the furnace. This part of ash, known as bottom ash is water quenched, ground and then conveyed to pits for subsequent disposal to ash disposal area or sale.
- (4) Major part of the ash (about 80%) is in fine powder form, known as Fly Ash, and is carried out of the boiler along with the flue gas. The flue gas, after heat recovery, is passed through the electrostatic precipitator's, where the ash trapped by electrodes are charged with high voltage electricity.
- (5) The flue gases exiting from the Electrostatic Precipitators (ESPs) are discharged through a tall chimney for wider dispersal. The ash collected in the ESP hoppers is extracted in dry form and conveyed to dry ash storage silos from where it is supplied to user industries.
- (6) Unused part of fly ash is mixed with water and conveyed as slurry to ash disposal area. Ash can also be lifted from ash ponds for utilization.
- (7) The steam, after passing through the turbines, is condensed back into water in condensers and the same is re-used as a boiler feed water for making steam. The reasons for condensing and reusing the steam are following: -
 - The cost of boiler feed water is very high as it is very pure de-mineralized water hence reuse is economical.
 - The use of condenser lowers the temperature at the exit end and hence increases the efficiency of the turbine. The condenser contains tubes through which cold water is constantly pumped.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 14 of 179	

- (8) The steam passing around the tubes loses heat and condenses as water. During this process, the steam gets cooled while cooling water gets heated up (by about 10°C). This hot water is cooled in a cooling tower and recycled for cooling. However, in order to control dissolved solids, a certain amount of blowdown is required from the cooling towers, which is used in the plant for other usages such as service water, coal dust suppression etc.

2.4 POLLUTION CONTROL/ ENVIRONMENTAL COMPONENTS

General

The various types of pollution from the proposed power plant are categorized under the following types:

- Air pollution;
- Water pollution;
- Solid waste generation; and
- Noise pollution.

Waste gases of combustion are the major waste products generated from the proposed power plant. In addition, wastewater and solid waste (ash generation) will be generated. The gaseous, liquid and solid waste generated in the plant will be treated to conform to the statutory requirements .

The various proposed pollution control systems are described in the following sections.

2.4.1 Air Pollution Control Systems

1. It is proposed to install high efficiency electrostatic precipitator having an efficiency that limits the outlet emission to 150 mg/Nm³ while the boiler is operating at its BMCR. This will limit the particulate emission to specified levels even under contingency, such as wide variations in the coal properties etc.
2. One stack with two flues (for 2x500 MW units) of 275m height for wider dispersal of pollutants. The details of stack and its emission are given in **Table 2.4.1**.
3. Space provision for retrofitting Flue Gas Desulphurisation (FGD) system, if required in future has been made in the layout of the Main Plant.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 15 of 179	

4. For the control of fugitive dust emissions within and around the coal handling plant and coal stockyard suitable dust suppression system will be installed.
5. Dust suppression and extraction systems shall be provided in the coal handling plant area to control fugitive dust.
6. Water spraying at all dust generation areas viz., the coal and ash handling areas.
7. Water cover over entire ash disposal area to prevent emission of fugitive dust.

Table 2.4.1: Details of Stack Emissions

Sr. No.	Parameters	Units	Beneficiated Coal
1.	Stack Height	M	275
2.	Number of stacks	No.	One
3.	Flue stack diameter	M	6.75
4.	Flue gas velocity/flue	M/sec	22.2
5.	Flue gas temperature	°K	413
6.	Volumetric flow rate	Nm ³ /sec	573.44
7.	Number of flues in the stack	No.	Two
8.	Coal consumption (1000 MW)	TPH	627.85
10.	Emission Rates *		
	Sulphur dioxide (500 MW)	gm/sec	563.64
	Oxides of Nitrogen (500 MW)	gm/sec	429.90
	Particulate Matter (500 MW)	gm/sec	57.30

* SO₂ at 0.34% Sulphur in coal, SPM, at 100 mg/ Nm³ and NO_x at 750 mg/ Nm³.

2.4.2 Water Pollution Control Systems

Water Treatment System and Liquid Effluent Treatment system

The water treatment system and liquid effluent treatment system comprises of Desalination System, Chlorination Plant, Condensate Polishing Plant, Ash Water Re-circulation System and Effluent Treatment System as described below:-

Desalination Plant

Desalination process could be either Reverse Osmosis (RO) type or Thermal Desalination such a Multi-Effect Distillation (MED). For MED process, steam

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 16 of 179	

shall be provided from the auxiliary steam header. Final selection of the process shall be carried out before project implementation stage.

The desalination system shall be equipped with Water Pre-treatment section such as clarification, chemical dosing and filtration. The treated water shall be used for plant water requirement such as service water, HVAC makeup, makeup to the fire water storage tanks, sealing water for vacuum pumps of ash handling plant and potable water for plant and colony.

To produce demineralized water for power cycle makeup, it is required to provide a set of Mixed Bed Ion-exchanger units at the downstream of desalination plant. For regeneration of ion-exchange resins of mixed bed unit, regeneration systems comprising a set of acid tanks and a set of alkali tanks, dosing pumps, acid and alkali unloading pumps, neutralization pit, effluent disposal pumps etc. shall be provided.

Chlorination Plant

Chlorination plant shall be provided for chlorine dosing in the CW system to avoid the growth of algae and bacteria. Each chlorination system shall be provided with required chlorine tonne containers, instrumentation panels, chlorine leak detectors etc. Complete chlorination plant shall be located indoor. Chlorine leak absorption system, as plant emergency measure shall be provided for each of the chlorination plants to neutralize chlorine leakage from the plant. As the project uses sea water, alternative to the proposed gas chlorinators, use of electro chlorinators shall be studied and if found suitable the same can be implemented.

Effluent Treatment Systems

A Central Monitoring Basin (CMB) shall be provided to collect all the plant effluents. The liquid effluents shall be collected and treated/recycled as per the following design philosophy to minimise quantity of effluent generation and maximum reuse of treated effluent in the system.

Considering seawater in the CW system, it is preferred to adopt cooling towers of Natural Draft type. There would be one (1) number of Natural Draft cooling tower per 500 MW unit.

A portion of CW blow down water shall be used for dust suppression system of coal stockyard and balance shall be diverted to central monitoring basin. Provision shall be kept to use CW blow down water for ash handling plant when the system is operating in once through mode.

Ash water system shall be generally operating in re-circulation mode. Blow down if any from the ash water system shall be led to the CMB.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 17 of 179	

Other plant drains/effluent of seawater quality shall be collected and pumped to central monitoring basin.

The sludge from the pre-treatment section of Desalination Plant shall be pumped to the ash slurry sump so that same may be pumped alongwith ash to the ash dyke.

The filter backwash water in desalination system shall be collected and recycled back to the pretreatment section/clarifier of desalination plant.

The reject from the desalination plant shall be discharged through the Central monitoring basin.

Power cycle blow-down, treated service water and Neutralised Regeneration Wastes from DM Plant and condensate Polishing units shall be discharged through CMB. However, provisions shall be made to recycle these effluents to the inlet of desalination plant as these effluents shall have much less TDS as compared to raw seawater.

Drains from coal stockyard shall be drained to a set of coal settling pond for removal of coal particles. The treated water shall be led to central monitoring basin.

All the plant liquid effluents shall be mixed in CMB and quality of the effluent shall be measured and monitored. Further, through a set of waste effluent disposal pumps and piping, the same shall be disposed off from central monitoring basin up to the final disposal point.

Ash Water Recirculation System:

It is proposed to provide ash water re-circulation system. Decanted water from ash pond shall be led to the plant area and the same will be used further in the ash handling system. Further additional make up to the ash water system shall be from fresh seawater makeup. However, provision shall also be kept for operating ash water system on "Once Through" mode also. During once through mode operation, CW system blow down water shall be used for ash transport.

Disposal of Treated Effluents

The quantity of wastewater streams that will be routed to the CMB are given in **Table-2.4.2.**

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 18 of 179	

Table-2.4.2: Quantity of Wastewater Streams Routed to CMB

Sr.No	Unit	Quantity (m ³ /hr)
A] WITH ONCE THROUGH ASH WATER SYSTEM		
1	Desalination rejects	1500
2.	Coal dust settling tank waste	250
3.	Ash pond waste	2000
4.	NDCT blow down (unused part)	1670
5	Power Cycle Blowdown	40
6	DM plant & CPU Regeneration waste	15
7	Service Waste	100
	TOTAL	5575
B] WITH ASH WATER RECIRCULATION SYSTEM		
1.	Desalination rejects	1500
2.	Coal dust settling tank waste	250
3.	Ash pond waste	1000
4.	NDCT blow down (unused part)	4170
5	Power Cycle Blowdown	40
6	DM plant & CPU Regeneration waste	15
7	Service Waste	100
	TOTAL	7075

Different type of wastewater generated from various units, their expected quality and proposed treatment is summarized in **Table-2.4.3**.

While utmost care has been taken to maximise the recycle/ reuse of effluents and minimize effluent quantity, the discharge of effluents from a power plant of 1,000 MW capacity cannot be totally eliminated. The liquid effluents from the project and effluent treatment measures proposed to be adopted are summarized below: -

Table-2.4.3: Wastewater Treatment and Disposal System

Type of Waste	Significant Parameters	Treatment /Disposal
NDCT blow down water	Temperature	Closed cycle cooling system is proposed to reduce temperature to regulatory norms. Part of CT blow down shall be used in ash handling and coal dust suppression. Balance effluent will be routed to the CMB and will be disposed into the sea.
Power cycle blow down	pH and TDS	This waste will have much less TDS as compared to other waste streams using seawater (e.g. CT Blowdown, Ash pond overflow / Blowdown, CHP waste etc.). It may be discharged to CMB or recycled back to the inlet of desalination plant.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 19 of 179	

Type of Waste	Significant Parameters	Treatment /Disposal
DM Plant regeneration	pH, SS and TDS	This waste will have much less TDS as compared to other waste streams using sea water (e.g. CT Blowdown, Ash pond overflow / Blowdown, CHP waste etc.) . It may be discharged to CMB or recycled back to the inlet of desalination plant.
Ash pond supernatant waste	SS, pH	In the once through system the ash pond effluent conforming to standard will be routed to the CMB for subsequent disposal into the sea. In case of ash water recirculation system the ash pond effluent (2000m ³ /hr) will be re-circulated to ash water sump and blowdown will be routed to CMB for subsequent disposal into the sea.
Sanitary waste from the Plant and Colony	pH, SS, TDS, COD and BOD	The wastewater will be treated in sewage treatment plant and the treated water will be used for green belt development to the extent feasible and the balance discharged into sea.
Desalination Rejects	TDS	The waste from the desalination plant will be routed to the CMB for subsequent disposal into the sea.

2.4.3 Noise Pollution Control Systems

Reduction in noise levels shall be achieved through built-in design system of equipment, proper lay out of the buildings and plant area, providing sound barriers, use of enclosures with suitable absorption material etc. Acoustic enclosures will be provided wherever required to control the noise level below 90 dB(A). Provision of green belt and afforestation will further help in reducing the noise levels. However, workers within the construction area and plant area, may be affected due to high noise levels. Adequate protective measures in the form of ear-muffs/ ear plugs/ masks shall be provided to such persons, which will minimize/eliminate adverse impacts.

The major noise generating sources are turbines, turbo-generators, compressors, pumps, fans, coal handling plant etc. from where noise is continuously generated. The noise levels of various equipment at 1m distance from the source are given in **Table-2.4.4**.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 20 of 179	

Table-2.4.4 Noise Generating Sources

SI No.	Source	Noise level in dB(A)
1	Generator	90
2	Boiler feed Pump	90
3	Pumping Air Fan	90
4	Freed draft Fan	90
5	Coal Mill	90
6	Cooling Towers	85
7	Instrument Air Compressor	90
8	C.W. Pump House	90
9	Induced Draft Fan	90
10	Diesel Generator	105

2.4.4 Ash Management Systems

The ash management scheme involves dry collection of fly ash, supply of dry fly ash and pond ash to entrepreneurs for utilization, promoting ash utilization and safe disposal of unutilized ash.

Quantities of Ash to be Generated, Utilised and Disposed

The coal consumption will be about 627.85 tonnes/hr. The ash content in the coal will be 34% and the expected ash generation will be about 213.47 tonnes/hr. The bottom ash will be about 20% of the total ash generated i.e. 42.70 tonnes/hr. The fly ash will be about 170.77 tonnes/hr. The fly ash will be utilized as much as feasible.

Ash Disposal

Unutilized fly ash and bottom ash shall be disposed off in slurry form in a well-designed and operated ash pond. For disposing off 170.77 tonnes / hr. of fly ash and 42.70 tonnes / hr bottom ash, about 500 acres of land is proposed to be used for ash disposal.

Initially water for ash handling system shall be drawn from plant make up water system. After the disposal lagoons are filled up, it is proposed to re-circulate the ash pond overflow for its reuse in the ash handling system. The make up to the ash water system during re-circulation shall be provided from cooling tower blow down.

Settled effluents from ash pond shall be led to the plant area for further utilization in the ash handling system. Only treated blow down shall be discharged through Central Monitoring Basin. A blanket of water shall be

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 21 of 179	

maintained over the entire ash pond area to control fugitive dust emissions. After the ash pond is abandoned, it shall be reclaimed by through vegetation.

Ash Handling System

The bottom ash shall be extracted and disposed off in wet form while the fly ash shall be extracted in dry form from the electrostatic precipitator hoppers and disposed in wet form.

Pneumatic conveying system shall be employed for extraction of fly ash from the electrostatic precipitator hoppers in dry form. This dry ash shall either be taken to buffer hoppers or to the wetting head/collector tank units. The dry ash buffer hoppers and wetting head/collector tank units shall be located adjacent to the ESP. There shall be 4 nos. of ash silos. The user industries shall take the dry fly ash from these silos. For wet disposal of dry ash extracted from various ESP hoppers, the same shall be diverted to wetting head/collector tank units.

Ash Utilization

Ministry of Environment & Forest's Notification on Ash Utilization dated 14-09-1999 stipulates that new power stations shall have to utilize ash to the extent of 30% in 3 years of commissioning and to attain 100% utilization by 9th year. In order to achieve this the following course of action are planned.

NTECL considers utilization of ash produced by its coal based power stations as a thrust area of its activities. At the project site, various avenues for utilization of ash shall be explored. In order to meet the regulatory requirement on ash utilization, following actions are planned: -

1. The company shall provide system of 100% extraction of dry fly ash along with suitable storage facilities. Provision shall also be kept for segregation of coarse and fine ash, loading this ash into closed / open trucks. This will ensure availability of dry fly ash required for manufacture of Fly Ash based Portland Pozzolana Cement (FAPPC), asbestos cement products, ash based building products and other uses of ash.
2. The company shall make efforts to motivate and encourage entrepreneurs to set up ash based building products such as fly ash bricks etc.
3. Fly ash brick manufacturing plant shall be set up as part of project area and bricks produced shall be utilized for in-house construction activities and also for demonstration to the local entrepreneurs to encourage them for manufacturing ash bricks in the area.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 22 of 179	

4. All government/private agencies responsible for construction/design of buildings, development of low lying areas, construction of road embankments etc. within 100 kms of the plant area shall be persuaded to use ash and ash based products in compliance of MoEF's gazette notification.
5. Wherever feasible, appropriate technical/managerial assistance and marketing information would be provided to entrepreneurs for setting up ash based products manufacturing units.
6. Wherever feasible, the company will provide facilities like water, steam, mill reject, etc. on chargeable basis to entrepreneur's units located near/adjacent to the plant.
7. FAPPC and fly ash bricks shall be utilized in most of its construction works in order to promote them. This would encourage utilization of fly ash as a whole in the country.

In order to prepare realistic Ash utilization Plan for 100% of utilization, detailed market study shall be carried and based on the recommendation of study, detailed road map for 100% ash utilization in line with MoEF gazette notification shall be prepared and submitted to regulatory authorities.

2.4.5 Green Belt Development Plan

A greenbelt of 100m width has been planned round the main plant area, except for switch yard and transmission corridor. In addition to this, a green belt around township and large scale plantations shall also be implemented in all the available spaces within and around the main plant and township areas along with the implementation of the project. Further details of the green belt are presented in Chapter 5.

2.4.6 Rehabilitation And Resettlement Plan

A detailed socio-economic survey of the persons affected due to land acquisition for the project shall be conducted. The families affected due to acquisition of private land shall be compensated as per the rules of Tamilnadu Govt. and shall be properly rehabilitated. The Rehabilitation and Resettlement (R&R) Plan shall be prepared in line with the National Policy on R&R , 2003 , and R & R Policy of NTPC in consultation with the State Government and the same shall be implemented at site, in order to restore livelihood and alleviate the economic conditions of Project Affected Persons. Suitable community development activities in the surrounding villages depending upon their needs and requirement shall also be undertaken.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 23 of 179	

2.5 Fire Detection and Protection System

A comprehensive Fire detection and protection system is envisaged for the complete power station. This system shall be as per the recommendations of TAC (INDIA)/ IS:3034 and NFPA - 850. The following protection systems are envisaged:

- 1] Hydrant system for complete power plant covering main plant building, Boiler area, turbine and its auxiliaries, coal handling plant, all pump houses and miscellaneous buildings of the plant. The system shall be complete with piping valves, instrumentation, hoses, nozzles, hose boxes/stations etc.;
- 2] Foam injection system for fuel oil / storage tanks consisting of foam concentrate tanks, foam pumps, in-line inductors, valves, piping & instrumentation etc.;
- 3] 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, turbine oil/lube oil piping (zoned) in turbine area, generator seal oil system, lube oil system for turbine driven boiler feed pumps, boiler burner fronts etc. This system shall consist of detectors, deluge valves projectors, valves, piping & instrumentation;
- 4] Automatic medium velocity water spray system for cable vaults and cable galleries of main plant, switchyard control room and ESP control room consisting of smoke detector, linear heat sensing cable detectors, deluge valves, isolation valves, piping, instrumentation, etc.;
- 5] Automatic medium velocity water spray system for coal conveyors, coal galleries, transfer points and crusher house consisting of QB detectors, Linear Heat Sensing Cables, deluge valves, nozzles, piping, instrumentation, etc.;
- 6] Automatic medium velocity water spray system for un-insulated fuel oil tanks storing fuel oil having flash point 65°C and below consisting of QB detectors, deluge valves, nozzles, piping, instrumentation, etc.;
- 7] For protection of control equipment room, computer room and other unmanned electrical and electronic equipment rooms, suitable "Halon substitutes" such as INERGEN or FM-200 or "ARGONITE" system shall be opted. Actual type of system shall be decided during pre-tendering stage;
- 8] Fire detection and Alarm system - A computerized analogue, addressable type early warning system shall be provided to cover the complete power plant;
 - Ionisation type smokes detection system.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 24 of 179	

- Photoelectric type smoke detection system.
 - Linear heat sensing cable detectors.
 - Quartzoid bulb heat detection system.
 - Infrared heat detectors.
 - Spot type electrical heat detectors.
- 9] Portable and mobile extinguishers, such as pressurized water type, carbon-dioxide type, foam type, dry chemical powder type, will be located at strategic locations throughout the plant;
- 10] Required Fire tenders/Engines of water type, DCP type/Foam type, trailer pump with fire jeep etc. shall be provided in the fire station;
- 11] Raw water from treated storage tank shall be used for supply of firewater. It is proposed to provide two numbers of mild steel water storage tanks to store firewater. An over ground fire water pump house shall be constructed near these firewater storage tanks. Horizontal 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 rules of TAC. The water for foam system shall be tapped off from the hydrant system pumps. For the above fire water pumping station, automatic pressurization system consisting of jockey pumps and air compressors shall be provided; and
- 12] Complete Instrumentation and control system for the entire fire detection and protection system shall be provided for safe operation of the complete system.

CHAPTER-3

BASELINE

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 25 of 179	

3.0 BASELINE DATA

The baseline environmental status with respect to various environmental components like air, noise, water, land, flora and fauna and socioeconomic, being integral part of an EIA, forms the basis for predicting/assessing the environmental impacts of the proposed project. Field monitoring at site was performed for a period of one year from 1st July 2003 to 30th June, 2004. Various environmental components were monitored and samples were analyzed. Apart from this, additional data were also collected from secondary sources like Government/ Non-Governmental Agencies, Universities, Irrigation Department, India Meteorological Department, Ground Water Board, etc.

3.1 ENVIRONMENTAL IMPACT ASSESSMENT METHODOGY

The methodology adopted for carrying out the Environmental Impact Assessment for the proposed power plant project has been based on the Guidelines issued by Ministry of Environment & Forests (MoEF). An effective environmental impact assessment calls for establishing sufficient background data on various environmental components through reconnaissance survey, sampling and available literature sources etc. The methodology adopted in preparing the EIA report is described below:

3.1.1 Project Setting and Description

To start with the proposed project site, details including main process and off site facilities need to be clearly defined. The description also gives details of effluent (gaseous/liquid/solid/noise) generation sources. However, the treatment/control strategies for these effluents have also been covered as a part of Environmental Management Plan (EMP). In this part the justification for the selected site is also provided.

3.1.2 Identification of Impact

The impact identification of each of the environmental parameters is the first step of assessment. In order to identify the impact comprehensively, all the activities associated with the proposed project during the construction as well as operational phase are identified and listed. A careful examination of each of these activities with respect to the environmental components establishes a "Cause and Effect" relationship between the activity and environmental parameters.

3.1.3 Baseline Data Collection/Reconnaissance Survey

Once the affected environmental parameters are identified, a monitoring network is set up for each environmental parameter to establish its

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 26 of 179	

background quality. The monitoring has been carried out as per the schedule mentioned in **Table 3.1.1**.

Table No. 3.1.1: Details of Baseline Data Collection Schedule

Field	Parameters	No. of Sampling Location	Frequency
Ambient Air Quality	SO ₂ Nox SPM RPM	4	Twice a week
Meteorology	Wind Speed Wind Direction Ambient Temperature at Two Heights 2m & 10m Solar Insolation	1	Continuous Automatic 1 hourly Average
	Max. & Min Temperature		Daily at 08:30 & 17:30 IST
	Humidity		Daily at 08:30 & 17:30 IST
	Atmospheric Pressure		Daily at 08:30 & 17:30 IST
	Rainfall		Daily if rainfall is > 2.5mm
	Other Parameters		As and when occur
Water Quality (Surface & Ground Water Sample)	Physical Parameters pH, Temp., DO, Conductivity and TSS	6	Monthly
	Chemical Parameters TDS, Alkalinity, Hardness, BOD, COD, NO ₃ , PO ₄ , Cl, SO ₄ , Na, K, Ca, Mg, Si, O&G and phenolic compounds	6	Monthly
	Bacteriological MPN and Total Coliform	6	Monthly
	Heavy Metals Pb, Cd, Cr ⁺⁶ , Total Cr, Cu, Zn, Se and Fe	6	Quarterly
Noise	L _{eq}	10	Twice in a year
Sediments	Metals, trace metals, pesticides and benthos	5	Twice in a year
Soil	pH, conductivity, CEC, N, P, K, etc.	6	Twice in a year
Ecology	Aquatic	3	Twice in a year
	Terrestrial	3	Twice in a year

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 27 of 179	

3.1.4 Environmental Impact Prediction & Evaluation

In this part of the report the sources of emissions (gaseous, liquid, solid, noise) due to the proposed activities are identified and their emission load and characteristics are estimated. These estimations are conservative in nature and based on design and operating data for similar power plant. These emissions from the plant are used as part of the input data for predictive mathematical modeling/software. Usage of this predictive software programmes yields the quantitative prediction related to the affected parameters of a given environmental component. Part of the predictions are qualitative in nature also, especially in cases where such prediction techniques are not available. These predictions are subsequently superimposed on the background quality of various environmental components.

3.1.5 Environmental Management Plan (EMP)

In order to mitigate the negative impacts of the proposed project, an effective EMP is delineated. Therefore, in the final part of the report the planning and implementation of various pollution abatement strategies including the proposed monitoring/ surveillance network has been described.

3.1.6 Occupational Health & Safety

The problem envisaged at construction phase are mainly due to accidents and noise and at operation and maintenance phase are also accidents, exposure to heat, arc lights, hazardous chemicals, fire, noise etc. Suitable personnel protective equipment should be provided to all employees working in these areas. Safety requirements are covered in the safety policy statement of the power plant. All the hazardous chemicals storage are to be monitored regularly. Safety training is provided to officers and staff.

3.1.7 Disaster Management Plan

Disaster Management Plan (DMP) has been prepared for "on-site" emergencies, incorporating measures for safety, prevention, mitigation and control of hazardous events, and the Emergency Preparedness Plan (EPP) for "Off-site" emergencies for warnings, evacuation and co-ordination of off-site emergency situation.

3.2 DESCRIPTION OF SITE AND SURROUNDING

The study area is having predominantly industrial activities and some agricultural land with good irrigation facilities. The proposed TNEB-NTPC JVC Thermal Power Project Site is located at latitude of 13°13'45" and longitude of 80°18'5" at a distance of approximately 20 km from Chennai City. The site is on the western side of the Ennore Creek in Ponneri Taluk of Thiruvallur district.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 28 of 179	

River Korattalaiyar surrounds the proposed project site from three sides as shown in Figure 1.1. The site is easily accessible by both road and rail. The nearest railway station Kathivakkam is at a distance of 2 km from the site. The nearest state highway connecting Chennai and Minjur is also at a distance of 2 km, west to the plant. The nearest airport is Meenambakkam, Chennai at a distance of about 36km from the proposed site.

The general topography of the area is more or less plane. The details of the surroundings area are as follows:

- a) North: Athippattu is located very close to the northern boundary of the plant site.
- b) East: Kathivakkam and Ennore Thermal Power Plant is in the east of the proposed plant site. Kathivakkam Railway station is also located in this direction.
- c) South: There is a village Edayanchavadi in the south of the proposed plant.
- d) West: There is a village Vallivayalchavdi in the west of the proposed plant.

3.3 LAND USE

Land is the most vital resource for sustenance of life. Its degradation, due to industrialization, urbanization and population growth is a matter of concern. Therefore, it is necessary to establish the existing land use pattern to optimize the land use as well as minimize degradation due to the developmental activities.

3.3.1 Objectives of the Study

The objectives of the present study are:

- To map the study area with respect to various land use/land cover categories
- To identify the sensitive areas within 7 km radius around the project site.

3.3.2 Methodology

The land use pattern has been established based on Census Data of 1991 and interpretation of Satellite Imageries of the study area with limited ground truth verifications. Ground and ancillary information have been used to identify the sensitive places within 7 km radius of the proposed plant. The land use map has been developed based on the satellite imagery.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 29 of 179	

3.3.3 Land Use Classification Based on Satellite Data of the Year 1997

The land use/land cover map has been prepared based on Satellite Imagery for the year 1997 using classification system based on Manual of Land Use/land Cover Mapping using Satellite Imagery, Part –1 & part – 2 (NRSA, 1989). Table 3.3.1 gives land use classification system and details of land use in the study area. Land use classification of the study area with respect to major land use categories are presented in Table 3.3.2 and Figure 3.3.1.

Table No. 3.3.1: Land use / Land Cover Classification System

S.N.	Level 1	Level 2	Numbers*
1.	Built – up Land (Settlement)	Rural	02
2.	Agricultural Land	Cultivable Land	03
		Fallow	06
		Plantation	07
3.	Waste Land	Water Logged	17
		Marsh	18
4.	Water Bodies	River/ Canal / Water bodies	25

** The numbers are to be read along with the Figure 3.3.1*

Built-Up Land:

All the urban and rural residential settlement including industrial installations and salt pans covering about 2973.8 ha (19.31% of total study area) area is included in these categories. The built – up land is scattered within the study area throughout the seacoast and along the Chennai – Minjur road. The proposed project area comprises of about 450 ha, which comprises roughly 2.92% of the study area.

Agricultural Land:

Agricultural land is one of the major constituents of the study area (30.11%), which indicates considerable agricultural practices in the area. The cropped land (as on the data of satellite imagery) comprises about 3315 ha (about 21.53%) of the study area.

The land without crop, but suitable for cultivation, comprise 1320 ha, i.e. almost 8.57% of the study area.

Forest Land:

There is no forest land within the study area. However, scattered patches of plantation can be seen in (Figure 3.3.1).

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 30 of 179	

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Figure 3.3.1: Land Use Classification based on Satellite Imagery



	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 31 of 179	

Waste Lands:

The wastelands comprises 1525.0 ha, i.e. 9.91%, of the study area. Major part of the waste land is located in and along the river belt and the seacoast. There are distinguished patches of marshy land stretching at various places in the riverbed. These are generally submerged during the rainy season. These comprise 610.0 ha (3.96%) of the study area. Sand belt can be seen along the seacoast and at a few places by the river banks comprising of 50 ha (0.33%) of the land. The lands with scrubs are significant and cover about 865 ha i.e. 5.6% of the study area. The proposed site is falls within this category of land.

Water Bodies:

A large portion (40.67%) of the study area is covered with water bodies. This comprises area of Bay of Bengal, Korattalaiyar river, Buckingham Canal and Tanks/ reservoirs etc. Total area under water bodies is 6260.0 ha. Out of this 30.09% of the land is covered by seawater, 7.93% by river and canal. About 410 ha of land is utilized for water storage.

Table No. 3.3.2: Land Use Pattern of the Study area based on Satellite Imagery (Year 1997)

S.N.	Class	Area in Ha.	% of the Study Area
1.	Agriculture	4635.0	30.11
	Cropped Land (with Rabi Crop)	3315.0	21.54
	Fallow Land	1320.0	8.57
2.	Settlements	2973.8	19.31
3.	Waste Land	1525.0	9.91
	Sand	50.0	0.33
	Marsh	610.0	3.96
	Land with Scrub	865.0	5.62
4.	Water Bodies	6260.0	40.67
	Sea	4630	30.09
	River/Canal	1220	7.93
	Tank	410	2.65
	Total	15393.8	100.00

3.3.4 Land Use Classification Based on Census Data

The land use pattern of villages based on census data of 1991 is given in Table-3.3.3 and Figure-3.3.2.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 32 of 179	

**Table-3.3.3 Land Use Pattern of Villages in the Study Area
Based on Census Data**

Land Use Classification	Area, Hectare	% of Study Area
Forest	Nil	Nil
Agricultural Land		
i. Irrigated	4210.32	29.59
ii. Un-irrigated	1725.70	12.13
Area not available for cultivation	5198.10	36.54
Cultivable Waste Land	3092.60	21.74

The table shows that there is no forest area within the study area. The irrigated and un-irrigated agricultural lands are 29.53% and 12.13%, respectively. The percentage of cultivable wasteland and area not available for cultivation is quite significant and it accounts 58.24% of the total area. This indicates that major portions of the land within the study area is either wasteland or used for settlement or industrial installations. The site proposed for the power plant is under the category "area not available for cultivation", therefore, there may not be any significant impacts on the cultivable land of the study area.

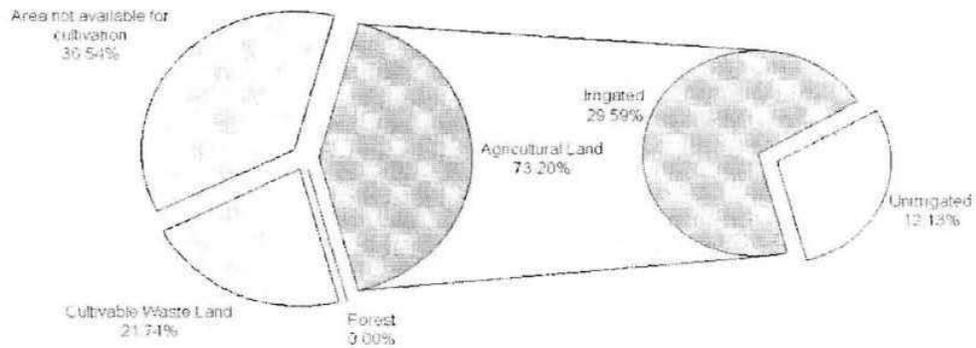


Figure No. 3.3.2 Land Use Classification based on Census Data 1991

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 33 of 179	

3.3.5 Sensitive Area

No important archaeological, historical, cultural, aesthetic, religious and ecologically sensitive area as per MoEF list within the radius of 7km exists. However, there are some sensitive locations within the radius of 25km from the proposed plant site. **Table 3.3.4** enlists the sensitive area/sites within 25 km of the study area.

Table No. 3.3.4: Major Sensitive Area within 25 km of the Study Area

S. N.	Places	Approx. Distance, km	Direction	Remarks
		from Proposed Site		
1	Alamedi Reserved Forest	18.25	WS W	Reserve forest
3	Mangrove Forest	14.0	N	
5	Fort St. George	16	S	Built by British East India Co.
6	Deer Park	23	S	Unique for being worlds only sanctuary located within the metropolitan city limit
7	Snake Park	23	S	Snake park and reptillium are the part of huge Raj Bhavan Estate of Governor

3.4 WATER USE

3.4.1 Sources of Water

The river Korattalaiyar and water tanks are the major surface water resource in the study area. There are a number of surface water bodies like ponds formed due to shallow depth of water level. Therefore, a number of water tanks with pumping station can be seen in the study area, which exploit the surface water. Ground water drawn through electric tube wells are also very common.

3.4.2 Trends of Surface and Ground Water Use

Irrigation Use

Major demand of irrigation is met from the water tanks in the study area. Lift irrigation, mainly from dug-wells, tanks and occasionally from river is observed

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 34 of 179	

in the study area. According to the land use pattern of the study area established through 1991 Census, (Due to non availability of 2001 village directory CD) it has about 5936.02 ha agricultural land, out of which 4210.32 ha land is irrigated. Estimated annual requirement of water for irrigation from surface and ground water works out to be 16.84million m³ per annum considering that the Kharif is the main crop of this area as well as the total irrigated land.

Domestic Use

Water from surface water bodies is mainly used for bathing, washing and other general usage. Recreational use of water is, in general, not observed in the study area. Only localized and unorganized navigation, mainly by small boats operated by local people for fishing is practiced on Bay of Bengal at some places. Drinking water requirement is principally met from tube wells, dug wells and supply water.

The water used for domestic purposes in the study area has been estimated to be 19.96×10^6 m³ per annum based on population (1991 census) and 70 liters per capita per day average consumption.

The water requirement for industrial and other commercial activities are about 14.67×10^6 m³ per annum as per the data collected from Ponneri Taluk. The annual water requirement within the study area is presented in Table 3.4.1.

Table No. 3.4.1: Water Uses Pattern within the Study Area

Use	Requirement, million m ³
Agriculture	16.84
Domestic	19.96
Industrial	14.67

3.5 DEMOGRAPHY AND SOCIOECONOMIC

Information about demographic and socio-economic profile was collected from the District Census Handbook (1991). (Dist:- Chengalpattu, TamilNadu)and Census CD 2001 (TamilNadu).The census data available for different blocks, taluks and towns have been analyzed with respect to demographic profile, community structure, educational facilities, occupational structure and infrastructure facilities. Towns and villages with their major portions falling within the study area have been considered fully in the study, whereas those with their minor portions within the study area have not been considered from the study. The rural/urban settlements falling under the study area of 7-km radius around the project site is given in **Figure 3.5.1**.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 35 of 179	

Figure 3.5.1: Rural/Urban Settlement Under the Study Area



	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 36 of 179	

The details of demographic profile, including literacy of villages and towns in the study area are presented in **Annexure – IIA and IIB** for the year 1991 and 2001, respectively and the details of socio- economic structure of villages and towns within the study area are presented in **Annexure – IIIA and IIIB** for the year 1991 and 2001, respectively. The status of infrastructural facilities and amenities of the villages are presented in **Annexure IVA** for the year 1991 and the status of infrastructural facilities and amenities of the towns with their medical, educational, recreational, culture, civic facilities and other amenities, trade, commerce, industry, banking and finances are also given in **Annexure – IV B** for the year 1991.

3.5.1 Demographic Profile of the Study Area Based on 1991 data

Population

There are about 19 villages and four towns falling under the radius of 7 km from the project site in the study area. The total population in these villages and towns are 66,699 and 2,18,453, respectively totaling to 2,85,152 persons. The total population of Chengalpattu district is 46,53,593 indicating thereby that the population of the study area is only 6.37 percentage of the whole district.

The percentage of male, female population and sex ratio are 50.90%, 49.10% and 1000:965, respectively in villages whereas the percentage male, female population and sex ratio are 52.04%, 47.96% and 1000:921 in towns, respectively.

Social Structure

The schedule caste and schedule tribe population within the study area is 15.45% and 0.52%, respectively of the total population in the year 1991. The percentage male and female schedule caste population is 51.14% and 48.86%, respectively and the percentage of male and female population of schedule tribe is 50.23% and 49.76%, respectively. The sex ratio for schedule caste and schedule tribe is 1000:988 and 1000:990, respectively in the year 1991.

Literacy

The literacy in the study area is very poor especially among the female population in the rural area. The literacy rate in villages and towns are 12.65% and 52.46%, respectively. The percentage of male and female literacy of towns is 57.36% and 42.64%, and percentage of male and female literacy of villages is 60% and 40%, respectively. The maximum literacy was found in Minjur village and Tirivottiyur towns in the study area.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 37 of 179	

3.5.2 Demographic Profile of the Study Area Based on 2001 Census Data

Population

There are about 16 villages and five towns falling under the radius of 7 km from the project site in the study area. The total population in these villages and towns are 50513 and 305723, respectively totaling to 356236 persons.

The percentage of male, female population and sex ratio are 50.45%, 49.55% and 1000:982, respectively in villages whereas the percentage male, female population and sex ratio are 52.25%, 48.75% and 1000:921, respectively in towns.

Social Structure

The schedule caste and schedule tribe population within the study area are 19.05% and 0.24%, respectively of the total population. The percentage male and female schedule caste population is 50.52% and 49.48%, respectively and the percentage of male and female population of Schedule Tribe is 51.74% and 48.26%, respectively within the study area. The sex ratio for schedule caste and schedule tribe is 1000:979 and 1000:932, respectively.

Literacy

The literacy in the study area is very poor especially among the female population in the rural area. The literacy rate in villages and towns are 8.78% and 63.76%, respectively. The percentage of male and female literacy of towns and villages is 54.93%, 45.17% and 57.61% and 42.39%, respectively. The maximum literacy was found in Vallur village and Tirivottiyur towns in the study area.

3.5.3 Evolution of Demographic Profile of the Study Area during 1991-2001 decade

In the 1991, population within the study area is 285152 and in the year 2001, population within the study area is 356236. According to census data, percentage of male population decreases from year 1991 to year 2001 and in the same decade female population increases. Similarly, percentage of schedule caste population increases from 1991 to 2001 and percentage of schedule tribe population decreases from 1991 to 2001. Details are given in the **Table no:-3.5.1**

Table: - 3.5.1 Comparison of Demographic Profile of Study Area Over One Decade

SI No:	Subject	Status in 1991	Status in 2001	Remarks
1	Population	285152	356236	Increase
2	Percentage of male	51.77%	51.29%	Decrease
3	Percentage of Female	48.22%	48.87%	Increase
4	Percentage of SC	15.45%	19.05%	Increase
5	Percentage of ST	0.52%	0.24%	Decrease
6	Literate	65.17%	72.24%	Increase

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 38 of 179	

3.5.4 Socioeconomic Profile of the Study Area Based on 1991 Census Record

Occupational structure

The occupational structure of the population in the study area has been studied with reference to main workers, marginal workers and non-workers. The main workers in the study area from villages and towns are 23,705 and 64,773, respectively totaling to 88,478. The percentage distribution of main workers in the villages and towns are 8.31% and 22.71%, respectively of the total population. The percentage of male and female main workers in the study area is 86.43% and 13.57%, respectively. Main workers have been grouped into three categories namely cultivators, agricultural labourers and other workers. The details of these groups are given below.

Cultivators

The persons who are engaged either as employer, single worker or family worker in cultivation of land owned is known as cultivator. Total cultivators in the study area are 4059, which is 1.42% of total population. The percentage of cultivators residing in villages and towns are 96.87% and 4.13%, respectively. The male and female cultivators are 78.36% and 18.52%, respectively in the villages and 2.88% and 0.24% in the towns indicating thereby that cultivators are much less in towns as compared to the villages.

Agricultural Labourers

Persons working in the land of others for wages or share in the yield are classified as agricultural labourers. The total workers in the study area of this category are about 10,035, which is 3.52% of total population. The percentage of agricultural labourers working in village and towns are 95.44 and 4.56, respectively. The percentage of male workers and female workers in villages are 55.39%, 40.05% and in towns are 3.82% and 0.74%, respectively. The maximum numbers of male and female workers are found in Vallur villages and minimum number of workers is observed in Kattivakkam town.

Other Workers

All workers other than cultivators or agricultural labourers who have been engaged in some economic activities are other workers. The workers that come under this category include mining and quarrying, manufacturing, processing, serving and repairs, construction workers, trade and commerce, transport, storage, communications, livestock, forestry, fishing, hunting and plantations and allied activities and other services.

The total numbers of other workers under this category in the study area is 73294, which is 25.70% of total population. The male and female populations of other workers in villages are 12.36%, 1.39% and in towns are 77.7% and 8.46%, respectively. The maximum number and minimum number of male

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 39 of 179	

and female workers are in Minjur village and Koltali villages, respectively. Tiruvattiyur town and Sadayankuppam are having maximum and minimum numbers of other workers in town.

Marginal Workers

The marginal workers are those workers who are engaged in some work for a period less than six months during the reference year prior to the census survey. The total number of marginal workers in the study area is 893, which is approx. 0.31% of total population of 285152. The total population of marginal workers in villages and towns is 23.45% and 70.55%, respectively. The male and female marginal workers in villages 5.59%, 23.89% and in towns are 26.99% and 43.56%, respectively. There are ten villages and two towns in the study area that has no marginal workers.

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 195107, which is 68.42% of the total population. In this category percentage of male and female non-workers in villages are 8.11%, 13.44% and in towns are 28.16% and 50.28%, respectively. The total population in villages and towns are 21.56% and 78.44%, respectively.

The maximum and minimum number of non-workers belong to village Minjur and Chinnamilvoyal, respectively whereas TREVOTTYUR town and Sadayankappam towns are having maximum and minimum non-workers, respectively. The occupational structure of the study area is presented in **Figure-3.5.2**.

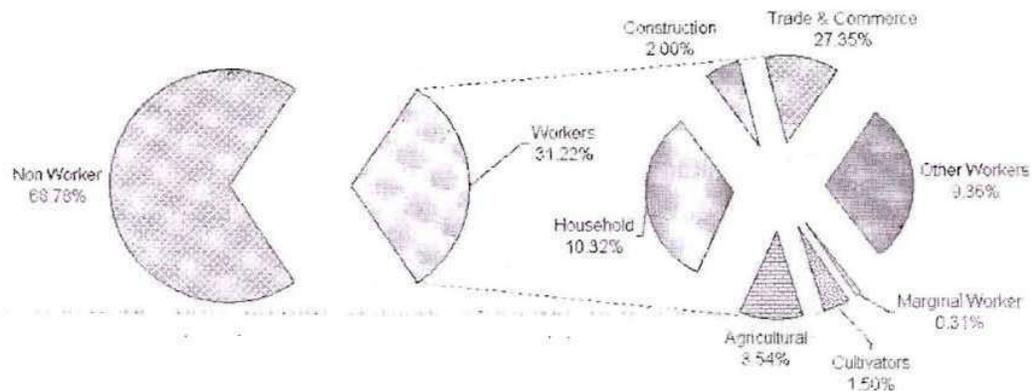


Figure 3.5.2: Occupational Structure of the Study Area on 1991 Census Record

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 40 of 179	

3.5.5 Socioeconomic Profile of the Study Area Based on 2001 Census Record

Occupational structure

The occupational structure of the population in the study area has been studied with reference to main workers, marginal workers and non-workers. The main workers in the study area from villages and towns are 13823 and 88660, respectively totaling to 102483. The percentage distribution of main workers in the villages and towns is 3.88% and 24.88%, respectively of the total population. The percentage of male and female main workers in the study area is 86.06% and 13.94%, respectively. Main workers have been grouped into three categories namely cultivators, agricultural labourers and other workers. The details of these groups are given below.

Cultivators

The persons who are engaged either as employer, single worker or family worker in cultivation of land owned is known as cultivator. Total cultivators in the study area are 2817, which is 0.79% of total population. The percentage of cultivators residing in villages and towns are 69.57% and 30.42%, respectively. The male and female cultivators are 55.12% and 0.85 %, respectively in the villages and 18.12% and 6.24% in the towns indicating thereby that cultivators are much less in towns as compared to the villages.

Agricultural Labourers

Persons working in the land of others for wages or share in the yield are classified as agricultural labourers. The total workers in the study area of this category are about 4122, which is 1.15% of total population. The percentage of agricultural labourers working in village and towns are 80.88% and 19.12% , respectively. The percentage of male workers and female workers in villages are 54.44%, 26.44% and in towns are 14.45% and 4.65%, respectively. The maximum numbers of male and female workers are found in Vichoor villages and no workers is observed in Chinnamullaivoyal towns.

Other Workers

All workers other than cultivators or agricultural labourers who have been engaged in some economic activities are other workers. The workers that come under this category include mining and quarrying, manufacturing, processing, serving and repairs, construction workers, trade and commerce, transport, storage, communications, livestock, forestry, fishing, hunting and plantations and allied activities and other services.

The total numbers of other workers under this category in the study area is 93577, which is 26.3% of total population. The male and female populations of other workers in villages are 7.65%, 1.10% and in towns are 80.12% and 11.07%, respectively.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 41 of 179	

Marginal Workers

The marginal workers are those workers who are engaged in some work for a period less than six months during the reference year prior to the census survey. The total number of marginal workers in the study area is 16331, which is approx. 4.54% of total population of 356236. The total population of marginal workers in villages and towns is 27.25% and 72.75%, respectively. The male and female marginal workers in villages 15.96%, 11.27% and in towns are 55.19% and 17.56%, respectively.

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 237422, which is 66.64 % of the total population. In this category percentage of male and female non-workers in villages are 3.27%, 5.77%, and in towns are 19.42% and 56.66 %, respectively. The total number of non-workers population in villages and towns are 7.01% and 92.99%, respectively.

The occupational structure of the study area is presented in **Fig 3.5.3**

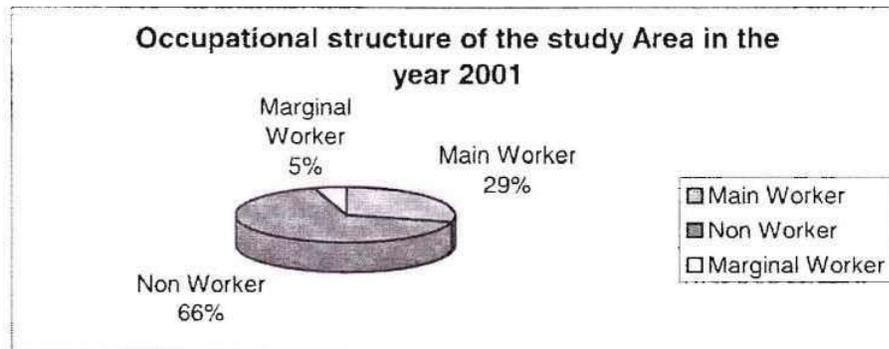


Fig 3.5.3 : Occupational Structure of the Study Area in the year 2001

3.5.6 Evolution of Socio- Economic Profile of the study Area during 1991-2001 decade

According to 1991 census data , the main workers, non- workers, marginal workers of the study area are 31.06%, 68.42%, and 0.31% , respectively. Whereas, as per 2001 census data the main workers, non workers, and marginal workers of the study area are 28.76%, 66.64% and 4.6%, respectively. Comparison of socio economic profile of the study area of one decade is given below:-

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 42 of 179	

Table:- 3.5.2 Comparison of socio Economic Profile of Study Area Over One Decade

Sl No	Subject	Status in 1991	Status in 2001	Remarks
1	Main worker	31.06%	28.76%	Decrease
2	Non worker	68.42%	66.64%	Decrease
3	Marginal worker	0.31%	4.6%	Increase

3.5.7 Availability of Infrastructural Facilities & Amenities

A review of infrastructural facilities available in the study area has been done on the basis of the information given in district census book 1991, part A and part B for Chengalpattu MGR district. The study area as a whole processes a good level of infrastructural facilities and amenities like education, health, drinking water, electrification, transport and communication network.

Educational Facilities

There are 19 villages and 04 towns in 7 km radius of the study area. The educational facilities in villages within 7 km radius are given in Table 3.5.3.1

Table No.-3.5.3.1: Educational Facilities in Villages within the Study Area

Educational Facilities	Radial Distance
	0-7.0 km
Primary/elementary school	39
Junior secondary/middle school	20
High school	4
Pre-university	1

There are 19 villages in the study area. Some villages are well advanced in educational facilities having primary school, middle school, pre-university and high school, e.g. Minjur, Vellur and Edayanchavadi. On the other hand, there are some villages, which are not having any educational facilities e.g. Narsingapuram, Chinnamullayal. In all four towns with in the study area have good educational facilities given in **Annex- IVA**

Medical Facilities

The medical facilities in villages within the study are not well developed. The status of medical facilities in villages in the study area is given in Table-3.5.2.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 43 of 179	

Table No.-3.5.3.1: Medical Facilities in Villages within the Study Area

Medical Facilities	Radial Distance, km
	0.0-7.0 km
Primary health sub-center	2
Maternity home	1
Nursing home	1
Registered private practitioner	11
Primary health center	1

Source: District Census Handbook, Chengalpattu MGR, 1991)

Drinking Water

The number of villages having well water, hand pumps, tap water, tank water, river water in the study area are given in the Table 3.5.3.3. In all four towns with in the study area have good drinking water facilities given in **Annex- IVA**

Table No. 3.5.3.3: Drinking Water Facility within the Study Area

Drinking Water Facilities	Radial Distance, km
	0.0 - 7.0
Well Water (W)	10
Tank Water(TK)	3
Hand Pump (HP)	1
Tap Water	14

Source: District Census Handbook, Chengalpattu MGR, 1991)

Power Supply

Electrification of the villages of the study area is very good. There are 15 villages out of the 19 villages, which are having electricity for all the purpose, and 4 villages are having electricity for domestic purpose and electricity for agricultural purpose. Thus all the villages are electrified. The break-up of electric availability is presented in Table-3.5.3.4. In all four towns with in the study area have good electric supply facilities given in **Annex- IVA**

Table No.-3.5.3.4: Electricity Facility of the Villages within the Study Area

Categories	Radial Distance in 0.0-7.0 km
	No. of Villages
Electricity for domestic use	4
Electricity for agriculture	4
Electricity for all purpose	15

Source: District Census Handbook, Chengalpattu MGR, 1991)

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 44 of 179	

Post and Telegraph

The villages in the study area are having post offices in 9 villages in telephone in 4 villages. The 7 villages are not having post office facility. All the towns in the study area are having post office and telephone facilities. Post and telegraph facilities within the study area are given in Table 3.5.3.5. In all four towns with in the study area have good post and telephone facilities given in **Annex- IVA**

Table 3.5.3. 5: Post & Telegraph Facility within the Study Area

Facilities	Radial Distance, km
	0.0 - 7.0
Post Office (PO)	9
Phone	4

Source: District Census Handbook, Chengalpattu MGR, 1991)

Transport and Communication

The mode of communication and transportation facility within the villages in the study area are given in Table-3.5.3.6

Table No. 3.5.3.6: Transportation Facility within the Study Area

Facilities	Radial Distance, km
	0.0-7.0
Bus Stand (BS)	14
Railway station	3
Navigable water way	1

Source: District Census Handbook, Chengalpattu MGR, 1991)

There are five villages, which are having no transportation facility. There are three villages, which are having railway station and bus stand facility. One village has navigable waterway facility also. In all four towns with in the study area have good transportation facilities given in **Annex- IVA**

Modified Area Development Approach (MADA):-

According to List published by Ministry of Tribal Affairs , there is no MADA pocket in state of Tamil Nadu.

3.5.8 Conclusion

- The urban area falling under the radius of study area has all the necessary civic and other amenities, however the villages are under inadequacy.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 45 of 179	

- The medical facilities are very poor in the study area. Only 4 villages have some medical facilities and 15 villages are having no medical facilities.

According to 1991 census data, the total population in these villages and towns are 66,699 and 2,18,453, respectively totaling to 2,85,152 persons. The percentage of male, female population and sex ratio are 50.90%, 49.10% and 1000:965, respectively in villages whereas the percentage male, female population and sex ratio are 52.04%, 47.96% and 1000:921 in towns. According to 2001 census data, the total population in these villages and towns are 50513 and 305723, respectively totaling to 356236 persons. The percentage of male, female population and sex ratio are 50.45%, 49.55% and 1000:982, respectively in villages whereas the percentage male, female population and sex ratio are 52.25%, 48.75% and 1000:921, respectively in towns.

3.6 GEOLOGY

The study area is made up of two major types of formations of upper and lower Gondwana. It is composed of purple molted sandstone, conglomerates and sands stone buff, shale and clay, respectively. As the study area comes under the restricted zones, no map was available through Geological Survey of India to include in this report. The geological study has been based on the secondary sources. There are four terraces at 35m, 20m, 7m and 3m above the riverbed overlaying the conglomerates of upper Gondwana. In some areas Pleistocene boulder conglomerates overlay upper groundwater followed by detrital laterite and alluvium layers. The metamorphic rocks consisting mainly hornblende charno kite and quartzite and queons (most common is laterite) are in various stage of formation.

The above geologic strata have resulted in sandy soil mixed with soda and alkali, red alluvium and laterite in the study area. The sub geology is black clay with varying stiffness at different depths. The inland plains show embryogenic geology with weak profiles almost bearing a close resemblance to parent material. Some areas are characterized by material of recent nature with dominance of quartz sand and lack of distinct pedogenic horizons. These are encountered along the East Coast and covered by sand dunes. Another category of soil encountered in these areas belong to dark gray soils devoid of diagnostic horizons owing to shrinking and swelling processes which mix them thoroughly. They show more than 30% clay to a depth of 1m and the dominant clay mineral is montmorillonite. Contrarily, the elevated lateritic areas present mature soils with marks of processes that translocate silicate clays and have medium to high supply of bases such soils are confined along the alluvial treat.

The dense to very dense sand layers are recorded up to 12m from ground level and a thin layer of clay sand within the top dense sand layers. The sandy

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 46 of 179	

clay layers have been recorded at different locations in the study area. The soil stratification as revealed by the borehole studies is interesting as the following categories are encountered at different depths: -

- i. Grayish and dark staff clay of 0.5m-2m thick is observed at 5.5 m below average ground level.
- ii. Sandy and clay layers are observed at 11.5m.
- iii. Light yellow and brown clay cemented sand is observed at 22m below ground level.

3.7 SOILS

3.7.1 Selection of sampling Locations

The soil sampling locations were identified in consultations with the Engineer-In-Charge, NTPC to assess the fertility and agricultural characteristics of the soil. The sampling locations are predominately representatives of marshy land in different directions. The sampling locations are given in Table-3.7.1 and presented in Figure 3.7.1.

Table No. 3.7.1: Soil Sampling Stations in the Study Area

Sl. No.	Sampling Stations	Type of Area	Direction from Project Site	Distance from Project Site
1.	Vallankulum	Agricultural	WSW	4.58 km
2.	Edayanchavadi	Agricultural	S	2.37 km
3.	East of Kuruvemedu	Cultivable waste land	E	1.8 km
4.	Kuruvemedu	Cultivable waste land	Center	0 km
5.	Athipattu	Cultivable waste land	NNE	3.81 km
6.	South of Kuruvemedu	Cultivable waste land	S	0.9 km

3.7.2 Methodology

The soil samples were collected in the month of August 2003 and June 2004 for analysis. The samples collected from all locations are homogeneous representative of each location. At random 5 sub locations were identified at each location and soil was dug from 30 cm below the surface. It was uniformly mixed before homogenizing the soil samples. The samples were filled in polythene bags, labeled in the field with number and site name. The soil samples collected were transported to laboratory for further analysis.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 47 of 179	

3.7.3 Physicochemical Characterization of Soil

Physical Properties

Table-3.7.2 and 3.7.2A shows the analytical results of physical properties of soil for the pre and post monsoon season. The colour of the soil is yellowish brown at Vallankulum and east of Kuruvemedu, brown at Kuruvemedu and south of Kuruvemedu and blackish brown at Athipattu and Edayanchavadi. The bulk density of soil varies between 1.05 to 1.28 with average value of 1.17. The soil is loamy sand at Vallankulum and other location it is sandy loam.

Table No. 3.7.2: Physical Characteristics of Soil in the Study Area (Pre-Monsoon)

Location Name	Colour	Texture	Sand, %	Silt, %	Clay, %	Bulk Density	Porosity
Vallankulum	Slightly Brown	Sandy Loam	64	22	16	1.06	56
East of Kuruvemedu	Slightly Brown	Loamy Sand	68	17	13	1.09	52
Edayanchavadi	Brown	Sandy Loam	70	18	12	1.16	48
Kuruvemedu	Slightly Brown	Sandy Loam	66	23	17	1.22	44
Athipattu	Brown	Sandy Loam	69	12	19	1.20	40
South of Kuruvemedu	Slightly Brown	Sandy Loam	72	18	10	1.28	36

Table No. 3.7.2A: Physical Characteristics of Soil in the Study Area (Post-Monsoon)

Location Name	Colour	Texture	Sand, %	Silt, %	Clay, %	Bulk Density	Porosity
Vallankulum	Slightly Brown	Sandy Loam	69	18	13	1.05	56
East of Kuruvemedu	Slightly Brown	Loamy Sand	70	16	12	1.06	52
Edayanchavadi	Brown	Sandy Loam	68	18	14	1.16	48
Kuruvemedu	Slightly Brown	Sandy Loam	64	20	16	1.21	44
Athipattu	Brown	Sandy Loam	66	14	20	1.20	40
South of Kuruvemedu	Slightly Brown	Sandy Loam	70	17	13	1.27	36

Chemical Properties

The chemical analysis of soil in the study area sampled during pre and post monsoon, is shown in Table 3.7.3. and 3.7.3A. The data shows that the pH

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 48 of 179	

varies from 6.02 to 7.94 indicating that the soil is mostly neutral. The conductivity varies from 83 to 128.7 $\mu\text{mho/cm}$, respectively. The average concentrations of nitrogen, phosphorus and potassium are 298 mg/100g, 23.25 mg/100g and 5.91, respectively. The cation exchange Capacity varies from 52 to 72 mg/100g with an average value of 62 mg/100g. The average sodium absorption ration is 2.46, which is much below the value 9 where after the permeability of soil is affected.

Table No. 3.7.3: Chemical Characteristics of Soil in the Study Area (Pre-Monsoon)

Location Name	pH	Conductivity, $\mu\text{mho/cm}$	N	P	K	CEC	SAR
Vallankulum	6.56	128	430	20.1	9.7	52	1.72
East of Kuruvemedu	7.94	120	280	26.0	3.9	58	2.04
Edayanchavadi	6.40	84	305	34.0	9.2	60	2.04
Kuruvemedu	6.96	83	210	43.1	3.6	64	2.29
Athipattu	6.02	86	298	28.2	5.0	72	3.52
South of Kuruvemedu	7.01	128	270	18.1	4.1	66	3.19

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 49 of 179	

Figure 3.7.1: Soil Quality Monitoring Stations



	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 50 of 179	

Table No. 3.7.3A: Chemical Characteristics of Soil in the Study Area (Post-Monsoon)

Location Name	pH	Conductivity, $\mu\text{mho/cm}$	mg/100g				
			N	P	K	CEC	SAR
Vallankulam	6.56	128.7	420	18.9	8.2	50	1.70
East of Kuruvemedu	7.94	120.2	278	24.3	2.8	52	1.89
Edayanchavadi	6.40	83.4	301	32.2	8.3	58	1.87
Kuruvemedu	6.96	83.4	203	41.3	3.2	61	2.21
Athipattu	6.02	83.2	292	26.7	4.4	67	3.48
South of Kuruvemedu	7.01	128.2	264	16.4	3.6	62	3.14

3.8 HYDROLOGY

Ground water hydrology has been established with respect to potential and availability of ground water. The detail of hydrology is mainly based on the information of PWD and Surface & Ground Water Board, Taramani, Chennai.

3.8.1 Depth of Ground water Table

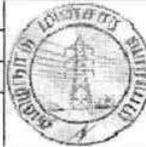
The measurements have shown that the water table was very shallow in Ponneri Taluk and annual variation is from 1.32 – 3.60m bgl. The ground water table at 3 numbers of observation wells around the project site is given in Table 3.8.1.

Table 3.8.1: Ground Water Table Measured at 3 Wells around the Project Site

Month	Palayanapalayam 80°27'E, 13°21'N	Nandiambakkam 80°28'E, 13°26'N	Red Hills 80.183E, 13°18'N
January, 02	0.43	1.13	2.85
February, 02	0.43	1.08	3.10
March, 02	0.63	1.33	3.20
April, 02	1.03	2.13	3.55
May, 02	1.58	2.68	3.70
June, 02	2.03	3.03	4.05
July, 02	1.93	3.03	4.15
August, 02	1.91	3.03	4.30
September, 02	1.83	3.03	4.40
October, 02	1.43	2.93	3.75
November, 02	1.33	2.83	2.95
December, 02	1.23	2.79	3.25
Annual Avg.	1.32	2.42	3.60

Source: Surface and Ground Water Board, Taramani, Chennai

The rise in water table was indicated in the month of June and gradual decline towards winter to summer.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 51 of 179	

Aquifer Characteristics:

During EIA study, pump tests were conducted, to conduct these test three bore wells were drilled near proposed ash disposal area. Soil profile of these bore wells are presented in Fig – 3.8.1 to 3.8.3. The aquifer zone tapped by these bore wells lie generally within 10 ft. below ground level and this aquifer is in semi – confined condition and the characteristics, as determined by pump test are as below:

Table 3.8.2: Pump Test Results

Sl. No.	Location	Yield (m ³ /h)	Drawdown (m)	Trans.(m ² /d)	Permeab.(m/d)
1.	Borewell No.1	18	0.55	924.8	18
2.	Borewell No.2	21	0.23	1548.28	17
3.	Borewell No.3	23	0.51	1794.5	17

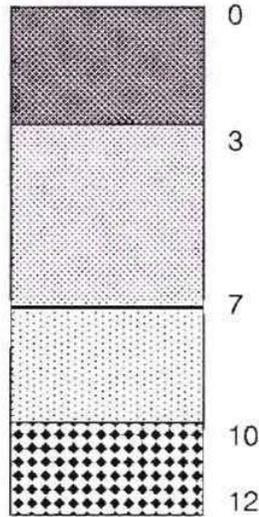
Recharge Discharge of the Area & Ground Water Budget:

The estimation of ground water potential in an area is essential for the development of agriculture, municipal and industrial water demand without creating any adverse effect on environment. The exact estimation of ground water is used to express the equilibrium between ground water recharge and draft in the aquifer zones, which is necessary for the best utilization. The excess withdrawal or recharge of ground water will disturb hydraulic equilibrium. Excessive draft results in ground water level decline, creating crop failing, adverse salt imbalance, land subsidence etc. while excessive recharge may create rise in ground water level, water logging and salt precipitation, which also causes crop failure.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 52 of 179	

Fig-3.8.1
SOIL PROFILE – S1 (Borewell No. 1)

Depth in Feet

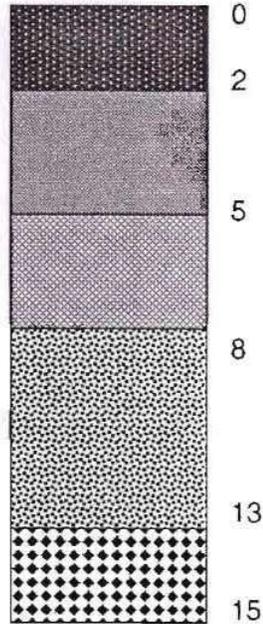


Index	
	Red Clay Soil
	Light Red Fine Sandy Clay Soil
	Reddish Course Sandy Clay Soil
	Gravel Sandy Soil

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 53 of 179	

**Fig. 3.8.2
SOIL PROFILE – S2 (Borewell No. 2)**

Depth in Feet



Index	
	Black Clay Soil
	Light Black Sandy Clay Soil
	Fine Sandy Clay Soil
	Course Sandy Clay Soil
	Gravel Sandy Soil

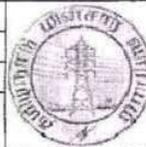
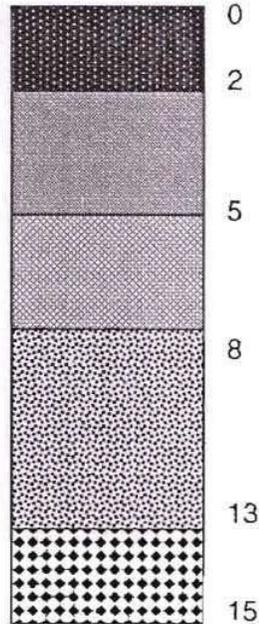
	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 54 of 179	

Fig. No. – 3.8.3
SOIL PROFILE – S3 (Borewell No. 3)

Depth in Feet



Index	
	Black Clay Soil
	Light Black Sandy Clay Soil
	Fine Sandy Clay Soil
	Course Sandy Clay Soil
	Gravel Sandy Soil

3.9 WATER QUALITY

3.9.1 Selection of Sampling Locations

The assessment of present status of water quality within the study area was conducted by collecting water from ground water sources and surface water sources during July 2003 to June 2004. The sampling locations have been identified on the basis of their importance. Three ground water samples and three surface water samples were collected every month. The locations of sampling stations of ground water and surface water are shown in Figure-3.9.1. Details of sampling locations, their distance and direction from the proposed plant site are presented in Table-3.9.1.



	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 55 of 179	

Table No.: 3.9.1: Water Quality Sampling Location of the Study Area

Code	Location Name	Direction from Projected area	Distance from Projected area, km	Nature of Water
SW1	Kathivakkam	SE	3.7	Sea Water
SW2	Ennore	E	5.2	Creek Water
SW3	Edayanchavadi	S	2.37	River Water
GW1	Kathivakkam	E	2.65	Dug Well
GW2	Kuruvelmedu	Site Center	0	Hand Pump
GW3	Vallivayalchavdi	WNW	2.55	Dug Well

3.9.2 Methodology

The samples were analyzed for selected physicochemical parameters to establish the existing water quality of the study area. Samples were collected, preserved and analyzed as per methods given in the Standard Methods for the Examination of Water and Wastewater (APHA, AWWA and WPCF 2000). The samples were analyzed for pH, temperature, conductivity, total dissolved solids, suspended solids, alkalinity, hardness, chloride, sulphate, nitrates, phosphate, calcium, magnesium, sodium, potassium, silica, dissolved oxygen, BOD, COD, Phenolic Compounds.

The samples for bacteriological quality of water analysis was collected in the sterilized bottle and sample were analyzed for bacteriological quality of water for MPN and total coliforms on monthly basis.

The samples were analyzed for As, Hg, Pb, Cd, Cr⁺⁶, Total Chromium, Cu, Zn, Se and Fe by atomic absorption spectrophotometer.

3.9.3 Surface Water Quality

Physico – chemical characteristics of surface water samples, were collected from free sources for the twelve months, have been presented in Tables 3.9.2 to 3.9.4. the tables also contains statistical analysis of observed values, comprising minimum, maximum, average, median and standard deviation.

3.9.4 Ground Water Quality

The physicochemical analysis of Ground water samples are given in Tables- 3.9.5 to 3.9.6 for the twelve consecutive months from July 2003 to June 2004. Here also, statistical analysis of values observed during the 12 months have been performed. The well water pH varies between 6.8 to 8.8. The total dissolved solids, hardness, chloride sulphates are all within permissible limit if IS:10500 except bacteriological quality. The detail results are given in Table No. 3.9.2

 NTPC	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001
		Rev. No.: 0
		Issue Date: 25-05-2006
		Page No.: 57 of 179



**Table No. 3.9.2
Characteristics of Marine Water from Kathivakkam**

Sl. No.	Parameter	Month (July 2003 to June 2004)												Min	Max	Avg	Med	S.D.	
		July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June						
1	pH	8.0	7.9	7.8	7.7	7.7	7.8	7.6	7.8	7.9	7.9	7.4	7.6	7.8	7.4	8.0	7.8	7.8	0.2
2	Temperature, °C	28.5	27.0	27.0	26.5	26.5	26.0	28.5	29.0	29.0	29.0	29.5	30.0	30.5	26.0	30.5	28.2	28.5	1.5
3	Conductivity, μs/cm	49360	50100	52000	51500	49600	49800	5000	5278	56200	56200	47000	5228	52200	47000	56200	51068	50800	2304
4	Suspended Solids, mg/l	77	110	103	80	95	106	85	68	88	88	68	82	72	84	110	88	85	13
5	Dissolved Solids, mg/l	30910	33000	31000	30000	27050	29625	2900	3100	34500	34500	27050	3100	34500	27050	34500	30882	30955	2233
6	Alkalinity, mg/l	160	205	200	210	209	198	180	190	210	210	160	200	210	220	220	199	203	16
7	Hardness, mg/l	7600	7500	7325	7750	7968	7870	7720	7705	7540	7320	7140	7320	7405	7140	7968	7570	7570	245
8	Dissolved Oxygen, mg/l	5.0	5.2	5.4	5.6	5.5	5.4	6.2	6.1	5.8	6.0	5.0	6.3	5.4	5.0	6.3	5.7	5.6	0.4
9	B.O.D., mg/l	6.0	5.0	6.0	6.5	7.0	6.0	4.0	3.0	3.5	5.0	3.0	4.0	4.5	3.0	7.0	5.0	5.0	1.3
10	C.O.D., mg/l	17	14	23	21	22	24	11	12	13	14	11	12	14	11	24	16	14	5
11	Nitrate as NO ₃ , mg/l	3.09	2.04	2.41	3.14	2.38	2.4	15.4	16.47	19.56	16	17	17	21	2.0	21.0	10.1	9.3	8.0
12	Phosphate as PO ₄ , mg/l	0.23	0.94	0.94	0.95	0.96	0.95	0.28	0.29	0.38	0.32	0.35	0.35	0.45	0.2	1.0	0.6	0.4	0.3
13	Chloride as Cl, mg/l	17890	18820	18940	18600	18790	18825	1650	1780	19520	1450	14500	1580	17520	14500	19520	17792	18245	1497
14	Sulphate as SO ₄ , mg/l	1500	1400	1450	1455	1476	1488	1600	1580	1650	1200	1180	1200	1180	1180	1650	1442	1462	145
15	Sodium as Na, mg/l	9279	9680	9365	9140	8660	8690	7540	9010	9940	7140	8810	7140	8810	7140	9940	8875	9075	814
16	Potassium as K, mg/l	39	76	73	71	75	85	45.9	60.6	65.8	52.9	63.6	65.8	65.8	39.0	85.0	64.5	65.8	13.2
17	Calcium as Ca, mg/l	580	500	520	630	522	509	600	650	690	620	650	620	650	500	710	598	610	72
18	Magnesium as Mg, mg/l	1500	1525	1470	1544	1472	1470	1510	1500	1410	1480	1400	1480	1400	1310	1544	1466	1476	65
19	Silica as SiO ₂ , mg/l	4.76	3.80	3.60	3.92	3.90	3.00	3.60	3.20	2.90	3.40	3.20	2.70	2.70	2.7	4.8	3.5	3.5	0.6
20	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	-
21	Phenolic Comps, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	-
22	Arsenic as As, mg/l	BDL	-	-	BDL	-	BDL	-	BDL	-	BDL	-	BDL	-	-	-	-	-	-
23	Mercury as Hg, mg/l	BDL	-	-	BDL	-	BDL	-	BDL	-	BDL	-	BDL	-	-	-	-	-	-
24	Lead as Pb, mg/l	0.11	-	-	0.08	-	0.08	-	0.08	-	0.12	-	0.12	-	-	-	-	-	-
25	Cadmium as Cd, mg/l	BDL	-	-	BDL	-	BDL	-	BDL	-	BDL	-	BDL	-	-	-	-	-	-



 Comprehensive Environmental Impact Assessment for TNEB - NTPC JVC Thermal Power Project (2x500 MW)	
	Doc. No.: 0260/999/GEG/S/001
	Rev. No.: 0
	Issue Date: 25-05-2006 Page No.: 59 of 179

**Table No. 3.9.3
Characteristics of Back Water from Ennore Creek**

Sl. No.	Parameter	Month (July 2003 to June 2004)												Min	Max	Avg	Med	S.D.
		July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June					
1	pH	7.6	7.5	7.4	7.5	7.6	7.4	7.4	7.5	7.2	7.1	7.4	7.1	7.6	7.4	7.5	0.2	
2	Temperature, °C	28	27.8	27.2	26.5	26.4	26.4	27.4	27.8	29.4	30	30.5	26.3	30.5	27.8	27.6	1.4	
3	Conductivity, Γ /scm	28900	31000	30500	32500	33900	34845	3178	3472	32150	3138	3442	28900	34845	32437	32325	1848	
4	Suspended Solids, mg/l	95	98	94	90	93	95	92	82	85	86	82	80	96	89	91	6	
5	Dissolved Solids, mg/l	17500	18500	18400	28500	28818	28529	1851	1962	17850	1821	1942	17650	28818	20959	18505	4660	
6	Alkalinity, mg/l	190	210	205	210	200	203	180	190	185	190	210	195	210	197	198	10	
7	Hardness, mg/l	3430	3210	3285	3326	3395	3296	3320	3160	3390	3120	3120	3340	3430	3283	3308	107	
8	Dissolved Oxygen, mg/l	5.6	5	5.4	5.4	5.2	5.3	5.1	5	5.1	5.1	5	5.1	5.0	5.2	5.1	0.2	
9	B.O.D., mg/l	<4	<4	<4	5.0	5.0	4.0	3.6	4.1	4.5	4.6	4.1	5.5	3.6	5.5	4.5	0.6	
10	C.O.D, mg/l	23	22	18	21	20	19	15.2	15.9	16.8	15.2	16.2	16.4	15	23	18	3	
11	Nitrate as NO ₃ , mg/l	2.40	2.10	1.95	2.10	1.13	1.96	1.98	1.54	1.86	2.24	1.78	2.15	1.1	2.4	1.9	0.3	
12	Phosphate as PO ₄ , mg/l	0.80	0.97	0.97	0.86	0.92	0.96	0.89	0.97	0.98	0.89	0.97	0.98	0.8	1.0	0.9	0.1	
13	Chloride as Cl, mg/l	9400	8000	8500	8450	8550	8624	8100	8560	9100	7900	7560	8100	7560	9400	8475	513	
14	Sulphate as SO ₄ , mg/l	1250	1380	1190	1205	1198	1190	1290	1180	1250	1220	1140	1220	1140	1380	1226	62	
15	Sodium as Na, mg/l	3900	4100	4170	4560	5095	4945	3950	4180	4270	4050	4160	4200	3900	5095	4298	377	
16	Potassium as K, mg/l	400	408	402	390	380	385	390	410	425	410	430	425	380.0	430.0	404.6	16.5	
17	Calcium as Ca, mg/l	340	300	290	280	296	298	360	310	340	360	310	340	280	360	319	28	
18	Magnesium as Mg, mg/l	630	600	650	657	652	685	590	630	620	610	640	630	590	685	633	26	
19	Silica as SiO ₂ , mg/l	5.8	8.4	10.2	8.5	10.5	9.8	6.1	8.4	7.5	6.1	8.4	7.5	5.8	10.5	8.1	1.6	
20	Oil & Grease, mg/l	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	-	-	-	-	
21	Phenolic Comps, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	-	-	
22	Arsenic as As, mg/l	BDL	-	-	BDL	-	BDL	-	BDL	-	BDL	-	-	-	-	-	-	
23	Mercury as Hg, mg/l	BDL	-	-	BDL	-	BDL	-	BDL	-	BDL	-	-	-	-	-	-	
24	Lead as Pb, mg/l	0.12	-	-	BDL	-	BDL	-	BDL	-	BDL	-	-	-	-	-	-	
25	Cadmium as Cd, mg/l	BDL	-	-	BDL	-	BDL	-	BDL	-	BDL	-	-	-	-	-	-	
26	Hexaval. Chromium, mg/l	BDL	-	-	BDL	-	BDL	-	BDL	-	BDL	-	-	-	-	-	-	



	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001
		Rev. No.: 0
		Issue Date: 25-05-2006
		Page No.: 61 of 179



**Table No. 3.9.4
Characteristics of Surface Water from Edayanchavadi River**

Sl. No.	Parameter	Month (July 2003 to June 2004)												Min	Max	Avg	Med	S.D.			
		July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June								
1	pH	6.8	6.5	6.6	6.7	6.7	6.6	6.8	6.5	6.5	6.7	6.9	6.9	6.7	6.6	6.5	6.9	6.7	6.7	6.7	0.1
2	Temperature, °C	28.8	26.5	26.3	25.1	21.0	21.0	27.0	26.5	27.0	29.5	29.0	29.5	29.5	30.5	21.0	30.5	26.6	26.8	26.8	3.0
3	Conductivity, μ s/cm	2000	2350	2300	5126	5260	5200	5000	5500	5400	4800	5400	5200	4900	2000	5500	4420	5063	5063	1345	
4	Suspended Solids, mg/l	48	44	50	55	65	62	49	40	35	43	35	40	31	31	65	47	46	46	10	
5	Dissolved Solids, mg/l	1360	1400	1450	3540	3630	3526	3100	3410	3300	2800	3110	3100	3100	1360	3630	2811	3105	3105	880	
6	Alkalinity, mg/l	168	208	205	207	205	208	200	240	230	230	260	240	240	168	260	217	208	208	24	
7	Hardness, mg/l	740	810	780	2576	3020	3010	2320	2540	3100	2120	2340	2800	2800	740	3100	2180	2440	2440	898	
8	Dissolved Oxygen, mg/l	3.5	3.1	4.5	4.8	4.8	4.6	4.9	4.7	4.5	4.9	4.5	4.7	4.5	3.1	4.9	4.5	4.7	4.7	0.6	
9	B.O.D., mg/l	15.0	10.0	17.0	21.5	26.0	25.0	20.2	18.1	15.6	18.2	16.1	17.6	10.0	26.0	18.4	17.9	17.9	17.9	4.4	
10	C.O.D., mg/l	165	150	160	226	265	248	180	190	168	210	200	174	150	265	195	185	185	36		
11	Nitrate as NO ₃ , mg/l	17.3	17.0	15.8	12.6	10.8	11.0	13.5	14.4	16.5	16.5	16.5	16.5	16.5	10.8	17.3	14.8	15.6	15.6	2.3	
12	Phosphate as PO ₄ , mg/l	0.92	0.89	0.78	0.81	0.89	0.84	0.85	0.91	0.79	0.9	0.91	0.83	0.8	0.9	0.9	0.9	0.9	0.9	0.0	
13	Chloride as Cl, mg/l	700	730	750	1976	2268	2298	1800	1990	1850	1700	1890	1850	700	2298	1650	1850	1850	584		
14	Sulphate as SO ₄ , mg/l	20	18	21	33	39	38	86	78	84	80	74	82	18	86	54	57	57	28		
15	Sodium as Na, mg/l	182	180	184	312	388	380	350	390	310	320	370	310	180	390	306	316	316	81		
16	Potassium as K, mg/l	10	10	11	37	45	40	35.1	32.5	38.1	32.1	28.5	33.1	10.0	45.0	29.4	32.8	32.8	12.2		
17	Calcium as Ca, mg/l	135	130	125	225	252	229	250	290	310	240	270	280	125	310	228	245	245	64		
18	Magnesium as Mg, mg/l	100	120	115	512	565	562	410	440	490	410	440	490	100	565	388	440	440	174		
19	Silica as SiO ₂ , mg/l	4.2	3.7	3.5	6.1	7.0	7.2	6.2	6.8	7.3	5.2	5.8	6.3	3.5	7.3	5.8	6.2	6.2	1.3		
20	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL		
21	Phenolic Compds, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL		
22	Arsenic as As, mg/l	BDL	-	-	BDL	-	-	BDL	-	-	BDL	-	-	-	-	-	-	-	-		
23	Mercury as Hg, mg/l	BDL	-	-	BDL	-	-	BDL	-	-	BDL	-	-	-	-	-	-	-	-		
24	Lead as Pb, mg/l	BDL	-	-	BDL	-	-	BDL	-	-	BDL	-	-	-	-	-	-	-	-		
25	Cadmium as Cd, mg/l	BDL	-	-	BDL	-	-	BDL	-	-	BDL	-	-	-	-	-	-	-	-		
26	Hexaval. Chromium, mg/l	BDL	-	-	BDL	-	-	BDL	-	-	BDL	-	-	-	-	-	-	-	-		
27	Total Chromium, mg/l	BDL	-	-	BDL	-	-	BDL	-	-	BDL	-	-	-	-	-	-	-	-		
28	Copper as Cu, mg/l	0.029	-	-	0.09	-	-	0.11	-	-	0.11	-	-	0.03	0.11	0.08	0.10	0.10	0.04		



 एनटीसी NTPC	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001
		Rev. No.: 0
		Issue Date: 25-05-2006
		Page No.: 63 of 179



**Table No. 3.9.5
Characteristics of Ground Water from kathivakkam**

Sl. No.	Parameter	Month (July 2003 to June 2004)												Min	Max	Avg	Med	S.D.
		July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June					
1	pH	6.8	6.9	6.8	6.9	7.1	7.0	7.1	7.5	6.9	7.2	7.3	6.8	7.6	7.1	7.1	0.3	
2	Temperature, °C	28.0	27.8	27.0	27.5	28.3	29.0	29.0	29.5	28.6	30.0	30.6	27.0	32.5	29.0	28.8	1.5	
3	Conductivity, μ scm	2260	2210	2320	2300	2452	2645	2300	2700	2750	2100	2500	2100	2750	2432	2386	215	
4	Suspended Solids, mg/l	103	110	105	65	70	60	40	50	55	45	52	40	110	68	60	24	
5	Dissolved Solids, mg/l	1412	1400	1430	1550	1620	1580	1780	1650	1700	1680	1550	1400	1780	1591	1600	128	
6	Alkalinity, mg/l	158	205	200	210	225	230	220	250	240	210	240	158	250	217	220	24	
7	Hardness, mg/l	970	940	935	1260	1355	1460	1780	1430	1570	1740	1420	935	1780	1367	1425	291	
8	Dissolved Oxygen, mg/l	5.0	5.0	5.6	5.1	5.4	5.2	5.0	5.2	5.4	5.0	5.2	5.0	5.6	5.2	5.2	0.2	
9	B.O.D., mg/l	6.0	5.0	5.0	3.2	4.5	3.8	3.6	6.1	3.8	3.4	6.6	3.2	6.6	4.6	4.5	1.1	
10	C.O.D., mg/l	24	23	25	15	18	17	14.8	18.2	15.6	16.8	20.2	15	25	19	18	4	
11	Nitrate as NO ₃ , mg/l	2.48	2.39	2.41	2.50	2.85	1.90	2.50	2.05	1.98	2.80	2.20	1.4	2.9	2.3	2.4	0.4	
12	Phosphate as PO ₄ , mg/l	0.81	0.94	0.95	0.85	0.92	0.88	0.87	0.85	0.98	0.86	0.81	0.8	1.0	0.9	0.9	0.1	
13	Chloride as Cl, mg/l	750	720	730	770	818	910	950	900	940	910	870	720	950	849	885	86	
14	Sulphate as SO ₄ , mg/l	50	53	55	52	56	50	50	52	48	60	62	48	62	54	53	4	
15	Sodium as Na, mg/l	138	135	136	125	130	118	110	95	90	140	105	90	140	118	122	18	
16	Potassium as K, mg/l	14	16	19	12	14	10	9	7	8	10	8	7.1	19.0	11.4	10.0	3.7	
17	Calcium as Ca, mg/l	130	110	115	130	140	160	200	160	175	180	140	110	200	150	150	27	
18	Magnesium as Mg, mg/l	160	165	160	234	251	265	310	250	275	280	260	160	310	242	256	53	
19	Silica as SiO ₂ , mg/l	2.8	5.0	4.1	5.2	4.8	5.8	6.1	5.4	6.8	6.1	5.4	2.8	6.8	5.4	5.4	1.1	
20	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	
21	Phenolic Compds, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	
22	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	
23	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	
24	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	
25	Cadmium as Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	
26	Hexaval. Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	
27	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	
28	Copper as Cu, mg/l	0.18	-	-	0.16	-	-	0.15	-	-	0.21	-	0.15	0.21	0.18	0.17	0.03	





**Comprehensive Environmental
Impact Assessment for TNEB –
NTPC JVC Thermal Power
Project (2x500 MW)**

Doc. No.: 0260/999/GEG/S/001
Rev. No.: 0
Issue Date: 25-05-2006
Page No.: 65 of 179



**Table No. 3.9.6
Characteristics of ground Water from Kurvelmedu**

Sl. No.	Parameter	Month (July 2003 to June 2004)												Min	Max	Avg	Med	S.D.
		July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June					
1	pH	8.8	8.8	8.7	8.5	8.6	8.3	8.3	8.2	8.4	8.4	8.1	8.3	8.1	8.8	8.5	8.4	0.2
2	Temperature, °C	28.9	28.8	27.5	27.0	26.5	26.6	28.5	29.6	27.6	30.5	26.5	29.6	26.5	30.6	28.5	28.7	1.4
3	Conductivity, s/cm	2500	2400	2800	2760	2748	2695	2800	2700	2750	2600	2400	2550	2400	2800	2642	2698	148
4	Suspended Solids, mg/l	10	7	12	15	20	20	8	6	5	8	5	5	5	20	10	8	5
5	Dissolved Solids, mg/l	1520	1470	1700	1660	1590	1530	1720	1650	1700	1620	1470	1600	1470	1720	1609	1610	80
6	Alkalinity, mg/l	210	248	240	185	199	200	200	180	210	200	180	210	180	248	205	200	21
7	Hardness, mg/l	1055	1120	1090	1120	1062	1080	1050	1050	1200	1020	1020	1300	1020	1300	1097	1071	81
8	Dissolved Oxygen, mg/l	5.6	5.6	5.8	5.6	5.0	5.5	3.8	3.0	2.9	4.8	2.9	3.9	2.9	5.8	4.6	4.9	1.1
9	B.O.D., mg/l	6.2	5.9	5.2	4.5	5.1	5.4	5.2	5.1	5.4	4.2	4.1	4.4	4.1	6.2	5.1	5.2	0.7
10	C.O.D, mg/l	20	18	16	16	18	21	16	14	13	18	13	17	13	21	17	17	2
11	Nitrate as NO3, mg/l	2.2	2.1	2.1	2.1	2.0	2.1	2.1	1.8	2.0	2.2	1.8	2.1	1.8	2.2	2.1	2.1	0.1
12	Phosphate as PO4, mg/l	0.62	0.73	0.72	0.78	0.95	0.94	0.75	0.99	0.85	0.85	0.6	0.95	0.6	1.2	0.9	0.9	0.2
13	Chloride as Cl, mg/l	750	640	840	790	765	806	1050	900	950	1020	640	850	640	1050	847	823	117
14	Sulphate as SO4, mg/l	34.6	23	33	35	34	36	30	35	32.5	32	23	31.5	23	36	32	33	3
15	Sodium as Na, mg/l	121	128	124	128	132	130	120	128	130	130	120	125	120	138	128	128	5
16	Potassium as K, mg/l	41	48	46	45	42	35	29.9	31.5	35.1	30.9	29.9	34.1	29.9	48.0	37.5	35.1	6.5
17	Calcium as Ca, mg/l	238	272	270	264	245	250	240	250	280	250	238	270	238	280	257	255	14
18	Magnesium as Mg, mg/l	117	105	104	115	112	114	108	105	120	102	102	110	102	120	110	109	6
19	Silica as SiO2, mg/l	3.1	5.2	4.4	4.7	5.1	5.2	5.4	3.6	3.1	5.2	3.1	3.4	3.1	5.4	4.3	4.6	0.9
20	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	-
21	Phenolic Compds, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	-
22	Arsenic as As, mg/l	BDL	-	-	BDL	-	BDL	-	BDL	-	BDL	-	-	-	-	-	-	-
23	Mercury as Hg, mg/l	BDL	-	-	BDL	-	BDL	-	BDL	-	BDL	-	-	-	-	-	-	-
24	Lead as Pb, mg/l	BDL	-	-	BDL	-	BDL	-	BDL	-	BDL	-	-	-	-	-	-	-
25	Cadmium as Cd, mg/l	BDL	-	-	BDL	-	BDL	-	BDL	-	BDL	-	-	-	-	-	-	-
26	Hexaval. Chromium, mg/l	BDL	-	-	BDL	-	BDL	-	BDL	-	BDL	-	-	-	-	-	-	-
27	Total Chromium, mg/l	BDL	-	-	BDL	-	BDL	-	BDL	-	BDL	-	-	-	-	-	-	-
28	Copper as Cu, mg/l	0.03	-	-	0.05	-	-	0.08	-	-	0.12	-	-	0.03	0.12	0.07	0.07	0.04



	Comprehensive Environmental Impact Assessment for TNEB - NTPC JVC Thermal Power Project (2x500 MW)		
	Doc. No.: 0260/999/GEG/S/001		
	Rev. No.: 0		
	Issue Date: 25-05-2006 Page No.: 67 of 179		

**Table No. 3.9.7
Characteristics of Ground Water from Valivayachavdi**

Sl. No.	Parameter	Month (July 2003 to June 2004)												Min	Max	Avg	Med	S.D.
		July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June					
1	pH	8.5	8.6	8.8	8.7	8.5	8.6	8.3	8.0	7.9	8.2	8.1	8.4	7.9	8.8	8.4	8.5	0.3
2	Temperature, °C	28.5	26.0	26.0	26.5	26.0	26.8	27.5	28.6	28.8	29.5	30.6	30.8	26.0	30.8	28.0	28.0	1.8
3	Conductivity, s/cm	826	810	865	850	840	860	810	830	780	780	810	790	780	865	821	818	29
4	Suspended Solids, mg/l	12	10	11	10	10	15	12	10	8	12	10	8	8	15	11	10	2
5	Dissolved Solids, mg/l	500	475	470	460	455	470	450	480	460	410	430	450	410	500	459	460	23
6	Alkalinity, mg/l	190	200	200	185	180	170	160	150	160	170	160	170	150	200	175	170	16
7	Hardness, mg/l	300	230	242	240	245	235	240	240	245	230	220	225	220	300	241	240	20
8	Dissolved Oxygen, mg/l	3.6	4.2	4.6	4.5	4.3	4.4	4.8	4.6	4.5	4.8	4.6	4.5	3.6	4.8	4.5	4.5	0.3
9	B.O.D., mg/l	<4	<4	<4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	-	-	-
10	C.O.D, mg/l	6	8	9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	-	-	-
11	Nitrate as NO ₃ , mg/l	2.51	2.42	2.48	2.32	2.18	2.15	1.59	1.98	2.05	1.65	1.68	2.2	1.6	2.5	2.1	2.2	0.3
12	Phosphate as PO ₄ , mg/l	0.32	0.46	0.36	0.28	0.31	0.36	0.25	0.30	0.35	0.35	0.40	0.45	0.3	0.5	0.3	0.4	0.1
13	Chloride as Cl, mg/l	120	100	110	112	124	118	130	140	150	140	150	160	100	160	130	127	19
14	Sulphate as SO ₄ , mg/l	19	15	19	18	20	18	25	20	15	35	30	25	15	35	22	20	6
15	Sodium as Na, mg/l	35	34	36	28	21	29	30	34	39	35	34	40	21	40	33	34	5
16	Potassium as K, mg/l	4.4	4.5	4.6	5.1	4.8	4.2	3.9	3.8	4.1	4.1	4.2	4.3	3.8	5.1	4.3	4.3	0.4
17	Calcium as Ca, mg/l	75	58	60	60	54	56	45	58	50	45	62	56	45	75	57	57	8
18	Magnesium as Mg, mg/l	28	20	22	23	28	24	30	20	29	32	25	27	20	32	26	26	4
19	Silica as SiO ₂ , mg/l	4.8	3.7	4.6	3.2	3.5	2.9	3.5	3.9	4.1	3.6	3.7	4.4	2.9	4.8	3.8	3.7	0.6
20	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	-	-	-
21	Phenolic Compds, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-	-	-	-
22	Arsenic as As, mg/l	BDL	-	-	BDL	-	-	BDL	-	-	BDL	-	-	-	-	-	-	-
23	Mercury as Hg, mg/l	BDL	-	-	BDL	-	-	BDL	-	-	BDL	-	-	-	-	-	-	-
24	Lead as Pb, mg/l	BDL	-	-	BDL	-	-	BDL	-	-	BDL	-	-	-	-	-	-	-
25	Cadmium as Cd, mg/l	BDL	-	-	BDL	-	-	BDL	-	-	BDL	-	-	-	-	-	-	-
26	Hexaval. Chromium, mg/l	BDL	-	-	BDL	-	-	BDL	-	-	BDL	-	-	-	-	-	-	-
27	Total Chromium, mg/l	BDL	-	-	BDL	-	-	BDL	-	-	BDL	-	-	-	-	-	-	-
28	Copper as Cu, mg/l	0.026	-	-	0.016	-	-	0.01	-	-	0.021	-	-	0.02	0.03	0.02	0.02	0.00



	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 69 of 179	

3.10 METEOROLOGY

The climate at the site is characterized by oppressive summer. Dampness in the air remains throughout the year because of its vicinity to the Bay of Bengal.

The climate of the project area can be divided into following four seasons:

- | | | |
|------|-----------------------|------------------------|
| i. | Winter | (December to February) |
| ii. | Summer or Pre-monsoon | (March to May) |
| iii. | Southwest Monsoon | (June to September) |
| iv. | Northeast Monsoon | (October to November) |

The northeast monsoon period is the main rainy season of the area. A fully instrumented continuous recording meteorological on-site observatory was established and operated at the project site for a period of one year, i.e., from July 2003 to June 2004. The following parameters were recorded and/or measured: temperature at 2 m and 10 m level, barometric pressure, relative humidity, wind speed and direction, solar intensity and rainfall.

However, the past decade meteorological data from the nearest India Meteorological Department (IMD) observatory at Chennai (Nungambakkam Observatory), which is about 15 km in south from the project area, has been collected for background purposes. The comparison between synoptic meteorological data and on-site meteorological data of the study area has been made.

3.10.1 Climatological Data

The latest meteorological data from the nearest IMD station at Chennai (Nungambakkam) is processed and in this report the meteorological data for the period 1992 – 2000 has been discussed, which may be representative of the climatic conditions for the project site in general. The observatory records the meteorological parameters twice in a day at 08:30 and 17:30 hrs IST (Indian Standard Time). These data are used to compare observed data at the project site.

The monthly mean values of the various meteorological parameters for the period of 1992-2000 are presented in Table – 3.10.1. A brief description of the data related to the temperature, relative humidity, rainfall, barometric pressure, wind pattern, cloud cover and occurrence of inversions and other weather phenomena are described in the following paragraphs.

Temperature

The monthly mean values for temperature of past decade (1992-2000) are presented in Table 3.10.1. It is observed that from the February, the ambient temperature gradually rise till May, which is the hottest month of the year with a maximum and minimum of 44.1°C and 21.8°C respectively. With the advancement of the Southwest monsoon around July, there is

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 70 of 179	

drop in the day temperature but the night still continued to be warm. With the onset of northeast monsoon the temperature drops to its lowest of about 24°C and remains till mid February. The diurnal temperature variation throughout the year varies around 2 - 3°C, indicator of a typical coastal area climate.

The decrease in temperature starts from the October and is rapid from November. January - December are the coldest months.

The extreme lowest temperature recorded was 13.9°C on January 29, 1905 and the highest was 45.0°C on May 21, 1910. The annual mean of maximum and minimum temperature was 37.7°C and 20.6°C respectively.

Relative Humidity

The annual relative humidity of the area varies from 61.2 to 84.7%, the lowest being in the month of June and maximum in the month of November. Relative humidity remains high during October to January i.e. during the northeast monsoon and winter. The annual mean is 76.2% in the morning and 68.6 % in the afternoon.

Rainfall

About 61% of the normal rainfall is received during northeast monsoon month i.e. October to December. The average annual rainfall is 1124.4mm and there are average 49.6 rainy days in a year. The rainiest month is November and the driest month is March. The heaviest rainfall in 24 hrs recorded during the last decade was 44.1 mm on November 01, 1999 and during the last century it was 452.4 mm on November 25, 1976.

Barometric Pressure

The analysis of the observed data shows that the barometric pressure recorded at 08:30hrs is higher than the pressure recorded at 17:30hrs IST due to the diurnal variation of air density near the earth surface. The mean maximum barometric pressure is recorded during January with 1014.4 and 1011.3 mbar at 05:50 and 17:30 hrs respectively. The mean minimum barometric pressure is recorded during June with 1004.4 and 1000.9 mbar at 05:30 and 17:30 hrs respectively. The annual mean of barometric pressure is 1009.5 and 1005.9 mbar at 05:30 and 17:30 hrs respectively.

Wind Strength

Analysis of wind records during 1992 – 2000 shows that the winds are generally light to moderate in this area. It can be seen that the annual mean wind speed is 5.5 Km/h. Wind speed is higher in the evening than in the morning. The strongest winds are observed during May – June i.e. Summer Season and the weakest during northeast monsoon i.e. October – November.



**Comprehensive Environmental
Impact Assessment for TNEB -
NTPC JVC Thermal Power
Project (2x500 MW)**

Doc. No.: 0260/999/GEG/S/001
Rev. No.: 0
Issue Date: 25-05-2006
Page No.: 71 of 179



Table 3.10.1 : Climatological Table Based on the Observations at Nungambakkam Observatory (1992-2000)

Month	Barometric Pressure mbar	AIR TEMPERATURE						Relative Humidity %	Cloud Octas	Monthly total mm	RAIN FALL				Mean Wind Speed Kmph	
		Dry Bulb °C	Wet Bulb °C	Mean		Extreme					No. of Rainy Days	Heaviest Rain Fall in 24 Hrs. mm	Date & Year			
				Highest in the Month	Lowest in the Month	Highest	Lowest							Date and Year		Date and Year
JAN	I 1014.4	24.0	21.9	33.0	16.7	33.0	23	16.7	26	82.0	1.8	22.4	1.0	0.0	0	3.0
	II 1011.3	26.3	22.2				1998		1992	68.1	1.7				0	6.3
FEB	I 1013.0	25.4	23.1	35.0	18.7	35.0	20	18.7	20	81.1	1.7	24.8	0.7	0.2	26	3.0
	II 1009.8	27.9	23.5				1993		1993	67.1	1.0				1999	6.7
MAR	I 1011.4	27.2	24.4	37.1	19.7	37.1	4	19.7	20	78.2	1.7	3.4	0.2	0.6	20	3.6
	II 1007.7	29.8	25.0				1992		2000	66.0	0.5				2000	6.9
APR	I 1008.9	29.8	26.4	41.6	23.7	41.6	16	23.7	16	74.4	2.6	12.0	0.8	14.0	16	4.3
	II 1005.2	31.0	26.7				1999		1999	69.6	0.6				1999	7.9
MAY	I 1006.0	31.2	26.4	44.1	21.8	44.1	30	21.8	14	67.2	1.3	33.6	1.7	7.4	10	5.7
	II 1002.4	32.1	27.4				1998		1996	67.9	1.0				1999	7.6
JUN	I 1004.4	30.6	25.4	42.5	22.0	42.5	01	22.0	20	64.0	0.9	59.6	2.9	5.3	16	5.9
	II 1000.9	32.6	26.6				1998		2000	61.2	2.0				1992	8.3
JUL	I 1007.8	29.3	25.0	39.3	22.5	39.3	01	22.5	17	69.4	1.3	71.9	4.9	21.4	02	5.0
	II 1001.4	31.7	26.3				1994		2000	63.9	2.3				1993	6.9
AUG	I 1006.1	28.5	24.9	38.1	21.4	38.1	07	21.4	17	73.3	1.4	91.4	6.2	8.8	30	4.5
	II 1002.6	31.4	26.1				1994		1992	64.8	2.3				2000	6.6
SEP	I 1007.3	28.6	25.3	37.9	21.7	37.9	02	21.7	22	75.8	1.5	119.1	6.3	20.4	04	4.2

Lat 13°04'

Long 80°15'

Height above M.S.L.

6 m

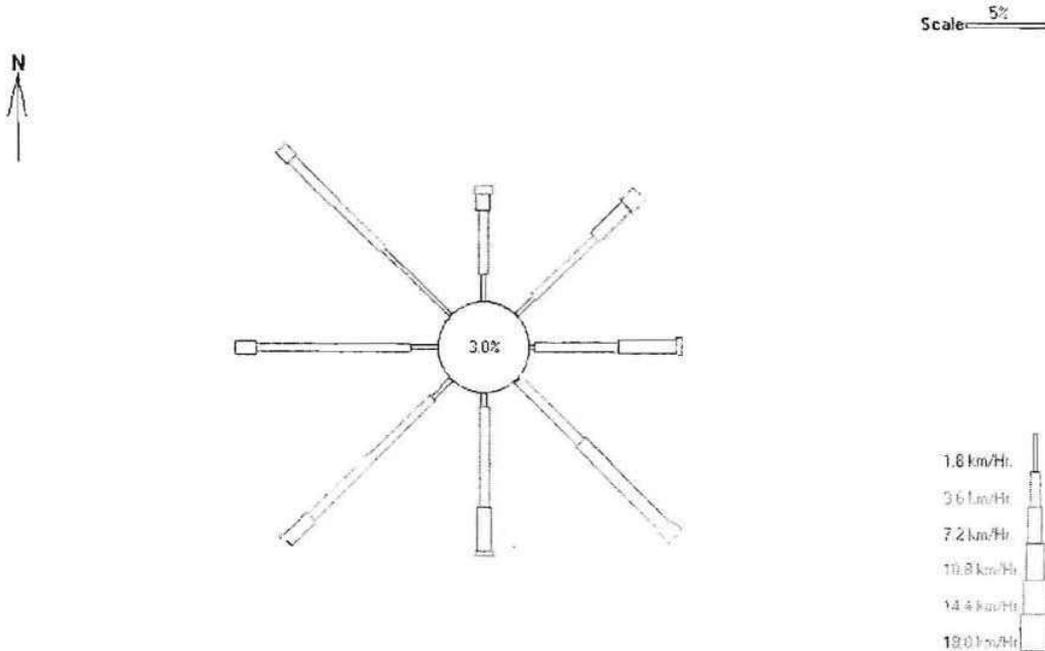
	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 73 of 179	

Wind Pattern

The wind pattern data shows the seasonal changes in wind directions. The annual windrose shows the winds coming from all directions (Figure 3.10.1).

In the summer season i.e. March – June, predominant wind direction is SE for about 53.5% during 08:30 hrs and S – SW for 54.24% during 17:30 hrs.

In the southwest monsoon season i.e. July – September, the predominant wind directions during 08:30 hrs are SW – W sector for about 80.7%. Predominant wind directions during 17:30 hrs are SE, S and SW for 28.76%, 18.06% and 16.05% respectively.



**Figure 3.10.1: Annual Windrose Diagram at Nungambakkam
Based on IMD DATA (1992-2000)**

In the northeast monsoon season, October – November, the predominant wind directions during 08:30hrs are NW for 38.46% of the days. During 17:30 hrs the wind mainly blows from NE for 33.33% of the days.

In the winter season i.e. December to February, the winds blow predominantly from NW for 40.4% during 08:30 hrs and changed to NE for 41.49% during 17:30 hrs.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 74 of 179	

The area falls under the coastal region, therefore, the phenomenon of land and sea breeze can be distinctly observed in the diurnal changes in wind directions at Nungambakkam.

The important point observed that the wind blows in the morning (08:30hrs) from land to sea and shifts almost by 180° clockwise in the evening (17:30hrs) when winds started blowing from sea to land. This diurnal variation is shown in Figure 3.10.2.

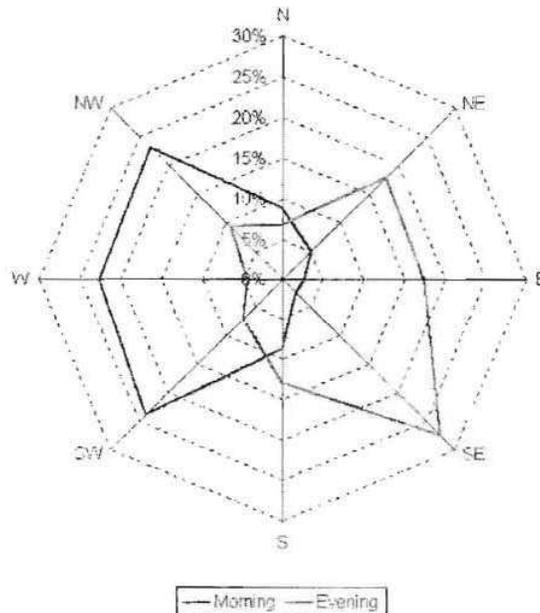


Figure 3.10.2: Diurnal Variations on the Wind Direction

Cloud Cover

The sky generally remains clouded throughout the year. It remains over clouded mainly during monsoon season.

Special Weather Phenomena

The thunder is the common weather phenomena associated with rain, which occurs mostly during the monsoon seasons. Occasional fog occurs during winter season.

Inferences

The analysis of climatological data supports the **Tropical Coastal** type of climate of the study area. The following characteristics are observed:

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001 Rev. No.: 0 Issue Date: 25-05-2006 Page No.: 75 of 179	
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1. Warm and humid climate, the average maximum temperature varies from 31.2 to 44.1 °C.
2. High Relative Humidity, it varies from 61.2 – 84.7% throughout the year.
3. Diurnal Temperature changes is very small i.e. 3-4°C.
4. Diurnal variation in Pressure
5. There are two Monsoon seasons, however the rain during northeast monsoon is maximum
6. There is complete change in day and night wind pattern.

3.10.2 Meteorological Observation at Kathivakkam

A fully instrumented continuous recording meteorological observatory is established and operated within the project site at Anna Nagar, Kathivakkam, from July, 2003 to June, 2004. The following parameters are being measured: - Temperature at 2 m and 10 m level, barometric pressure, relative humidity, wind speed and direction, solar intensity and duration, and rainfall. The brief details of instruments, parameter and frequency are presented in Table 3.10.2

**Table 3.10.2: Instruments, Parameters and Frequency of
Meteorological Monitoring at Site**

S. N.	Parameters	Instruments	Frequency
1	Wind Speed	Automatic Weather station (Envirotech WM 251)	Continuous Automatic 1 hourly Average
2	Wind Direction		
3	Ambient Temperature at Two Heights 2m & 10m		
4	Solar Insolation		
5	Max. & Min Temperature	Wet & Dry Bulb Thermometer	Daily at 08:30 & 17:30 IST
6	Humidity	Hygrometer	Daily at 08:30 & 17:30 IST
7	Atmospheric Pressure	Aneroid Barometer	Daily at 08:30 & 17:30 IST
8	Rainfall	Rain Gauge	Daily if rainfall is > 2.5mm
9	Other Parameters	Visual observation and data interpretation	As and when occur

The aforesaid meteorological parameters were being observed in the field over a period of 12-months starting from July, 2003 to June, 2004, which represents the pre monsoon season. The meteorological data recorded at site is given in Table 3.10.3.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 76 of 179	

**Table No. 3.10.3: Recorded Meteorological Data at Site
(July 2003–June 2004)**

Month	Temperature, °C			Relative Humidity, %			Rainfall		Barometric Pressure, mbar		Wind Speed, Km/Hr		
	Min	Max	Mean	Min	Max	Mean	Rainy Days	Total Rainfall, mm	At 08:30	At 17:30	Min	Max	Mean
July	26.1	32.1	28.5	61.9	89.8	82.7	4	19.0	1001.2	1001.4	6.3	9.4	7.6
August	25.8	33.0	28.9	60.0	92.1	85.4	4	54.2	1001.7	1002.2	5.4	9.4	7.5
September	26.4	32.7	29.2	60.3	91.9	82.4	3	45.0	1001.7	1001.5	5.8	8.7	7.3
October	22.9	35.1	27.9	45.0	99.0	86.2	13	175.5	1008.2	1007.3	0.0	14.1	5.2
November	20.0	32.6	27.4	49.0	99.0	79.0	10	64.85	1009.8	1007.6	0.8	11.0	5.8
December	19.6	30.6	25.5	26.5	99.0	82.4	4	87.7	1011.2	1010.8	1.5	12.4	5.8
January	17.9	29.6	25.4	50.0	99.0	76.0	2	22.0	1011.4	1011.2	0.4	11.6	5.7
February	19.0	30.7	25.9	49.0	99.2	72.0	0	0	1010.9	1010.4	1.2	11.5	5.2
March	19.5	32.0	28.0	34.8	99.0	84.2	0	0	1010.7	1009.8	0.5	19.8	5.7
April	23.5	33.6	29.0	7.7	99.0	88.0	0	0	1008.2	1007.5	0.1	45.6	9.8
May	24.2	38.3	29.5	23.7	99.6	82.3	9	117.3	1006.8	1006.2	0.3	69.2	7.3
June	22.0	37.5	30.3	6.0	99.0	74.0	2	2.2	1006.4	1005.9	0.3	17.1	7.9

The analysis of the field observation is given below:

Ambient Temperature

The monthly mean of minimum, maximum and average temperature for July were 26.1, 32.1 & 28.5°C, for August 25.8, 33.0 & 28.9°C and for September 26.4, 32.7 & 29.2°C respectively. Minimum temperature were recorded during January 2004 where as maximum temperature were recorded during May 2004. Details are given in Table No.3.10.3.

Relative Humidity

The monthly mean of minimum, maximum and average relative humidity for July were 61.9, 89.8 & 80%; for August 60.0, 92.1 & 80.8% and for September 60.3, 91.9 & 80.2% respectively. Details are given in Table No.3.10.3.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 77 of 179	

Barometric Pressure

The monthly mean of average barometric pressure were 1001.32 & 1001.39 mbar in July, 1001.72 & 1002.24mbar in August, 1004.49 & 1001.49mbar in September respectively at 08:30hrs and 17.30hrs respectively. Details are given in Table No.3.10.3.

Rainfall

The total monthly rainfall during July, August and September were 17.8, 54.2 and 54.0mm respectively. The number of rainy days during July, August, September was - 4, 4 and 3 respectively. Maximum number of Rainy days and maximum amount of Rain occurred during the month of October 2003. Details are given in Table No.3.10.3.

Wind Strength

Analysis of hourly wind speed shows that the winds are generally light to moderate in this area. The monthly mean of minimum, maximum and average wind speed for July were, 6.3, 9.4 & 7.6 Km/h for August 5.4, 9.4 & 7.5 Km/h; for September 5.8, 8.7 & 7.3 Km/h respectively.

The hourly maximum wind speed observed was 17.5, 15.6 and 16.7 km/h during July, August and September respectively. Details are given in Table No.3.10.3.

Wind Pattern

The windrose diagram for July, August and September 2003 has been drawn on the basis of hourly wind speed and direction data. During the month of July, the predominant wind direction was SE (11.17%) and in August, it was WSW (23.96%), W (20.19%) and during September the winds were blowing predominantly from SE (17.94%) and W - WSW (13.77 – 14.33%) sector.

The annual and monthly windrose diagrams are presented in Fig 3.10.3 to 3.10.15.

Solar Radiation

The solar radiation was directly measured used solar radiation sensor. The monthly average solar radiation received during July was 24 langley/hr, 30 langley/hr during August and 36 langley/hr during September respectively.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 79 of 179	

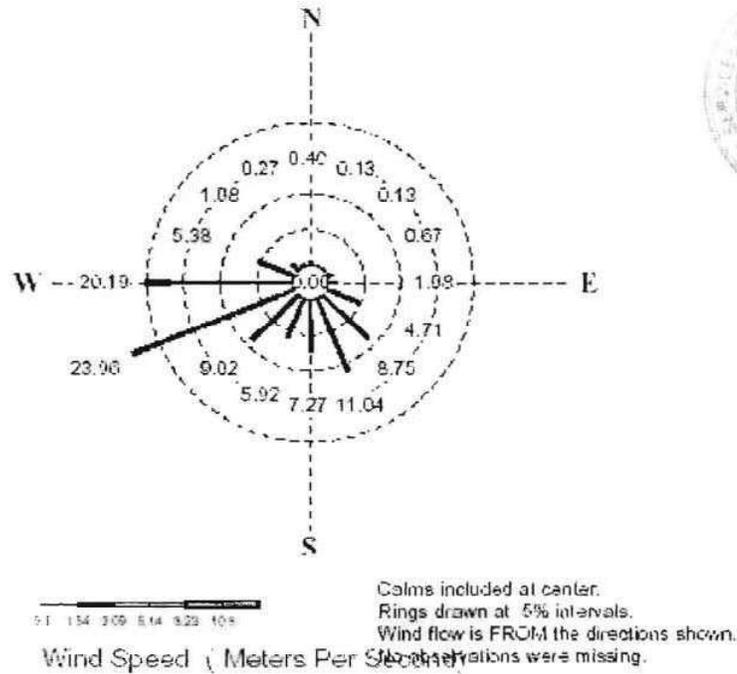
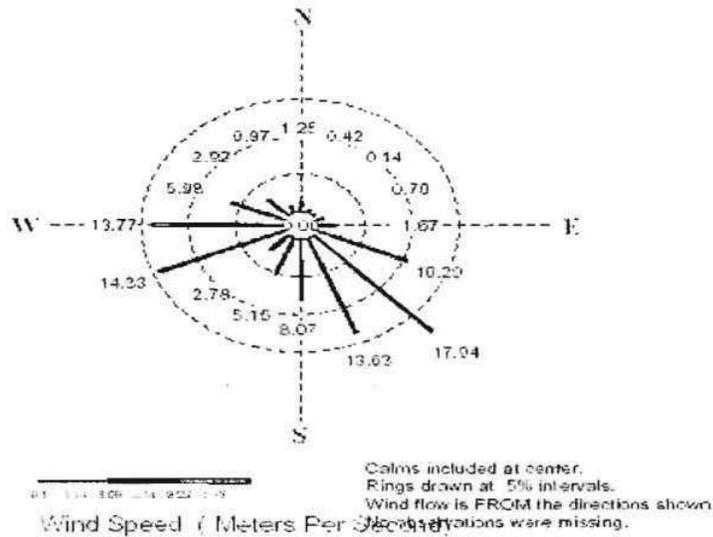
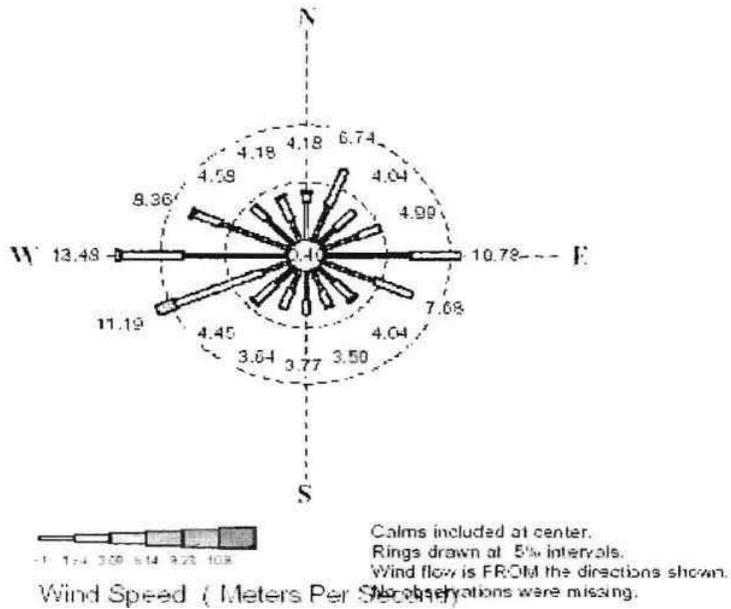


Fig. 3.10.5 Monthly Wind Rose -August



3.10.6 Monthly Wind Rose –September

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 80 of 179	



3.10.7 Monthly Wind Rose -October

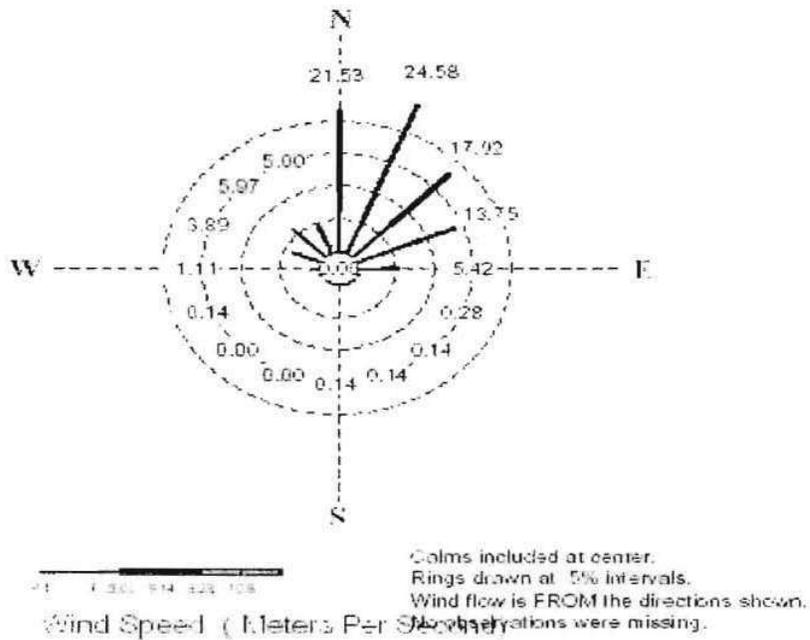


Fig. 3.10.8 Monthly Wind Rose –November

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 81 of 179	

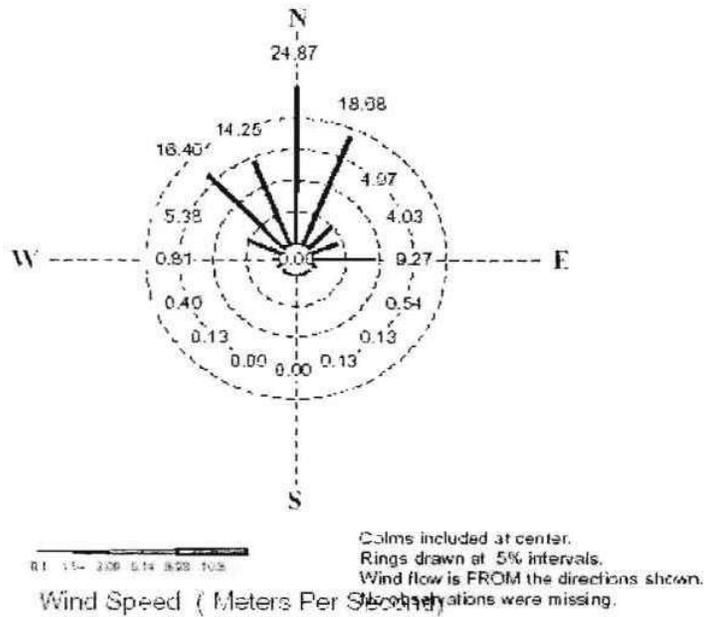


Fig. 3.10.9 Monthly Wind Rose –December

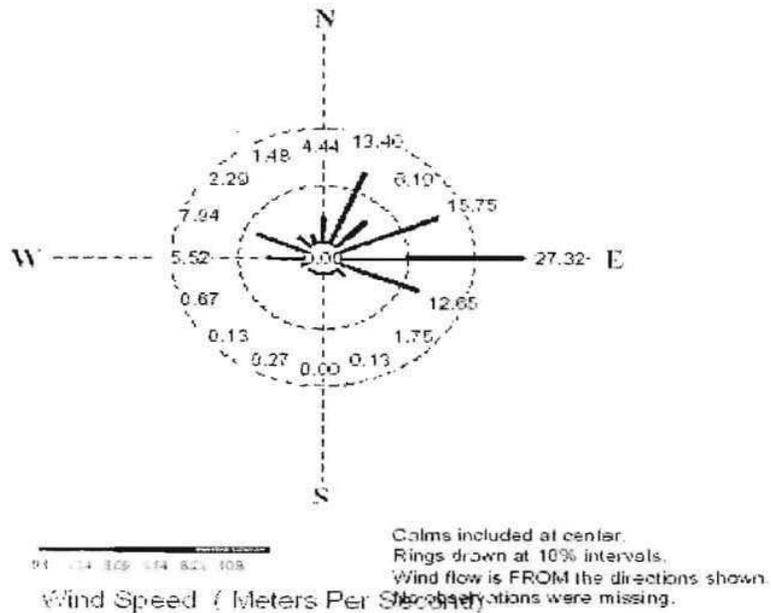


Fig. 3.10.10 Monthly Wind Rose –January

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 82 of 179	

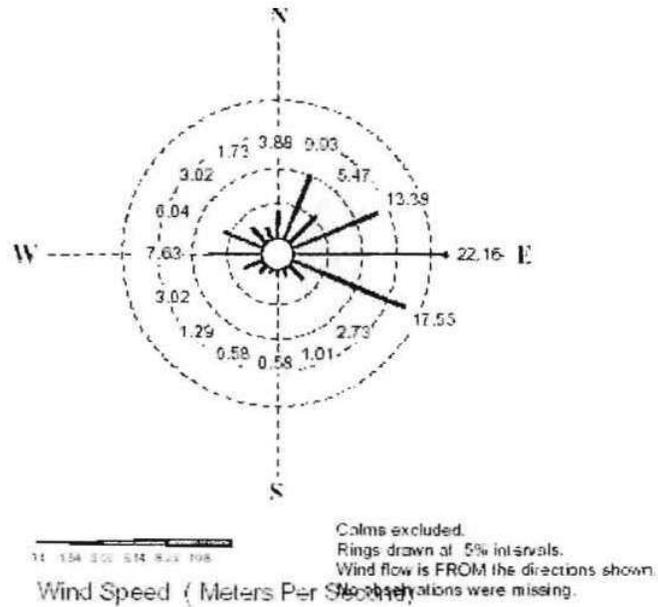


Fig. 3.10.11 Monthly Wind Rose –February

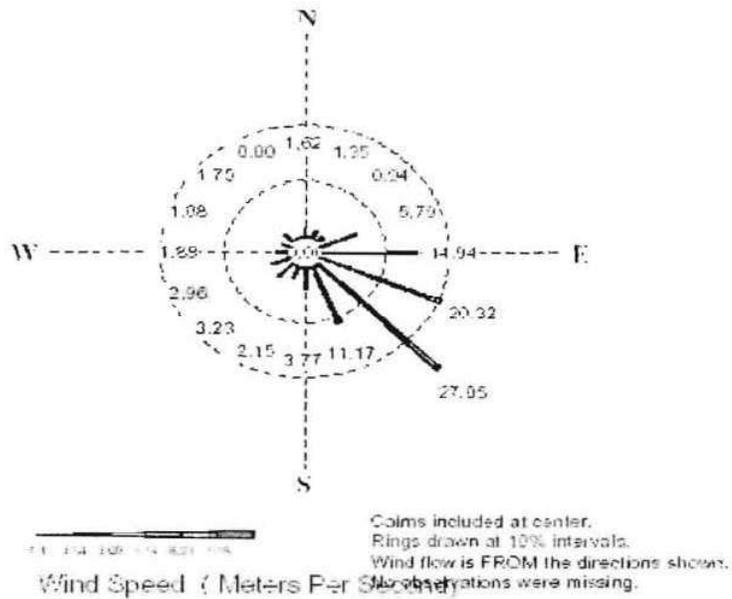


Fig. 3.10.12 Monthly Wind Rose –March

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 83 of 179	

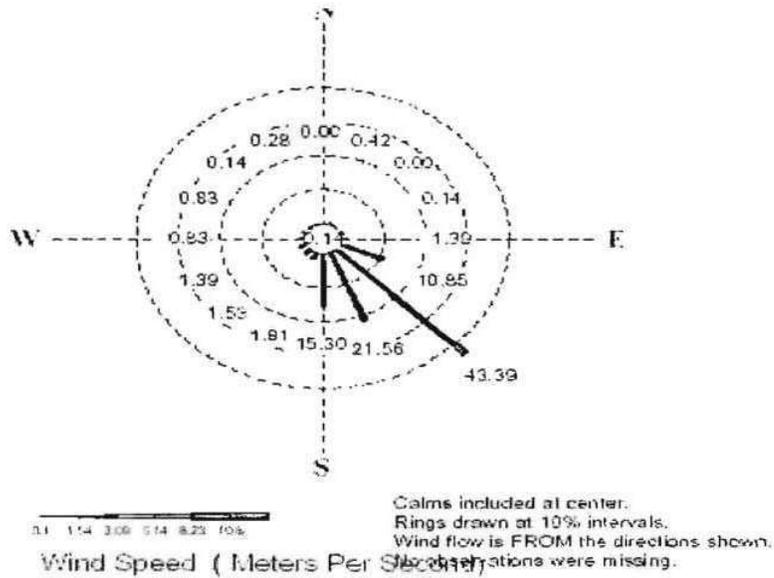


Fig. 3.10.13 Monthly Wind Rose –April

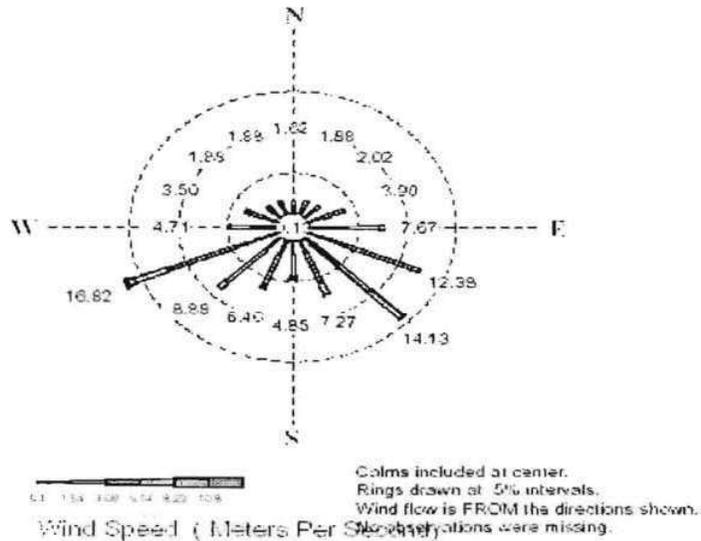


Fig. 3.10.14 Monthly Wind Rose –May

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 85 of 179	

Inferences:

The analysis of the onsite meteorological data confirm the typical coastal type climate inferred from the synoptic meteorological data on the followings observations:

1. The climate is humid, the average humidity during the southwest monsoon months vary from 82.7 to 85.4%.
2. There are no significant changes in Diurnal Temperature.
3. The phenomenon of land breeze and sea breeze is quite significant and this will help in proper dispersion of air pollutants into the atmosphere.

3.11 SEDIMENT QUALITY

3.11.1 Metals

The concentrations of metals in sediments (Table-3.10.1) were higher in Kathivakkam (Near Sea-SD4) and Backwater (Near Ennore creek-SD3) then in Buckingham canal (Near Ennore-SD5). The contamination of the water body may be due to its nature, is susceptible to accumulating metals.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 86 of 179	

Table-3.11.1: Concentration of Metals in Sediments

Sl. No.	Code	Sample	Metals Conc. (µg/g)							
			Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn
1.	SD1	Korattalayar River, Near Edayanchavadi	0.004	0.0048	0.05	8.42	0.38	0.18	0.04	0.06
2.	SD2	Korattalayar River, Near Vallivayalchavadi	0.038	0.0042	0.07	8.32	0.48	0.12	0.07	0.24
3.	SD3	Back water near Ennore creek	0.062	0.0073	0.08	10.46	0.62	0.18	0.13	0.32
4.	SD4	Sea near Kathivakkam	0.068	0.0084	0.08	12.51	0.63	0.21	0.15	0.36
5.	SD5	Buckingham canal near Ennore	0.052	0.0078	0.08	9.24	0.52	0.19	0.12	0.31

3.11.2 Pesticides

Among the pesticides only HCH and DDT were found in the sediment samples collected from sediment monitoring locations. None of the other pesticides (aldrin, endosulfan and organophosphorous pesticides) were detected in any other samples. Only DDT were detected in river sediments. The DDT were detected due to regular use of DDT as pesticide.

Table 3.11.2 : Concentration of Pesticide in Sediments

S.NO.	SAMPLE	CONCENTRATION OF PESTICIDE IN SEDIMENTS			
		PESTICIDE CONC. (Ug/g)			
		HCH	HCH	DDE	DDT
1	SD1	ND	ND	ND	0.0014
2	SD2	ND	ND	ND	0.0011

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 87 of 179	

3	SD3	ND	ND	ND	0.0012
4	SD4	ND	ND	ND	0.0014
5	SD5	ND	ND	ND	0.008

Table No. 3.11.3 : Benthos organism's composition and Biomass

Sam[ple	Common Species	Group	Animals/ sqm	%	Biomass (in gm)	
SD1 Korattal aiyar River, Near Edayanc havadi	<i>Erioppisa chilensis</i>	Amphipods	78	20	55	
	<i>Quadrivio bengalensis</i>		39	10		
	<i>Amphithose ramondi</i>		39	10		
	<i>Daptonema conicum</i>	Nematodes	79	22		
	<i>Prionospio capensis</i>		Polychaetes	80		30
	<i>Lucifer sp.</i>			Crustaceans		39
SD2 Korattal aiyar River, Near Vallivay alchavdi	<i>Erioppisa chilensis</i>	Amphipods	78	20	55	
	<i>Quadrivio bengalensis</i>		39	10		
	<i>Amphithose ramondi</i>		39	10		
	<i>Daptonema conicum</i>	Nematodes	79	22		
	<i>Prionospia capensis</i>		Polychaetes	80		30
	<i>Lucifer sp.</i>			Crustaceans		39
SD3 Back water near Ennore creek	<i>Daptonema conicum</i>	Nematodes	39	20	64	
	<i>Metalinhomoeus longgiseta</i>		39	20		
	<i>Chaetopterus varieopedatus</i>	Polychaetes	199	40		
	<i>Glycera alba</i>		39	20		
SD4 Sea near Kathivak kam	<i>Operculina ammonoides</i>	Foraminiferans	39	15	62	
	<i>Quiqueloculina seminulum</i>		39	15		
	<i>Rotalia beccarii</i>	Bivalves	159	30		
	<i>Cardium setosum</i>		40	20		
	<i>Dosinia Sp.</i>	Gastropods	25	10		
	<i>Oliva sp.</i>		20	10		
SD5 Bucking ham canal near Ennore	<i>Carithidea cingulata</i>	Molluscs	380	70	68	
	<i>Nassa jacksoniana</i>	Gastropods	60	30		

3.12 AMBIENT AIR QUALITY

The ambient air quality monitoring were carried out at four locations within the 7 km radius around the proposed site of power project, to know the existing background ambient air quality. The purpose of the estimation of background pollutant concentration is to assess the impact of the proposed power project on the ambient air quality within the region based on the activities of the proposed power plant. The parameters chosen for

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 88 of 179	

assessment of air quality are Respirable Particulate Matter (RPM), Suspended Particulate Matter (SPM), Sulphur Dioxide (SO₂) and Oxides of Nitrogen (NO_x).

3.12.1 Selection of Sampling stations

The monitoring stations were identified on the basis of the followings:

- Prevailing Meteorology in the upwind and downwind direction as well as to represent the cross sectional scenario.
- Results of Mathematical air dispersion screening model, to determine the likely direction and distance of maximum impact due to the proposed power project.
- Factors like approach road, security and availability of electricity etc.

The four sampling stations for monitoring ambient air quality has been selected on the basis of the aforesaid points and in consultation with the Engineer-In-Charge. The details of these locations are given in Table 3.12.1 and shown in Figure 3.12.1

Table No. – 3.12.1: Ambient Air Quality Monitoring Stations within the Study Area

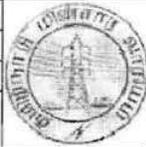
S. No.	Locations	Code	Direction	Distance, km	Remarks
1	Kathivakkam	AQ1	SE	2.7	Industrial Area
2	Athipattu	AQ2	N	3.8	Industrial Area
3	Vallivayalchavdi	AQ3	WNW	2.6	Residential Area
4	Vallankulum	AQ4	WSW	4.6	Residential Area

3.12.2 Monitoring Parameters, Frequency and Methodology

Calibrated Respirable Dust Samplers (Envirotech model APM 451) were used for the sampling of SPM, RPM, SO₂ and NO_x. Ambient air sampling for RPM, SPM, SO₂ and NO_x was performed continuously for 24 hours to determine 24-hour average concentrations. The sampling frequency was twice in a week i.e. 8 days in a month at each location. The sampling was performed at a height of 2.5m from the ground level. Standard methods specified under "National Ambient Air Quality Standards" notification G.S.R. 176(E) were adopted for sampling and analysis.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 89 of 179	

Figure 3.12.1: Ambient Air Quality Monitoring Stations

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 90 of 179	

Respirable Particulate Matter and Suspended Particulate Matter

Calibrated 'Respirable Dust Samplers' with Whatman GF/A microfibre filter paper (size: 8" X 10") was used for the collection of RPM. A known volume of ambient air is passed through the cyclone to the initially preprocessed filter paper. The centrifugal force in cyclone acts on particulate matter to separate them into two parts and collected as followings: -

- | | | | |
|--|---|-------------|--------------|
| a. Particles <10 μ size (Respirable) | : | GF/A | Filter Paper |
| b. Particles >10 μ size (Non Respirable) | : | Cyclone Cup | |

The differences in final and initial weight of filter paper and cyclone cup are used in estimation of particulate matter. The mass of particulates collected on the GF filter, divided by the volume of sampled air, gives the concentration of RPM. The total mass of dust, i.e., the sum of masses of particulates collected on the filter and in the cyclone cup, divided by the volume of sampled air gives the concentration of SPM. The results are expressed as $\mu\text{g}/\text{m}^3$.

Sulphur Dioxide

Sampling and analysis of ambient SO_2 was performed by adopting the 'Improved West and Gaeke Method'. The ambient air, drawn through the draft created by the RDS, is passed through an impinger, containing a known volume of absorbing solution of *sodium tetrachloromercurate*, at a pre determined and measured flow rate of 1 liter/minute (lpm). SO_2 in ambient air reacts with the *tetrachloromercurate* to form a stable complex, *dichloro-sulphito mercurate*. On reacting with *formaldehyde* and *p-rosaniline hydrochloride*, the sulphite ion forms an intensely coloured compound, *p-rosaniline methyle sulphonic acid*. The intensity of the colour developed is estimated by spectrophotometer at 560 nm wave length. The measured OD is used to determine the concentration of SO_2 from the calibration curve already prepared against known concentrations of sulphite ion. The mass of SO_2 in the absorbing reagent, divided by the volume of sampled air provides the concentration of SO_2 , which is expressed as $\mu\text{g}/\text{m}^3$.

3.12.2.3 Nitrogen Oxides

Sampling and analysis of ambient NO_x was performed by adopting the 'Jacob Hochheister Modified (Na arsenite)' method. Ambient air is drawn through an impinger at a pre determined flow rate of 1 lpm. The impinger contains known volume of absorbing solution of *sodium arsenite* and *sodium hydroxide*. Oxides of nitrogen react with the absorbing reagent to form a stable solution of *sodium nitrite*. The nitrate ion produced during the sampling is estimated colorimetrically, after reacting with *phosphoric acid*,

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 91 of 179	

sulphanilamide and *naphthyl ethylenediamine dihydrochloride* (NEDA), using spectrophotometer at 540 nm wave length. The measured OD is used to determine the concentration of NO_x from the calibration curve already prepared against known concentrations of nitrite ion. The mass of NO_x in the absorbing reagent, divided by the volume of sampled air provides the concentration of NO_x, which is expressed as µg/m³.

3.12.3 Analysis and Interpretation Data

Respirable Particulate Matter

The summary of observations made during the twelve months at the four locations are presented in Table 3.12.2 and Figure 3.12.2. The annual minimum, maximum and average RPM concentrations during the period were 22 to 34 µg/m³, 94 to 100 µg/m³ and 61 to 68 µg/m³, respectively. The highest 24-hr average concentration of 100 µg/m³ was observed at Vallivalchalchavdi during July, and the lowest value of 22 µg/m³ at Vallankulum during the same month. The annual average concentrations show similar trend at all locations.

Table No. – 3.12.2: Ambient Air Quality Status with respect to Respirable Particulate Matters

Location Name	Code	Concentration, µg/m ³		
		Min	Max	Avg
Kathivakkam	AQ1	34	98	63
Athipattu	AQ2	24	94	63
Vallivalchalchavdi	AQ3	30	100	68
Vallankulum	AQ4	22	99	61

The concentration of RPM at all stations was found to be within the National Ambient Quality Standards (100 µg/m³) for industrial area.

Suspended Particulate Matter

The summary of observations made during the twelve months at the four locations are presented in Table 3.12.3 and Figure 3.12.3. The annual minimum, maximum and average SPM concentrations during study period were 30 to 80 µg/m³, 174 to 198 µg/m³ and 117 to 132 µg/m³, respectively. The highest 24-hr concentration of 198 µg/m³ was observed during September at Vallivalchalchavdi, and the lowest of 30 µg/m³ during July at Vallankulum.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 92 of 179	

Table No. – 3.12.3: Ambient Air Quality Status with respects to Suspended Particulate Matter

Location Name	Code	Concentration, $\mu\text{g}/\text{m}^3$		
		Min	Max	Avg
Kathivakkam	AQ1	58	174	122
Athipattu	AQ2	52	186	119
Vallivayalchavdi	AQ3	80	198	132
Vallankulum	AQ4	30	193	117

The concentration of SPM at all stations was found to be within the National Ambient Air Quality Standards ($200 \mu\text{g}/\text{m}^3$) for industrial area.

Sulphur Dioxide

The summary of observations made during the twelve months at the four locations are presented in Table 3.12.4 and Figure 3.12.4. The annual minimum, maximum and average sulphur dioxide concentrations during the study period were 5 to $9 \mu\text{g}/\text{m}^3$, 24 to $30 \mu\text{g}/\text{m}^3$ and 13 to $17 \mu\text{g}/\text{m}^3$, respectively. The highest 24-hr average concentration of $30 \mu\text{g}/\text{m}^3$ was observed at Vallivayalchavdi and the lowest concentration of $5 \mu\text{g}/\text{m}^3$ at Kathivakkam.

Table No. – 3.12.4: Ambient Air Quality Status with respect to Sulphur Dioxide

Location Name	Code	Concentration, $\mu\text{g}/\text{m}^3$		
		Min	Max	Avg
Kathivakkam	AQ1	5	24	13
Athipattu	AQ2	5	26	17
Vallivayalchavdi	AQ3	9	30	16
Vallankulum	AQ4	6	28	13

The concentration of SO_2 at all locations was found to be well below the National Ambient Air Quality Standards ($80 \mu\text{g}/\text{m}^3$) for industrial area.

Nitrogen Oxides

The summary of observations made during the twelve months at the four locations are presented in Table 3.12.5 and Figure 3.12.5. The annual minimum, maximum and average NO_x concentrations during the study period were $6 \mu\text{g}/\text{m}^3$, 16 to $24 \mu\text{g}/\text{m}^3$ and 10 to $13 \mu\text{g}/\text{m}^3$, respectively. The highest 24-hr concentration of $24 \mu\text{g}/\text{m}^3$ was observed at Kathivakkam and the lowest of $6 \mu\text{g}/\text{m}^3$ at all location during the study period.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 93 of 179	

Table No. – 3.12.5: Ambient Air Quality Status with respect to Nitrogen Oxides

Location Name	Code	Concentration, $\mu\text{g}/\text{m}^3$		
		Min	Max	Avg.
Kathivakkam	AQ1	6	24	13
Athipattu	AQ2	6	18	12
Vallivayalchavdi	AQ3	6	20	13
Vallankulum	AQ4	6	16	10

The concentration of NO_x at all locations was found to be well below the National Ambient Air Quality Standards (80 $\mu\text{g}/\text{m}^3$) for industrial area.

Status of Ambient Air Quality around the Project Site

- The concentrations of RPM, TSPM, SO₂ and NO_x are well within the National Ambient Air Quality Standards for industrial areas.
- The monthly results of ambient air quality during the study period show more or less similar trends during the study period. The overall monthly averages remained more or less constant at all monitoring locations.
- The location wise analysis reveals similar trends of variation in air pollutants level at Kathivakkam, Athipattu and Vallankulum. The comparatively higher concentration at Vallivayalchavdi may be due to the local activities.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 94 of 179	

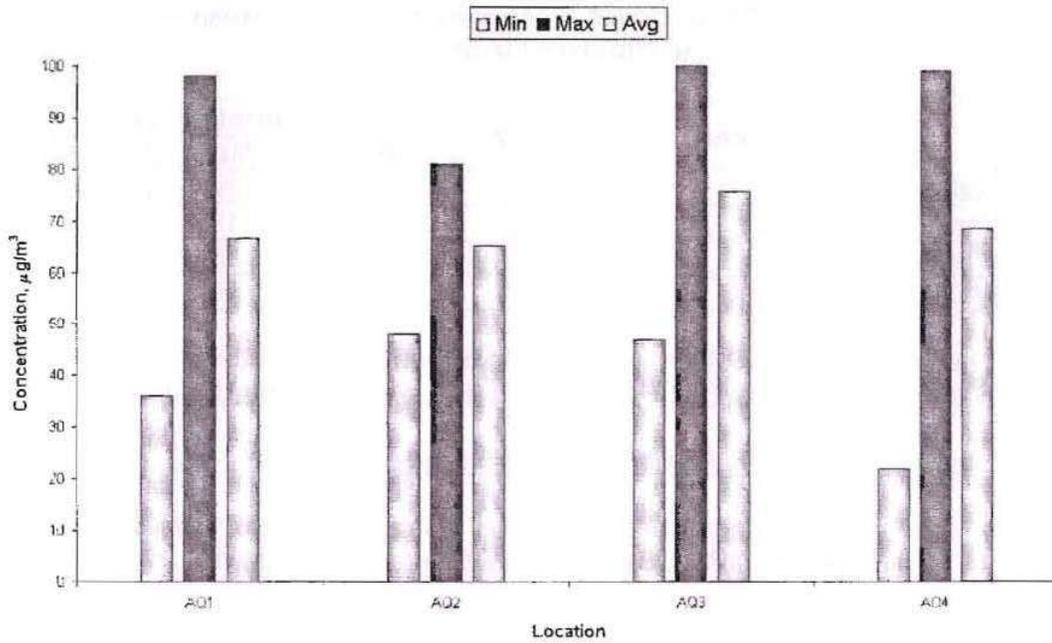


Figure – 3.12.2: Variation in Ambient Air Quality Status with Respect to Respirable Particulate Matter

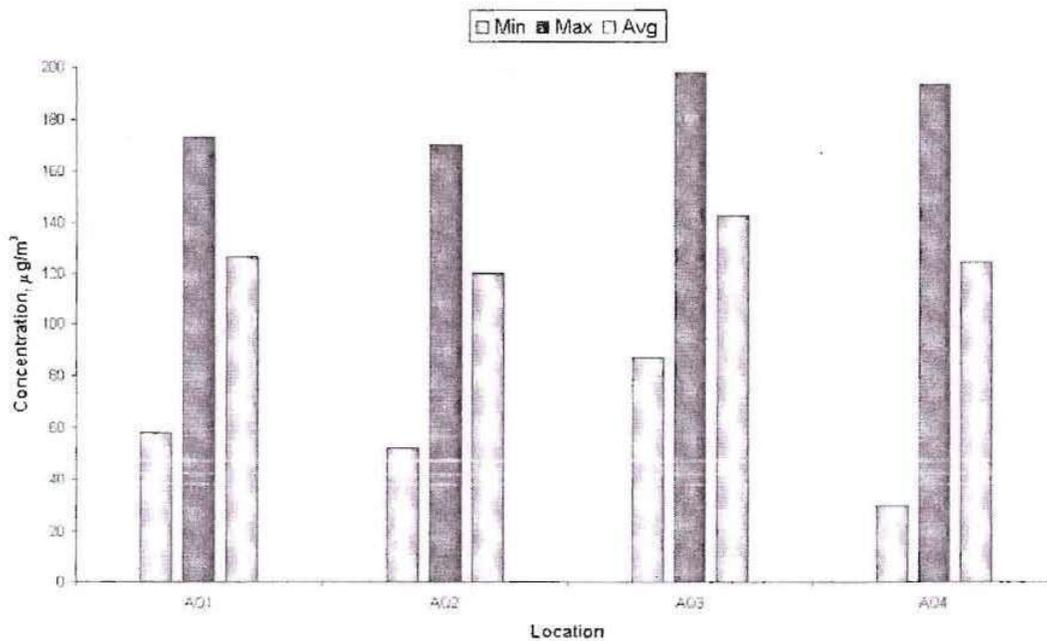


Figure – 3.12.3: Variation in Ambient Air Quality Status with Respect to Suspended Particulate Matter

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 95 of 179	

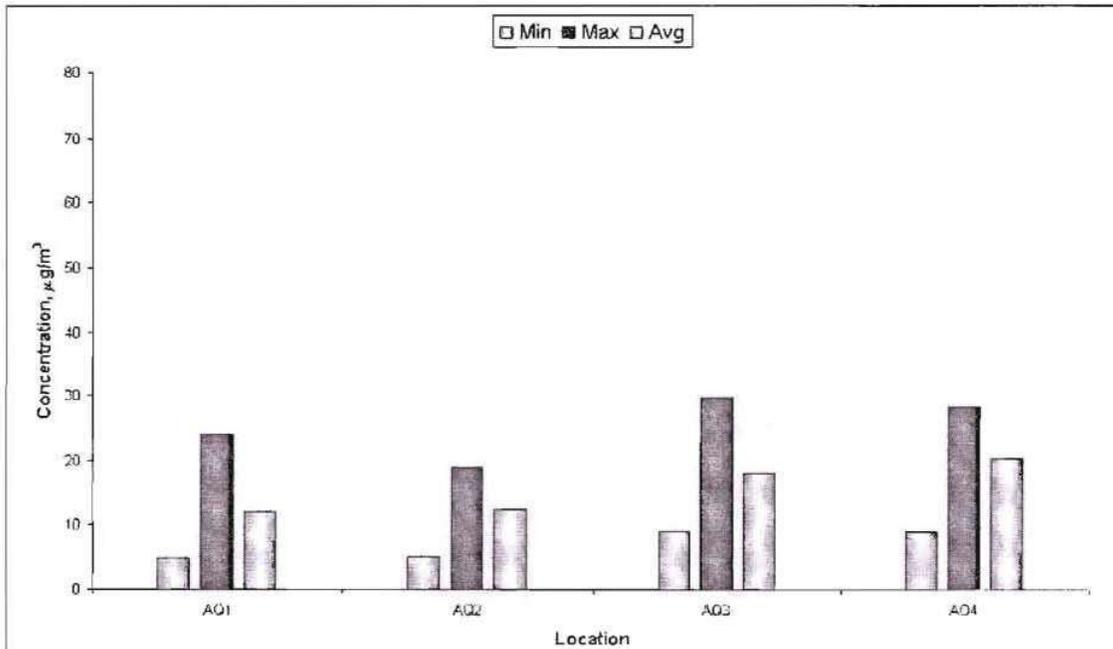


Figure – 3.12.4: Variation in Ambient Air Quality Status with Respect to SO₂

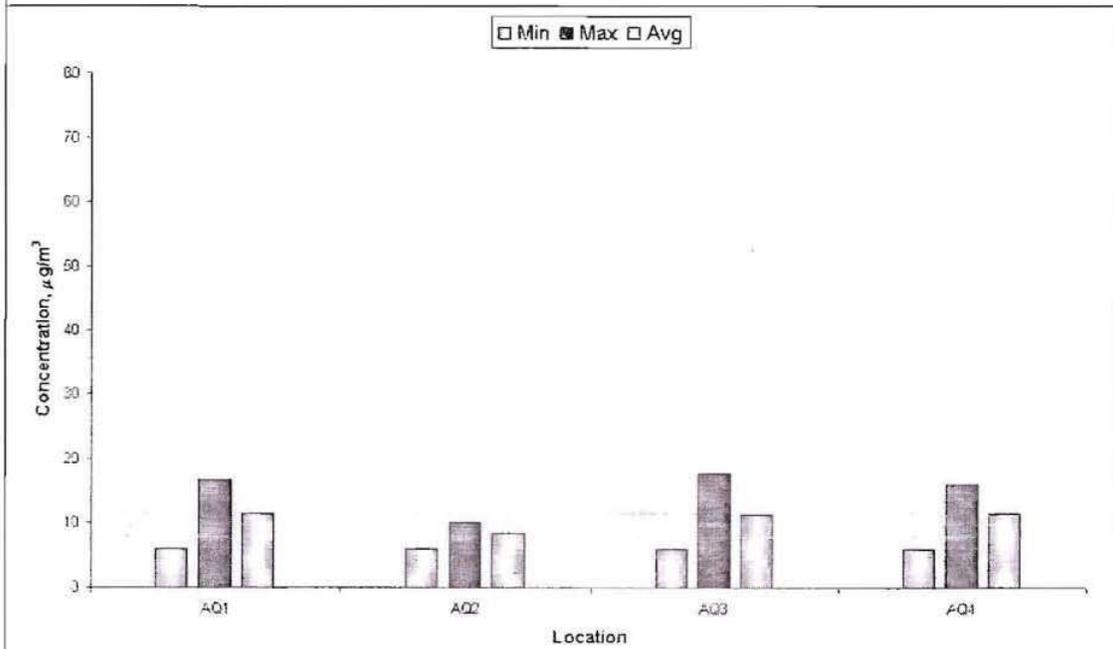


Figure – 3.12.5: Variation in Ambient Air Quality Status with Respect to NO_x

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 96 of 179	

3.13 ECOLOGY

3.13.1 Terrestrial Ecology

The study of terrestrial ecology within the study area of 7km radius has been carried out through field investigation and satellite imagery data as discussed in land use under section 3.3.3. The area can be classified into the following ecological zone.

i. Scrub Eco-system (dry evergreen vegetation)

This type of ecosystem is dominated by *Phoenix sylvestris* species. Apart from typical scrub jungle species, a few salt tolerant species were also recorded, probably because of the proximity to the sea and the estuary.

ii. Tidal Eco-system

The plants growing in this area are salt tolerant as they are covered by the saline water during high tides. The species like *Arthrocnemum indicum*, *Suaeda maritima* are dominating species in this ecosystem.

iii. Mangrove Eco-system

This type of ecosystem existed in western bank of the river Korattaliar. This is dominated by *Avicinnia marine*, *Sesuvium Portulacastrum* & *Suaeda Maritima*. These plants are periodically washed by the tides and as a result in some areas quick sands are noticed.

iv. Marsh Eco-system

The marshes are essentially fresh water supporting variety of plant. *Acacia nilotica* and *Azadirachata indica* are the common species of the study area.

v. Agro Ecosystem

Rice and banana species of plant are the main species of this ecosystem.

Apart from the physical survey of the entire study area, an extensive study and seasonal sampling for pre-monsoon season were carried out at a few locations representing the natural vegetation of the study area for density, diversity, frequency, relative abundance, cover etc. These locations are presented in Table 3.13.1:

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 97 of 179	

Table 3.13.1: Locations of Terrestrial Ecological Study

S.No.	Name of The Study area	Nature of the Study area	Distance from the Plant Site
TE1	Athipattu	Cultivable wasteland	3.81 (N)
TE2	Vallankulum	Agricultural land	4.58 (WSW)
TE3	Kuruvelmedu	Proposed Plant area	0 (Centre)

Flora

The field investigation and satellite imagery data show, that the study area is a mixture of agricultural (33.11%), wasteland (9.91%) and get irrigated by the tanks and Tube well and are good cultivable.

The dry tropical vegetation is observed within the study area. The experimental finding of the pre monsoon season shows the dominance of grasses like *Cyanodon* followed by *Parthenium hysterophorus*, *Croton sparsiflorus* & *Odina odiya* and trees like *Acacia nilotica*, *Azadirachta indica*, *Anona squamosa*, *Delonix regia*, *Ficus benghalensis* within the study area.

Cultivation

Cultivation of paddy crop and Banana are done in intensive way. Rice is cultivated on large scale, while banana and others are cultivated on small scale in the study area. The details of cultivable land is given in Table– 3.3.2. The weed like congress grass invades the cultivable fields, specially near Ennore and Athipattu area. These biological invasions disturb the common practice of agricultural system in coming day. It requires preventive control measures immediately to get rid of this menace of agro-ecosystem of the study area.

Forests

The study area is completely devoid of natural forest. The list of flora including, grasses, shrubs and trees encountered during the study of pre monsoon season within the study area are presented in Table – 3.13.2.

Groves

The presence of groves is rare in the study area. These groves are mainly of *Psidium guayava*, *Citrus auvaulium* *Mangifera indica*. The artificially developed Social forests mainly consisting of *Mangifera indica*, *Terminalia catappa*, *Citrus auvaulium*, *Psidium guayava*, and other local species of economic importance.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 98 of 179	

Fauna

Domestic

The domestic animals are mainly mammals. The domestic animals present in the study area are listed in the Table - 3.13.3.

Wild Animal

Since the natural forests constitute negligible of the forest area and since they are in isolated pockets, the wild life does not offer a wide spectrum of species. Wild animals are rarely seen due to absence of natural dense forest and land occupied by human being. The wild animals like Nilgai, Jackals, Fox and Rabbit have drastically reduced due to increase in human population and clearance of wild flora for making residential and commercial land. Other than these, some reptiles and amphibians can also be seen with a number of bird species.

A list of birds, reptiles, amphibians and rodents based on information gathered from local inquiries is presented in Table-3.13.4.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 99 of 179	

Figure 3.13.1: Ecological Monitoring Stations

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 100 of 179	

Table No. 3.13.2: List of Important Flora found in the Study Area

Sl. No.	Botanical Name	Common Name
1.	<i>Azadirachta indica</i>	Veppam
2.	<i>Acacia nilotica</i>	Karuvelamaram
3.	<i>Terminalia catappa</i>	Natvadam
4.	<i>Tararindus indica</i>	Amilampul
5.	<i>Mangifera indica</i>	Munga
6.	<i>Psidium guayava</i>	Koyya
7.	<i>Phoenix sylvestris</i>	Icham
8.	<i>Ficus religiosa</i>	Arasu
9.	<i>Ficus benghalensis</i>	Al
10.	<i>Delonix regia</i>	Mayarum
11.	<i>Citrus auvanlium</i>	Narattai
12.	<i>Anthocephalus chinensis</i>	Vellai
13.	<i>Ziziphus mautifiana</i>	Elentha
14.	<i>Anona squamosa</i>	Atta
15.	<i>Alstonia scholaris</i>	Elilappalai
16.	<i>Bambusa arundinacia</i>	Mullumungil
17.	<i>Bauhinia varigata</i>	Shemmandarai

List of Herbs and Shrubs found in the Study Area

Sl. No.	Botanical Name	Common Name
1	<i>Cyanadon dactylon</i>	Pilloo
2	<i>Muringa olifera</i>	Murungai
3	<i>Parthenium hysterophorus</i>	
4	<i>Croton sarsiflorus</i>	Gabbu pund chadi
5	<i>Lantena camera</i>	Unniced
6	<i>Amranthus spinoza</i>	Virudis
7	<i>Odina odiya</i>	Othiyam
8	<i>Vitex nugundo</i>	Nochi
9	<i>Prosopis scigigera</i>	Velikkamuram
10	<i>Achras sapota</i>	Shimai-elluppai

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 101 of 179	

Table No. 3.13.3: List of Domestic Fauna in the Study Area

Sl. No.	Zoological Name	Common Name
1.	<i>Bos indicus</i>	Cow
2.	<i>Bubalus indicus</i>	Buffalo
3.	<i>Cains familiaris</i>	Dog
4.	<i>Capra hircus</i>	Goat
5.	<i>Equus caballus</i>	Horse
6.	<i>Equus hermionus</i>	Ass
7.	<i>Felis domesticus</i>	Cat
8.	<i>Ovius pollic</i>	Sheep
9.	<i>Sus cristatus</i>	Pig

Table No. - 3.13.4. List of Wild Fauna in the Study Area

Sl. No.	Zoological Name	Common Name
1	<i>Canis aureus</i>	Jackal
2	<i>Felis chaus</i>	Jungle cat
3	<i>Funambulus pennanti and F palmarum</i>	Palm squirrels
4	<i>Lepus nigricollis nigricollis</i>	Hare
5	<i>Harpestes edwardsi</i>	Common mongoose
6	<i>Suncus sp.</i>	Shrew
7	<i>Manis crassicaudata</i>	Pangolim
8	<i>Milvus migrans govinda</i>	Pariyakite
9	<i>Haliastur indus</i>	Brahminy kite
10	<i>Francolinus pondicerianus</i>	Partridge
11	<i>Eudynamys scolopacea</i>	Koel
12	<i>Athene brahma</i>	Spotted owlet
13	<i>Ptyas mucosus</i>	Common rat snake
14	<i>Naja naja</i>	Cobra
15	<i>Ahaetulla nasutus</i>	Green whip snake
AMPHIBIAN		
1	<i>Bufo malanostidus</i>	Toad
2	<i>Rana cynophlyctis</i>	Frog
3	<i>Rana tigrina</i>	Frog
4	<i>Rhacophorus bimaculatus</i>	Tree frog
5	<i>Hyla arborea</i>	Tree frog
RODENTS		
1	<i>Bandicota indica</i>	Bandicoot rat
2	<i>Mus muscatus</i>	Mouse
3	<i>Rathus rathus</i>	House rat
4	<i>Ratufa indica</i>	Squirrel

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 102 of 179	

3.13.2 Aquatic Ecology

The specific biological species (Fishes, Phytoplankton, Zooplankton etc.) for a particular environmental conditions are the best indicators of environmental quality. Information on the environmental stress due to the impacts of any industrial activities on the community structure serves as inexpensive and efficient early warning and control system to check the effectiveness of the measures to prevent damage to a particular ecosystem.

Planktons

Phytoplankton and Zooplankton are indicators of environmental stress. The quantity and quality of such biological species in a particular environment largely depends on various physicochemical characteristics of water such as pH, Conductivity, nutrients, BOD, alkalinity etc.

The field sampling was undertaken at the following three locations during October 2003. A1-Kathivakkam (marine), A2- Ennore creek (backwater), A3- Korattalaiyar river (near Edayanchavadi). A list of zooplankton and phytoplankton is depicted in Tables 3.13.5 and 3.13.6 respectively.

Fishes

The fish/aquatic fauna of the study area is reported based on the field sampling and confirmed by the local people and secondary data provided by Thiruvallur district office is listed in Table 3.13.7. The fishes like Chirocentrus, Lesser Sardines, Thriossocles, Anchoviella, Flying Fish, Sciaenids, Caranx, Meckerel, Seer, Crabs found in good number in the study area.

**Table No. - 3.13.5(a). List of Zooplankton identified within the Study Area
(Pre Monsoon)**

Sl. No.	Kathivakkam (Marine)	Ennore Creek (Backwater)	Korattalaiyar River (River Water)
1.	<i>Favella species</i>	<i>Brachionnus unceolaris</i>	<i>Favella bervi</i>
2.	<i>Tintinnopsis species</i>	<i>Brachionnus plicatilis</i>	<i>Favella sp.</i>
3.	<i>Globigerina species</i>	<i>Brachionnus candatns</i>	<i>Tintinnopsis minuta</i>
4.	<i>Acartia donae</i>	<i>Monostyla bulla</i>	<i>Tintinnopsis tubulosa</i>
5.	<i>Acartia erythraea</i>		<i>Tintinnopsis sp.</i>
6.	<i>Acartia clausi</i>		<i>Diphyes sp.</i>
7.	<i>Calanns finmarchicns</i>		<i>Brachionus urceolaris</i>
8.	<i>C furcatns</i>		<i>Evadne tergestina</i>
9.	<i>Paracalanus parvus</i>		<i>Acartia danae</i>
10.	<i>Microsetella norvegica</i>		<i>Acartia erythraea</i>
11.	<i>Microsetella rosea</i>		<i>Acartia spinicauda</i>
12.	<i>Capilia vitrea</i>		<i>Acartia clausi</i>
13.	<i>Corycaeus danae</i>		<i>Calanus finmarchicus</i>
14.	<i>Oithona rigida</i>		<i>Canthocalanus pauper</i>

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 103 of 179	

15.	<i>Oncacea venusta</i>		<i>Centropages orsinii</i>
16.	<i>Gastropod veliger</i>		<i>Centropages furcatus</i>
17.			<i>Nannocalanus minor</i>
18.			<i>Paracalanus parvus</i>
19.			<i>Labidocera acuta</i>
20.			<i>Euterpina acutifrous</i>
21.			<i>Microsetella norvegica</i>
22.			<i>Macrosetella gracilis</i>
23.			<i>Metis jousseaumei</i>
24.			<i>Copilia vitrea</i>
25.			<i>Corycaeus danae</i>
26.			<i>Oithona bivicornis</i>
27.			<i>Oithona rigida</i>
28.			<i>Oncacea venusta</i>
29.			<i>Bivalve veliger</i>
30.			<i>Gastropod veliger</i>
31.			<i>Copepod nauplius</i>

**Table No. - 3.13.5(b). List of Zooplankton identified within the
Study Area (Post Monsoon)**

Sl. No.	Kathivakkam (Marine)	Ennore Creek (Backwater)	Korattalaiyar River (River Water)
1.	<i>Favella species</i>	<i>Brachionnus unceolaris</i>	<i>Favella bervi</i>
2.	<i>Tintinnopsis species</i>	<i>Brachionnus plicatilis</i>	<i>Favella sp.</i>
3.	<i>Globigerina species</i>	<i>Brachionnus candatns</i>	<i>Tintinnopsis minuta</i>
4.	<i>Acartia donae</i>	<i>Monostyla bulla</i>	<i>Tintinnopsis tubulosa</i>
5.	<i>Acartia erythraca</i>		<i>Tintinnopsis sp.</i>
6.	<i>Acartia clansi</i>		<i>Diphyes sp.</i>
7.	<i>Calanns finmarchicns</i>		<i>Brachionus urceolaris</i>
8.	<i>Paracalanus parvus</i>		<i>Acartia danae</i>
9.	<i>Microsetella norvegica</i>		<i>Acartia erythraea</i>
10.	<i>Microsetella rosea</i>		<i>Acartia spinicauda</i>
11.	<i>Capilia vitrea</i>		<i>Acartia clausi</i>
12.	<i>Corycaeus danae</i>		<i>Calanus finmarchicus</i>
13.	<i>Oncacea venusta</i>		<i>Centropages orsinii</i>
14.	<i>Gastropod veliger</i>		<i>Centropages furcatus</i>
15.			<i>Nannocalanus minor</i>
16.			<i>Paracalanus parvus</i>
17.			<i>Labidocera acuta</i>
18.			<i>Euterpina acutifrous</i>
19.			<i>Microsetella norvegica</i>
20.			<i>Macrosetella gracilis</i>
21.			<i>Metis jousseaumei</i>
22.			<i>Copilia vitrea</i>
23.			<i>Corycaeus danae</i>

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 104 of 179	

24.		<i>Oithona berricornis</i>
25.		<i>Oithona rigida</i>
26.		<i>Oncacea venusta</i>
27.		<i>Bivalve veliger</i>
28.		<i>Gastropod veliger</i>
29.		<i>Copepod nauplius</i>
30.		

**Table No. - 3.13.6(a). List of Phytoplankton identified within the Study Area
(Pre Monsoon)**

Sl. No.	Kathivakkam (Marine)	Ennore Creek (Backwater)	Korattalaiyar River (River Water)
1.	<i>Amphora lineolata</i>	<i>Lyngbya sp.</i>	<i>Amphora lineolata</i>
2.	<i>Amphora decusseata</i>	<i>Microcystis sp.</i>	<i>Amphora decusseata</i>
3.	<i>Asterionella glacialis</i>	<i>Spirulina sp.</i>	<i>Aulacodiscus orbiculatus</i>
4.	<i>Bacteriastrium verians</i>	<i>Synechococcus sp.</i>	<i>Bacteriastrium delicatulum</i>
5.	<i>Bellerochea malleus</i>	<i>Chlorella sp.</i>	<i>Bacteriastrium sp.</i>
6.	<i>Chaetoceros denticulatum</i>	<i>Dictyosphaerium sp.</i>	<i>Bellerochea mallens</i>
7.	<i>Corethron inerme</i>	<i>Pedastrum sp.</i>	<i>Chaetoceros brevis</i>
8.	<i>Coscinodiscus centralis</i>	<i>Sirocladium sp.</i>	<i>Chaetoceros curvicetes</i>
9.	<i>Cyclotella striata</i>	<i>Ulotrix sp.</i>	<i>Chaetoceros lorenzians</i>
10.	<i>Dithlum species</i>	<i>Zygnemopsi sp.</i>	<i>Chaetoceros species</i>
11.	<i>Gossilieriella tropica</i>		<i>Corethron hystrix</i>
12.	<i>Lithodesmium undulatum</i>		<i>Corethron inerme</i>
13.	<i>Navicula hasta</i>		<i>Coscinodisens apiculatus</i>
14.	<i>Nitzschia sp.</i>		<i>Coscinodisens eccentricus</i>
15.	<i>Odontella sinensis</i>		<i>Cyclotella menegheniana</i>
16.	<i>Pleurosigma normanii</i>		<i>Diploneis subovalis</i>
17.	<i>Rhizosolenia castracanci</i>		<i>Eunotia pseudolunaris</i>
18.	<i>Rhizosolenia cylindrus</i>		<i>Assleriella tropica</i>
19.	<i>Rhizosolenia imbricata</i>		<i>Guinardia flaccida</i>
20.	<i>Rhizosolenia sp.</i>		<i>Gyrosigma battium</i>
21.	<i>Skeletonema costatum</i>		<i>Hemidiscus hardmanniams</i>
22.	<i>Streptotheca indica</i>		<i>Teptocylindrus danicus</i>
23.	<i>Stephanopyxis palmeriana</i>		<i>Teptocylindrus species</i>
24.	<i>Thalassionema nitzschioides</i>		<i>Melosira dubia</i>
25.	<i>Ceratium tripos</i>		<i>Navicula lyra</i>
26.	<i>Exuviaella compressa</i>		<i>Nitzselia closterium</i>

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 105 of 179	

27.	<i>Noctiluca miliaris</i>		<i>Nitzselia species</i>
28.	<i>Ornithocercus stenii</i>		<i>Odontella mobiliensis</i>
29.	<i>Prorocentrum gracile</i>		<i>Plenrosigma directum</i>
30.	<i>Prorocentrum micans</i>		<i>Plenrosigma normanii</i>
31.	<i>Protoperidinium oceanicum</i>		<i>Rhizosolenia alata</i>
32.			<i>Rhizosolenia cylindrus</i>
33.			<i>Rhizosolenia robusta</i>
34.			<i>Schroederello delicatula</i>
35.			<i>Thalassiothrix frauenfeldii</i>
36.			<i>Thalassionema nitzschioides</i>
37.			<i>Triceratium species</i>
38.			<i>Dinophyceae uracomtha</i>
39.			<i>Ornithocercus stenii</i>
40.			<i>Protoperidinium brochil</i>
41.			<i>Pyrophas borologicum</i>

BENTHIC ORGANISM (Pre Monsoon)

Kathivakkam	Ennore creek	Korttalaiyer River
<i>Operculina ammonoides</i>	<i>paracomesoma</i>	<i>Eriopisa chilensis</i>
<i>Quiqueloculina seminulum</i>		<i>Quadrivio bengalensis</i>
<i>Rotalia beccarii</i>		<i>Amphithoe ramondi</i>
<i>Cardium setosum</i>		<i>Daptonema conicum</i>
<i>Dosinia sp.</i>		<i>Prionospia capensis</i>
<i>Oliva sp.</i>		<i>Glessula perrotteti</i>
		<i>Lucifer sp.</i>

Table No. - 3.13.6(b). List of Phytoplankton identified within the Study Area (Post Monsoon)

Sl. No.	Kathivakkam (Marine)	Ennore Creek (Backwater)	Korattalaiyar River (River Water)
1.	<i>Amphora lineolata</i>	<i>Lyngbya sp.</i>	<i>Amphora lineolata</i>
2.	<i>Amphora decusseata</i>	<i>Microcystis sp.</i>	<i>Amphora decusseata</i>
3.	<i>Asterionella glacialis</i>	<i>Spirulina sp.</i>	<i>Aulacodiscus orbiculatus</i>
4.	<i>Bacteriastrium verians</i>	<i>Synechococcus sp.</i>	<i>Bacteriastrium delicatulum</i>
5.	<i>Bellochea malleus</i>	<i>Chlorella sp.</i>	<i>Bacteriastrium sp.</i>
6.	<i>Chaetoceros denticulatum</i>	<i>Dictyosphaerium sp.</i>	<i>Bellochea mallens</i>
8.	<i>Coscinodiscus centralis</i>	<i>Sirocladium sp.</i>	<i>Chaetoceros curvicetes</i>
9.	<i>Cyclotella striata</i>	<i>Ulotrix sp.</i>	<i>Chaetoceros lorenzians</i>
10.	<i>Dithlum species</i>	<i>Zygnemopsi sp.</i>	<i>Chaetoceros species</i>
11.	<i>Gossleriella tropica</i>		<i>Corethron hystrix</i>
12.	<i>Lithodesmium undulatum</i>		<i>Corethron inerme</i>

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 106 of 179	

14.	<i>Nitzschia sp.</i>		<i>Coscinodisens eccentricus</i>
15.	<i>Odontella sinensis</i>		<i>Cyclotella menegheniana</i>
16.	<i>Pleurosigma normanii</i>		<i>Diploneis subovalis</i>
17.	<i>Rhizosolenia castracanci</i>		<i>Eunotia psendolunaris</i>
18.	<i>Rhizosolenia cylindrus</i>		<i>Assleriella tropica</i>
19.	<i>Rhizosolenia imbricata</i>		<i>Guinardia flaceida</i>
20.	<i>Rhizosolenia sp.</i>		<i>Gyrosigma battium</i>
21.	<i>Skeletonema costatum</i>		<i>Hemidiscus hardmanniams</i>
22.	<i>Streptotheca indica</i>		<i>Teptocylindrus danicus</i>
23.	<i>Stephanopyxis palmeriana</i>		<i>Teptocylindrus species</i>
24.	<i>Thalassionema nitzschioides</i>		<i>Melosira dubia</i>
25.	<i>Ceratium tripos</i>		<i>Navicula lyra</i>
26.	<i>Exuviaella compressa</i>		<i>Nitzselia closterium</i>
27.	<i>Noctiluca miliaris</i>		<i>Nitzselia species</i>
28.	<i>Ornithocercus stenii</i>		<i>Odontella mobiliensiz</i>
29.	<i>Prorocentrum gracile</i>		<i>Plenrosigma directum</i>
30.	<i>Prorocentrum micans</i>		<i>Plenrosigma normanii</i>
31.	<i>Protoperidinium oceanicum</i>		<i>Rhizosolenia alata</i>
32.			<i>Rhizosolenia cylindrus</i>
33.			<i>Rhizosolenia robusta</i>
34.			<i>Schroederello delicatula</i>
35.			<i>Thalassiothrix frauenfeldii</i>
37.			<i>Triceratium species</i>
38.			<i>Dinophyceae uracomtha</i>
39.			<i>Ornithocercus stenii</i>
40.			<i>Protoperidinium brochil</i>
41.			<i>Pyrophas borologicum</i>

BENTHIC ORGANISM (Post Monsoon)

Kathivakkam	Ennore creek	Korttalaiyer River
<i>Operculina ammonoides</i>	<i>paracomescoma</i>	<i>Eriopisa chilensis</i>
<i>Quiqueloculina seminulum</i>		<i>Quadrivio bengalensis</i>
<i>Rotalia beccarii</i>		<i>Amphithoe ramondi</i>
<i>Cardium setosum</i>		<i>Daptonema conicum</i>
<i>Dosinia sp.</i>		<i>Prionospia capensis</i>
<i>Oliva sp.</i>		<i>Glessula perrotteti</i>
		<i>Lucifer sp.</i>

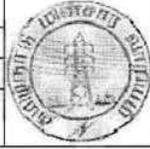
	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 107 of 179	

Table No. 3.13.7(a): Aquatic Fauna Identified, Economic Varieties and its Vulnerability as provided by Thiruvallur district office (Pre Monsoon)

Sl. No.	Scientific Name	Economic Variety	Species Vulnerable to Environmental Stress Factors
1.	Sharks	Yes	
2.	Skates & Rays	Yes	
3.	Eels	No	
4.	Cat fishes	Yes	
5.	Chirocentrus	Yes	
6.	Oil sardines	Yes	Yes
7.	Lesser sardines	Yes	Yes
8.	Hilsa ilisha	Yes	Yes
9.	Thriossocles	Yes	Yes
10.	Anchoviello	Yes	Yes
11.	Other ciupeids	Yes	Yes
12.	Bombay duck		
13.	Saurida & saurus	Yes	
14.	Hemirhamphus & Belone	No	Yes
15.	Flying fish	Yes	
16.	Perches	Yes	
17.	Red mullets	Yes	Yes
18.	Polynemids		
19.	Sciaenids	Yes	Yes
20.	Ribbon fish	Yes	
21.	Caranx		
22.	Chorcnimus		
23.	Other carangids		
24.	Elacate	Yes	Yes
25.	Silverbellics	No	Yes
26.	Lactarius	Yes	
27.	Pomfrets		
28.	Meckerel		
29.	Seer		
30.	Tunnles		
31.	Sphyreana		
32.	Mugil	Yes	
33.	Soles		
34.	Penacid prawns	Yes	
35.	N. P. prawns	Yes	
36.	Other crustaceans		
37.	Lobsters	Yes	Yes
38.	Crabs		
39.	Cephalopodes	Yes	
40.	Lethrinus		
41.	Sillago		
42.	Bregmaceros		
43.	Ora		
44.	Spotted dory		

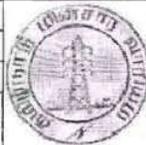
	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 108 of 179	

Table No. 3.13.7(b): Aquatic Fauna Identified, Economic Varieties and its Vulnerability as provided by Thiruvallur district office (Post Monsoon)

Sl. No.	Scientific Name	Economic Variety	Species Vulnerable to Environmental Stress Factors
1.	Sharks	Yes	
2.	Skates & Rays	Yes	
3.	Eels	No	
4.	Cat fishes	Yes	
5.	Chirocentrus	Yes	
7.	Lesser sardines	Yes	Yes
8.	Hilsa ilisha	Yes	Yes
9.	Thriossocles	Yes	Yes
10.	Anchoviello	Yes	Yes
11.	Other ciupelds	Yes	Yes
12.	Bombay duck		
13.	Saurida & saurus	Yes	
14.	Hemirhamphus & Belone	No	Yes
15.	Flying fish	Yes	
16.	Perches	Yes	
17.	Red mullets	Yes	Yes
18.	Polynemids		
19.	Sciaenids	Yes	Yes
20.	Ribbon fish	Yes	
22.	Chorcnimus		
23.	Other carangids		
24.	Elacate	Yes	Yes
25.	Silverbellics	No	Yes
26.	Lactarius	Yes	
27.	Pomfrets		
28.	Meckerel		
29.	Seer		
30.	Tunnles		
31.	Sphyreana		
32.	Mugil	Yes	
33.	Soles		
34.	Penacid prawns	Yes	
35.	N. P. prawns	Yes	
36.	Other crustaceans		
37.	Lobsters	Yes	Yes
38.	Crabs		
39.	Cephalopodes	Yes	
40.	Lethrinus		
42.	Bregmaceros		
43.	Ora		
44.	Spotted dory		

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 109 of 179	

3.13.3 Rare and Endangered Species

Following endangered species of flora and fauna have been reported in the area with respect to Red Book of Botanical Survey of India and Wildlife (Protection) Act 1972. (Table 3.13.8)

Table No. 3.13.8: Rare and Threatened Species of Flora and Fauna in Thiruvallur District

Category	Name of the Species
Reptiles	
Vulnerable	Indian Flapshell turtle
Endangered	Olive Ridely Sea Turtle
	Common Monitor Lizard
Birds	
Endangered	Spoonbill
Plants	
Possibly Extinct	<i>Aponogeton Appendiculatus Von Bruggen (I)</i>
	<i>Decaschistia rufa Craib (I)</i>
Endangered	<i>Lindsaea malabarica Bedde (E)</i>
	<i>Hildegardia Populifolia Roxb (E)</i>
Vulnerable	<i>Murdannia lanceolata Wight (V)</i>

3.13.4 Ecologically Sensitive Areas

There are no ecologically sensitive areas within the study area of 7km, however, there are some reserved forests and zoological parks within 25-km radius from the plant site. The list of ecologically sensitive areas are already listed in Table 3.3.4.

3.14 NOISE

Noise is one of the most undesirable and unwanted sounds. It is, therefore, necessary to measure both the quality as well as the quantity of environment noise in and around the power plant.

3.14.1 Methodology

The intensity of sound energy in the environment is measured in 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

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 110 of 179	

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 L_p and L_{eq} . Keeping the mode in L_p 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 L_{eq} was measured at all locations.

The day noise levels have been monitored during 6.00am to 10.00pm and night noise levels, during 10.00pm to 6.00am at all the ten locations covered in 7 km radius of the study area.

The L_{10} , L_{50} , L_{90} , L_{eq} , L_d , L_n , and L_{dn} were computed based on the sound pressure level recorded.

- L_{10} - The noise level exceeds 10% of the time (measure of peak noise level).
- L_{50} - The noise level exceeds 50% of the time (measure of median noise level).
- L_{90} - The noise level exceeds 90% of the time (measure of residual noise level).
- L_{eq} - Log Equivalent Noise
- L_d - Daytime L_{eq}
- L_n - Nighttime L_{eq}
- $L_{dn} = 10 \log \{1/24[16(10^{L_d/10}) + 8(10^{L_n+10/10})]\}$

3.14.2 Types of Sound Fields

Based on the distance from the source of sound generation, the types of sound field are identified. They are of three types viz. (i) Free Field (ii) Near Field and (iii) Far Field.

3.14.2.1 Free Field

The sound waves that propagate without obstruction from source to the receiver are free field. The sound waves obey the inverse square law so that sound pressure level decreases by 6 dB(A) as the distance is doubled. Such a field is known as free field.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 111 of 179	

3.14.2.2 Near Field

This field is located within a few wavelengths of the source and it is also influenced by the dimensions of the source. The inverse square law does not apply in this field.

3.14.2.3 Far Field

The far field has two parts one is known as free part and the other as reverberation part. In the free part of the far field, the sound pressures level obeys the inverse square law and propagate without obstruction from source to the receiver. The reverberant part of the field exists for enclosed situation where the reflected sound waves are superimposed on the incident sound waves. If there are many reflected waves from all possible direction, a diffuse sound field exists.

3.14.3 Sampling Locations

A preliminary reconnaissance survey was undertaken to identify the major noise generating sources in the area. The noise survey was conducted during the month of August 2003 to assess the background noise levels in different zones. viz. industrial, commercial, residential and silence zones as per the Gazette Notification (S.O. 123(E)) of MoEF dated February 14, 2000 on ambient air quality standards in respect of noise.

Sampling locations for noise are confined to Industrial, commercial, residential and silence zone. 10 sampling locations were selected for the sampling of noise, out of which five are residential areas, two industrial & commercial area and rest one is Silence zone. The sampling locations are shown in Figure - 3.14.1 and also given in Table-3.14.1.

Table No. 3.14.1: Noise Level Monitoring Stations in the Study Area

Code	Locations	Type of area	Distance in (Km)
N1	Athipattu	Industrial	3.81
N2	Komterpalayam	Silence	3.00
N3	Vallenkulum	Residential	4.58
N4	Kuruvlmedu	Residential	0.0
N5	Edayanchawdi	Residential	2.37
N6	Vellvayalchawdi	Residential	2.25
N7	Ennore market	Commercial	5.20
N8	Sadayan Kuppam	Residential	5.50
N9	Tiruvattur	Commercial	6.00
N10	Kathivakkam	Industrial	3.70

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 112 of 179	

Figure 3.14.1: Noise Level Monitoring Stations

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 113 of 179	

3.14.4 Ambient Noise Standards

Ministry of Environment & Forests (MoEF) has notified the noise standards vide gazette notification dated February 14, 2000 for different zones under the Environment Protection Act (1986). These standards are given in Table-3.14.2

Table No.-3.14.2 Ambient Air Quality Standards in respect of Noise

Area Code	Category of Area	Noise dB(A) L_{eq}	
		Daytime*	Nighttime*
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Note:

1. Daytime is from 6.00am to 10.00pm and Nighttime is from 10.00pm to 6.00a m.
2. Silence zone is defined as area up to 100 meters around premises of hospitals, educational institutions and courts. Use of vehicle horns, loud speakers and bursting of crackers are banned in these zones

3.14.5 Results and Discussion

The noise data compiled on noise levels is given in Table - 3.14.3 & 3.14.4 and 3.14.5 & 3.14.6. It can be seen that the hourly noise levels are ranging between 45.2 and 78.6 dB(A) during daytime and 37.1 to 59.8 dB(A) during nighttime. The nighttime L_{eq} (L_n) varies from 43.4 to 54.6 dB(A) and the daytime L_{eq} (L_d) varies from 50.0 to 69.6 dB(A) within the study area.

The variation of L_d and L_n within the residential areas are 52.6 – 69.6 dB(A) and 43.4 – 52.9 dB(A) respectively, which is crosses the prescribed limit of MoEF. Within the commercial area the variation of L_d were 54.0 – 65.9 dB(A) which is just above the MoEF standards. This is mainly due to the movement of goods carriers and public transportation system within the commercial zone. However, the L_n within the commercial area varies from 44.8 to 52.1 dB(A) and is well within the standards of MoEF. While the L_d and L_n of silence zone is 67.3 and 48.5 dB(A) which crosses the prescribed limit of MoEF. This is mainly due to crossing of traffic movement near by silence zone sampling site (School), and L_d and L_n of Industrial zone varies between 50.0 – 67.7 dB(A) and 43.4 – 54.6 dB(A) , which is well within the prescribed limit of MoEF.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 114 of 179	

Table No. 3.14.3: Hourly L_{eq} Noise Level in the Study Area (Pre Monsoon)

Times in Hours	Location code									
	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
06 – 07	52.5	50.4	46.2	49.1	50.2	48.1	46.2	51.3	52.7	50.8
07 – 08	56.7	52.3	48.8	52.3	51.3	48.3	50.3	56.1	55.6	52.3
08 – 09	58.2	56.7	50.1	55.7	51.8	49.5	58.4	62.3	59.2	56.3
09 – 10	62.6	61.2	53.6	59.6	56.7	52.4	63.2	67.4	61.2	61.2
10 – 11	67.7	63.4	55.7	60.1	62.8	58.1	69.4	69.8	63.6	62.6
11 – 12	67.2	62.8	58.4	59.6	61.7	62.4	70.3	66.4	67.2	62.4
12 – 13	67.0	61.7	57.2	56.2	61.2	63.1	66.3	62.1	70.1	66.8
13 – 14	66.8	59.7	54.3	53.8	60.2	64.6	63.4	61.3	65.6	71.4
14 – 15	66.0	58.9	52.7	51.6	57.6	62.3	57.3	58.2	62.3	68.5
15 – 16	66.1	58.4	53.1	50.4	56.2	58.1	57.4	63.1	60.1	67.3
16 – 17	67.2	59.6	54.8	49.6	58.4	59.3	63.2	67.1	68.3	66.4
17 – 18	69.6	62.4	61.2	48.7	60.1	62.1	64.4	69.7	70.1	65.6
18 – 19	68.2	63.7	57.4	48.6	61.2	58.4	69.5	70.3	68.4	65.8
19 – 20	67.6	60.2	54.3	47.8	60.3	56.2	70.2	68.2	67.4	62.8
20 – 21	65.4	59.8	52.4	47.6	59.2	54.3	66.4	59.3	62.6	58.4
21 – 22	62.8	56.7	50.6	45.2	58.3	50.1	62.5	58.1	57.8	53.4
22 – 23	58.4	55.8	48.2	42.1	56.3	48.6	57.3	53.4	52.3	49.6
23 – 24	54.2	52.6	47.2	40.3	52.4	44.3	52.6	50.2	48.4	45.6
00 – 01	52.7	48.6	43.6	38.1	48.2	42.4	51.2	47.3	45.0	42.0
01 – 02	48.6	43.2	39.2	37.6	44.6	40.6	48.4	42.1	42.6	39.8
02 – 03	42.1	39.7	37.6	39.2	39.3	37.1	46.1	38.4	43.7	41.6
03 – 04	39.6	38.8	40.1	43.1	39.3	39.6	42.3	37.1	43.6	41.7
04 – 05	43.7	40.1	42.7	45.3	44.7	42.3	39.1	42.3	46.3	42.4
05 – 06	50.2	44.2	43.8	47.1	47.3	46.1	42.3	47.2	50.2	46.4
Average	59.2	54.6	50.1	48.6	54.1	52.0	57.4	57.0	55.8	57.6

Table No. 3.14.4: Ambient Noise Level at the Study Area

	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
Daytime										
L_{10}	68.2	63.4	58.4	59.6	61.7	63.1	70.2	69.8	70.1	68.5
L_{50}	66.1	59.7	53.6	50.4	58.4	58.1	63.2	62.3	62.6	62.8
L_{90}	58.2	56.7	50.1	47.6	51.8	49.5	57.3	58.1	57.8	53.4
L_d	67.7	60.4	54.7	52.6	60.0	61.1	65.9	64.5	65.1	66.6
Nighttime										
L_{10}	58.4	55.8	48.2	47.1	56.3	48.6	57.3	53.4	52.3	49.6
L_{50}	50.2	44.2	43.6	42.1	47.3	42.4	48.4	47.2	46.3	42.4
L_{90}	42.1	39.7	39.2	38.1	39.3	39.6	42.3	38.4	43.6	41.6
L_n	54.6	48.5	44.9	43.4	52.1	43.7	52.1	50.9	47.5	43.4
Average of Hourly L_{eq}										
L_{eq}	59.2	54.6	50.1	48.6	54.1	52.0	57.4	57.0	55.8	57.6
L_{eq} Day & Night										
L_{dn}	56.5	50.4	46.8	45.3	54.0	45.6	54.0	52.8	49.4	45.3

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 115 of 179	

**Table No. 3.14.5: Hourly L_{eq} Noise Level in the Study Area
(Post Monsoon)**

Times in Hours	Location code									
	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
06 – 07	56.7	68.0	78.6	69.6	68.0	65.4	75.2	69.8	57.7	58.7
07 – 08	51.0	66.5	68.7	66.8	67.4	65.0	64.7	67.5	57.7	58.1
08 – 09	50.8	66.0	68.6	66.7	67.0	64.2	64.5	67.4	57.4	57.7
09 – 10	50.6	65.9	67.6	64.5	67.0	64.1	61.7	65.1	57.1	57.5
10 – 11	50.2	64.9	67.5	64.1	65.8	64.0	61.1	64.9	56.9	55.2
11 - 12	50.2	64.7	66.7	63.6	65.6	62.8	57.4	64.4	56.5	54.1
12 – 13	50.1	64.6	66.5	63.4	64.3	62.5	55.0	64.1	56.3	54.0
13 – 14	50.1	64.5	66.4	63.3	63.6	61.0	51.9	64.0	55.9	53.8
14 – 15	50.0	64.4	65.7	62.9	63.2	60.8	50.0	63.8	55.9	53.0
15 – 16	49.8	64.1	64.8	62.5	62.7	60.4	50.0	63.8	55.8	51.9
16 – 17	49.3	63.9	64.6	62.4	62.3	60.2	48.2	63.1	55.5	51.7
17 – 18	49.1	63.9	64.5	61.9	60.9	57.1	47.3	62.6	55.0	51.2
18 – 19	46.4	63.2	64.2	60.8	60.1	56.8	46.8	62.2	54.8	50.3
19 – 20	46.3	63.0	63.9	59.9	59.3	56.7	46.8	62.1	53.0	50.3
20 – 21	46.1	62.4	62.7	59.7	59.0	55.5	46.8	61.6	52.3	50.2
21 – 22	46.0	60.6	60.9	57.9	58.2	54.5	46.5	61.0	52.2	50.2
22 – 23	45.8	59.8	57.0	57.7	57.9	53.0	45.9	58.4	51.3	50.0
23 – 24	45.6	56.0	56.5	57.7	55.1	52.5	45.8	58.1	50.5	46.6
00 – 01	45.3	55.7	51.7	52.8	54.8	51.5	45.7	52.8	50.2	46.1
01 - 02	45.0	51.9	51.4	52.1	51.0	50.7	45.4	52.7	45.8	45.2
02 – 03	44.2	51.8	51.4	51.8	50.9	50.6	45.2	52.1	44.0	44.6
03 – 04	43.5	51.7	51.4	51.5	50.3	50.5	45.0	52.1	43.8	43.7
04 – 05	43.4	51.7	51.1	50.8	50.2	50.3	44.4	51.1	43.7	43.0
05 – 06	43.2	51.3	50.5	50.8	49.9	50.1	43.7	51.0	43.7	42.9

Table No. 3.14.6: Ambient Noise Level at the Study Area

	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
Daytime										
L_{10}	50.8	66.0	68.6	66.7	67.0	64.2	64.5	67.4	57.4	57.7
L_{50}	49.1	63.9	64.5	61.9	60.9	57.1	47.3	62.6	55.0	51.2
L_{90}	43.4	51.7	51.1	50.8	50.2	50.3	44.4	51.1	43.7	43.0
L_d	50.0	67.3	69.6	66.1	65.6	60.3	54.0	67.0	58.1	54.8
Nighttime										
L_{10}	45.6	56.0	56.5	57.7	55.1	52.5	45.8	58.1	50.5	46.6
L_{50}	44.2	51.8	51.4	51.8	50.9	50.6	45.2	52.1	44.0	44.6
L_{90}	43.2	51.3	50.5	50.8	49.9	50.1	43.7	51.0	43.7	42.9
L_n	44.2	52.2	52.0	52.6	51.4	50.7	45.3	52.9	44.8	44.8
Average of Hourly L_{eq}										
L_{eq}	47.9	60.8	61.8	59.8	59.8	57.5	51.5	60.7	52.6	50.8
L_{eq} Day & Night										
L_{dn}	49.3	63.5	65.8	62.9	63.4	61.1	56.0	63.4	55.2	53.6

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 116 of 179	

3.14.6 Conclusion

The status of noise quality within the Industrial zones of the study area is well within the MoEF standards. However, the daytime noise level within the commercial areas is more than the standards due to the movement of goods carriers and public transportation.

3.15 Potential of Ash Utilization

It is estimated that fly ash about 1.65 MTPA will be generated due to very low calorific value and higher ash content of the coal. The per day ash generation is about 5,500 tones. To assess the potential of ash utilization, a detailed market survey is being conducted in and around 100 km radius, from the site of proposed plant at Kathivakkam.

A structured questionnaire is prepared in consultation with the NTPC. This is circulated to the potential users of fly ash including govt. departments, non government agencies, coal companies, cement manufacturer, mining and other institutes to assess the ground situation and expected ash consumption level around 100 km radius of the Ennore Thermal Power Plant.

The study has revealed that ash generated at Ennore Thermal Power Station may be utilized in the following areas:

1. Fly Ash based Portland Pozzolana Cement Manufacturing (FAPPC).
2. Clay fly ash brick manufacturing.
3. Fly ash as lime/cement brick manufacturing.
4. Roads and embankment.
5. Agriculture.
6. Mine filling.

Table No. 3.15.1: Expected Potential Ash Utilizer in the Study Area

Sl. No.	Name of Industry / Govt. Deptt.	Amount of Fly Ash Used Presently (Amount in tones)
1.	Universal Pavers Pvt. Ltd.	3300 MT/month
2.	Kwality Building Products	450 MT/month
3.	MR Bricks Ltd.	300 MT/month
4.	Sri Maruti Holloro Bricks	500 MT/month
5.	Malabar Building Products	600 MT/month
6.	Ramco Industries Ltd.	2800 MT/month
7.	BESSER Concrete System Ltd.	300 MT/month
8.	Om Shakti Industries	300 MT/month
9.	Lakshmi Corporation	800 MT/month
10.	Standard Building Industries	300 MT/month
11.	Vishaka Industries Ltd.	900 MT/month
12.	Baghya Laxmi Agencies	300 MT/month

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 117 of 179	

13.	Aeon's Construction Product Ltd.	700 MT/month
14.	Gopalan Builders & Architects	500 MT/year
15.	PWD Ennore	200 MT/month
16.	NHAI (Four Laning Activity)	1100 MT/month

The Fly Ash can be Utilized for Different Possible Purposes Such As:-

1. Engineering activities such as road construction, land filling, cement industry etc.
2. Making bricks and a soft sponge like material, which can be used as office partitions and false roofing.
3. Fly ash has got the ability to remove Omega Chrome Red ME (a chrome dye, mostly used in textile industries) from water.
4. It is used for the treatment of water contaminated with lead and cadmium.
5. Fly ash may be used in water renovation through phosphate stripping.
6. Ca-rich fly ash is a supplement to agricultural lime.
7. It is used for the treatment of acidic coalmine spoils.
8. It is a good source of micronutrients.
9. It can be used to correct the deficiency of some micronutrients.

CHAPTER-4

IMPACTS

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 118 of 179	

4.0 IMPACTS

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 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 the proposed TPP are identified, based on the nature of the various activities associated with construction and operation.

Mathematical models are the best tools to quantitatively describe cause-effect relationships between source of pollution and different components of environment. The present study uses a Simulation Model for Atmospheric Dispersion of Stack Emissions (Industrial Source Complex Version 02035 [ISCST3] of USEPA) for prediction of ambient air quality after commissioning of proposed power plant. For noise impacts, the phenomenon of decrease in SPL with increasing distances was studied with the help of computer simulation using a 'Multi-source Noise Attenuation Model' which is based on Community/ In-plant Noise Model developed by Floor. In case of water, land, biological and socioeconomic environments, qualitative predictions have been made based on available scientific data and judgments.

4.1 LAND USE

4.1.1 Impacts During Construction and Operation phase

Construction of Main Plant, Ash Disposal Area, and other facilities will cover 1184 acres of total identified land out of which about 1103.82 acres consists of Salt Pan area which includes 1.65 acres of land situated across the Ennore Creek.. Rest of the land is barren/single crop agricultural land. This will result into conversion of some agriculture land for nonagricultural purpose. Further the vegetation in these areas will also be cleared resulting into loss of vegetation.

The construction activities attract a sizeable population and influx of population is likely to be associated with construction of temporary hutment for construction work force. However, this will be only a temporary change and shall be restricted to construction period.

Further due to the construction activities, the land use of adjoining area (which is not acquired by the project) may also change due to increased opportunities for business and increase in its commercial value.

	Comprehensive Environmental Impact Assessment for TNEB - NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 119 of 179	

As soon as the construction phase is over, the land use pattern modified to meet the requirement of construction phase shall be reversed. However, the change in land use pattern due to land acquisition and secondary effects shall be permanent.

4.2 WATER USE

The proposed power plant will abstract its entire water requirement from sea. The makeup water requirement for the project shall be 9720 m³/hr considering ash water re-circulation. If once through ash water system is adopted, the total sea water requirement will be about 8720 m³/hr. If ash re-circulating system is used the additional sea water requirement is estimated at 1000 m³/hr.

The details of various water systems for the project are presented in Chapter 2. Once through ash water system has been envisaged during the initial stage of the project, when ash pond is being filled up and there is no overflow. Once the ash pond gets filled up, the ash pond overflow shall be re-circulated for further use in ash handling system and this represents the normal operation of the project. The total effluent entering into the Central Monitoring Basin (CMB) is about 5575 m³/hr (once through ash water system) and 7075 m³/hr (ash water re-circulation system). The treated effluents, conforming to the standards shall be discharged back to the natural watercourses leading to sea.

Based on the water requirement, an annual water budget for the plant is presented in Table – 2.2.3. The total annual requirement of the power plant at operational stage based 6000 hrs of operations i.e. 69% PLF would be about 58.32 million m³ (MCM).

4.2.1 Water Budget of the Study Area

An annual overall water budget for the study area has been prepared on the basis of the hydrological and meteorological data collected from the secondary sources like Central Ground Water Board and published synoptic meteorological data of Chennai (Nungambakkam) Station. The data used in computing the water budget has been present in **Table-4.2.1** and the resultant, annual overall water budget is presented in **Table-4.2.2**.

Table 4.2.1: Input Data for Computing Annual Water Budget

Land Cover	Area in hectares*
Forest cover	0.0
Cultivated Land	4635.0
Not available for cultivation	4498.8
Water body	6260.0

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 120 of 179	

Total	15393.8
	* Based on Satellite Imagery
Other Data	
Annual Average Temperature	33°C
Total annual rainfall, mm	1124.4
Transpiration from vegetation cover (mm/year)	82.55
Evaporation from land (mm/year)	63.50
Evaporation from water surface (mm/year)	1704.55

Table 4.2.2: Annual Surface Water Budget of the Study Area

Input	Quantity (MCM)
Precipitation ($1124.4 \times 15393.8 / 10^5$)	+173.09
Total Input	+173.09
Losses	
Evaporation from land surface ($63.5 \times 9133.8/10^5$)	-5.80
Evaporation from water surface ($1704.55 \times 6260.0/10^5$)	-106.70
Transpiration by vegetative cover including crops (assuming cultivation, over 9 months) [$82.55 \times 4635.0 \times 0.75/10^5$]	-2.87
Drafts	
Irrigational uses (assuming 50% of the total irrigational use); refer Table-3.4.1	-8.42
Domestic uses refer Table – 3.4.1	-24.93
Industrial uses refer Table –3.4.1	-14.67
Total losses including drafts	-163.39
Surplus (available as surface runoff, stream flow and groundwater stream recharge)	+9.70
Proposed drafts	
Net requirement of the project for Proposed TPP	-58.32
Net Deficit	-48.62

- It is assumed that 50% of the irrigational water draft is met by the river canal irrigation system, which brings water from outside the study area.

The proposed study area is found to water deficit as per the water budget shown in Table 4.2.2. Since the water requirement for the plant is proposed to be drawn from the sea, therefore the load on the existing load on inland water shall be negligible.

4.2.2 Impacts During Operation Phase

It is evident from Table 4.2.2 that the net annual water requirement (58.32 MCM) of the proposed Power Plant is more than the net input of the water

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 121 of 179	

budget of the area (precipitation). Since the seawater from Bay of Bengal shall fulfill the demand of the power plant, it is concluded that the impact on inland water use would be negligible.

Further, the maximum demand of water for the project (9,720 m³/hr with once through ash water system) is less insignificant than the discharge to Bay of Bengal. It may, therefore be concluded that the impact of withdrawal of water on sea and the availability of water to the other users would be negligible. As the project does not envisage the use of ground water as the de-salination plant is proposed to meet the sweet water requirements, there will be no impact of project on ground water sources.

4.3 DEMOGRAPHY AND SOCIOECONOMIC

4.3.1 Impact During Construction Phase

The following impact during construction phase would be felt with the start of the construction activities.

1. Migration of people to project site would have a marginal impact on demography of the study area such as slight changes in total population, sex ratio, literacy level etc. Flow of the men, material and money in the study area will change the socio-economic status of the local community.
2. The project will provide temporary employment to non-skilled and semi-skilled manpower. Most of the people will be employees of contractors/sub-contractors. The number of employees deployed is likely to increase gradually, attain peak and then gradually fall to normal levels on the completion of the project.
3. The non-workers in the study area constitute about 66.64 % (as per 2001 census data) of the total population of the study area. This indicates the availability of sizeable manpower required for the construction activity.
4. In addition to the opportunity of getting employment as construction labourers, the local population would also have employment opportunities in related service activities like petty commercial establishments, small contracts/sub-contracts and supply of construction materials of buildings and ancillary infrastructures etc. Consequently, this may lead to economic upliftment of the area.
5. During the construction period, there will be increase in floating population and hence additional strain on civic amenities like road, transport, communication, drinking water, sanitation and other facilities to meet the work force requirement.
6. The influx of a large number of people is likely to bring further urbanization of the area. The social conflicts between the guest and host communities are expected in the initial stages of development. Constructional activities may interfere with the rural life of neighboring villages. This is expected to get stabilized in a short period.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 122 of 179	

7. Construction of power plant may attract migrant labour force. The migrant labour force will be allowed to settle in a specified area through main contractors. The contractors have to necessarily provide basic amenities like water supply, sanitation, electricity etc. at the labour camp to maintain hygienic condition and aesthetics.
8. Land Prices: With arrival of personnel for plant construction, house rent rates will rise for non-locals. Land prices in 3 – 7 km area around the plant site will further appreciate. This will be the first sign of rising land and property prices when market force believe that there may be additional disposable income in the area.
9. Labour Rate: As work on plant construction begins, the inflationary push will manifest itself in increase in labour rate.
10. Consumer Prices: The local population will be affected by inflationary trend sometime later. Prices of local services and consumer goods like egg, fish, vegetables, milk etc. may start rising. This will happen only when a sizeable staff of the project and other associate companies settle in the area. However, the prices of common consumer items non made locally will not be affected much.
11. Incomes: A rise in consumer prices usually triggers a demand for greater incomes. But this cannot be realized as the construction of power plant has few immediate ancillary industrial activities, which could pump more money into the local economy. However, rapid growth of service sector will result in some increase in the income of the area.
12. Transport and Civil Construction: The transport companies would benefit from the construction of the plant. The civil construction companies would also grow.
13. Services: The services like retail shops, banks, automobile workshops, school, health care etc. will further expand in and around the township.
14. Transport: Transport network will be augmented/strengthened during the construction of power plant.

Expectations of Population:

Since the proposed area is falling under the industrial area there would not be any objections from the people in the area and generally they will welcome the project.

1. Unemployment in the area tilted majority of the people to give a positive outlook towards the proposed project.
2. As far as impact due to establishment of project is concerned, majority of the people expect for a positive change.
3. The project proponents would further undertake suitable community development activities in the surroundings villages depending upon their needs and requirement.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 123 of 179	

Rehabilitation and Resettlement (R & R):

The land for the project has been so selected as to cause minimum disturbance to the existing settlements. A detailed socio-economic survey of the land proposed to be acquired will be collected and the number of project-affected persons (PAPs) will be assessed based on the survey.

A Rehabilitation and Resettlement Plan for the PAPs will be formulated in close coordination with state government authorities based upon R&R policy of NTPC. Besides, community development works would also be undertaken in the villages around project site based upon local requirements.

4.3.2 Impacts During Operation Phase

The impacts of power project during operational phase shall be as follows:

1. The trend of out migration for employment is likely to reduce due to better economic opportunities available in the area.
2. Operation phase of power plant will require work force of non-technical and technical persons. Migration of persons with better education and professional experience will result in minor increase of population and literacy in the area.
3. Commissioning of power plant will result in considerable growth of service sector and will also generate new industrial and business opportunities in the area. As the power plant and its ancillary facilities would act as an active nucleus for new industries and business activities, shift of population towards this center and peripheral area is likely to increase.

The socio-economic impacts discussed in the construction phase of the proposed plant will also be manifested during the operation phase in the following manner.

1. Increase in consumer prices of indigenous produce and services, land prices, house rent rates and labour prices.
2. Influx of persons with higher spending power and different socio-cultural background will improve the socio cultural environment of the area, though occasional tension as a result of this influx cannot be totally ruled out.
3. Improvement in transport, communication, health and educational services.
4. Increase in employment due to large flow of financial and material resources through increased business, trade, commerce and service sector.
5. Commissioning of power plant would transform rural environment into semi-urban environment. Urban traits with respect to economic, cultural and Infrastructural changes in place of traditional rural customs will tend to prevail.

	Comprehensive Environmental Impact Assessment for TNEB - NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 124 of 179	

Health:

Impact on health, if any, will be primarily due to air pollution i.e. emissions of particulate, NO_x and SO₂, and noise generation. Adequate air pollution and noise pollution control measures will be provided to conform to regulatory standards. Employees working in high noise work place would be provided protective devices like ear plugs/ear muffs for ensuring minimum impact on human health. The environmental management and emergency preparedness plans are proposed to ensure that the probability of undesired events and consequence are greatly reduced, and adequate mitigation is provided in case of an emergency.

4.4 SOILS

4.4.1 Impacts During Construction Phase

Constructional activities of involve leveling, excavation and removal of existing vegetation would invariably disturb the soil of the area. The impacts on soil during construction phase shall be mainly due to loss of topsoil in the construction areas and contamination of the soils of surrounding area due to construction materials such as cement, sand, oils, etc. The disturbances would be more pronounced during the summer and monsoon seasons with strong rains. However, it shall be temporary and shall be confined to the areas of construction only. Generally, such disturbances are confined to the area of activity i.e. the main plant, town ship and ash disposal area. Appropriate soil conservation measures (plantation rotation of vegetation, treatment with appropriate chemical, to adopt mixed agriculture habit) associated with improved construction techniques would minimize such local impacts. Timely afforestation activities would also contribute positively towards soil conservation, to some extent.

4.4.2 Impacts During Operation Phase

The impact on the soil during operation of the project could result due to deposition of residual particulate matter and gaseous emissions on the soil. The soil with predominant sand content, moderate silt content and low clay content has pH in the range of 6.02 to 7.94. The impact on the soil due to operation of the power plant and gaseous emissions are likely, as the incremental SO₂ level is in the range of 38.08 µg/Nm³. The impact of SPM would be negligible, as the incremental concentration is only 4.24 µg/Nm³. Therefore, it is advisable to undertake periodic monitoring of soils at the maximum impact zone of the pollutants mentioned above.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 125 of 179	

4.5 HYDROLOGY

4.5.1 Impact on Surface Water

The water for TNEB – NTPC JVC Thermal Power station will be drawn from Bay of Bengal. For the entire project including cooling water, plant water, ash water and domestic water requirement, which is insignificant compare to the seawater available near the proposed site. Therefore, withdrawal of water from sea will not have any effect on the availability of water to down stream users.

4.5.2 Impacts on Ground Water

The ground water recharge of the study area is due to rainfall. According to reports the ground water of the study area has been depleted and has great pressure to meet the current domestic commercial and industrial requirements as presented in Table 4.2.2. This indicates that study area has scarcity of ground water for future industrial activities. Therefore, withdrawal of ground water even in small quantities will have great impact on the ground water potential of the study area.

4.6 WATER QUALITY

4.6.1 Impacts During Construction Phase

Effluents from the construction area mainly contain suspended solids while the sanitary waste from the labour colonies contains suspended as well as organic matter. The loose construction material like sand, cement etc. and excavated earth/construction debris may get washed off during heavy precipitation and finally reach the sea through natural water courses. This may increase the suspended/dissolved solid concentration of the receiving body and affect the sediment composition.

Adequate arrangement for proper drainage and disposal of wastewater and routing of the effluents from construction area through sedimentation basins and provision of proper sanitary facilities with treatment will eliminate these problems of water pollution. Moreover, these impacts will be temporary in nature.

4.6.2 Impacts on Surface Water Quality During Operation Phase

The impacts of a coal based thermal power project during operation phase could result from several activities such as discharge of hot cooling water, discharge of main plant effluents and sanitary effluents and discharge of ash pond overflow. However, in case of the proposed power project, all these impacts are envisaged to be insignificant, as discussed below:

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 126 of 179	

- The project will have a closed cycle cooling system with cooling towers; hence there will be no significant thermal pollution of the receiving water body.
- Ash handling system will also have a re-circulating system and there will be no discharge of overflow from ash disposal area. Only treated blow down, conforming to standards shall be discharged.
- Each of the effluent stream emanating from the project shall be individually treated (as described in Section 5.2.2) and then routed through a Central Monitoring Basin (CMB), which will also act as an equalization chamber. Only treated effluents, conforming to regulatory standards shall be discharged.
- The sanitary effluents from the main plant and township areas shall be treated in a Sewage Treatment Plant (STP) and the treated effluent from STP conforming to regulatory standards shall be discharged.
- All the effluents shall be treated and recycled/ reused to the maximum possible extent and only a minimum quantity of effluents shall be discharged (about 374 m³/hr with ash water recirculation system), which is negligible as compared to the volume of the seawater.

4.6.3 Impacts on Ground Water Quality During Operation Phase

The contamination of ground water due to leachate from ash disposal area is a major area of concern. The detailed investigations of the ash disposal area for assessing the risk of ground water contamination (such as infiltration tests, bore hole tests, pump tests etc.).

NTPC has conducted several geo-hydrological studies of the ash disposal areas at its projects (Singrauli, Rihand, Vindhyachal, Korba, Farakka and Talcher) through reputed institutions like Indian Institutes of Technology, Roorkee and Mumbai, Centre for Studies on Man and Environment, Calcutta. All these studies conclude that the leaching of heavy metals from ash occurs only under pH 4 or below. In practice, the pH of the ash water is either neutral or alkaline (7 or above) and hence the leaching of heavy metals is highly unlikely.

Detailed geo-technical investigations in the ash disposal areas A1 and A2 indicate that both these areas are overlain by several layers of fine grained & coarse grained strata. The thickness and depth of these layers vary widely. The fine grained strata layers comprises of silty clay of medium to high plasticity (CH/Cl), clayey silt of medium to high plasticity (Cl/CH), sandy clay of medium to high plasticity (CH/Cl) & sandy silt of low to medium plasticity (Cl/CH). The layers of coarse grained strata comprise of clayey sand (SC), silty sand (SC/SM/SP-SM) & medium to fine sand (SP-SM/SP). The clay content of the fine grained strata layers is generally high (as high as 50%).

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 127 of 179	

The permeability of the soil was measured at 5 locations at four different depths and the permeability varied from 6.04×10^{-7} cm/sec to 5.52×10^{-5} cm/sec. In view of the low permeability and high clay content of the soils, it is highly unlikely that there will be any possibility of ground water contamination.

4.7 AIR QUALITY

4.7.1 Impacts During Construction Phase

In absence of the infrastructural facilities at the project site like paved roads, and gritty terrain of the project site impact on ambient air quality within the project site and nearby areas may be significant. 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

4.7.2 Impacts During Operation Phase

This proposed thermal power plant is a coal fired and thus there may be impacts on ambient air quality due to the coal burning. For the predictions of the impacts of stack emission from the power plant on ambient air quality during its operational phase, Air Dispersion Mathematical Model was run for the pollutants like, Total suspended particulate matter (TSPM), sulphur dioxide (SO_2) and oxides of Nitrogen (NO_x).

The air dispersion model used is **Industrial Source Complex Short Term (ISCST3)**, Version 02035 developed by the US Environmental Protection Agency (US EPA), released on 02/04/2002 and recommended by Ministry of Environment & Forests (MoEF).

For the modeling purpose three pollutants namely, TSPM, SO_2 and NO_x are considered for the **POINT** source emission. The details of stack and emissions for the proposed thermal power project are presented in **Table-4.7.1**.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 128 of 179	

**Table No. 4.7.1: Stack and Emission Characteristics for
TNEB NTPC JVC Thermal Power Project**

Sr.No.	Parameters	Units	Beneficiated Coal
1.	Stack Height	M	275
2.	Number of stacks	No.	One
3.	Flue stack diameter	M	6.75
4.	Flue gas velocity/flue	M/sec	22.2
5.	Flue gas temperature/ flue	°K	413
6.	Volumetric flow rate/flue	Nm ³ /sec	573.44
7.	Number of flues in the stack	No.	Two
8.	Coal consumption (1000 MW)	TPH	627.85
10.	Emission Rates*		
	Sulphur dioxide (500 MW)	gm/sec	563.64
	Oxides of Nitrogen (500 MW)	gm/sec	429.90
	Particulate Matter (500 MW)	gm/sec	57.30

* SO₂ at 0.34% Sulphur in coal, SPM, at 100 mg/ Nm³ and NO_x at 750 mg/ Nm³.

4.7.2.1 Meteorological Data

The hourly micro-meteorological data were recorded near the site at Ennore for twelve months (July 02, 2003 to July 01, 2004) using a microprocessor based automatic weather monitoring system (WM251). This site specific hourly met data like wind direction, wind speed, ambient temperature, stability classes have been used for dispersion modeling.

4.7.2.2 Determination of Atmospheric Stability

In the present study the Pasquill – Gifford Stability Classes have been determined using Solar radiation/Delta-T (SRDT) method as discussed below:

4.7.2.2.1 Solar radiation/Delta-T (SRDT) method

The method is based on the Bowen et al. with modifications in the Turner's Method. In this method the structure of the Turner's are tried to retain as much as possible however, the need of observations of cloud cover and ceiling is obviated. This method uses the surface layer wind speed wind measured at 10m height in combination with the measurement of total solar radiation during daytime and a low-level vertical temperature difference (ΔT) i.e. 2m and 10m at the night time.

The relationship employed in the estimation method assumes that the steady state conditions. The nighttime is defined as a period from one hour before sunset to one hour after sunrise.

The key to Solar radiation/Delta-T (SRDT) method for estimation of P-G stability categories are given in **Table – 4.7.2.**

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 129 of 179	

Table 4.7.2: Key to Solar Radiation Delta-T (SRDT) Method for Estimating Pasquill-Gifford (P-G) Stability Categories

DAY TIME

Wind Speed (m/s)	Solar Radiation (W/m ³)			
	≥ 925	925 – 675	675 – 175	≤ 175
<2	A	A	B	D
2 – 3	A	B	C	D
3 – 5	B	B	C	D
5 – 6	C	C	D	D
≥ 6	C	D	D	D

NIGHT TIME

Wind Speed (m/s)	Vertical Temperature Gradient, °C	
	< 0	≥ 0
<2	E	F
2.0 – 2.5	D	E
≥ 2.5	D	D

4.7.2.3 Mixing Depth

The site-specific mixing depth data are not available. Therefore, in the present study the hourly daytime mixing depth has been derived on the basis of the data presented in a CPCB publication "Spatial Distribution of Hourly Mixing Depth over Indian Region". The hourly mixing depth considered for the dispersion modeling is presented in Table 4.7.3

Table 4.7.3: Mixing Depth Considered for Dispersion Modeling (North East Monsoon)

Time Period, Hr.	Mixing Depth (m)
20:00- 05:00	0160
6:00	125
7:00	170
8:00	200
9:00	500
10:00	700
11:00-19:00	1000

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 130 of 179	

Mixing Depth Considered for Dispersion Modeling (Winter)

Time Period, Hr.	Mixing Depth (m)
20:00-05:00	0160
06:00	0125
07:00	0170
08:00	0200
09:00	0500
10:00-12:00	0700
13:00-19:00	1000

Mixing Depth Considered for Dispersion Modeling (Summer)

Time Period, Hr.	Mixing Depth (m)
20:00-05:00	0160
06:00	0125
07:00	0170
08:00	0200
09:00	0500
10:00-12:00	0700
13:00-19:00	1000

Mixing Depth Considered for Dispersion Modeling (South West Monsoon)

Time Period, Hr.	Mixing Depth (m)
20:00- 05:00	0160
6:00	125
7:00	170
8:00	200
9:00	500
10:00	700
11:00-19:00	1000

4.7.2.4 Application of ISCT3 Model

The impact of stack emission on the ground level concentration (GLC) of TSPM, SO₂ and NO_x in the ambient air have been predicted through Industrial Source Complex – Short Term Model (Version 02035). The assumptions made for short-term computations are as follows: -

1. The ISC short-term model for stacks uses the steady state Gaussian plume equation for a continuous elevated source
2. The wind power law is used to adjust the observed wind speed, from a reference measurement height of 10m, to the stack or release height.

	Comprehensive Environmental Impact Assessment for TNEB - NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 131 of 179	

3. The plume rise is estimated by, Briggs formulae.
4. Buoyancy Induced Dispersion is used to describe the increase in plume dispersion during the preliminary phase
5. Stack tip down wash is not considered
6. Processing of Calm conditions is ignored
7. It is assumed that the pollutants do not undergo any physicochemical transformation and that there is not pollutant removal by dry deposition.
8. Washout by rain is not considered
9. Polar coordinate system has been used for computations, and
10. The model computations have been done for 15 km.

4.7.2.5 Presentation of Results

The predictions have been made for the monitoring period (12 months). The hourly data on wind speed, direction, atmospheric stability and temperature have been used.

For the short-term simulations, the concentrations were estimated around 324 receptors to obtain an optimum description of variations in concentrations over the site in 625 sq. km. covering 16 direction 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 TSPM, SO₂ and NO_x are presented in Table-4.7.4.

The 24 hours, maximum predicted ground level concentrations (GLCs) for SPM, SO₂ and NO_x are 4.24, 38.07 and 31.86 µg/m³ respectively and these were observed in the North, northwest direction at distance of 4.0 km.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 132 of 179	

Table-4.7.4: First 10 Maximum 24 Hourly Short Term Incremental Concentration

Rank	Concentration in $\mu\text{g}/\text{m}^3$			Distance (Km)	Direction
	SPM	SO ₂	NO _x		
1 st	4.24	38.07	31.86	4	NNW
2 nd	4.15	37.25	31.18	4	NNW
3 rd	4.11	36.89	30.87	5	NNW
4 th	4.09	36.70	30.72	5	NNW
5 th	3.85	34.54	28.91	5	NNW
6 th	3.80	34.10	28.54	6	WNW
7 th	3.78	33.91	28.38	4	WNW
8 th	3.69	33.14	27.74	6	WNW
9 th	3.66	32.87	27.51	6	WNW
10 th	3.64	32.69	27.36	4	WNW

The isopleths overlaying on the topographical map of the study area, for maximum 24 hourly concentrations of SO₂, TSPM, NO_x are presented in Figures 4.7.1., 4.7.2, 4.7.3 respectively

4.7.2.6 Resultant Concentrations after Commissioning of the Project

The resultant concentration after the commissioning of the proposed power plant on the GLC of TSPM, SO₂ and NO_x are predicted by super imposing the predicted values on the 98 percentile baseline concentrations recorded during the study period irrespective to the direction and distance of the monitoring location. The cumulative ground level concentrations (baseline + increment) after commissioning of the proposed project are presented in **Table - 4.7.5**. The ground level concentration predicted at the current ambient air quality monitoring stations, is presented in Table – 4.7.6.

The estimated cumulative GLCs for TSPM, SO₂, NO_x after commissioning of the thermal power project are found to be within the ambient air quality standards prescribed by CPCB for industrial areas

Table No. 4.7.5: Resultant Maximum Ground Level Concentration after Commissioning of the Project

Pollutant	98 percentile AAQ Concentration recorded during study period ($\mu\text{g}/\text{m}^3$) (area)	Maximum Incremental Concentration due to the Proposed Power Project ($\mu\text{g}/\text{m}^3$)	Resultant Concentration ($\mu\text{g}/\text{m}^3$)
TSPM	186.0	4.24	190.24
SO ₂	26.0	38.08	64.08
NO _x	19.0	31.87	50.87

	Comprehensive Environmental Impact Assessment for TNEB - NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 133 of 179	

Table No. 4.7.6: Resultant Maximum Ground Level Concentration after Commissioning of the Project at the Air Quality Monitoring Stations

Station	98 percentile AAQ Concentration recorded during study period ($\mu\text{g}/\text{m}^3$)			Maximum Incremental Concentration due to the Proposed Power Project ($\mu\text{g}/\text{m}^3$)			Resultant Concentration ($\mu\text{g}/\text{m}^3$)		
	TSPM	SO ₂	NO _x	SPM	SO ₂	NO _x	TSPM	SO ₂	NO _x
Kathivakam	166.4	23.1	20.1	0.03	12.82	10.73	166.4	35.92	30.83
Athipattu	182.2	26.0	18.0	0.00	4.66	3.90	182.2	30.66	21.90
Vallivaya Ichavadi	189.0	29.0	19.0	0.02	9.27	7.77	189.0	38.27	26.77
Vallankulam	189.1	20.8	15.1	0.00	9.60	8.04	189.1	30.40	23.14

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 134 of 179	

**Figure 4.7.1: 24 Hourly Maximum Ground Level Concentration of
Sulphur Dioxide (Ug/m³)**



	Comprehensive Environmental Impact Assessment for TNEB - NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 136 of 179	

**Figure 4.7.3: 24 Hourly Maximum Ground Level Concentration of
Suspended Particulate Matter (Ug/m³)**

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0250/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 137 of 179	

4.8 NOISE ENVIRONMENT

4.8.1 Impact During Construction Phase

The major noise generating sources during the construction phase are vehicular traffic, construction equipment like, dozer, 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 1.5 km from the source is 23.9 dB(A).

The ambient noise level recorded during field studied in the near by village Kuruvemedu located near the site ranges between 37.6 – 69.6 dB(A). The 24 hour Leq is 48.6 & 59.8 dB (A). As the ambient noise levels are higher than the predicted noise levels, due to masking effect, no increase in the ambient noise levels during construction phase is envisaged.

4.8.2 Impact During Operational Phase

Noise Sources:

The main noise generating sources in thermal power plant are Turbine, Boiler feed pumps, Air compressors, Cooling towers, CW pumps Forced draft fan, induced draft fan, Primary air fan and Coal mills. Intermittent noise is generated due to operation of diesel generator.

Impact on Noise Level:

Any industrial complex in general consists of several sources of noise in clusters or single. This clusters/single source may be housed in buildings of different dimensions made of different materials or installed in open or under sheds. The material of construction implies different attenuation co-efficient. In order to predict ambient noise levels due to the proposed power plant the noise modeling has been done. For computing the noise levels at various distances with respect to the plant site, noise levels are predicted by a user friendly model the details of which are elaborated below.

Model for Sound Wave Propagation During Operation:

For an approximate estimation of dispersion of noise in the ambient air from the point source, a standard mathematical model for sound wave propagation is used. The noise generated by equipment decrease with increase distance from the source due to wave divergence. An additional decrease in sound pressure level with distance from the source is expected due to atmospheric effect or its interaction with objects in the transmission path.

For hemispherical sound wave propagation through homogenous loss free medium, one can estimate noise levels at various locations, due to different sources using model based on first principles, as per the following equation:

$$L_{p2} = L_{p1} - 20 \log (r_2 / r_1) - A_E - A_M \quad (1)$$

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 138 of 179	

Where,

Sound L_{p2} and L_{p1} are the Sound Pressure Levels (SPL) at points located at a distances of r_2 and r_1 from the source. A_E & A_M are attenuations due to Environmental conditions (E) and Machine correction (M). The combined effect of all the sources can be determined at various locations by the following equation.

$$L_{p(\text{total})} = 10 \log (10^{(L_{pa})/10} + 10^{(L_{pb})/10} + 10^{(L_{pc})/10} + \dots) \quad (2)$$

Where L_{pa} , L_{pb} , L_{pc} are noise pressure levels at a point due to different sources.

Machine Correction (A_M):

The background noise level, when the machine is not in operation should be determined at one or more locations while conducting the test. The readings at each location, with the machine in operation should exceed the background levels by at least 10 dB in each pressure level of interest. If the difference is less than 10 dB, correction should be applied. If the difference between the measured sound and the background sound in any sound pressure level is less than 3 dB a valid measurement of the machine cannot be made. In order to reduce background noise to acceptable levels, it may be necessary to acoustically treat the equipment.

Environmental Correction (A_E):

The equivalent sound pressure level can be calculated from the measured sound pressure level ($L_{eq \text{ measured}}$) averaged over the measurement surface area 'S' and from corrections K_1 and K_2 and is given by ;

$$(L_{eq \text{ measured}}) = (L_{eq \text{ measured}}) - K_1 - K_2 \quad (3)$$

Where,

K_1 = Factor for the background noise correction. The correction was not applied in this modeling exercise, as it was not possible to measure the background noise levels by putting off machines. Hence it was considered as zero.

K_2 = Environmental correction

Model Details:

Based on the above equation user friendly model has been developed. The details of the model are as follows:

1. Maximum number of sources is limited to 200;
2. Predicted Noise levels at any distance specified from the source;
3. Model is designed to take topography or flat terrain;
4. Co-ordinates of the sources in meters;
5. Maximum and Minimum levels are calculated by the model;

	Comprehensive Environmental Impact Assessment for TNEB - NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 139 of 179	

6. Output of the model in the form of isopleths; and
7. Environmental attenuation factors and machine corrections have not been incorporated in the model but corrections are made for the measured L_{eq} levels.

Input for the model :

The sources where noise level monitored inside the building are Turbine, I. D. Fan, P. A. Fan, F. D. Fan, air compressors boiler feed pumps, cooling water pumps and cooling tower. The designed noise level for the various equipment for Stage-I are given in Table 4.8.1 the values mentioned are at 1 m distance from the source.

Table No. 4.8.1: Likely Noise Levels in TNEB-NTPC TPP

Sl. No.	Source Name	Unit-I	Unit-II
		Noise level in dB (A)	
1	Turbine	90	90
2	Diesel generator*	75	75
3	Cooling Water Pump	90	90
4	Boiler feed Pump	90	90
5	FD Fan	90	90
6	ID Fan	90	90
7	PA Fan	90	90
8	Coal Mill	90	90
9	Cooling Tower	85	85
10.	Coal Handling Plan	90	90

Note: *After acoustic enclosure

Presentation of Results:

Ambient Noise Levels:

The ambient noise levels have been predicted with proposed value for TNEB – NTPC JVC TPP. The predicted noise levels at the boundary of the plant in different directions are given in Table 4.8.2. There will not be any significant impact on the village due to masking effect.

Table No. 4.8.2: Predicted Noise Levels

Sl. No.	Distance (m)	Noise level dB (A)
1	100	60.2
2	200	52.4
3	300	48.3
4	400	45.1
5	500	40.2

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 140 of 179	

6	750	35.6
7	1000	30.8
8	1500	23.9
9	2000	20.0

Industrial Noise Standards:

The OSHA has recommended permissible noise exposure limit for Industrial worker which is based on 90 dB(A) for 8 hours exposure a day with 5 dB (A) trading rates. The limits are given in Table 4.8.3:

Table No.: 4.8.3: Permissible Exposure Noise Limits

Total time of exposure per day in hours	Sound pressure level in dB(A)
8	90
6	92
4	95
3	97
2	100
1	105
½	110
¼	115

Work Zone Noise Levels:

The protective measures need to be provided to the operators and workers working near the high noise generating machinery. As per Occupational Safety and Health Administration (OSHA) Standards, the maximum allowable noise level for the workers is 90 dB (A) for 8 hours exposure a day. Therefore, adequate protective measures in the form of ear muffs/ear plugs to the workers working in high noise areas need to be provided. In addition reduction in noise levels in the high noise machinery areas could be achieved by adoption of suitable preventive measures such as use of enclosures with suitable absorption material, etc. Further, in addition to the in plant noise control measures, all the open areas within the plant premises and all along the plant boundary will be provided with adequate green belt to diffuse the noise.

4.9 TERRESTRIAL ECOLOGY

4.9.1 Impact During Construction Phase

As the study area is devoid of natural forests, the overall impacts on terrestrial ecosystem (e.g. loss of flora and fauna) will be negligible. Removal of topsoil often leads to soil erosion. 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

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 141 of 179	

would also be regulated and minimized through adoption of control measures such as paving and surface treatment, water sprinkling and plantation schemes. The impact would generally be restricted to surrounding flora within the plant boundary.

4.9.2 Impact During Operation Phase

The impact on the terrestrial ecosystem due to operation of the proposed project would mainly occur from deposition of air pollutants. Particulates, sulphur dioxide and oxides of nitrogen are major pollutants of a coal based thermal power plant. These pollutants affect biotic and abiotic components of the ecosystem individually and synergistically. Chronic and acute effects on plants and animals may be induced when the concentration of these pollutants exceeds threshold limits.

The fly ash particles depending upon their size and weight settle down at varying distances on vegetation and soil surfaces in the prevailing and direction. Foliar deposition of fly ash may interrupt gaseous exchange through stomatal clogging, thereby affecting plant growth.

Agrawal and Agrawal (1989) have identified injuries (necrosis and chlorosis) due to dust deposits in the range 4.5 to 32.5 g/m², but no damage has been observed in the range 1.0 to 2.2 g/m². The emission of Particulates from the stack would be maintained at 150 mg/Nm³ through efficient functioning of the ESP. Furthermore, emission of the residual amount of fly ash through 275 m tall stack results in a very wide dispersion of the particulates, leading to maximum 24 hourly average incremental ground level concentrations of about 4.24µg/m³ (Refer Section – 4.7). Such low concentration of fly ash in the air and its deposition would not induce any change in the ecosystems.

Chronic exposure to SO₂ causes injury characterized by yellowing of the leaf (Chlorosis). Acute injury is characterized by development of dry dead areas with an ivory to brown colour (necrosis). Scientific literatures reveal that low concentration of SO₂ over long period lead to intravascular chlorosis in high humidity. However at higher concentrations, SO₂ combines with moisture in the air to form aerosol, which erodes cuticle and cell membrane, thus inviting easy entry of pathogens. It may alter the pH of the soil. Changes in pH of the soil may affect microflora and fauna of the soil. Scientific literatures on effect of SO₂ on plants reveal the following:

- i) Agricultural crop (rye-grass) suffered growth reduction at 200 µg/m³ concentration of SO₂. SO₂ concentrations of 500 µg/m³ caused major damage.
- ii) SO₂ concentrations in the range of 240 to 1200µg/m³ stimulated stomatal opening.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 142 of 179	

- iii) SO₂ concentrations in the range of 50 to 200 µg/m³ changed productivity, but drastic injury to foliage was not caused.
(Source: M J Kejiol et al, Gaseous Air Pollutants and Plant Metabolism – 1984)

The range of injury or possible for the most sensitive species is 1.0 ppm (2.6 mg/m³ for 1 hour to 0.05 ppm (130 µg/m³) for 8 hours. Taking a seasonal and annual average, the threshold for chronic plant injury has been estimated at approximately 130 µg/m³ (A.J Dvorack and B G Lewis, 1978). Reduction in biomass and productivity has been found by Pandey and Rao (1978) on wheat exposed to 0.8 ppm SO₂ for 2 hours daily for 60 days.

Maximum 24-hour average ground level concentration, during operation of the power station (Section 4.7), would be well within the National Ambient Air Quality Standards for industrial areas and It would thus be observed that pollutant concentration due to operation of the project are much lower than the threshold limits for damage to terrestrial flora and as such, the impact on the terrestrial ecosystem would be marginal.

4.10 AQUATIC ECOLOGY

4.10.1 Impact During Construction Phase

The runoff from construction area may lead to a short-term increase in suspended solids and decrease in dissolved oxygen near the discharge area. This may lead to a temporary decrease in the photosynthetic activity of phytoplanktons, rise in anaerobic conditions, habitat destruction and food chain modification. However, for major part of the year during construction phase, no detectable impact is expected because water quality will not change significantly.

4.10.2 Impact During Operation Phase

TNEB – NTPC JVC Thermal Power Project will draw water from Bay of Bengal, which is a natural water body. Therefore, there is a likelihood of entrapment or impingement of phytoplankton/ zooplankton in the water intake system. However, as the water system of the project has been designed with maximum recycle/ reuse of water, and a very small quantity shall be drawn as a make-up to the system, this impact shall be negligible.

Further, as the project will have a close cycle cooling system with cooling towers and clarified water as make-up to the cooling system, there will be no thermal impact on aquatic ecosystem due to operation of the project. The treated effluents conforming to the regulatory standards shall only be discharged into natural water course and it has been concluded that there will be no significant impact on the water quality due to discharge of effluents. It may, therefore, be concluded that there would be no impact on aquatic life.

CHAPTER-5

ENVIRONMENTAL MANAGEMENT PLAN

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 143 Of 179	

5.0 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) for the thermal plant has to ensure that the residual environmental impacts are minimized, by adopting best possible economically viable techniques. The EMP also has to ascertain compliance with all statutory conditions as per No Objection Certificate (NOC) from Tamilnadu State Pollution Control Board and Ministry of Environment & Forests.

National Thermal Power Corporation Limited is a partner in the proposed joint venture TNEB - NTPC JVC Thermal Power Project and has the management control for setting up, operation and maintenance of the project. It is the largest thermal power generating company in India and is already operating thirteen coal based thermal power projects of various capacities all over India. Based on its vast experience in the area of construction and operation of thermal power projects, NTPC has already envisaged various pollution control/ environmental measures for the project, which are summarised under Chapter 2. These measures are found to be adequate for the control of pollution and maintenance of healthy environmental conditions.

However, the following additional measures are recommended for implementation during construction and operation phases of the project. These measures are delineated to mitigate the adverse impacts and to ensure that the maximum benefits are achieved without harming the environment and also without adversely affecting the quality of life of the people in the area.

5.1 ENVIRONMENTAL MANAGEMENT FOR CONSTRUCTION PHASE

Environmental impacts during the construction phase can be attributed to the site preparation activity and the mobilization of workforce. The potential for environmental pollution during construction phase is less and temporary than the operation phase of the plant.

Detailed procedures will be developed for control of pollution during project execution phase whenever and wherever applicable. However, in this chapter the basics of the environmental management plans have been discussed. The construction activities typical for a project of this size include following major operations:

- Site preparation and soil consolidation
- Roads, temporary and permanent
- Foundations and structures
- Pipes crossings
- Process unit erections



	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 144 Of 179	

Site preparation and construction for the plant shall take about three years from the zero date. In addition to the onsite construction activities required by the project, offsite utility area will also be disturbed and are expected to reduce gradually with the completion of the construction activities. The Environmental Management Plan for the construction phase is described below:

- During construction phase, water would be sprinkled in the vulnerable areas to suppress the dust generated during excavation, leveling and other operations.
- The effluents from construction area should be channeled through sedimentation tanks to remove suspended solids.
- Suitable water supply and sanitation facilities should be provided to the labor colonies housing the construction work force. The sanitary waste from these areas should be accorded suitable treatment measures such as septic tanks.
- Safety equipment such as earplugs and earmuffs, helmets, face shields, safety goggles etc. should be provided to workers engaged in high risk areas.
- A first aid center should be established to provide immediate medical aid to the workers and their family members. An ambulance should also be made available at site to transport injured workers to nearby hospitals.
- Development of green belt should be started along with the construction activities itself.
- Construction actively will be restricted to daytime as far as possible to avoid disturbance to surrounding areas.

5.2 ENVIRONMENTAL MANAGEMENT FOR OPERATIONAL PHASE

At the operational phase, there are several measures proposed to be incorporated, in the process so as to minimize the environmental impacts of the power plant. The environmental impacts could be moderated to the minimum possible level during operational phase, with strict adherence to the pollution prevention and control measures. The Environmental Management Plan during operational phase of the plant shall be directed to the following:

- It should be ensured that all the pollution control/ environment management systems are commissioned as a part of main plant equipment, before the commencement of operation of the project.
- Regular monitoring for various components of environment, as described in Section 5.4 should be undertaken to ensure effective functioning of pollution control measures as well as to safeguard against any unforeseen changes in environment.
- The recommendations for Disaster Management Plan and Occupational Health and Safety Plan should also be implemented along with the commissioning of the project.



	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 145 Of 179	

- The effluents from the project should be utilized for the green belt development and afforestation purposes and only effluents conforming to the regulatory standards should be discharged out of the plant premises.
- The project should obtain certification under Environment Management Systems (ISO:14000) for effective environmental management and continual improvement.
- The efforts towards 100% ash utilization should be made.

5.2.1 Environmental Management Measures for Socioeconomic Environment

The project should contribute towards improvements in the quality of life of the people in the area. With this in view, following measures are recommended:

1. Scheme to increase employment opportunities for the local people would be implemented, as a part of Rehabilitation and Resettlement measures, such as vocational training for skilled jobs for youth and women, providing opportunities for setting up ancillary industries/ service industries etc.
2. Adequate infrastructure facilities, viz., housing, medical, education, transportation, communication, playground, library, canteen, market for the township would be developed within the project, so as to avoid strain on the existing infrastructure resource base.
3. Social forestry would be encouraged as an income avenue for the local people and helpful in maintaining the ecological balance.
4. Awareness programmes for likely hazards viz., fire, explosion and gas leakage etc. and protection measures of these hazards would be conducted.
5. Regular safety and environmental awareness programmes would be conducted in the nearby villages to promote awareness. Periodic health check programmes for the nearby villages would also be taken up.

5.3 GREEN BELT DEVELOPMENT

5.3.1 Greenbelt Design

The green belt has been recommended as one of the major components of the EMP which will further enhance the environmental quality through:

1. Mitigation of air pollution problems
2. Attenuation of noise level
3. Maintain the bio diversity of the area and improve aesthetics.

In any industrial project it is most important to chalk out a long-term approach to keep air clean. One such measure is using the plants for absorbing and trapping the air pollutants. The hypothesis that trees are important particulate sinks is supported by evidence obtained from studies dealing with diverse

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 146 Of 179	

particulate including pollen, salt, precipitation, dust and other unspecified particles. So far as gaseous pollutants are concerned, substantial evidence is available to support the fact that plants in general and trees in particular, function as sinks for gaseous pollutants and this is achieved through various physiological processes occurring within the plant system.

The gaseous pollutants are transferred from the atmosphere to vegetation by the combined forces of diffusion and flowing air movement. Once the gaseous pollutants come in contact with the plants, they may be bound or dissolved on exterior surface or taken up by the plants via stomata. If the surface of the plant is wet and if the gas is water soluble, the former process can be very important. As a matter of fact, plants act as bio filters for the air pollutants and play a major role in safeguarding the environment and controlling the increasing level of air and noise pollution. It can serve as buffer and shock absorber against transient and accidental release of pollutants from industrial complex.

5.3.2 Greenbelt Design Methodology and Approach

5.3.2.1 Preparation of Plantation Area

A green belt of average 100m wide has been proposed all around the periphery of the plant. Plantation site would be cleared from all wild vegetation. Suitable soil and water conservation measures will be adopted, if required. Since planting area is large, it would be divided into blocks inter-linked by paths laid out in such a way that every tree is accessible for all post plantation care. The planting arrangement and size would be based on the optimum use of the available land and quantum of irrigation water.

A tree requires sufficient space below and above the ground to spread its roots and branches. However, spacing varies with the type of trees, soil fertility, availability of moisture and purpose of plantation.

5.3.2.2 Preparation of Pits and Sapling Transplantation:

The location of each pit would be marked according to the design and distance of plantation. The size of the pits vary with type of trees. While digging the pit, care would be taken to place the topsoil on one side and bottom soil on the other side. Dug out soil and pit would be exposed to weather for two to three months. After exposing to the weather, pit would be filled two-third to three-fourth height with a mixture of topsoil and well rotten farmyard manure.

Planting of the tree would be done in suitable width. While planting the trees, care would be taken that the installation structure would be difficult to see through the foliage when seen from a point outside the green envelop. For

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 147 Of 179	

preventing the horizontal dispersion of the pollutants, the trees would be planted in alternate rows in straight line. Tree trunk being free from foliage up to a height of 2 –3 meters, it is advisable to grow shrubs in front of tree so as to give coverage to the open portion.

5.3.2.3 Time of Plantation:

Plantation would be done two weeks after the rain starts, as the trees benefit from the seasonal rains. It is advised to avoid planting during the dry season, as this will require watering. It is advantageous to plant trees on cloudy days.

5.3.2.4 Protection of Greenbelt:

- No pruning or lopping of branches would be done within the greenbelt at least for 10 – 15 years
- Gap filling in the greenbelt would be done in the same season to avoid gaps.
- Protection of young plants from the ravages of cattle, sheep and goat and other animals.
- Timely replacement of damaged plant and thereafter care is important.

5.3.3 Selection of Tree Species

Plants possess a large surface area and their leaves exhibit an efficient pollutant trapping mechanism. The effectiveness of plants to control pollution depends upon the physiological, morphological traits such as leaf epidermis, size, leaf orientation, internal enzyme system, etc. Systematic screening of plants for their ability to tolerate pollutant need be undertaken. For pollution abatement purposes tree species would be fast growing, wind firm, unpalatable to animals, hardy and pollutants tolerant/resistant. List of some plant species for greenbelt plantation purpose is given in Table – 5.3.1.

Table No. 5.3.1: List of Tree Species for Green Belt Plantation

Sl. No.	Botanical Name	Common Name
1	<i>Alstonia scholaris</i>	Elilappalai
2	<i>Mimusops elengi</i>	Magilam
3	<i>Cassia fistula</i>	Arakkuvadam
4	<i>Bauhinia purpurea</i>	Mandaram
5	<i>Zizyphus mauritiana</i>	Elentha
6	<i>Cassia siamea</i>	Manja-konnai
7	<i>Ficus religiosa</i>	Arasu
8	<i>Albizia lebeck</i>	Vakai
9	<i>Polyalthia longifolia</i>	Asogam
10	<i>Diospyros melanoxylon</i>	Karai
11	<i>Ailanthus excelsa</i>	Perumarautha
12	<i>Melia azedarach</i>	Malaivernbu

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 148 Of 179	

13	<i>Butea monosperma</i>	Tarasa
14	<i>Tamarindus indica</i>	Amilam
15	<i>Terminalia arjuna</i>	Vellamatta
16	<i>Azadirachta Indica</i>	Veppam
17	<i>Grevillea robusta</i>	Savukkamaram
	Shrubs & Grasses	
1	<i>Calotropis gigantea</i>	Erukkam
2	<i>Nyctanthus arboriristis</i>	Pavala - malligai
3	<i>Nerium indicum</i>	Karaviram

5.3.4 Plantation for Noise Pollution Control

Trees having thick and fleshy leaves with petioles flexible and capacity to withstand vibration are suitable. Heavier branches and trunks of the trees also deflect or refract the sound waves. The density, height and width are critical factors in designing adequate noise screen plantation. Combination of trees and shrubs together appears to be the best system for combating pollution. The following species are suggested for noise pollution:

- *Alstonia scholaris*
- *Azadirachta indica*
- *Melia azedarach*
- *Grevillea robusta*
- *Tamrindus indica*
- *Terminalia arjuna*

Plantation in different manner will reduce noise unequally. In addition to this it is also relies on categories of plant to block noise. Some type of trees alienate formation of same height will block noise better than a straight line blocking, which can reduce noise up to 3.48%. The formation of plant in different heights that lineup from the heights to lowest in straight line will have best noise blocking. In the port line can reduce noise up to 4.39%. The formation of plant from the highest to lowest in alternate formation will have the best noise reduction in the fifth line, which is 7.63% (Chakree, 1989).

5.4 ENVIRONMENTAL MONITORING PROGRAMME

Regular monitoring of important and crucial environmental parameters is of paramount importance to assess the status of environment during plant operation. With the knowledge of existing baseline conditions, the monitoring programme can serve as an indicator for any deterioration in environmental conditions due to operation of the plant and suitable and adequate mitigatory steps could be taken in time to safeguard the environment.

The post operational environmental monitoring programme recommended to be implemented at TNEB - NTPC JVC TPP is presented in Table 5.4.1.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 149 Of 179	

Table 5.4.1: Environmental Monitoring Programme

S. No	Area of Monitoring	Number of Sampling Stations.	Frequency of Sampling	Parameters to be Analysed
1.	Meteorology	One	Continuous/ Daily	Wind speed and direction, Max. and Min. Temperature, Humidity, Solar Insolation, Atm. Pressure, Rainfall
2.	Ambient Air Quality	4 Stations	Twice a week; 24 hourly	SPM, RPM, SO ₂ and NO _x
3.	Noise	5 (two within plant premises and three outside plant premises)	Once in a year for 24 hours	Ambient Equivalent continuous Sound Pressure Levels (Leq) at day and Night time.
4.	Stack Emission	All the Stacks	Fortnightly	SPM, SO ₂ and NO _x
5.	Liquid Effluents	Main Plant Effluents	Monthly	pH, Temp, Cond., TSS, TDS, BOD, O&G, Phenolics
			Quarterly	Heavy Metals
		Ash Pond Effluents	Monthly	pH, TSS, TDS, O&G
			Quarterly	Heavy Metals
Sanitary Effluents	Monthly	pH, TSS, BOD		
6.	Water Quality	Sea, upstream of intake and down stream of discharge point	Quarterly	pH, Temp, Cond., TSS, TDS, BOD, O&G Heavy metals
7.	Soil	10 locations	Once in five years	Physico-chemical properties, Nutrients, Heavy Metals
8.	Terrestrial Ecology	within 7 km. around the project	Once in five years	Density and Diversity.
9.	Aquatic Ecology	Sea	Once in five years	Phyto-planktons and zoo-planktons

5.5 INSTITUTIONAL SETUP FOR ENVIRONMENTAL MANAGEMENT

As the management control for setting up, operation and maintenance of the projects lies with NTPC, TNEB - NTPC JVC Thermal Power Project shall utilise the extensive experience of NTPC in the area of environmental management. NTPC has a three-tier organization structure as shown in Table 5.5.1.

	Comprehensive Environmental Impact Assessment for TNEB - NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 150 of 179	

Table-5.5.1: Organization Structure of NTPC for Environmental Management

Corporate Center	Engineering	Environmental Engineering
	Operations	Environmental Management
	Personal & Administration	Rehabilitation & Resettlement
		Horticulture
		Medical & Public Health
Safety		
Regional Headquarters	Environmental Management	As Coordinator
Project Site	Coordinator	Environmental Management
	Operation & Maintenance	Chemistry
		ESP Maintenance
		Ash Handling & Disposal
		Safety
	Personnel & Administration	Community Development Group
		Horticulture
Medical & Public Health		

5.5.1 Institutional Setup at TNEB - NTPC JVC Thermal Power Project

An Environmental Management Group (EMG) shall be formed at TNEB - NTPC JVC TPP site under Technical services. The group shall be headed by a Senior Executive and supported by executives/staffs and other infrastructural facilities.

The responsibility of environmental; management of TNEB - NTPC JVC TPP shall lie with Environmental Management Groups at the project, which shall act as coordinator for environmental matters. This group shall also act as a nodal agency for various groups at project, regional headquarters and corporate level as well as outside agencies like State Pollution Control Board. The main functions of Env. Management Group at Project could be summarized as

- Obtaining Consent order from SPCBs
- Environmental Monitoring
- Analysis of environment data, reports, preparations and transmission of report of statutory authorities, Corporate Center etc.
- Compliance with guidelines and statutory requirements
- Coordination with statutory bodies, functional groups of the station, regional head quarters corporate EMG/Engg etc.
- Interaction for evolving and implementation of modification programmes to improve the availability / efficiency of pollution control devices / systems
- Environmental Appraisal (Internal) and Environmental Audit.

The project shall also have a dedicated Rehabilitation and Resettlement Group, with the following functions:

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 151 of 179	

- Preparation, implementation and follow-up of Rehabilitation Action Plan (RAP).
- To strengthen the public images of the company in respect of social aspects and maintain good relationship with the community in the vicinity.

However, this group shall draw support from Environmental Engineering Group, Environmental Management Group and Rehabilitation & Resettlement Groups at Corporate Center, NTPC. The functions of main groups are summarized as follows:

5.5.2 Functions of Environmental Groups

Environmental Engineering Group (EEG) at Corporate Center, NTPC:

- Associating in site selection for new projects with engineering services
- EIA studies for new project sites and obtaining clearance from SPCB/MoEF.
- Finalization of specification of equipment for pollution monitoring
- Special studies relating to environmental problems
- Interaction with MoEF, Pollution Control Boards and funding agencies for new projects.
- Provide assistance to sites in overcoming specific technical problems related to environment.

Environment Management Group (EMG) at Corporate Center, NTPC

- Coordination and monitoring with stations, regions, Engg. Division and other concerned agencies on all environmental matters concerning operating stations.
- Maintenance of an environmental database trends analysis of pollution monitoring data and prepare reports.
- Environmental Audit of power Stations.
- Providing operational feedback to Engineering for carrying out necessary modifications in existing/future systems, overseeing implementation of modification/improvement programme.
- Providing Corporate support to stations through organization of meetings on Environment Management, obtaining management approvals.
- Organizing Training workshops, Seminars etc.

Rehabilitation and Resettlement Group at Corporate Center, NTPC

- Socioeconomic studies
- R&R aspects of EIA, finalization of R& R plans for new projects.
- Policy review and ensuring implementation
- Collection and collation of various statistics on R & R measures
- Providing these statistics to various agencies
- Finalization of the training programme in R & R

 एनटीपीसी NTPC	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 152 Of 179	

5.5.3 Environmental Laboratory

The project would have an analytical laboratory for regular monitoring of various environmental parameters as described under Section 5.4. It is recommended that the laboratory would be equipped with the following equipment.

Ambient Air Quality	Quantity
Respirable Dust Sampler	5
Stack monitoring Kit with Assessors	4
Continuous SO ₂ Analyzer for stack	-
SO ₂ , NO _x , CO and SPM analyzer	-
Meteorological Instruments	
Automatic Weather Station	1
Noise Monitoring	
Sound level Meter	1
Water Monitoring	
pH meter	1
Conductivity meter	1
Ion Analyzer for fluoride, cyanides	1
DO Analyzer	1
BOD Incubator	1
COD distillation Unit	1
TOC Analyser	1
UV/VIS Spectrophotometer	1
Flame photometer	1
Single pan balance	1
Water distillation unit	2
Electric oven	2
Flow meter	2
Microscope	1

However, the project authorities may also undertake the monitoring through approved laboratories/ consultants.

5.5.4 COST PROVISION FOR ENVIRONMENTAL MEASURES:-

SI NO:	Item Description	Total (Rs. In Millions)
1	Electrostatic Precipitator	1000.00
2	Chimney	4031.20
3	Cooling Towers incl Civil Works	1192.19
4	Ash Handling and Ash water recirculation	1123.39
5	Ash Dykes – First 9 years	9209.90
6	Effluent Treatment Plant incl AWRS	181.72
7	Dust extraction & suppression system	40.00
8	Control of fire & explosion hazards	329.47
9	DM plant waste treatment system	30.00



	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 153 of 179	

10	Sewerage collection, treatment and disposal	10.00
11	Environmental Lab Equipment	10.00
12	Green belt , Afforestation and land scaping	15.10
13	Rehabilitation & Resettlement	100.00
	Total	17272.97

5.6 ASH UTILIZATION

The Notification on ash utilization dated 14.09.1999 of Ministry of Environment and Forests and its subsequent amendments stipulate that new coal based power plants shall have to utilize ash to the extent of 30 % in three years of commissioning and would attain 100% utilization by the end of 9th year. It is recommended that the project would make maximum efforts towards 100% utilisation of the ash and the ash would be disposed off in the ash disposal area only in case of emergencies or till the facilities/ demand for 100% ash utilisation has been established.

It is estimated that about 1.87 Million Tonnes Per Annum of fly ash will be generated due to very low calorific value and higher ash content of the coal, with the daily generation of about 5123.28 tons. To assess the potential of ash utilization, a detailed market survey is being conducted around 100 km radius from the proposed project. Based on the preliminary survey and experience with the other stations of NTPC, an ash utilization plan has been prepared and the same has been presented in Chapter 2. However, the specific uses of ash could only be identified after the detailed survey and the same shall be presented in final report. Various possible applications of fly ash are presented in Table – 5.6.1.

Table No. 5.6.1: Uses Of Fly Ash From Coal Based Thermal Power Plant

Low value Use	Medium Value use
<ul style="list-style-type: none"> • Used mines filling • Embankments • Backfill • Highway base • Soil stabilization • Structural fills • Concreting in dams • Harbor structures 	<ul style="list-style-type: none"> • Light weight aggregate • Fly ash concrete • Pozzolana cement • Cellular concrete • Bricks • Grouting • Slabs and wall panels • Prefabricate Building blocks

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 154 Of 179	

High value Use <ul style="list-style-type: none"> • Metal Recovery (Aluminum and Iron) • Magnetite 	Soil management, Fertilizer etc. <ul style="list-style-type: none"> • Soil conditioning of <ul style="list-style-type: none"> ○ High clay soil ○ Acidic clay virgin soils ○ Slightly lump clay • Manufacture of granulated fertilizers
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Though fly ash is inert and does not have any cementation property in itself, it is a pozzolainic material, which has affinity of combination with lime to form a binder. The qualities and pulverization of the coal, burning temperature in burning zone and collection media influence the pozzolainic activity of pulverized coal. All these factors are responsible for the physical, morphological and chemical characteristics of fly ash, which finally affect the lime reactivity.

As per Indian standard, suitability of use of ash depends on percentage of MgO (max. 5%), SO₃ (max. 3%), Na₂O (max. 1.5 %), Loss On Ignition (12%) and specific surface (320 m²/kg). Broadly, lime reactivity as experienced with Indian coal is found in the range of 14.75 Kg/cm² which is higher than the desired minimum value of 4.0 kg/cm². It can be said that 15 to 20% of fly ash can be blended in pozzolana cement. In ordinary portland cement, it gives better engineering properties, like reduction in bleeding, low heat of hydration, production of alkali-sulphate reaction, minimizing expansion etc.

5.6.1 Use of Fly Ash in Agriculture

There is considerable research in India, U.K, USA & other countries regarding the use of fly ash in agriculture. The experiments at Punjab Agricultural University have clearly shown that with applications of fly ash @ 10 Tons/ha the output of wheat increased from 21.5 q/ha to 24.1 q/ha.

Compost made with the method of vermiculture mixed with fly ash proves to be a potentially valuable source of biomass and biofertilizers. This form of compost would be promoted.

5.6.2 The use of Fly Ash for FAL-G bricks

The name FAL-G derives from the fact that the ingredient used for making these bricks are fly ash (FA), and Lime (L). The use of fly ash for roads & embankment is one of the identified thrust areas. A project has successfully demonstrated use of fly ash as a structure fill material in the construction of embankments for fly over bridges at Delhi across the river Yamuna and construction of roads near Raichur. The construction of 1.7 km long and high road using embankment at new Nizamuddin Bridge, New Delhi is completed using 1.5 lakh m³ of fly ash. Several other examples of use of fly ash can be cited. The fly ash is a better geo technical material than commonly available soils for structural fill operations particularly in view of better rating of grain

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500 MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 155 Of 179	

size; density, compaction characteristics, strength, permeability and ease of working.

The FAL-G bricks are of superior strength as compared to clay brick and the product can be casted under pressure fire conditions that gains strength in normal environment with simple water curing. About 150 FAL-G plants are already in operation under the different parts of the country. It is recommended that the use of conventional earthen bricks would be banned in the area around TNEB - NTPC JVC and bricks of fly ash would be made available and would be promoted. This will not only save the cultivable land to be turned into wastelands due to operational activities associated with the conventional brick kilns but will also provide a business opportunity to the local people.

5.6.3 FAL-G for Coarse Aggregate

FAL-G bricks can be broken into coarse aggregate and made into concrete. This is engineering properties of natural stone aggregate. The use of FAL-G for coarse aggregate will help to conserve stone and stop stone quarry activities in the nearby hills, and also help to meet the demand for aggregates in area where stone is not available.

5.6.4 FAL-G as Cement

FAL-G can be used as cement by itself in association with OPC (Ordinary Portland Cement). When used in association with OPC, it is called Portland FAL-G. If we look at the environmental aspect we find that cement is one of the major contributors of CO₂ @ 0.9 to 1 ton per every ton of production. This means that at the present level of production of 85 million tons per annum the cement industry is contributing 76-85 million ton per annum of CO₂ and this is about 8% of the national emission of CO₂. Hence the production of blended cement would no longer be an option but would be made mandatory.

CHAPTER-6

OCCUPATIONAL HEALTH & SAFETY PLAN

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 156 of 179	

6.0 Occupational Health & Safety Plan

6.1 OCCUPATIONAL HEALTH

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 and operation and maintenance.

Occupational health needs attention both in construction and erection and operation and maintenance phases. However, the problems vary in magnitude and variety in the above phases.

6.1.1 Construction and Erection Phase

The problems envisaged at construction and erection phase can mainly be due to accident and noise. To overcome these problems, the contractor in charge of construction and erection activities have to maintain noise levels within threshold limit values and the workers should be provided with personal protective equipment. The details of occupational health and safety plan for construction and erection phase are given below.

Air Environment:

Dust generated as a result of clearing, leveling and site grading operations will be suppressed by using water sprinklers. It will be ensured that the construction machinery using diesel driven prime movers are properly maintained to minimize exhaust emissions of CO, SPM and Hydrocarbons. Construction actively will be restricted to daytime as far as possible to avoid disturbance to surrounding areas.

Noise Environment:

All noise generating equipment used during the construction phase shall be provided with noise control devices. Wherever required, personal protective equipment such as earplugs, earmuffs etc., will be provided to the persons engaged in noisy operations. This will minimize their exposure to noise.

Storage of Hazardous materials:

The hazardous materials expected to be stored at the construction site will be acetylene cylinders, petroleum spirit, diesel and lubricating oil, LPG paint material, etc. These materials will be stored as per the statutory regulations in line with Manufactures, Storage and Import of Hazardous Chemicals Rules. 1989 under the Environment (Protection) Act, 1986.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 157 of 179	

Safety Measures:

The site will have necessary security arrangements to prevent entry of unauthorized personnel and proper control of hazardous materials on site. All the employees as well as contracted labour will be trained in safety aspects related to their job. There will be a special emphasis on safe handling of material, safety in welding and fabrication activities will be provided to staff working at heights. 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.

To ensure that the local inhabitants are not exposed to these hazards, the site will be secured by fencing and manned at entry points.

6.1.2 Operation and Maintenance Phase

The problem of occupational health, in the operation and maintenance phase is due to noise hearing losses, exposure to dust and heat, exposure to arc lights & welding lights, exposure to chemicals, gases, acids and alkalies etc. Engineering controls are provided in design itself to contain these hazards, otherwise the employees are isolated from the source of hazards. Suitable personnel protective equipment is also given to employees.

To overcome these hazards while arrangements are made to reduce it within threshold limit values, required personnel protective equipment shall also be supplied to workers.

The following Personnel Protective Equipment (PPE) will be given to workers at TNEB - NTPC JVC Thermal Power Station under their specific job requirement.

- Industrial safety helmet for work at high level, coal yard and at plant in general.
- Zero power plain goggles with cut type filters on both ends to work under highly dusty area like maintenance of dry fly ash collection system.
- Welders equipment for eye and face protection during welding activity.
- Cylindrical type earplug at moderate level noise like wagon tippler, ID fan etc.
- Ear muffs at high-level noise area like coal mill, boiler etc.
- Dust respirator with filter at high dust level area like coal yard.
- Canister Gas mask for maintenance in contained space viz. inside vessels, storage tank, boiler furnace etc.
- Self-contained breathing apparatus – maintenance in contained space viz. inside vessels, storage tank, boiler furnace etc.
- Asbestos apron at high temperature area near furnace, turbine etc.
- Rubberized apron at acid/alkali leak prone area viz. chlorine handling, caustic handling etc.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 158 of 179	

- Boiler suit-for maintenance work in boiler unit during plant shut down.
- Safety belt/line man's safety belt-work at high level viz. stack monitoring, coal mill etc.
- Asbestos hand gloves handling of hot material viz. dry bottom ash, equipment near furnace, boiler or turbine.
- Acid/Alkali proof rubberized hand gloves-for handling acid/alkali.
- Electrically tested electrical resistant hand gloves-work at switch, maintenance of transmission lines, turbo generator etc.
- Industrial safety shoes with steel toe-near process equipment.
- Electrical safety shoes without steel toe gum boots-essential for a wireman/electrician.

Full-fledged hospital facilities should also be available round the clock for attending emergency arising out of accidents, if any. All working personnel will be medically examined at least once every year and at the end of his term of employment. This is in addition to the pre-employment medical examination.

6.2 ELECTROCUTION

At TNEB - NTPC JVC Thermal Power Plant the area prone to electrocution are turbo generator area, transformer area, switchyard area and high-tension transmission lines and towers. There should be no green belt in switchyard side. The growth of grasses and bushes should be controlled in switchyard and transformer area. Sagging in high tension wires may also take place due to high ambient temperature, dust storm or poor coupling at HT tower. This should be regularly checked to prevent any possibility of electrocution to vehicles passing on road. Person attending for faults any of the above areas should be trained and should wear electrical resistant shoes, gloves and hamlet with cotton clothes.

6.3 HOUSE KEEPING

Thermal power plant operation involves bulk handling and crushing of coal. This causes dust nuisance inside the plant. The fly ash and bottom ash hoppers and ESPs will also create nuisance if the same is not controlled inside and outside the plant. Better house keeping can improve the working conditions. The following measures should be practices at TNEB - NTPC JVC Thermal Power Plant.

- Regular cleaning of shop floors with service water.
- Keeping all dedusting systems in perfect working conditions to avoid dust fall inside and outside the plant.
- Proper control of fugitive dust from sources inside the plant including coal yard.
- Avoiding accumulation and dumping of wastes and damaged equipment and items anywhere inside the plant affecting aesthetics and increasing risk of fire and other hazards.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 159 of 179	

- 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.
- Encouraging gardening in township and nearby areas and setting up nurseries and arranging subsidized services of expert gardeners to employees and local inhabitants.
- Maintaining adequate green belt width of minimum 100 m along the plant (except switchyard) and township boundary to suppress noise, fugitive dust and to improve the aesthetics.
- Regular checking of emission of dust in coal handling area.
- Developing a positive outlook in the employees for improving the working place, both in plant and office or laboratory clean and well maintained.

6.4 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 is possible 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 TNEB - NTPC JVC Thermal 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 upto date knowledge.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 160 of 179	

- To provide appropriate instruction, training, retraining and supervision in health and safety, first aid and to ensure that adequate publicity 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 ensure 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.

6.4.1 Safety Organization

When the construction is completed the posting of safety officers shall be done in accordance with the requirement of Factories Act and their duties and responsibilities shall be defined there of.

6.4.2 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 occupational health and safety of the staff involved in such activities. The circle consists of 5-6 employees from that 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 precautions and remedial measures recommended to be adopted to prevent fires are:

- The accumulation of coal dust forms a base medium for fire, therefore, the ventilation system particularly at transfer points and junction houses would be such as to minimize this phenomenon and extremely good housekeeping would be ensured.
- Compartmentation 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.

 एनटीपीसी NTPC	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 161 of 179	

- Spread of fire in horizontal direction could be checked by providing fire stops for cable shafts.
- Reliable and dependable type of fire detection system with proper zoning and interlocks for alarms are effective protection methods for conveyer galleries.
- Provision of automatic or manually operated water spray system along the lengths of the conveyer belt would help in meeting eventualities of fire in an effective manner. Tunnels and underground hoppers would also be protected by devising protection systems to suit individual installations.
- Housekeeping of high standard helps in eliminating the causes of fire and regular fire watching system strengthens fire prevention and fire sighting and
- Proper fire watching by all concerned would be ensured.

6.4.3 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.

Training Program for Employees:

Training programs 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 programs will be conducted periodically in a planned manner to refresh their knowledge.

A suggested list of training courses is given in Table-6.4.1 and Table-6.4.2 gives the names of some of the institutions offering courses on Industrial Safety.

Table-6.4.1: 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
3.	Health & Hygiene	- Industrial hygiene - Training on first aid - Casualty evacuation - Health hazards from heat, noise and suspended particulate matter

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 162 of 179	

Table-6.4.2: 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	Courses in Environmental Science & Engineering 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 (India) Building Race Course Circle Vadodara-390 007 Diploma in Industrial Safety	Industrial Safety and Health Association C/o Dy. Chief Inspector of Factories 3694, Shankar Bhavan Adarsh Nagar, Pune-411 037 Diploma in Industrial Safety
Indian Institute of Social Welfare & Business Management Kolkata-700 073 Diploma in Industrial Safety	Institution of Industrial Safety Professional of India ¼, Bharatiya Bhavan, 17 th Road, Khar, Mumbai-400 052 Diploma in Industrial Safety
Regional Labour Institute TTI Post, Tharamani Madras-600 113 Diploma in Industrial Safety	Regional Labour Institute Lake Town, Pattipukur Kolkata-700 089 Diploma in Industrial Safety

Methodology

Training program will be conducted using audio-visual aids, practical demonstration, etc. to make it more effective and interesting. These programs 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.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 163 of 179	

Mode of Training:

- a. Lectures
- b. Seminar and workshops
- c. Mock drills
- d. Distribution and practice of safety instructions
- e. Safety quiz contests/competitions for individuals as also for groups.
- f. Display of the safety posters and safety slogans at convenient and conspicuous places.
- g. Explanation of instructions (in Tamil 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.
- h. Developing safety instructions/booklets or manuals for every job and ensuring practice of these instructions by the workers.
- i. 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 equipment
 - 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

First Aid Training

First aid training programs will be conducted for all employees with the help of qualified medical and para-medical staff. This program may be conducted in batches. The program will include basic first-aid techniques for burn treatment and procedure for artificial respiration. This program will be repeated periodically to refresh knowledge.

Training in Industrial Safety:

Training in industrial safety shall also be given to all employees. The training shall include the following:

1. Preventive measures
2. Protective measures
3. Corrective measures in case of malfunctions

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 164 of 179	

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 effect them. The awareness programmes will be make in close coordination with civil authorities and local area.

6.5 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.

6.6 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.

6.7 MEDICAL FACILITIES

First few hours after an accident are very important for the injured persons to avoid fatalities. A well-equipped medical center takes care of all the eventualities during these hours. Well-equipped medical center can handle emergency resuscitation and treatment to stabilize the patient before transferring to a referral hospital identified for the purpose.

6.7.1 First Aid Center

A list of items to be kept at first aid center is given in Table-6.7.1. Medical Officer will review and add/delete the medicines/equipment required specific to the industry based on experience. This will be kept under lock and key and it will be opened only during emergency.

Table 6.7.1: List of Items for First Aid Center

1. Sufficient dressing material
2. Medicines special to the industry as recommended by the doctor.
3. First aid box, emergency box kit
 - a. Medical grade oxygen cylinders
 - b. Burn sheets
 - c. Rescue blankets
 - d. Oxygen breathing kit
 - e. Instant glucose
 - f. Paramedic scissors
 - g. Bandage scissors
 - h. Forceps
 - i. Suction unit
 - j. Ring cutter
 - k. Cervical collar (3 sizes)

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 165 of 179	

- l. Eye pads
- m. Intravenous fluid
- n. Flexible bandages
- o. Pocket masks/eye-wash bottles
- p. Orthopedic stretcher
- q. Artificial resuscitators
- r. Trauma medicines
- s. Portable respirators
- t. Ophthalmic solution
- u. Blood pressure equipment
- v. Gloves
- w. Portable lamps/torches

6.8 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.

6.8.1 Fire Detection System

The system of fire detection would provide an alarm signal at the very initial state of fire. For this purpose, suitable type of detectors would be located at strategic positions in the area covered by this system. Detectors would be arranged in zones and cross zoning would be done. Microprocessors based addressable analogue type fire detection system shall be used. For fire protection of power plant and auxiliaries, all the areas and plant equipment would have one or suitable combinations of the following fire protection systems.

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.
- Photoelectric type smoke detection system.
- Combination of both ionization and photoelectric type smoke detection systems.
- Linear heat sensing cable detector.
- Quartzoid bulb heat detection system.
- Infra red type heat detectors.
- Spot type heat detectors

6.8.2 Fire Protection System

- Automatic hydrant system

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 166 of 179	

- Automatic high velocity water spray system
- Automatic manual medium velocity water spray system.
- Sprinkler system
- CO₂ protection system
- Foam injection system
- Fore detection system using smoke detectors, liner heat sensing cable and ROR infrared type detectors.
- Portable and mobile fire extinguishers

The system would be designed in line with the recommendations of Tariff Advisory Committee IS: 3034 & NFPA-850.

The proposed fire fighting equipment at TNEB - NTPC JVC Thermal Power Plant is given in section 6.8.3.

6.8.3 Automatic Hydrant System

Hydrant system for complete power plant covering the entire power station including all the auxiliaries and buildings in the plant area. The system shall be complete with piping, hydrants, valves, instrumentation, hoses, nozzles, hose boxes/stations etc.

6.8.4 Automatic High Velocity Water Spray Systems

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, generator seal oil system, lube oil system for turbine driven boiler feed pumps, consisting of detectors, deluge valves, projectors, valves, piping, instrumentation etc.

6.8.5 Automatic Medium Velocity Spray System

Automatic medium velocity water spray system for cable vaults and cable galleries of main plant, switchyard control room, CHP control room and ESP control room consisting of smoke detectors, linear heat sensing cable detectors, deluge valves, isolation valves, piping, instrumentation, etc.

6.8.6 Automatic medium Velocity Water Spray System

Automatic medium velocity water spray system for coal conveyors, coal galleries, transfer points and crusher house consisting of QB detectors, linear heat sensing cables, deluge valves, nozzles, piping, instrumentation etc.

Automatic medium velocity water spray system for un-insulated fuel oil tanks storing fuel oil having flash point 65⁰ C and below consisting of QB detectors, deluge valves, nozzles, piping, instrumentation, etc.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 167 of 179	

6.8.7 Halon 1301/Extinguishing System

This system would be provided for Unit Control Room, control equipment room Distributed Digital Control Management Information Systems room and Uninterrupted Power Supplies room. These systems would be of modular type having automatic actuation with manual over ride facilities. Halon quantity would be based on minimum 5% concentration by volume. Detection system comprises of smoke detectors of ionization and photoelectric types. Adequate cross zoning, to obviate false alarms, would be used for automatic operation of the system. This system may be changed by FM200MT system in view of environmental reservations regarding the use of halon Gas (green house effects) requirement.

6.8.8 Foam Injection System

Foam injection system for fuel oil/storage tanks consisting of foam concentrate tanks, form pumps, in-line inductors, valves, piping and instrumentation etc.

6.8.9 Manual Medium Velocity Spray System

This system is employed for fuel oil storage tanks and light diesel oil storage tanks to control the burning of flammable liquids by cooling the surface of tanks through water film and also employed to prevent adjacent tanks catching fire when one tank is alight. Water is tapped from hydrant system. Spray system would be designed to give a water density of not less than 10.1 litre/min/m² of surface area. Water pressure at sprayers would not be less than 1.4 bar and would not exceed 3.5 bar system would be manually operated.

6.8.10 Fire Detection System

The system of fire detection would provide an alarm signal at the very initial state of fire. For this purpose, suitable type of detectors would be located at strategic positions in the area covered by this system. Detectors would be arranged in zones and cross zoning would be done. Microprocessors based addressable analogue type fire detection system shall be used.

6.8.11 Portable and Mobile Fire Extinguishers

Portable and mobile extinguishers of following types would be provided at suitable location inside the power station area. These extinguishers would be used during early stages of localized fires to prevent its spread.

- Pressurized water type
- Foam type
- CO₂
- Dry chemical powder type
- BCF (HALON-1211) type

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 168 of 179	

6.8.12 Chlorine Detection Kit

Chlorine is stored in 900 kg tonner at the DM plant. There should be a chlorine detection kit near the chlorine tonner storage area. This will help in suppressing any possibility of major hazard at the initial stage itself. Ammonia torch can also be provided to detect any leakage of chlorine gas. Windssock should be provided at top of coal mill to help the people run in appropriate direction in case of leakage.

6.8.13 Blow Down of Circulating Water System

Circulatory water system blow down shall be used for supply of firewater. It is proposed to provide two numbers of mild steel water storage tanks, which shall be fed from the circulatory water blow down water. An over ground fire water pump house shall be constructed near these fire water storage tanks. Horizontal 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 rules of TAC. The water shall be tapped off from the hydrant system pumps.

For the above fire water-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 protections system shall be provided for safe operation of the complete system.

6.8.14 Inert Gas Extinguishing System

For protection of control room, equipment room, computer room and other electrical and electronic equipment rooms, Inert Gas extinguishing system as per NFPA-2001 would be opted.

6.9 PROTECTIVE EQUIPMENT

List and quantity of the safety equipment proposed is given in Table-6.9.1

Table- 6.9.1: Safety Equipment

Sl. No.	Appliance	Nos./Pair
1.	Gas Mask	20
2.	Canister for gas mask	20
3.	Compressed air breathing apparatus	3
4.	PVC yellow hand gloves	10
5.	PVC white hand gloves	20
6.	PVC white gum boots	20
7.	Electrical hand gloves	20
8.	Asbestos hand gloves	10
9.	Asbestos blanket	5
10.	PVC apron	20
11.	PVC suit with hood	10

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 169 of 179	

	(Acid and Alkali proof)	
12.	Aluminated asbestos suit	3
13.	Dust respirator	30
14.	Face shield of different colour	20
15.	Goggles of different types	30
16.	Safety belt	10
17.	Safety helmet	50
18.	Leather hand gloves	70
19.	Chargeable hand set	15
20.	Ear muffs and ear plugs	10
21.	Smoke exhaustor cum blower	1
22.	Asbestos suit	3

List of fire fighting equipment is given in the Table-6.9.2. These will be periodically inspected for their serviceability and adequacy.

Table – 6.9.2 Fire Fighting Safety Equipment

Sl. No.	Safety Equipment
1.	Gum boots
2.	Red colour jackets
3.	Hand gloves
4.	Blankets
5.	Respiratory equipment/breathing apparatus
6.	Helmets

CHAPTER-7

DISASTER MANAGEMENT PLAN

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 170 of 179	

7.0 Disaster Management Plan

7.1 INTRODUCTION

Disaster is an undesirable happening of such magnitude and nature, which can adversely affect man, material and environment. Industrial hazards 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 power plants, chemical and 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, common accidents are absorbed by the community, 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 a major emergency in plants, 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:

1. Fire
2. Explosion
3. Toxic release

It is therefore, necessary to ensure safety and reliability of any power station, through a systematic study based on mathematical modeling to identify possible failures and prevent their occurrence before the disaster.

7.2 PURPOSE AND SCOPE OF THE DISASTER MANAGEMENT PLAN (DMP)

Preparation of a DMP through carrying out the industrial hazards assessment, 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.
- On-site emergency plan
- Safety review check list
- Accident reporting
- Off-site and vicinity

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 171 of 179	

7.3 DISASTER CONTROL PHILOSOPHY

The principal strategy of Disaster Management Plan of power plant is prevention of the identified major hazards. Since these hazards can occur only in the event of loss of the chemicals from its containment, one of the key objectives of technology selection, project engineering, construction, commissioning and operation is "Total and Consistent Quality Assurance". The project authority is committed to this philosophy right from the conceptual stage of the plan so that the objective of prevention can have ample opportunities to mature and be realized in practice.

The second control strategy adopted for reducing potential emergencies is "Minimization of Operation Inventories of Hazardous Substances" both in process plants as well as in storage within limits of viability of continuous operation.

Another control measure that will be adopted is "Early Detection of any accidental leak and activation of well structured, resourced and rehearsed On-Site Emergency Plan" to intercept the incident with speed and ensure safety of employees, operating plants, public and environment as a matter of priority.

7.4 VULNERABLE UNITS

The maximum credible accident and consequence analysis carried out during Industrial hazards. Vulnerable units needing consideration in Disaster Management Plan (DMP) are coal, chlorine, high-speed diesel and heavy fuel oil/LSHS.

7.4.1 Analysis of Vulnerable Zones

From the analysis of the vulnerable zones the action suggested are discussed below:

- All the storage vessels containing hazardous chemicals like HSD, LSHS & HFO at the tank farm will be dyked. The dyke volume will not be less than 1.1 times the volume of the storage vessel.
- All the storage vessels will be placed in the storage area in such a manner so as to conform to the requirements of Chief Controller of Explosives.
- Presence of human beings in the hazardous storage areas will be controlled and no unauthorized person will be allowed in these areas.
- Weeds, long grass, deciduous shrubs and trees and any combustible material will be removed from hazardous storage areas from time to time.
- Windsocks will be provided at oil storage yard and chlorine storage area.
- Tank farm would be provided with PCC at ground.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 172 of 179	

7.5 PREVENTIVE MEASURES AND PLANS

In Disaster Management Plan, the person in operation must be clear about the actions to be taken in case of disaster. This may include the preventive and corrective actions to be taken so as to mitigate the disaster, e.g. shutting of the pump, shutting of the valves, sounding the alarms, isolating the system etc. The project proponent will make concise safety practices and procedures, "Do's and Don'ts" relevant to plant operations for different sections. Operating manuals having the startup procedures and shut down procedures along with the normal operating procedure will be available to all the plants.

7.6 LOADING AND UNLOADING FACILITIES

Based on the preliminary identification, the major hazardous installation at power plant are storage of hydrogen, HFO, HSD and chlorine. Heavy Fuel Oil and HSD are the secondary fuel for combustion support at low load and for startup. Following are the important considerations for loading/unloading of hazardous chemicals.

1. Written instructions will be given which clearly define responsibilities for all personnel involved in loading/unloading operations.
2. A responsible person normally a section supervisor on site will check that the quantity and type of fuel oil being transferred is suitable for the receiving tanks. Tanks will be checked to see how full they are before filling, and also during filling using the contents gauge. The maximum level device will be used to ensure overfilling does not occur.
3. The point of transfer, where connections and disconnection are made will be sited in a well-ventilated position.
4. Flexible hoses used for conveying fuel oil to and from truck into fixed vessels will:-
 - a. Have a means of identification.
 - b. Be examined for kinks and wear on very occasion prior to use. Hose fittings will be similarly examined.
 - c. Be periodically checked for electrical continuity and written records of the tests should be maintained.
 - d. Be properly used so that the hose will not be physically damaged or adversely affected by the weather when not in use or when being conveyed.
 - e. Have means for protecting and fittings against damage or ingress of foreign material.
 - f. Loading hoses should be earth and should also be bonded with the wagon.
 - g. Be replaced or repaired when damaged or worn.
5. Loading arms of flexible hoses in which liquid could be trapped between shut-off valves will be protected against excess pressure caused by the



	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 173 of 179	

thermal expansion of the contents, e.g. by hydrostatic relief valves or by their design.

6. In order to minimize the risk of accidental movement, the tanker will stand on a level site during loading or unloading. Checks will be placed against the vehicles wheels or other means provided to prevent vehicle movement prior to loading/unloading. These will only be removed when transfer is complete. The ground beneath the tanker will have a shallow gradient to a safe place to prevent any spillage from remaining under the vehicle.
7. The loading/unloading operation will only be carried out when it is safe to do so and where practical be separated from other traffic movement. Where vehicles or pedestrian are likely to pass by, physical barriers will be provided to deter them approaching the transfer operation.
8. Consideration will be given to the provision of a driveway protection device such as self-sealing, breakaway, coupling connected to the flexible hose, means to shut emergency isolation valves on the fixed plant, etc.

7.7 PREVENTIVE MEASURES

For the safety of man and material, various preventive measures will be taken. These are:

1. Periodical checking of electrical wiring, fittings, and equipment.
2. Immediate removal of all combustible and flammable material from the vicinity of sources of ignition.
3. All welding/cutting operations will be carried out taking suitable precautions under permit procedure in consultation with the office-in-charge of the plant and the Fire and Safety division.
4. All the pipelines and vessels will be clearly marked for its content and quantity and will also be colour coded for easy identification.
5. All plant equipment, lines, vessels and storages will be inspected in all shifts for leakage and release of inflammable liquids. Any such leakage, if found will be stopped and attended to at once.
6. All the hazardous areas will be marked with prominent display symbols.
7. Areas where spontaneous combustion is possible due to storage of material or in scrap yard will be inspected regularly for immediate control of fire on its outbreak.
8. Stacked material, which can generate heat or can spontaneously ignite, will be inspected regularly to detect any fire. Material will be stacked with sufficient space in between the rows to permit free circulation of air and remove any heat if generated.
9. Plant and machinery will be operated under close supervision. Any malfunction will be attended to at once before it can lead to breakdown, fire or any such dangerous occurrence.
10. Air-conditioning equipment will be inspected regularly and defects are to be attended at once.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 174 of 179	

11. Dry grass and vegetation will be cut as and when required.
12. Smoking will be prohibited in the plant premises. It may be allowed in the safe locations outside the plant area. All persons will be checked at plant gate for matches, lighters, beedi, cigarettes and other smoking materials.
13. Safety display boards should be provided wherever hazardous chemicals are stored.

7.8 DISASTER CONTROL MEASURES

Events like explosion pool fire, toxic release and fireball are such calamities, which had never been foreseen, and for the persons working in the plant doing routine type of operations, the procedure becomes so monotonous that they forget that such type of events could occur any moment. Under these circumstances, as the people are unaware, they flee in all directions by vehicles or on foot. Although the traffic is halted, it leads to a massive jam making access to the site impossible for the rescue team. Due to explosions and smoke leading to confusion of common people, coordination becomes difficult and without the cooperation of these persons, the situation becomes uncontrollable.

Though the probability values of occurrence of major hazards considered yet give a message of not to panic, but at the same time asks us to keep ourselves ready to face such type of eventualities. Thus comes the need of the emergency Preparedness Plan (EPP).

Emergency preparedness planning can be divided in two subsections:

1. On-site emergency planning
2. Off-site emergency planning

7.8.1 On-site Emergency Planning

- a. Preventive and predictive system
- b. Protective systems
- c. Personnel protective equipment
- d. Mock drill and simulation exercises
- e. Mutual aid scheme
- f. Communications
- g. Medical facilities
- h. Reporting to external agencies

7.8.2 Off-site Emergency Planning

- a. Educating the people around
- b. Mock drills
- c. Communication
- d. Transport



	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 175 of 179	

- e. Medical facilities
- f. Coordination
- g. Evacuation
- h. Mutual aid scheme

7.9 SITE EMERGENCY PLAN

7.9.1 Control Requirement of an On-site Emergency Plan

The Disaster Management Plan will set out the way in which designated people at the site of the incident can initiate supplementary action both inside and outside the works at an appropriate time. An essential element of the plan will be to make safe the affected unit, for example by shutting down. The plan will contain the full sequence of key personnel to be called in from other sections or from off-site.

Management will ascertain that sufficient resources exist at their works to carry out the plan for various assessed incidents in conjunction with preliminary services, for example, sufficient water for cooling and fire fighting.

7.9.2 Alarm and Communication Mechanism

Communication is crucial factor in handling an emergency. As a general practice, all employees will be able to raise an emergency alarm so that the earliest possible action can be taken to control the situation. There will be an adequate number of points from where the alarm can be raised either directly by activating an audible warning or indirectly, viz. a signal or message to the permanently manned location.

7.9.3 Control Center

The Emergency Control Center is the place from where the operations to handle the emergency are coordinated. An Emergency Control Center (ECC) will be established and equipped with relevant data and equipment to assist the control center personnel in disaster management. The Emergency Control Center will be manned by Deputy General Manager / Senior General Manager in charge of Operation and Maintenance of plant, Safety Officer and the senior officers of the other services. Other personnel will not have access to the control center. Emergency Control Center will be sited in an area of minimum risk and preferably close to a main road to allow for easy access to a radio-equipped vehicle for use if other systems fail or extra communication facilities are needed. An alternate center, similarly equipped, will also be available at a different location. Emergency Control Center will contain.

1. An adequate number of external and internal telephones / mobile phones.
2. Public address system
3. A few copies of the on-site emergency plan.
4. Note pads, pens and pencils to record messages received and any instructions for delivery by runners.



	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 176 of 179	

5. Rolls of employees.
6. Addresses of the employees
7. List of key personnel, their addresses and telephone numbers.
8. A tape recorder with battery and cassettes on which the incident occurred, actions being taken and progress can be recorded.
9. Torches, explosimeters, personnel protective equipment, artificial respirators, gas masks, emergency lights etc.

Two suitable emergency control center sites within power station complex will be:

1. At security gate-Emergency Control Center No. 1
2. At utility office-Emergency Control Center No. 2

7.9.4 Roles and Responsibilities (Proposed)

Shift manager will take overall control of the works during emergency as Works Main Controller (WMC) and will operate from Emergency Control Center (ECC). A multi-channel communication network will connect ECC with all the plant control rooms and also with local police control room, area fire station, area hospital and district authorities through hot lines.

Respective Unit Heads will immediately assume specific roles and emergency management responsibilities. The Roles and Responsibilities of power station personnel can be defined only after the commissioning of the plant.

7.9.5 Emergency Response Facilities (Proposed)

Preliminary facilities envisaged are-

- a) Emergency shut down procedure
- b) A dedicated and pressurized fire fighting ring-main with adequate number of fire hydrants, fixed position monitors, water curtains, fog nozzles located strategically throughout the site.
- c) A number of fire fighting pumps with both electric and diesel prime movers backed by adequate supply of raw water.
- d) Dedicated fire alarm networks with adequate number of fire alarm call points and emergency telephone handsets throughout the site.
- e) A two-way Public Address (PA) system installed independently in all production units and also in important service areas.
- f) Adequate supply of protective clothing & breathing apparatus will be made available to all personnel of emergency team.
- g) On-site first aid and treatment center with round the clock medical attendance.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 177 of 179	

7.9.6 Outline of Key emergency Actions

The on-site emergency will in all probability commence with a major spill of hazardous chemical like HSD, HFO, Chlorine etc. or its uncontrolled release into the plant atmosphere.

In accordance with the detail on-site emergency plan, the following key personnel will immediately take control of the emergency.

1. On-site fire crew led by a fire marshal will arrive at the scene of incident with fire fighting equipment as necessary.
2. Emergency Security Controller will commence his role from the main gate office.
3. Incident Controller will rush to the scene of emergency.
4. Works Main Controller will arrive at the ECC with members of Emergency Control team and will assume absolute control of the site. He will receive information continuously from Incident Controller & Emergency Security Controller and give directions to:
 - Incident Controller
 - All plant control rooms
 - Emergency Security Controller
 - Site or Shift Medical Officer
 - Personnel Manager

As soon as key emergency personnel will take up positions in their respective locations, the management of the incident will commence with the site main controller performing the lead functions.

At the site of incident, the incident controller will directly handle the emergency with the help of specific support groups.

At the security gate office the emergency security controller and personnel manager will be in contact with various external agencies as per requirements.

At the site medical center the shift/site medical officer will take control of medical support services.

Works main controller, will be directing and deciding a wide range of issues. In particular, WMC will decide and direct:

- Whether the incident controller requires reinforcement both in terms of manpower and other resources.
- Whether staffs in different locations are to be remain indoors or are to be evacuated and assembled at the designated collection centers.
- Whether and when district emergency services are to be called to supplement the resources of plant's emergency crew, intimation to district authority should be given.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.: 0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 178 of 179	

- How to deal with fatalities reported either by incident controller or by shift medical officer.

These are some of the key emergency decisions and actions, the Works Main Controller will have to take. When the incident has eventually been brought under control as declared by the incident controller, WMC will send two of his assisting managers for inspection of:

- Site of the incident for an assessment of total damage and prevailing conditions, with particular attention to possibility of re escalation of the emergency now under control.
- Other parts of the site which might have been affected by impacts of the incident.
- Personnel collection and roll call centers to check if all persons on duty have been accounted for.
- All plant control rooms to assess and record the status of respective plants and any residual actions deemed necessary.
- Site's first aid and medical center to inspect any casualty(ies), their state of treatment and also to get a report on off-site hospitalization, for subsequent follow-up.

The post-emergency inspectors will return to ECC with their observations and report their findings to WMC.

Based on these reports WMC will communicate further directive to all sub-centers of emergency management and will finally declare and communicate termination of emergency and authorize step by step restoration of normal operation of the site. The sirens will be sounded giving all clear signal.

7.9.7 Conducting Evacuation

Once WMC will decide that an area is to be evacuated, the evacuation will be conducted in a well-coordinated and safe manner. Evacuation involves a number of steps, which include assigning tasks to evacuation assistance personnel, informing potential evacuees, providing transportation, emergency medical care and security for evacuated areas and sheltering evacuees as necessary.

7.9.8 Evacuation Tasks

The first step is to assign tasks to evacuation assistance personnel. These tasks include information concerning:

- The specific area to evacuate
- Route of evacuation
- Protective gear to be worn
- Instructions to be given to evacuees
- Transportation of evacuees who are without private transportation.

	Comprehensive Environmental Impact Assessment for TNEB – NTPC JVC Thermal Power Project (2x500MW)	Doc. No.:0260/999/GEG/S/001	
		Rev. No.: 0	
		Issue Date: 25-05-2006	
		Page No.: 179 of 179	

- Assistance to specific population
- Shelter locations
- Traffic and pedestrian control
- communication procedures

The progress of the evacuation efforts will be monitored by WMC who will also provide continuous direction to evacuation assistance personnel.

7.9.9 Security in Evacuated Areas

Once an area is evacuated, law enforcement personnel will guard the area to prevent looting and other unauthorized sections. Security forces operating in or around an evacuated area will be dressed in appropriate protective gear.

7.9.10 Re-entry into Evacuated Areas

Before making the decision to authorize re-entry, data collected by the monitoring crews will be verified and the advice of health officials to be considered.

7.9.11 Updating of On-site Plan

On-site plan will be updated based on modifications in the factory or at-least once a year on specific authorization of Works Manager. Safety Officer will maintain a record to this effect.

7.9.12 Mock Drill for Rehearsing On-site Plan

A mock drill to rehearse on-site plan at-least once in a year with a view to train and make the personnel aware of the procedure in case of emergency will be carried out by Works Manager. The drill will be conducted seriously and lessons learnt will be analyzed and corrective actions will be taken. The record of rehearsal will be maintained.

7.9.13 Transport

Vehicles, ambulances and cars available with power plant, will immediately be made available for disaster management. Additional transport based on requirement will be requisitioned.

7.10 OFF-SITE PLAN

The off-site emergency plan is an integral part of a hazard control system. It will be based on the identified accident scenario, which could affect people and environment outside the works. Thus, the off-site plan follows logically from the analysis to provide the basis for the on-site plan and the two plans will therefore complement each other. During preparation of off-site emergency plan, the district authorities and other organization in the vicinity and pollution control board would be consulted. The key feature of a good off-site emergency plan is the flexibility in its application to emergencies.

210

By Speed Post

No.J-13011/33/2006-IA.II(T)
Government of India
Ministry of Environment & Forests

Paryavaran Bhawan,
CGO Complex, Lodi Road,
New Delhi-11003.

Dated 18th April, 2007

To

Shri M.H. Rao
General Manager (Env. Engg.),
National Thermal Power Corporation Ltd.,
Plot No. 8 A, Sector-24,
Post Box No. 13,
Noida-201 301, Uttar Pradesh.

Sub: 2x500 MW Thermal Power Project at Thiruvallur, Tamil Nadu by M/s NTPC-Tamil Nadu Energy Company Ltd. – Environmental Clearance regarding.

Sir,

The undersigned is directed to refer to your communication no. CC:ESE:0260:2006:GEN:05C dated 2nd November, 2006 regarding the subject mentioned above. Subsequent information furnished vide letters dated 29.11.2006 and 01.02.2007 have also been considered.

2. It is noted that the proposal is for grant of environmental clearance under the provisions of EIA Notification, 1994 to set up a thermal power plant of 1000 MW (2x500 MW) near village Kuruvimedu in Ponneri Taluk of Thiruvallur District, Tamil Nadu. The site is located near Ennore Port having a dedicated berth for receiving coal. The land requirement is estimated as 1184 acres. Proposed site is a salt pan land. An area of 114 acres fall within CRZ and this will be left undisturbed. The entire project activity will be outside CRZ. The coordinates of the proposed site are latitude 13^o 12' 45" N to 13^o 14' 30" N and longitude 80^o 18' 0" E to 80^o 19' 50" E. Washed coal requirement is estimated as 4.4 million TPA at 80% PLF and will be sourced from Talchar or Ib Valley Coalfields. Coal will be transported by sea route up to the Ennore Port. From North Chennai, it will be transported by pipe conveyor. Sea water after desalination will be used for the power plant and will be obtained from the intake channel of North Chennai Thermal Power Plant. No fresh water will be drawn for the project. Re-circulating type cooling water system with natural draft cooling towers shall be provided. No forestland is involved. No ecologically sensitive area is reported within 7 km radius of the project

boundary. No displacement of people is involved. Public hearing was held on 14th September, 2006. Total cost of the project is Rs 5321.08 crores which includes Rs 270.42 crores for environmental protection measures.

3. The proposal has been considered in accordance with para 12 of the EIA Notification dated 14th September, 2006 read with para 2.2.1 (i) (a) of the circular no. J-11013/41/2006-IA.II(I) dated 13th October, 2006 and environmental clearance is hereby accorded under the provisions there of subject to implementation of the following terms and conditions:

- (i) The total land requirement shall not exceed 1184 acres for all the activities / facilities of the power project put together.
- (ii) The requisite CRZ clearance for the greenbelt area, which partially fall within CRZ, shall be obtained before starting development of greenbelt work in that area.
- (iii) The requisite CRZ clearance for the conveyor belt for transportation of coal passing through CRZ and any other activity in CRZ area shall be obtained before starting work on these activities.
- (iv) Adequate maintenance of the drainage network shall be carried out for ensuring the storm water drainage efficiency in accordance with the study carried out by CWPRS.
- (v) The fill material require for leveling of the area shall be met from the pond ash of the Ennore Thermal Power Station and North Chennai Thermal Power Station to the extent possible.
- (vi) The intake water point shall be selected based on CWPRS study.
- (vii) A copy of the complete report on area drainage study reported to be undertaken by CWPRS shall be submitted to the Ministry within one month of the issue of this letter.
- (viii) Ash and sulphur content in the coal to be used in the project shall not exceed 34% and 0.34% respectively.
- (ix) A bi-flue stack of 275 m height shall be provided with continuous online monitoring equipments. Exit velocity of at least 22.2 m/sec shall be maintained.
- (x) High efficiency Electrostatic Precipitators (ESPs) with an efficiency of not less than 99.9% shall be installed to ensure that particulate emission does not exceed 100 mg/Nm³.

- (xi) Space provision shall be made for Flue Gas De-sulphurisation (FGD) unit, if required at a later stage.
- (xii) Adequate dust extraction system such as bag filters and water spray system in dusty areas such as coal and ash handling areas, transfer areas and other vulnerable areas shall be provided.
- (xiii) Fly ash shall be collected in dry form and shall be used in a phased manner as per provisions of the notification on Fly Ash Utilization issued by the Ministry in September, 1999 and its amendment. By the end of 9th year full fly ash utilization should be ensured. Unutilized ash shall be disposed off in the ash pond in the form of High Concentration Slurry.
- (xiv) Adequate safety measures shall be implemented to protect the ash pond bund from getting breached.
- (xv) Rain water harvesting shall be practiced. A detailed scheme for rain water harvesting to recharge the ground water aquifer shall be prepared in consultation with Central Ground Water Authority / State Ground Water Board and a copy of the same shall be submitted within three months to the Ministry.
- (xvi) The treated effluents conforming to the prescribed standards shall be discharged in the lagoon along with circulating water of existing North Chennai TPS. The temperature of the discharged effluents shall not exceed 5^o C over and above the ambient water temperature of lagoon / sea.
- (xvii) Regular monitoring of groundwater in and around the ash pond areas shall be carried out, records maintained and periodic reports shall be furnished to the Regional Office of this Ministry.
- (xviii) Greenbelt shall be developed all around the plant area, other utilities and ash pond covering at least 25% of the area.
- (xix) First aid and sanitation arrangements shall be made for the drivers and other contract workers during construction phase.
- (xx) Leq of Noise level should be limited to 75 dBA and regular maintenance of equipment be undertaken. For people working in high noise areas, personal protection devices should be provided.
- (xxi) Regular monitoring of the ambient air quality shall be carried out in and around the power plant and records maintained. The location of the monitoring stations and frequency of monitoring shall be decided in

consultation with SPCB. Periodic reports shall be submitted to the Regional Office of this Ministry.

- (xxii) The project proponent should advertise in at least two local newspapers widely circulated in the region around the project, one of which should be in the vernacular language of the locality concerned, informing that the project has been accorded environmental clearance and copies of clearance letter is available with the State Pollution Control Board / Committee and may also be seen at website of the Ministry of Environment and Forests at <http://www.envfor.nic.in>.
 - (xxiii) A separate environment monitoring cell with suitable qualified staff should be set up for implementation of the stipulated environmental safeguards.
 - (xxiv) A half yearly report on the status of implementation of the stipulated conditions and environmental safeguards should be submitted to this Ministry, its Regional Office at Bangalore, CPCB and SPCB.
 - (xxv) Regional Office of the Ministry of Environment & Forests located at Bangalore will monitor the implementation of the stipulated conditions. A complete set of documents including Environmental Impact Assessment Report and Environment Management Plan along with the additional information submitted from time to time shall be forwarded to the Regional Office for their use during monitoring.
 - (xxvi) Separate funds should be allocated for implementation of environmental protection measures along with item-wise break-up. This cost should be included as part of the project cost. The funds earmarked for the environment protection measures should not be diverted for other purposes and year-wise expenditure should be reported to the Ministry.
 - (xxvii) Full cooperation should be extended to the Scientists / Officers from the Ministry / Regional Office of the Ministry at Bangalore / the CPCB / the SPCB who would be monitoring the compliance of environmental status.
4. The Ministry reserves the right to revoke the clearance if conditions stipulated are not implemented to the satisfaction of the Ministry.
 5. The environmental clearance accorded shall be valid for a period of 5 years to the start of production operations by the power plant.
 6. In case of any deviation or alteration in the proposed project from that submitted to this Ministry for clearance, a fresh reference should be made to the Ministry to assess the adequacy of the condition(s) imposed and to incorporate additional environmental protection measures required, if any.

7. The above stipulations shall be enforced among others under the Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989, the Public Liability Insurance Act, 1991 and rules there under and the EIA Notification, 2006 and the amendments made therein from time to time.



(Dr. S.K. Aggarwal)
Director

Copy to:

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi-110 001.
2. The Secretary (Environment & Forests), Government of Tamil Nadu, St. George Fort, Chennai - 600 009, Tamil Nadu.
3. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110 066.
4. The Chairman, Tamil Nadu Pollution Control Board, 76, Mount Salai, Guindy, Chennai- 600 032, Tamil Nadu - **with a request to display a copy of the clearance letter at the Regional Office, District Industries Centre and Collector's office for 30 days.**
5. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi-110 032.
6. The Chief Conservator of Forests, Southern Regional Office, Ministry of Environment & Forests, Kendriya Sadan, 4th Floor, E&F Wings, 17th Main Road, Block, Koramangla, Bangalore- 560 034, Karnataka.
7. Director (EI), MOEF.
8. Guard file.
9. Monitoring file.



(Dr. S.K. Aggarwal)
Director

BY SPEED POST

No. J 13011/62/2008 -IA.II(T)
Government of India
Ministry of Environment & Forests

Paryavaran Bhawan
CGO Complex, Lodi Road
New Delhi-110 003

Dated: 3rd June,, 2009

To

M/s NTPC Tamil Nadu Energy Company Ltd.
NTPC Bhawan, Core- 7, Institutional Area
Lodi Road, New Delhi-110 003

Sub: 500 MW Vallur Thermal Power Project Stage-I, Phase-II at Vallur, Tamil Nadu
by M/s NTPC Tamil Nadu Energy Company Ltd - Environmental clearance
regarding

Sir,

The undersigned is directed to refer to your communication no. Nil dated 21.3.2008 regarding the subject mentioned above. Subsequent information furnished vide letters No. NTECL/CEO/2008/MOEF/01 dt. 28.07.2008, no. CC:ESE:261:2009:04C dt. 4.3.2009 and 16.4.2009 have also been considered.

2. It is noted that the proposal is for grant of environmental clearance for setting up of a 500 MW thermal power project as stage-I, phase-II at Vallur, Tamil Nadu. Environmental clearance for two units of 500 MW under phase-I was granted in April, 2007. No additional land is required for the main plant, however, 140 acres land is required for ash pond only. The ash pond will be at a distance of about 5 km from the main plant. The water requirement is 4550 m³/hr. Seawater will be used, which will be taken from the water channel of the North Chennai Thermal Power Project. The fresh water requirement will be met through desalination of seawater. Coal requirement is estimated as 2.52 million TPA, which will be obtained from MCL and transported by sea route up to Ennore and thereafter by conveyor. Public hearing for this project was held on 5.3.2008. No National Park and Wildlife Sanctuary is located within 10 Km from project area. Total cost of the project is Rs. 2640.68 crores which includes Rs. 177.48 crores for environmental protection measures.

3. The proposal has been considered and Ministry of Environment & Forests hereby accords environmental clearance to the said project under the provisions of

Environment Impact Assessment Notification, 2006 subject to implementation of the following terms and conditions:-

- (i) Boundary of the proposed power project shall be outside the CRZ boundary. No activity shall be taken up except permissible activity with due clearance in the CRZ area.
- (ii) Prior CRZ clearance for the activities/ facilities to be located in the CRZ area shall be obtained before start of the work on the project.
- (iii) Sulphur and ash contents in the coal to be used in the project shall not exceed 0.34% & 34 % respectively at any given time. In case of variation of coal quality at the time of issue of LOA, a fresh reference shall be made to MOEF for suitable amendments to environmental clearance conditions wherever necessary.
- (iv) A single stack of 275 m height shall be provided with continuous online monitoring equipments for SO_x, NO_x and Particulate & Hg emissions. Exit velocity of flue gases shall not be less than 22.2 m/sec.
- (v) High efficiency Electrostatic Precipitators (ESPs) shall be installed to ensure that particulate emission does not exceed 50 mg/Nm³.
- (vi) Space for FGD installation should be provided whenever the need arises for its installation, i.e. if emissions level exceeds the AAQ standards.
- (vii) Adequate dust extraction system such as cyclones/ bag filters and water spray system in dusty areas such as in coal handling and ash handling points, transfer areas and other vulnerable dusty areas shall be provided.
- (viii) Fly ash shall be collected in dry form and storage facility (silos) shall be provided. Fly ash shall be used in phased manner as per provisions of the notification on Fly Ash utilization issued by the Ministry in September , 1999 and its amendment. By the end of 9th year full fly ash utilization should be ensured. Unutilized ash shall be disposed off in the ash pond. Mercury and other heavy metals (As,Hg, Cr, Pb etc.) will be monitored in the bottom ash as also in the effluents emanating from the existing ash pond.
- (ix) Ash pond shall be lined with impervious lining. Adequate safety measures shall also be implemented to protect the ash dyke from getting breached.
- (x) Closed cycle cooling system with Natural Draft Cooling Tower shall be provided and the effluents shall be treated as per the prescribed norms.
- (xi) The treated effluents conforming to the prescribed standards only shall be discharged. The temperature of the discharged effluents shall not exceed 5⁰ C over and above the ambient water temperature of Creek

- water/ receiving water body. The temperature of the discharged water shall be monitored continuously and records maintained.
- (xii) A sewage treatment plant shall be provided and the treated sewage shall be used for raising greenbelt/plantation.
 - (xiii) 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.
 - (xiv) Adequate safety measures shall be provided in the plant area to check/minimize spontaneous fires in coal yard, especially during summer season. Copy of the these measures with full details along with location plant layout shall be submitted to the Ministry as well as to the Regional Office of the Ministry at Bangalore.
 - (xv) Storage facilities for auxillary liquid fuel such as LDO and/ HFO/LSHS shall be made in the plant area where risk is minimum to the storage facilities. Disaster Management Plan shall be prepared to meet any eventuality in case of an accident taking place. Mock drills shall be conducted regularly and based on the same, modifications required, if any shall be incorporated in the DMP. Sulphur content in the liquid fuel will not exceed 0.5%
 - (xvi) Regular monitoring of ground water in and around the ash pond area including heavy metals (Hg,Cr,As,Pb) shall be carried out, records maintained and six monthly reports shall be furnished to the Regional Office of this Ministry.
 - (xvii) A green belt of adequate width and density shall be developed around the plant periphery covering at least 25% area preferably with local species.
 - (xviii) Budgetary allocation for taking up activities under CSR should be at least Rs. 3.0 crores under capital expenditure and Rs. 50.0 lakh/annum under recurring expenditure.
 - (xix) First aid and sanitation arrangements shall be made for the drivers and other contract workers during construction phase.
 - (xx) 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.
 - (xxi) Regular monitoring of ground level concentration of SO₂, NO_x, Hg,SPM and RSPM 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 SPCB. Periodic reports shall be submitted to the Regional Office of this Ministry. The data shall also be put on the website of the company.

- (xxii) 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, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.
- (xxiii) The project proponent shall advertise in at least two local newspapers widely circulated in the region around the project, one of which shall be in the vernacular language of the locality concerned within seven days from the date of this clearance letter, informing that the project has been accorded environmental clearance and copies of clearance letter are available with the State Pollution Control Board/Committee and may also be seen at Website of the Ministry of Environment and Forests at <http://envfor.nic.in>.
- (xxiv) A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zila Parisad/Municipal Corporation, urban local Body and the Local NGO, if any, from whom suggestions/representations, if any, received while processing the proposal. The clearance letter shall also be put on the website of the Company by the proponent.
- (xxv) A separate environment management cell with qualified staff shall be set up for implementation of the stipulated environmental safeguards.
- (xxvi) 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, the respective Zonal Office of CPCB and the SPCB. The criteria pollutant levels namely; SPM, RSPM, SO₂, NO_x (ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the project shall be monitored and displayed at a convenient location near the main gate of the company in the public domain.
- (xxvii) The project proponent shall also submit six monthly 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, the respective Zonal Office of CPCB and the SPCB.
- (xxviii) Regional Office of the Ministry of Environment & Forests located at Bangalore will monitor the implementation of the stipulated conditions. A complete set of documents including Environmental Impact Assessment Report and Environment Management Plan along with the additional information submitted from time to time shall be forwarded to the Regional Office for their use during monitoring. Project proponent will up-load the compliance status in their website and update the same from time to time at least six monthly basis. Criteria pollutants levels (Stack & ambient levels of NO_x) will be displayed at the main gate of the power plant.

- (xxix) 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.
- (xxx) 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.
- (xxxi) Full cooperation shall be extended to the Scientists/Officers from the Ministry / Regional Office of the Ministry at Bangalore /the CPCB/the SPCB who would be monitoring the compliance of environmental status.

4. The Ministry of Environment and Forests reserves the right to revoke the clearance if conditions stipulated are not implemented to the satisfaction of the Ministry. MOEF may impose additional environmental conditions or modify the existing ones, if necessary.

5. The environmental clearance accorded shall be valid for a period of 5 years to start operations by the power plant.

6. In case of any deviation or alteration in the project proposed including coal transportation system from those submitted to this Ministry for clearance, a fresh reference should be made to the Ministry to assess the adequacy of the condition(s) imposed and to add additional environmental protection measures required, if any.

7. The above stipulations would be enforced among others under the Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986 and rules there under, Hazardous Wastes (Management and Handling) Rules, 1989 and its amendments, the Public Liability Insurance Act, 1991 and its amendments.

8. Any appeal against this environmental clearance shall lie with the National Environment Appellate Authority, if preferred, within 30 days as prescribed under Section 11 of the National Environment Appellate Act, 1997.


(LALIT KAPUR)
DIRECTOR

Copy to:-

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi-110001.
2. The Secretary, Department Environment & Forests Department, Secretariat Chennai- 600 009.
3. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.
4. The Chairman, No. 100, Mount Salai, Guindy, Chennai- 600 032 with a request to display a copy of the clearance letter at the Regional Office, District Industries Centre and Collector's office for 30 days.
5. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi- 110032.
6. The Chief Conservator of Forests, Ministry of Environment & Forests, Regional Office (SZ), Kendriya Sadan, 4th Floor, E&F Wings, 17th Main Road, II-Block, Koramangla, Bangalore-560034.
7. The Director(EI), MOEF.
8. Guard file.
9. Monitoring file.

(LALIT KAPUR)
DIRECTOR

Category of the Industry :

RED



CONSENT ORDER NO. 2208143045418 DATED: 28/06/2022.

PROCEEDINGS NO.T4/TNPCB/F.0318GMP/RL/GMP/W/2022 DATED: 28/06/2022

SUB: Tamil Nadu Pollution Control Board - RENEWAL OF CONSENT – M/s. NTPC TAMILNADU ENERGY COMPANY LIMITED , S.F.No. 1556, VELLIVOYAL village, Ponneri Taluk and Tiruvallur District - Renewal of Consent for the operation of the plant and discharge of sewage and/or trade effluent under Section 25 of the Water (Prevention and Control of Pollution) Act, 1974 as amended in 1988 (Central Act 6 of 1974) – Issued- Reg.

REF: 1. Unit's application no. 43045418 DATED:02.02.2022.
2. IR.No : F.0318GMP/RL/JCEE-M/GMP/2022 dated 03/06/2022

RENEWAL OF CONSENT is hereby granted under Section 25 of the Water (Prevention and Control of Pollution) Act, 1974 as amended in 1988 (Central Act, 6 of 1974) (hereinafter referred to as "The Act") and the rules and orders made there under to

The Chief Executive Officer
M/s.NTPC TAMILNADU ENERGY COMPANY LIMITED,
S.F.No. 1556,
VELLIVOYAL Village ,
Ponneri Taluk ,
Tiruvallur District .

Authorising the occupier to make discharge of sewage and /or trade effluent.

This is subject to the provisions of the Act, the rules and the orders made there under and the terms and conditions incorporated under the Special and General conditions stipulated in the Consent Order issued earlier and subject to the special conditions annexed.

This RENEWAL OF CONSENT is valid for the period ending March 31, 2027

RATNAM VIJAYABASKARAN Digitally signed by RATNAM VIJAYABASKARAN
Date: 2022.06.29 15:41:55 +05'30'

**For Member Secretary,
Tamil Nadu Pollution Control Board,
Chennai**

SPECIAL CONDITIONS

1. This renewal of consent is valid for operating the facility for the manufacture of products/byproducts (Col. 2) at the rate (Col 3) mentioned below. Any change in the product/byproduct and its quantity has to be brought to the notice of the Board and fresh consent has to be obtained.

Sl. No.	Description	Quantity	Unit
Product Details			
1.	Power generation (3x500) MW	1500	MW

2. This renewal of consent is valid for operating the facility with the below mentioned outlets for the discharge of sewage/trade effluent. Any change in the outlets and the quantity has to be brought to the notice of the Board and fresh consent has to be obtained.

Outlet No.	Description of Outlet	Maximum daily discharge in KLD	Point of disposal
Effluent Type : Sewage			
1.	Sewage	1680.0	On Industrys own land
Effluent Type : Trade Effluent			
1.	Trade Effluent	243000.0	Marine Coastal areas

Special Additional Conditions:

The unit shall obtain No Objection Certificate (NOC) from the Tamil Nadu Bio Diversity Board /National Bio Diversity Authority if the unit is using any Biological resources or knowledge associated thereto as per the provisions of Biological Diversity Act 2002.

Additional Conditions:

1. The unit shall ensure that the sewage including canteen waste water arising from the unit and colony is completely collected and treated through the STPs I & II and shall operate and maintain the Sewage Treatment Plant I & II components efficiently and continuously so as to achieve the treated sewage standards prescribed by the Board consistently.
2. The unit shall ensure that the treated sewage is completely utilized for gardening / tree plantation within the unit/colony premises without any stagnation.
3. The unit shall ensure that the EMFMs are provided at the inlet & outlet of STPs I & II and connected to WQW, TNPCB for continuous monitoring.
4. The unit shall ensure that the trade effluent discharged from the Central Monitoring Basin shall meet the marine standards prescribed by the Board consistently
5. The unit shall maintain the OCEMS installed at the outlet of Central Monitoring Basin for effluent parameters pH, TSS, BOD, COD, Conductivity, Turbidity & Temperature including an EMFM to ensure uninterrupted transmission data to WQW, TNPCB and calibrate the system periodically.
6. The unit shall ensure that no water is discharged from the ash pond to creek nearby either directly and indirectly under any circumstances.
7. The unit shall handle the ash from ash dyke with utmost care and ensure that there shall not be any spillages of ash around the ash dyke area.
8. The unit shall ensure that the fly ash is completely collected in dry form and disposed 100% for beneficial use in cement industries and hollow block brick manufacturing industries, without any accumulation within the unit premises as per the MoEF&CC Notification Dated 31.12.2021.
9. The unit shall comply with the MoEF& CC Notifications on Fly Ash Utilization S.O, 763(E) dated 14.09.1999, S.O. 979(E) dated 27.08.2003, S.O. 2804(E) dated 3.11.2009, S.O. 254(E) dated 25.01.2016 and 31.12.2021 as amended from time to time.
10. The unit shall comply with the special and general conditions imposed by the MoEF&CC, Government of India vide CRZ clearance dated.14.07.2009 under the CRZ Notification 1991 and vide Environmental Clearance dated 18.04.2007 (For 2x500 MW) & 03.06.2009 (For 1x500 MW) under the Environment Impact Assessment Notification 2006.
11. The unit shall comply with the orders of the Hon'ble High Court in W.P No. 30135 & 30237 of 2018.
12. The unit shall comply with the orders of the Hon'ble NGT(SZ) in O.A No256/2020 if any issued from time to time.
13. The unit shall maintain Form – 3 for the generation & handling of hazardous wastes and shall file annual return in Form – 4 & Form 13 if disposed the waste outside the premises to the Board to comply with the provisions of Hazardous and Other Wastes (Management & Trans Boundary Movement) Rules, 2016. The unit shall maintain the hazardous waste display board in front of the unit clearly updating the same regularly as mandated by the Hon'ble Supreme Court Order dated 14.10.2003 in the matter of WP No.657/1995.
14. The unit shall comply with the E-Waste Management Rules 2016.E-Waste as listed in Schedule-I, generated by them shall be channelized through collection centre or dealer of authorized producer or dismantler or recycler or through the designated take back service provider of the producer to authorized dismantler or recycler. The unit shall maintain records of e-waste generated by them in Form-2 and make such records available for scrutiny by the TNPCB. The unit shall file annual returns in Form-3, to the TNPCB on or before the 30th day of June following the financial year.
15. The unit shall not use 'single use and throwaway plastics items' such as plastic sheets used for food wrapping, spreading on dining table etc., plastic plates, plastic coated tea cups, plastic tumbler, water pouches and packets, plastic straw, plastic carry bag and plastic flags irrespective of thickness, within the industry premises. Instead it shall encourage use of eco friendly alternative such as banana leaf, arecanut palm plate, stainless steel, glass, porcelain plates/cups, cloth bag, Jute bag etc.,
16. The unit shall not go for expansion or enhanced production without valid consent of the Board.
17. The unit shall comply with the special and general conditions imposed by the MoEF&CC, Government of India vide CRZ clearance dated.14.07.2009 under the CRZ Notification 1991 and vide Environmental Clearance dated 18.04.2007 (For 2x500 MW) & 03.06.2009 (For 1x500 MW) under the Environment Impact Assessment Notification 2006.
18. The operation of the unit shall not invoke any complaint from the public
19. The unit shall strictly adhere to the approved mine closure plan.
20. In case of revision of consent fee by the Government, the unit shall remit the difference in amount within one month from the date of notification. Failing to remit the consent fee, this consent will be withdrawn without any notice and further action will be initiated against the unit as per law
21. This consent order does not absolve from obtaining necessary permission / clearance from other Authority or under other Statute as applicable.

RATNAM
VIJAYABASKARAN

Digitally signed by RATNAM
VIJAYABASKARAN
Date: 2022.06.29 15:42:24 +05'30'

**For Member Secretary,
Tamil Nadu Pollution Control Board,
Chennai**

To

The Chief Executive Officer,

M/s.NTPC TAMILNADU ENERGY COMPANY LIMITED,

NTPC Bhavan Core-7, SCOPE complex, 7 Institutional Area, Lodhi Road, New Delhi ,

Pin: 110003

Copy to:

- 1.The Commissioner, MEENJUR-Panchayat Union, Ponneri Taluk, Tiruvallur District .
2. The District Environmental Engineer, Tamil Nadu Pollution Control Board, GUMMIDIPOONDI.
3. The JCEE-Monitoring, Tamil Nadu Pollution Control Board, Chennai.
4. File

Category of the Industry :

RED



CONSENT ORDER NO. 2208243045418 DATED: 28/06/2022.

PROCEEDINGS NO.T4/TNPCB/F.0318GMP/RL/GMP/A/2022 DATED: 28/06/2022

SUB: Tamil Nadu Pollution Control Board - RENEWAL OF CONSENT –M/s. NTPC TAMILNADU ENERGY COMPANY LIMITED , S.F.No. 1556, VELLIVOYAL village, Ponneri Taluk and Tiruvallur District - Renewal of Consent for the operation of the plant and discharge of emissions under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981 as amended in 1987 (Central Act 14 of 1981) –Issued- Reg.

REF: 1. Unit's application no. 43045418 DATED:02.02.2022.
2. IR.No : F.0318GMP/RL/JCEE-M/GMP/2022 dated 03/06/2022

RENEWAL OF CONSENT is hereby granted under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981 as amended in 1987 (Central Act 14 of 1981) (hereinafter referred to as "The Act") and the rules and orders made there under to

The Chief Executive Officer
M/s.NTPC TAMILNADU ENERGY COMPANY LIMITED,
S.F.No. 1556,
VELLIVOYAL village,
Ponneri Taluk,
Tiruvallur District.

Authorizing the occupier to operate the industrial plant in the Air Pollution Control Area as notified by the Government and to make discharge of emission from the stacks/chimneys.

This is subject to the provisions of the Act, the rules and the orders made there under and the terms and conditions incorporated under the Special and General conditions stipulated in the Consent Order issued earlier and subject to the special conditions annexed.

This RENEWAL OF CONSENT is valid for the period ending March 31, 2027

RATNAM
VIJAYABASKARAN

Digitally signed by RATNAM
VIJAYABASKARAN
Date: 2022.06.29 15:40:05 +05'30'

**For Member Secretary,
Tamil Nadu Pollution Control Board,
Chennai**

SPECIAL CONDITIONS

1. This renewal of consent is valid for operating the facility for the manufacture of products (Col. 2) at the rate (Col. 3) mentioned below. Any change in the products and its quantity has to be brought to the notice of the Board and fresh consent has to be obtained.

Sl. No.	Description	Quantity	Unit
Product Details			
1.	Power generation (3x500) MW	1500	MW

2. This renewal of consent is valid for operating the facility with the below mentioned emission/noise sources along with the control measures and/or stack. Any change in the emission source/control measures/change in stack height has to be brought to the notice of the Board and fresh consent/Amendment has to be obtained.

I	Point source emission with stack :			
Stack No.	Point Emission Source	Air pollution Control measures	Stack height from Ground Level in m	Gaseous Discharge in Nm3/hr
1	Boiler 1725 T/hour - 2 NOS	ESP with stack	275	
2	Boiler 1725 T/hour - 1 NOS	ESP with stack	275	
3	DG Set 500 KVA - 2 NOS	ESP with stack	25	
4	DG Set 500 KVA - 2 NOS	ESP with stack	25	
II	Fugitive/Noise emission :			
Sl. No.	Fugitive or Noise Emission sources	Type of emission	Control measures	
1.	Coal handling Area	Fugitive	Dust Extraction and Suppression System	
2.	Fly Ash Silos - 3 Nos	Fugitive	Bag Filters and dry Fog Dust Suppression System	

Special Additional Conditions:

- i. The unit shall install the approved retrofit emission control device/equipment with at least 70% Particulate matter reduction efficiency on all DG sets with capacity of 125 KVA and above or otherwise the unit shall be shift to gas based generators within the time frame prescribed in the notification No. TNPCB/Labs/DD(L)02151/2019 dated 10.06.2020 issued by TNPCB.
- ii. The unit shall obtain No Objection Certificate (NOC) from the Tamil Nadu Bio Diversity Board /National Bio Diversity Authority if the unit is using any Biological resources or knowledge associated thereto as per the provisions of Biological Diversity Act 2002.

Additional Conditions:

1. The unit shall operate and maintain the existing APC measures /acoustic measures efficiently and continuously so as to adhere to the AAQ/SM/ANL standards prescribed by the Board.
2. The unit shall ensure that the fly ash is completely collected in dry form and disposed 100% for beneficial use in cement industries and hollow block brick manufacturing industries, without any accumulation within the unit premises.
3. The unit shall handle the ash from ash dyke with utmost care and ensure that there shall not be any spillages of ash around the ash dyke area.
4. The unit shall maintain the OCEMS provided at the outlet of stack attached to each three Boilers for emission parameters SPM, SO₂ & NO_x to ensure uninterrupted transmission data to CAC, TNPCB and calibrate the system periodically.
5. The unit shall comply with the emission standards for Thermal Power Plants as per Ministry's Notification S.O. 3305(E) dated: 07.12.2015, G.S.R. 593(E) dated: 28.06.2018 and as amended from time to time.
6. The unit shall ensure the compliance of MoEF & CC Notification G.S.R 02(E) dated 02.01.2014 as amended time to time regarding use of raw or blended or beneficiated/washed coal with ash content not exceeding 34%, as applicable.
7. The unit shall comply with the MoEF& CC Notifications on Fly Ash Utilization S.O, 763(E) dated 14.09.1999, S.O. 979(E) dated 27.08.2003, S.O. 2804(E) dated 3.11.2009, S.O. 254(E) dated 25.01.2016 and 31.12.2021 as amended from time to time.
8. The unit shall comply with the special and general conditions imposed by the MoEF&CC, Government of India vide CRZ clearance dated.14.07.2009 under the CRZ Notification 1991 and vide Environmental Clearance dated 18.04.2007 (For 2x500 MW) & 03.06.2009 (For 1x500 MW) under the Environment Impact Assessment Notification 2006.
9. The unit shall comply with the National Ambient Air Quality Standards issued vide MoEF, GoI Notification GSR826 (E) dated 16.11.2009.
10. The unit shall comply with the orders of the Hon'ble High Court in W.P No. 30135 & 30237 of 2018.
11. The unit shall comply with the orders of the Hon'ble NGT(SZ) in O.A No256/2020 if any issued from time to time.
12. The unit shall comply with the National Ambient Air Quality Standards issued vide MoEF, GoI Notification GSR826 (E) dated 16.11.2009.
13. The unit shall install Flue Gas Desulphurisation (FGD) System based on Lime/Ammonia dosing to capture Sulphur in the flue gases to meet the SO₂ emissions standard of 100 mg/Nm³.
14. The unit shall install Selective Catalytic Reduction (SCR) system or the Selective Non-Catalytic Reduction (SNCR) system or Low NO_x Burners with Over Fire Air (OFA) system to achieve NO_x emission standard of 100 mg/Nm³ within the permitted time line for all three units.
15. The unit shall operate and maintain adequate dust extraction/suppression system in coal handling, ash handling areas and material transfer points to control fugitive emissions.
16. The unit shall operate and maintain the Dust Extraction system(DEs)/Dust Suppression system(DSs) at all the dust generating sources including sufficient water sprinkling arrangements at various locations viz., roads, excavation sites, crusher plants, transfer points, loading and unloading areas, etc.
17. The unit shall properly maintain the Continuous Ambient Air Quality Monitoring System (CAAQMS) provided in 4 locations to monitor the parameters such as PM₁₀, PM_{2.5}, SO₂ & NO₂ and the same shall be connected to CAC, TNPCB, Chennai to ensure uninterrupted transmission data to CAC, TNPCB and calibrate the system periodically.
18. The unit shall continue to develop green belt to attain an area of 33% of the total area with indigenous native tree species and the green belt shall inter-alia cover an entire periphery of the unit.
19. The unit shall not go for expansion or enhanced production without valid consent of the Board.
20. The unit shall not go for expansion or enhanced production without valid consent of the Board.

RATNAM VIJAYABASKARAN Digitally signed by RATNAM
VIJAYABASKARAN
Date: 2022.06.29 15:41:13 +05'30'

**For Member Secretary,
Tamil Nadu Pollution Control Board,
Chennai**

To

The Chief Executive Officer,

M/s.NTPC TAMILNADU ENERGY COMPANY LIMITED,

NTPC Bhavan Core-7, SCOPE complex, 7 Institutional Area, Lodhi Road, New Delhi ,

Pin: 110003

Copy to:

- 1.The Commissioner, MEENJUR-Panchayat Union, Ponneri Taluk, Tiruvallur District .
2. The District Environmental Engineer, Tamil Nadu Pollution Control Board, GUMMIDIPOONDI.
3. The JCEE-Monitoring, Tamil Nadu Pollution Control Board, Chennai.
4. File

2015-16 (in mg/Nm³)

	Unit 1 NOx			Unit 1 SOx			Unit 1 PM			Unit 2 NOx			Unit 2 SOx			Unit 2 PM			Unit 3 NOx			Unit 3 SOx			Unit 3 PM				
	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max		
Apr-15	275	301	361	665	696	1461				182	397	445	246	445				280	341	412	1644	1631	1798						
May-15	205	179	246	479	492	602				205	252	521	589	699															
Jun-15		199	269	963	992	1162					290	288	139	288															
Jul-15		216	269	487	866	1290																							
Aug-15		179	246	479	492	602				205	440	524	589	699															
Sep-15		167	250	495	495	843					250	471	555	696															
Oct-15		237	382	455	474	563				207	258	544	589	717															
Nov-15	218	282	386	489	500	660				188	256	555	571	780				198	235	288	380	699	895						
Dec-15	273	322	389	516	550	691				199	252	552	607	767				239	237	288	725	715	869						
Jan-16	295	258	312	592	547	626				216	203	613	613	717				254	239	269	770	717	822						
Feb-16	278	337	391	497	565	995				201	216	613	660	809				207	226	288	626	683	874						
Mar-16	245	258	309	497	620	791				203	243	602	620	743				205	209	260	613	626	777						
	205	245	391	455	607	1461				201	440	471	525	809				198	220	858	380	684	1798						

Station Yearly average SPM Limit
 Sox 50
 Nox NA* *MoE target date for FGD commissioning 31.12.2027
 1072 450
 222

2016-17 (mg/Nm3)

	Unit 1 NOx			Unit 1 SOx			Unit 2 NOx			Unit 2 SOx			Unit 3 NOx			Unit 3 SOx		
	Min	Average	Max	Min	Average	Max	Min	Average	Max									
Apr-16	248	263	305	620	670	738	209	233	233	576	636	696	213	233	246	639	709	749
May-16																		
Jun-16	213	246	327		628	924		273	273	631	639	832						
Jul-16	258	267	329	654	681	945	216	265	265	610	654	806	220	292	882	681	683	835
Aug-16	228	226	314	584	691	958	211	290	290	633	641	882	198	218	292	605	665	890
Sep-16	213	214	273	696	715	942	205	293	293	633	623	893	228	228	310	649	675	950
Oct-16	241	224	269	733	720	767	231	295	295	618	696	900	224	233	305	654	670	898
Nov-16	246	226	284	644	649	872	228	263	263	623	688	801	203	201	373	599	592	1092
Dec-16	213	207	263	675	665	914	201	435	435	589	589	1204	198	196	271	571	569	788
Jan-17	209	201	265	620	618	851	196	293	293	537	542	814		182	373	495	521	1044
Feb-17			312		404	837	175	461	461		381	835			269		370	763
Mar-17	229	241	306	646	653	864	206	298	298	577	586	846	213	214	293	603	606	832
mg/Nm3	209	232	329	584	645	958	201	208	461	537	607	1204	198	222	882	495	606	1092

Station Yearly average SPM Limit
 Sox 1085 50
 Nox 221 450
 *MoEF target date for FGD commissioning 31.12.2027

2017-18 (mg/Nm3)																												
Station	Unit 1 NOx			Unit 1 SOx			Unit 1 PM			Unit 2 NOx			Unit 2 SOx			Unit 2 PM			Unit 3 NOx			Unit 3 SOx			Unit 3 PM			
	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	
Apr-17	228	243	311	636	632	879				201	257	562	572	764	202	203	276				485	551	780					
May-17	216	236	310	593	629	863				228	247	330	555	767		197	290				485	560	822					
Jun-17	226	218	306	644	642	922				228	228	421	529	959	223	202	261				633	575	741					
Jul-17	233	220	316	638	650	970				236	233	329	542	764														
Aug-17	222	234	314	677	686	953				254	245	319	570	741														
Sep-17	216	225	312	655	683	903				249	253	491	477	995														
Oct-17	219	216	333	695	718	996				249	261	375	624	950														
Nov-17	217		298	705	756	996				247	262	357	625	903														
Dec-17	228		297	583	682	995				202	224	339	565	857														
Jan-18	229	217	309	548	526	743					181	236	453	591														
Feb-18	233	228	310	557	547	769					181	234	451	585														
Mar-18	234	250	325	511	514	653					192	229	473	572														
	216.00	228.68	333.00	511.00	638.75	996.00				202.00	225.67	491.00	473.00	995.00	202.00	200.67	290.00				485.00	562.00	822.00					

Station Yearly average SPM Limit
 Sox 42.434 50
 Nox 937.37 NA*
 218.34 450

*MoEF target date for FGD commissioning 31.12.2027

		2019-20 (mg/Nm3)																											
		Unit 1 NOx			Unit 1 SOx			Unit 1 PM			Unit 2 NOx			Unit 2 SOx			Unit 2 PM			Unit 3 NOx			Unit 3 SOx			Unit 3 PM			
		Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	
Apr-19	118	156	245	603	461	446	539	176	226	214	401	443	568																
May-19	123	158	245	539	446	475	633	186	260	244	418	467	652																
Jun-19	123	153	244	633	475	418	633	427	928	174	437	467	652																
Jul-19	118	414			954			453	672	275	479	790	1174																
Aug-19	504	606	940	1103	604	589	655	1251																					
Sep-19	494	587	956	1251	655	589	655	1251																					
Oct-19	542	592	952	860	656	587	656	1272	274	332	433	477	579																
Nov-19	364	559	915	1272	713	525	713	1272	276	346	448	481	605																
Dec-19	518	602	950	831	639	581	639	831	282	350	457	491	611																
Jan-20	475	593	961	816	626	553	626	816	276	341	449	482	595																
Feb-20	361	537	968	1074	758	572	758	1074	384	573	450	748	1154																
Mar-20	339	468	749	1237	916	791	916	1237	452	599	855	910	1204																
	117.58	452.14	968.09	1271.95	377.42	700.14	1271.95	174.22	318.58	928.18	401.13	592.50	1292.79	201.53	455.02	747.85	480.00	790.00	1216.02										

Station Yearly average SPM Limit
 Sox 694.21 50
 Nox 408.58 NA* *MoE target date for FGD commissioning 31.12.2027
 450

		2020-21 (mg/Nm3)																											
		Unit 1 NOx			Unit 1 SOx			Unit 1 PM			Unit 2 NOx			Unit 2 SOx			Unit 2 PM			Unit 3 NOx			Unit 3 SOx			Unit 3 PM			
		Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	
Apr-20		320.00	450.25	721.00	881.00	881.63	996.00	428.00	435.70	492.00	859.00	873.40	927.00	441.00	441.18	513.00	877.00	884.93	975.00	442.00	435.75	503.00	819.00	869.00	977.00			0	
May-20		447.00	442.72	605.00	856.00	859.75	982.00	441.00	441.18	513.00	877.00	884.93	975.00	441.00	441.18	513.00	877.00	884.93	975.00	442.00	435.75	503.00	819.00	869.00	977.00			29.63	
Jun-20		442.00	436.66	604.00	855.00	855.83	992.00	373.00	449.60	516.00	900.00	901.60	961.00	373.00	449.60	516.00	900.00	901.60	961.00	431.00	434.78	524.00	854.00	862.89	978.00			30.44	
Jul-20		368.00	444.25	722.00	860.00	879.50	996.00	366.00	461.00	557.00	936.00	926.00	954.00	366.00	461.00	557.00	936.00	926.00	954.00	440.00	472.58	582.00	860.00	866.83	976.00			29.92	
Aug-20		442.00	439.40	703.00	872.00	866.60	996.00	426.00	432.40	554.00	854.00	866.70	990.00	426.00	432.40	554.00	854.00	866.70	990.00	515.00	510.00	695.00	889.00	867.92	956.00			29.5	
Sep-20								466.00	440.00	538.00	919.00	882.00	954.00	466.00	440.00	538.00	919.00	882.00	954.00	528.00	508.00	669.00	859.00	864.00	956.00			24.14	
Oct-20		433.00	437.94	744.00		885.72		447.00	442.58	640.00	863.00	888.33	966.00	447.00	442.58	640.00	863.00	888.33	966.00	532.00	512.10	717.00	862.00	870.10	972.00			19.47	
Nov-20		442.00	436.66	745.00	929.00	906.76	996.00	435.00	445.27	588.00	870.00	894.88	977.00	435.00	445.27	588.00	870.00	894.88	977.00	534.00	523.13	831.00	876.00	878.91	980.00			21.86	
Dec-20								438.00	439.81	585.00	890.00	881.73	946.00	438.00	439.81	585.00	890.00	881.73	946.00	534.00	558.74	804.00	899.00	899.81	996.00			25.74	
Jan-21		190.00	172.00	300.00	830.00	799.00	996.00																						
Feb-21		226.00	211.00	404.00	753.00	773.00	996.00	448.00	486.73	601.00	889.00	892.00	978.00	448.00	486.73	601.00	889.00	892.00	978.00	553.00	596.65	827.00	880.00	880.00	992.00			26.39	
Mar-21		194.00	224.00	437.00	791.00	826.13	996.00	445.00	463.21	615.00	886.00	884.16	957.00	445.00	463.21	615.00	886.00	884.16	957.00	582.00	600.00	794.00	823.00	857.00	992.00			30.12	
		190	202	437	753	853	996	366	447	640	846	886	990	366	447	640	846	886	990	431	524	831	819	883	996			32.5	

Station Yearly average SPM Limit
 Sox 36.61 50
 Nox 874 NA*
 *MoEF target date for FGD commissioning 31.12.2027
 391 450

2021-22

	Unit 1 NOx			Unit 1 SOx			Unit 1 PM			Unit 2 NOx			Unit 2 SOx			Unit 2 PM			Unit 3 NOx			Unit 3 SOx			Unit 3 PM			
	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	
Apr-21	133.00	190	415.00	794.00	801	995.00	28	410.00	431	614.00	739.00	785	992.00	35	580.00	608	815.00	839.00	870	994.00	27							
May-21	113.00	212.28	366.52	684.00	773.36	995.78	28.18	197.00	415.304	576.03	707.00	748.695	999.99	34.6	372.00	576.83	767.69	502.00	847.958	999.99	25.08							
Jun-21	210.00	215.17	372.17	789.00	797.75	995.90	30.928	182.00	405.96	571.35	714.00	736.72	999.99	33.96	556.00	611.28	823.26	685.00	868	999.99	35.21							
Jul-21	233.00	231.19	437.05	785.00	790.41	995.90	29.7	411.00	412.67	555.48	741.00	743.54	999.99	34.83	415.00	564.65	943.75	718.00	850.43	999.99	32.24							
Aug-21	261.00	220.9	449.27	814.00	836.43	995.00	31.1	233.15	280.06	383.42	503.82	503.82	999.99	33.286	314.00	329.1	892.23	999.00	1000.00	999.99	31.7							
Sep-21	269.00	292.47	615.32	859.00	813.67	995.90	32.033	246.21	243.4	433.63	520.99	999.99	999.99	33.78	343.00	372.97	497.47	999.00	999.99	999.99	38.3							
Oct-21	371.00	296	413.58	985.00	743.9032	995.90	23.61	404.00	253.7368	439.55	995.00	999.99	999.99	34.78	206.00	251.61	478.80	995.00	999.99	999.99	32.47							
Nov-21	152.00	306.91	418.15	373.00	628.36	995.90	23.46	310.00	251.2	442.85	388.95	995.90	995.90	36.3	147.00	246.93	482.65	947.00	947	995.00	34.37							
Dec-21	327.00	282.43	401.59	754.00	696.6	995.00	28.87	350.00	289.8519	435.81	312.00	999.00	999.00	36.2	166.00	237.41	485.23	266.00	999.00	999.00	25.19							
Jan-22	206.00	290.19	408.34	434.00	709.34	993.00	27.64	256.00	218.064	437.45	916.00	1000.00	1000.00	36.13	162.00	265.074	462.93	893.00	845.2	1000.00	32.5							
Feb-22	341.00	232.96	407.95	748.00	822.57	1413.10	31.07	280.00	433.63	950.00	950.00	1447.40	1447.40		114.00	468.79	314.00	314.00	1484.10	1484.10								
Mar-22	338.00		395.24	1137.00		1430.00		317.00		429.87	1105.00	1472.90	1472.90		306.00		473.01	1021.00		1650.90								

Station Yearly average SPM Limit
 Sox 41 50
 Nox 763.16 NA*
 *MoEF target date for FGD commissioning 31.12.2027
 319.36 450

**BEFORE THE NATIONAL GREEN TRIBUNAL
SOUTHERN ZONE, CHENNAI**

ORIGINAL APPLICATION NO. 183 OF 2025

IN THE MATTER OF:

K. Saravanan

...Applicant

Versus

The Union of India

Rep. by its Secretary to Government

Ministry of Environment & Forests & Climate Change and 3 others

...Respondents

TYPEDSET OF DOCUMENTS FILED ON BEHALF OF THE 4TH RESPONDENT

**M/S. KING & PARTRIDGE
ADVOCATES FOR 4TH RESPONDENT
9840353591**