BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL

PRINCIPAL BENCH, NEW DELHI

ORIGINAL APPLICATION No. 73 of 2020

IN THE MATTER OF:

In Re: Gas Leak at LG Polymers Chemical Plant in RR Venkatapuram Village, Vishakhapatnam in Andhra Pradesh

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Counsel for MoEF&CC

NEW DELHI

DATED: 21.10.2021

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ORIGINAL APPLICATION No. 73 of 2020

IN THE MATTER OF:

In Re: Gas Leak at LG Polymers Chemical Plant in RR Venkatapuram Village, Vishakhapatnam in Andhra Pradesh

REPLY AFFIDAVIT ON BEHALF OF MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE TO PLACE ON RECORD THE RECOMMENDATIONS OF THE COMMITTEE(S) FORMED IN PURSUANCE OF ORDER DATED 01.06.2020

MOST RESPECTFULLY SHOWETH:

I, Ved Prakash Mishra, currently working as Director in the Hazardous Substances Management Division (HSMD) of the Ministry of Environment, Forest and Climate Change (MoEFCC), New Delhi, do hereby solemnly affirm and state as under: -

1. That I, in my official capacity of Director (HSMD) in the MoEFCC, New Delhi, am fully conversant with the facts and circumstances of the case on the basis of official records available, and as such authorized and competent to swear this affidavit.

2. That, at the outset, instant respondent denies each averment and/ or submission made by other respondents, which are contrary to and inconsistent with the averments made and facts stated in this affidavit. The respondent also craves leave and liberty to file additional

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information/ affidavit(s), as may be required by the Hon'ble Tribunal, while hearing the instant matter.

Background:

3. That, it is submitted that Hon'ble Tribunal *vide* order dated 08.05.2020 took *suo-moto* cognizance of a chemical accident that occurred at M/s LG Polymers India Pvt. Ltd. Vishakhapatnam, Andhra Pradesh due to leakage of Styrene gas from one of the storage tanks, thereby resulting in the fatalities and injuries to the inhabitants of the surrounding area. The incident also caused damage to the property, stray/ pet animals and environmental media (air/ water/ soil). Further, *vide* the said order, the Hon'ble tribunal had constituted a six-member Expert committee headed by Justice B. Seshasayana Reddy, Former judge, Andhra Pradesh High Court and comprising of five (5) members technical/ expert members. The Member Secretary, Central Pollution Control Board (CPCB) was appointed as the nodal agency for providing logistical/ secretarial support to the Committee.

4. That, earlier, the MoEFCC had filed an affidavit on interim basis on 14.05.2020 wherein the provisions of Ministry's Regulatory Framework aimed at avoiding chemical accidents in industrial units were highlighted. MoEFCC implements two set of rules viz. Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 [MSIHC Rules, 1989] and Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 [CAEPPR Rules, 1996]. Further, the previous submission also mentioned about the meeting of Central Crisis Group (CCG) held on 08.05.2020 to coordinate with stakeholder authorities in the matter. The CCG is constituted under the provisions of CA (EPPR)

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Rules, 1996 under the chairmanship of Secretary (EF&CC).

5. That, the Central Government i.e. MoEFCC and other stakeholders *viz.* CPCB, Department of Chemical and Petro chemicals and National Disaster Management Authority (NDMA) had issued advisories to the State Governments(s), from time to time, to comply with the regulations/ statues already notified to ensure chemical safety. It was further advised to undertake measures to deal with issues arising out of operational safety and chemical accidents.

6. That, thereafter, the Hon'ble Tribunal heard matter on 01.06.2020 and considered the report prepared by the expert Committee. The Expert Committee submitted the report in two parts i.e., on 17.05.2020 and 28.05.2020. The report categorically observed that the incident happened due to human failure and negligence. The report also mentioned that the Person in-charge of the plant/ Plant management/ Maintenance personnel of storage tanks are responsible. The report further mentioned that the unit was operating without Environmental Clearance (EC).

7. That, other two similar matters i.e. O.A. 76/2020 *(EAS Sharma Vs UOI &Ors.)*& O.A. No. 80/2020 *(Centre for Wildlife and Environmental Litigation Foundation Vs UOI &Ors.)* pending before the Southern Bench of the Tribunal, were tagged with the main matter on account of pendency of the *suo-moto* proceedings.

8. That, *vide* the previously mentioned order, that the Hon'ble Tribunal had *inter-alia* issued certain directions in the said case. The following directions were issued to the Ministry:

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a) Preparation a Restoration plan comprising of representatives from MoEFCC, CPCB, State Govt. & District Magistrate; MoEFCC shall be the nodal agency;

b) Assessment of final quantification of compensation comprising of representatives from MoEFCC, CPCB, NEERI. Any other expert institution and individual assistance may also be sought. MoEFCC shall be the nodal agency; and

c) Constitution of an Expert Committee for suggesting ways and means to revamp monitoring mechanism to check and prevent violation of environmental norms.

Copy of order dated 01.06.2020 passed by the Hon'ble Tribunal in O.A. No. 73 of 2020 titled "Gas Leak at LG Polymers Chemical Plant in RR Venkatapuram Village Vishakhapatnam in Andhra Pradesh" is annexed herewith as **Annexure-I**.

Follow-up action by the Ministry:

9. That, in compliance of the directions of Hon'ble Tribunal, the Ministry *vide* letter no. F. No. 11/20/2020-HSMD dated 21.07.2020 had constituted the following two (2) committees for the purpose of "Preparation of restoration plan" and "Final quantification of compensation".

a) MoEFCC Nodal Committee for Restoration Plan: Headed by Advisor, MoEFCC as Chairman and comprising of seven (7) other representatives from Industry Division of the Ministry; CPCB; Andhra Pradesh Pollution Control Board (APPCB).

b) MoEFCC Nodal Committee for Finalization of Compensation: Headed by Member Secretary, CPCB as Chairman and comprising of four (4) other representatives from Violation Division, MoEFCC;

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National Environmental Engineering Research Institute (CSIR-NEERI).; and Director, HSM Division, MoEFCC as member convener.

The Director, Hazardous Substances Management (HSM) Division was designated as the member convener to both the committees. Copy of order no. F.No.11/20/2020-HSMD and dated 21.07.2020 is annexed herewith as **Annexure-II**.

10. That, vide the order dated 21.07.2020, the "Preparation of restoration plan" was categorized in two sub-components and nodal agencies were identified to prepared the same as mentioned below:

    a) Plan for restoration of environmental media viz. air, water and soil quality: CPCB was entrusted with responsibility to submit the plan.
    b) Restoration and Compensation plan for damage to property, health, crops, livestock etc.: A sub-committee headed by District Magistrate (DM), Vishakhapatnam and comprising of representatives from APPCB/ Environment/ Factories/ Health/ Agriculture Department etc. were entrusted with the responsibility to submit the plan.

11. That, the Terms of Reference (ToR) of the Nodal committee for 'Finalisation of compensation' *inter-alia* included the Assessment of compensation in line with prevailing rules/ guidelines of the State Govt./ Central Govt.; Review/ Examination of restoration plan(s) submitted by CPCB and DM, Vishakhapatnam. All the sub-committees were granted liberty to take references from various committees/ expert report as duly constituted by Central/ State Govt. in reference to gas leakage accidents etc.

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12. That, apart from complying with the directions of the Hon'ble Tribunal, the Ministry also supported the State Government in taking up a detailed investigation in the matter by nominating an official to the High Power Committee (HPC) constituted by the State Govt. of Andhra Pradesh as MoEFCC/ CPCB representative. Later, the HPC recommendations were also examined in consultation with the Chairman, HPC and other State Government stakeholders.

13. That, the Ministry had filed a detailed affidavit on 2nd November, 2020 thereby highlighting the action initiated by it, in coordination with other stakeholder, to comply with the directions of the Hon'ble Tribunal's order dated 01.06.2020. A copy of Ministry's affidavit filed on 2nd November, 2020 is annexed herewith as **Annexure-III**.

Action undertaken by Sub-committee constituted for 'Preparation of restoration plan of environmental media viz. air, water and soil'

14. That, the task for 'Plan for restoration of environmental media viz. air, water and soil quality' was assigned to CPCB, which further engaged CSIR-NEERI based on the expertise required for such assessment and calculation of environmental damages. The CPCB had submitted the draft report prepared by CSIR-NEERI to the Ministry in March-2020, which was duly examined. Pursuant to the deliberations in the Committee, CPCB and CSIR-NEERI submitted the final report on 20.07.2021 titled as 'Assessment of Environmental Damages and Preparation of Restoration Plan for Air, Water and Soil Environment due to Styrene Gas Leakage Incident at Visakhapatnam'.

15. That, CSIR-NEERI, Nagpur and Hyderabad Zonal Centre had conducted the study collecting the primary data from various secondary sources to

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assess environmental damages cost and prepared a Plan for Restoration of Environmental media *viz.* Air, water and soil. The summary of the existing environmental data monitored since the accident occurred at different times monitored and reported by different agencies including the impact and damage assessment has been given in the report. The key findings of the CPCB/CSIR-NEERI are as follows:

a) **Air Environment:** The ambient levels of styrene levels were monitored at different points and at varied time duration. Ambient levels of styrene were observed during the period May 7-10, 2020 and May 12-15, 2020 near LG Polymers Main Gate, Venakatapuram village, Venkatapuram Railway Bridge, Meghadrigadda reservoir, near M6 Storage tank and close to the industry. However, during the monitoring in October 28-30, 2020, the ambient levels of styrene within the study area of up to 1 km radius were recorded as BDL i.e. Below Detection Limit. The results indicated that the styrene levels are found to be high during the first few days of the accident occurred and rapidly reduced to very low levels in the next few days and are below detection limits after 8 or 10 days from the time of incident.

b) Areal Locations of Hazardous Atmospheres (ALOHA) model results show the predicted red zone extends up to 0.421 km and the Venkatapuram villages are located within this red zone. The occurrence of death cases is also observed to be within this zone of influence, which is around 0.42 km. The total or combined area covered under the three wind directions (120°, 145°, and 172°) for emission of 46 MT is calculated as 31.08 ha in Red Zone, 166.29 ha in Orange Zone and 715 ha in Yellow Zone (as per HPC Report).

c) ALOHA model used to predict the SMV concentrations and Threat Zones/ Zones of Influence in terms of Emergency Response Planning

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Guidelines (ERPG) with source strength of 46 MT for a release time of 15 minutes by CSIR-NEERI-HZC. The villages like Venkatapuram falls under Red zone and the villages like Naidu Thota falls under Orange Zone. The predicted SMV concentrations and Threat Zone distances from the source are in coherence with the HPC Report findings.

d) **Water Environment**: Styrene levels in all the samples viz., groundwater and surface water were below detectable limit during October 2020.

e) It was observed during May 2020 sampling that styrene levels were observed in surface water but the same sample in October 2020 showed BDL values of styrene, which indicate that the styrene concentration must have degraded from the surface water samples.

f) All water quality parameters including heavy metals were within the permissible limits of BIS.

g) The bioassay test was conducted in the four surface water samples around the LG Polymers from which it can be concluded that the fishes were found to be stable in all the concentrations of all the samples for 96 hours.

h) **Soil Environment**: Soil samples within and around LG Polymer industry showed very high level of styrene (109 to 5950 mg/kg) immediately after the gas leak (8-14 May 2020). However, after about 5 months (28-30 October 2020), the styrene level dissipated and could be detected at only 2 locations at very low concentrations (0.15-4.7ppb), which was below the CCME guideline values of 0.1 mg/kg and 50 mg/kg for agriculture and industrial activities of the soils respectively.

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i) **Damage Assessment**: Environmental Damage Cost Assessment (EDCA) calculations for styrene gas leakage accident includes the morbidity, mortality assessment for the people affected in the area; damages to croplands, livestock and air, water and soil environment. On ground survey for above parameters was conducted to determine the level of impact. Various econometric methods such as contingent valuation, cost of illness; value of statistical life; market price were used to calculate the EDCA. The data gaps for the application of the above methods were filled using scientific literature. Using the impact parameters, based on survey and with lower values of value transfer method/willingness to accept methods and based on various parameters; data collection, survey results, the damage value was estimated. The total estimated damage cost to environment, health, property, livestock, crops, etc., was thoroughly deliberated in the MoEFCC nodal committees and accordingly, based on assessments made by CSIR-NEERI and the sub-committee, the cumulative damage is assessed as ₹79,42,17,137 Crores (say ₹79.42 Crores). However, considering the health restoration component estimated by sub-committee (₹22,77,05,026) the comprehensive damage and restoration cost is assessed as ₹1,02,19,22,163 (say 102.19 Crores). The details of the damage assessment and deliberations are in preceding sections.

Copy of CPCB & CSIR-NEERI, Nagpur & Hyderabad Zonal Centre, Hyderabad final report submitted on 20.07.2021 is annexed herewith as **Annexure-IV**.

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Action undertaken by District Sub-committee constituted for 'Preparation of restoration plan of property, health, crops, livestock etc.'

16. That, the sub-committee constituted under the chairmanship of DM, Vishakhapatnam had submitted its report to the Ministry in October, 2020 titled as 'Restoration & Compensation Plan for damage to health, property, crops, livestock etc'. The sub-committee carried out individual field investigations as per the scope of the work and action points identified in the meeting held on 15.09.2020. The Revenue Divisional Officer, Visakhapatnam, submitted the restoration and compensation plan for damage to the property. The Principal, Andhra Medical College, Visakhapatnam and District Medical and Health Officer, Visakhapatnam, submitted the restoration and compensation plan for damage to the health. The Joint Director of Agriculture, Visakhapatnam, submitted the restoration and compensation plan for damage to the crops. The Joint Director, Animal Husbandry, Visakhapatnam, submitted the restoration and compensation plan for damage to the livestock. The key findings of the revised District Committee report submitted on 21.06.2021 (previously submitted in October-2020) are as follows:

a) **The restoration and compensation plan for damage to the property**: The report of the damage assessment of the property and the compensation for restoration was prepared taking into consideration the compensation paid to the victims under various heads by Government of A.P, theft amounts as per FIRs, food grains spoiled and discarded by households and the damage to the goods stored in the petty shops. The component-wise assessment of damage and Compensation for restoration to the property is **₹38,40,57,085/-**.

b) **The restoration and compensation plan for damage to the health:** The report of the damage assessment of the health and the compensation for restoration was prepared taking into consideration the establishment of 10 bedded hospital for monitoring the health of

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the affected public for five years, baseline investigations, research studies on accidental exposure, mental health assessment & restoration of health. The component wise assessment of damage and Compensation for restoration to the health is **₹22,77,05,026/-**.

c) **The restoration and compensation plan for damage to the Crops**: The report of the damage assessment of the crops and the compensation for restoration was prepared taking into consideration organic inputs and other expenses for restoration of crop in affected villages and analysis of soil and irrigation water. The component wise assessment of damage and Compensation for restoration to the crop is **₹8,57,278/-**.

d) **The restoration and compensation plan for damage to the Livestock**: The report of the damage assessment of the livestock and the compensation for restoration was prepared taking into consideration the livestock profile in the affected villages, value of milk discarded during 30 days, amount for replacement of livestock, feed and fodder support and long term monitoring and surveillance. The component wise assessment of damage and Compensation for restoration is **₹91,75,872/-**.

The total Compensation for Damage Assessment is **₹62,17,95,261/-**.Copy of District Sub-Committee report submitted on 21.06.2021 is annexed herewith as **Annexure-V**.

Action taken by MoEFCC Nodal Committee for 'Preparation of Restoration Plan'

17. That, the sub-committee's first meeting was held on 17.08.2020, wherein representatives of CPCB, APPCB, Director of Factories (DoF), Govt. of Andhra Pradesh; nominee of District Magistrate Vishakhapatnam and

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MoEFCC officials attended the meeting. The Committee deliberated on various issues like the availability of technical/ scientific data w.r.t. pollution of environmental media; the extent of area to be covered for preparation of restoration plan, requirement of on boarding expert institutions etc. Considering the expertise required for assessment for environmental damages, the committee agreed the CPCB's proposal to involve CSIR-NEERI.

18. That, due to the 2nd wave of corona virus, virus contraction by Committee members (including Chairman) and involvement of various State Govt. stakeholders in COVID-19 related duties, the second meeting of the said committee was held in 07.06.2021. The meeting was attended by representatives of CPCB, CSIR-NEERI, DoF-Govt. of Andhra Pradesh, APPCB and MoEFCC. A presentation was made by CSIR-NEERI on the report. However, State Authorities sought further time to present their findings/ report. The Committee considered the Styrene concentration monitoring in environmental media undertaken by CSIR-NEERI, Collection, analysis and assessment of health care data and Environment Damage Cost. Further, the committee also sought information on availability of baseline Styrene monitoring data *(styrene concentration in environment media 'prior to' the incident).*

19. That, the third meeting was held on 21.06.2021 wherein representatives of CPCB; CSIR-NEERI; APPCB and MoEFCC attended the meeting. The committee deliberated on the re-calculated morbidity/ mortality related component of Environment Damage Cost Assessment (EDCA) as per the Hon'ble Supreme Court guidelines; the total compensation estimated for damage assessment with regard to sub-component-2 etc. Further, the APPCB vide email dated 21.06.2021 had

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submitted its updated report on 'Restoration and compensation plan for damage to health, property, crops and livestock etc.'

20. That, the fourth meeting was held on 02.07.2021 wherein the representatives of CPCB; CSIR-NEERI; APPCB and MoEFCC attended the meeting. The committee deliberated on the results of field analysis done by CSIR-NEERI & APPCB w.r.t. the environmental monitoring component; finalisation of component–wise assessment of damage and restoration cost; assessment mythology of environmental, health, property, livestock and crop. Further, the committee unanimously recommended that the total estimated damage cost to the environment; health; property; livestock; crops etc. is **₹79,42,17,137 Crores (₹79.42 Crores**). However, considering the health restoration component proposed by District Committee, the comprehensive damage and restoration cost is assessed as **₹1,02,19,22,163 (₹102.19 Crores)**.

Copy of minutes of meeting held on 17.08.2020; 07.06.2021; 21.06.2021 & 02.07.2021 is annexed herewith as **Annexure-VI** (Colly).

Action taken by MoEFCC Nodal Committee for Finalization of Compensation

21. That, the first meeting of the nodal committee for finalization of compensation was held on 10.09.2020 wherein representatives of CPCB; CSIR-NEERI, APPCB &MoEFCC had attended the meeting. The committee deliberated on the need for a detailed restoration plan for undertaking the compensation assessment; assistance of CSIR-NEERI expert *(having experience in handling similar matters)* in undertaking the task assigned to it; and preparation of

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environmental restoration plan in two-phased manner.

22. That, the second meeting of the committee was held on 12.08.2021 wherein representatives of CPCB; CSIR-NEERI, APPCB &MoEFCC had attended the meeting. The committee thoroughly examined the report and analysed as well as documented the recommendations MoEFCC's nodal committee in 'Preparation of restoration plan' based on scientific justifications/ rationale.

Copy of minutes of meeting held on 10.09.2020; and 12.08.2021 is annexed herewith as **Annexure-VII**.

Consolidated Recommendations of the MoEFCC nodal committee(s) for 'Restoration Plan' and 'Finalization of Compensation':

23. That, the present affidavit is being filed in pursuant to the order dated 01.06.2020 and to place on record the recommendations of the MoEFCC nodal Committees(s) for 'Restoration Plan' and 'Finalization of Compensation'.

24. That, as informed by the CSIR-NEERI, a comparative examination has been done of the District sub-committee report *vis-a-vis* the CSIR-NEERI report and an attempt has been made to segregate the damage cost components for all the categories viz. Environmental media (air, water & soil), health, property crops, livestock etc. Further, the exercise was aimed at grouping the 'already calculated damage costs' under mutually exclusive sub-heads to assist the committee in understanding scope of damage costs calculated and arriving at final decision.

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25. That, the committee undertook detailed deliberations on the assessment methodology of environmental, health, property livestock & crop damages and considered the submissions of the sub-committees. The committee took into the account the fact that the values arrived at by CSIR-NEERI are based on scientific modelling and methodology, whereas the values arrived at by District Sub-Committee are based on the field assessment by the line departments. The committee recommended the following as component-wise damage assessment and restoration cost:

a) **Damage Assessment in respect of Health- Rs. 38,40,57,085 /-** (includes Compensation for deceased person, Medical treatment to victims, dead animals and individuals in affected area, Compensation for loss of valuables (theft cases), enumeration of petty shops, Compensation towards contaminated food grains/consumables for each family)

b) **Damage Assessment in respect of Soil-Rs. 39, 50, 90, 997/-** (includes cost estimate for the contaminated quantity of soil base remediation technique)

c) **Damage Assessment in respect of crops- Rs. 54, 93, 183/-** (includes income loss from cropland occurred to the affected people due to the accident, up to EDCA survey period)

d) **Damage in respect of Production from Livestock- Rs. 91, 75, 872/-** (includes the estimated value of mild discarded during 30 days after the incident interim release, amount required for replacement of animals, cost estimated for feed and fodder for 180 days and for conducting veterinary health camps)

e) **Restoration cost in respect of health- Rs. 22, 77, 05, 026/-** (includes the cost proposed towards undertaking health related

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research studies specialty treatment expenditure, suggestive baseline investigators and establishment of 10-bedded hospital)

26. That, the MoEFCC nodal committee on 'Preparation of Restoration Plan' constituted under the Chairmanship of Advisor, MoEFCC had series of deliberations on the report(s) submitted by the sub-committee(s) i.e. CPCB/CSIR-NEERI and District Committee. Thereafter, MoEFCC forwarded its recommendations to the MoEFCC nodal committee constituted for 'finalization of compensation'. Further, with regard to 'Restoration Plan, the following is submitted in the CPCB/CSIR-NEERI report:

a) The CPCB engaged CSIR-NEERI, Nagpur & Hyderabad Zonal Centre committee submitted its report with regard to 'Restoration of Environmental media viz. Air, water & soil. Further, Chapter 5 of the said report talks about 'Restoration Plan' which inter-alia mentions that currently, the styrene levels in the ambient air, groundwater and surface water and soil in the study area are below detectable limits and are not found, the restoration plan may not be required for these environmental components. However, continuous monitoring of ambient keels of styrene is required near the storage tank and at the boundaries of the industry and periodical monitoring in the residential areas near LG Polymers to avoid any further accidents.

b) Further, the report further mentions that the restoration plan w.r.t to health impacts may be implemented as several villagers, especially those from Venkatapuram, complained about the potential styrene-induced health effects several months after the gas leak. The persistence of headache, eye irritation, skin irritation, and breathing problems was exceptionally high. A regular medical examination through a team of doctors may be conducted further to verify and

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quantify the ling-term health effect of styrene exposure. Based on the medical findings appropriate treatment should be given to the affected population.

27. That, it was noted that the aspect of 'Finalization of restoration Plan' as well as 'Finalization of Compensation' has been thoroughly considered by the members of both the committees and a scientific rational has been built to arrive at the compensation. Accordingly, the committee unanimously recommended that the total estimated damage cost to environment, heath, property, livestock, crops etc is Rs. **79, 42, 17, 137 Cores (say Rs. 79.42 Crores)**. However, considering the health restoration component the comprehensive damage and restoration cost is assessed as **Rs. 1, 02, 19, 22, 163 (say 102.19 crores)**.

Additional Action undertaken by MoEFCC (HPC)

28. That, the HPC was constituted by the State Govt. of Andhra Pradesh after the incident of Styrene gas release to look into the root causes, suggest accident specific as well as general recommendations to avoid recurrence of such incidents. It comprised of representatives from Central agencies like CPCB, Central Institute of Petroleum Engineering & Technology (CIPET), Indian Institute of Petroleum (IIP), Director General Factory Advice Service Labor Institutes (DGFASLI), apart from the senior State Government functionaries. The then Special Chief Secretary (Environment, Forest and Science & Technology), Govt. Of Andhra Pradesh, Shri Neerabh Prasad, chaired the HPC.

29. That, a report was prepared by the HPC which was examined by the Ministry also w.r.t. recommendations for suitable implementation. The MOEFCC, being the nodal Ministry for handling matters related to

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chemical disasters, undertook detailed deliberations with the HPC. Subsequently, the 'Technical Recommendations' were discussed and adopted in the meeting of the Central Crisis Group (CCG) held on 16.02.2021 through video conferencing under the chairmanship of Secretary (EF&CC)

30. That, the following five (5) states (Andhra Pradesh, Gujarat, Maharashtra, Uttar Pradesh and Tamil Nadu) accounting for maximum no. of Major Accident Hazard (MAH) units and occurrence of chemical accidents during the last five years were also reviewed for their preparedness by CCG w.r.t accident prevention, preparedness and remedial measures taken by the States Govt. and Adoption of Red Book (Crisis Alert System). The CCG adopted Technical Recommendations of HPC for implementation.

    Copy of minutes of meeting held on 16.02.2021 is annexed herewith as **Annexure-VIII**.

31. That, the HPC made technical recommendations regarding operation of industries dealing with hazardous chemicals, in general and using styrene as raw material, in particular. The technical recommendations were adopted and further circulated to the States/ UT Administrations/ Stakeholder Ministries for reference and its implementation, as appropriate. Copy of the recommendations of the HPC is annexed herewith as **Annexure-IX**.

32. That, in view of the aforementioned facts and circumstances, this Hon'ble Tribunal may kindly be pleased to pass appropriate order(s)

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DEPONENT

(वेद प्रकाश मिश्रा)
(VED PRAKASH MISHRA)
निदेशक/Director
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
M/o Environment, Forest and Climate Change
भारत सरकार, नई दिल्ली
Govt. of India, New Delhi

VERIFICATION

I, the above named deponent do hereby verify that the contents of the above affidavit are true and correct on the basis of official record maintained by the Respondent Ministry in daily course of its business, no part of it is false and nothing material has been concealed there from.

Verified at New Delhi on this the day of October, 2021.

21 OCT 2021

DEPONENT

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(वेद प्रकाश मिश्रा)
(VED PRAKASH MISHRA)
निदेशक/Director
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
M/o Environment, Forest and Climate Change
भारत सरकार, नई दिल्ली
Govt. of India

BEFORE ME
RAJENDRA KUMAR
NOTARY, DELHI-R-5780
GOVERNMENT OF INDIA
SUPREME COURT OF INDIA
COMPOUND, NEW DELHI
Register Pg./Sl. No. 7547
Mobile No.: 9899446209

21 OCT 2021

CERTIFIED THAT THE CONTENTS EXPLAINED TO THE DEPONENT EXECUTANT WHO IS SEEMED PERFECT TO UNDERSTAND & AFFIRMED DEPOSED BEFORE ME AT DELHI ON 21 OCT 2021 IDENTIFIED BY IDENTIFY THE EXECUTANT/DEPONENT WHO HAS SIGNED IN MY PRESENCE

D-788/89

IDENTITY THE EXECUTANT / DEPONENT WHO WAS SIGNED IN THE PRESENCE OF

Corrected order
Uploaded on 04.06.2020

Item Nos. 04 to 07 Court No. 1

BEFORE THE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI

(By Video Conferencing)

Original Application No. 73/2020
(With Report dated 28.05.2020)
In re: Gas Leak at LG Polymers Chemical Plant in RR Venkatapuram Village, Visakhapatnam in Andhra Pradesh

WITH

Review Application No. 19/2020

LG Polymers India Applicant(s)

AND

Original Application No. 76/2020
(Earlier Original Application No. 68/2020 (SZ))

EAS Sarma Applicant(s)

Versus

Union of India & Ors. Respondent(s)

AND

Original Application No. 80/2020
(Earlier Original Application No. 73/2020 (SZ))

Centre for Wildlife and Environmental Litigation Foundation Applicant(s)

Versus

Union of India & Ors. Respondent(s)

Date of hearing: 01.06.2020

CORAM: **HON'BLE MR. JUSTICE ADARSH KUMAR GOEL, CHAIRPERSON**
HON'BLE MR. JUSTICE SHEO KUMAR SINGH, JUDICIAL MEMBER
HON'BLE DR. NAGIN NANDA, EXPERT MEMBER

For Applicant In O.A. 76/2020: Mr. Saurabh Sharma, Adv

For Respondent(s): Mr. Sidharth Luthra, Sr. Adv. with Mr. Anuj Berry, Adv. for LG Polymers India
Mr. Nikhil Nayyar, Sr. Adv. with Mr. TVS Raghavendra Sreyas, Adv. for Andhra Pradesh PCB
Mr. Raj Kumar, Adv. for CPCB
Mr. Satyalipsu Ray, Adv. for MoEF

ORDER

Original Application No. 73/2020
(With Report dated 28.05.2020)
In re: Gas Leak at LG Polymers Chemical Plant in RR Venkatapuram Village, Visakhapatnam in Andhra Pradesh
WITH
Review Application No. 19/2020
LG Polymers India Applicant(s)

Outline of the order

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Supreme Court order dated 19.5.2020 on Company's Appeal against NGT order of 8.5.2020

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IV. Discussion and Decision on the Issues

I. Background

NGT order dated 8.5.2020

1. Vide Order dated 08.05.2020, this Tribunal initiated *suo-motu* proceedings in this matter on the basis of media reports to the effect that leakage of hazardous gas Styrene took place at 03:45 AM on 07.05.2020, from a chemical factory owned by the South Korean company LG Polymers India Pvt. Limited ("the Company"),

R.R. Venkatpuram village, Pendurthy Mandal, Vishakhapatnam resulting in death of 11 persons (now 12) and hospitalization of more than 100 people, of whom at least 25 were then reported to be serious. These fatalities and injuries were reportedly likely to increase. More than 1000 persons were reported sick. There was also damage to environment and habitat.

2. While noting reported failure of the Company to follow the mandate of the Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 ("the 1989 Rules") and failure of the statutory authorities and regulating such activities as per mandate of law. The Tribunal issued notice to Andhra Pradesh State PCB, District Magistrate, Vishakhapatnam, Central Pollution Control Board (CPCB), Ministry of Environment, Forests & Climate Change (MoEF&CC) and LG Polymers India Pvt. Limited (The Company). The Tribunal also constituted a six-member Committee headed by Justice B. Seshasayana Reddy, former Judge, A.P. High Court to visit the site and give a report on the following:

a. The sequence of events;
b. Causes of failure and persons and authorities responsible therefor;
c. Extent of damage to life, human and non-human; public health; and environment – including, water, soil, air;
d. Steps to be taken for compensation of victims and restitution of the damaged property and environment, and the cost involved;
e. Remedial measures to prevent recurrence;
f. Any other incidental or allied issues found relevant.

3. The Tribunal, having regard to the *prima-facie* material as to loss of lives, public health and environment and liability of the Company engaged in inherently hazardous activity, directed the Company to forthwith deposit an initial amount of Rs. 50 Crore with the District Magistrate, Vishakhapatnam, which would abide by further orders of this Tribunal. The amount was fixed having regard to the financial worth of the company and the apparent extent of the damage caused.

Supreme Court order dated 19.5.2020 on Company's Appeal against NGT order of 8.5.2020

4. The Company filed *Civil Appeal Diary No(s) 11327/2020* on 14.05.2020 before the Hon'ble Supreme Court which came up for hearing on 19.05.2020. The Hon'ble Supreme Court gave liberty to the Company to raise appropriate contentions before this Tribunal to be dealt with by this Tribunal as early as possible. It was observed, in relevant part:

> *"Mr. Mukul Rohatgi, learned senior Advocate appearing in support of the appeal submitted that soon after the fateful incident, the High Court took cognizance in Suo Motu W.P.(PIL) No.112/2020 and directed the State Government to constitute a Committee of appropriate Officers not below the rank of Principal Secretaries.*
>
> … … …
>
> *Mr. Rohatgi further submitted that apart from this Committee, appropriate proceedings have been taken by concerned District Magistrates as well as by the Central Government and NHRC.* ***In his submission given the circumstances that the matter is engaging the attention of a Committee appointed pursuant to suo motu cognizance taken by the High Court, there was no occasion for the NGT to appoint a further Committee.***
>
> ***He stated that in compliance of the directions issued by the NGT, the appellant has deposited the amount of Rs.50 crores and at this stage the appellant is not seeking any relief with regard to said sum but the legal issues raised by the appellant need consideration. Reliance was also placed on some of the orders passed by this Court where the question whether NGT could take suo motu cognizance***

of any matter was squarely in issue. It was, therefore, submitted that the direction taking suo motu cognizance by the Tribunal be stayed."

(emphasis supplied)

II. Response of parties to NGT's order of 8.5.2020, Committee's Report, and further petitions filed before NGT

Response of Parties

5. **Response of the MoEF&CC**: The MoEF&CC in its reply dated 14.05.2020 has stated that the gas in question is hazardous chemical under the 1989 Rules and the safety measures are to be adopted by the occupier of the company by preparing onsite and off-site emergency plans and taking other steps. As per Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 (The 1996 Rules), Crisis Alert Systems have been established at the Central, State, District and Local levels. Among other authorities, the State Chief Inspector of Factories (CIFs) is to deal with the safety issues under the Factories Act, 1948. Petroleum and Explosives Safety Organization (PESO) is the nodal agency to approve the site of the industrial installation. MoEF&CC sought report from the State Authorities. 'Report on the Styrene gas leakage' annexed to the reply affidavit mentions about the incident. It is stated that 12 deaths have been reported and 4000 persons are affected. **The unit falls under the EIA Notification, 2006. It falls under category-A projects and the company has applied under 'violation category' for EC in 2018 to the SEIAA (State Environment Impact Assessment Authority). The MoEF&CC is yet to receive the transfer proposal from SEIAA.** On 08.05.2020, meeting of Central Crisis Group was held and suggestions were sought for dealing with the matter. Annexure-I is the report of the CPCB dated 07.05.2020 recommending follow up

action in the matter by the State PCB. Andhra Pradesh PCB is to carryout assessment of soil and groundwater. Annexure-2 is minutes of the Central Crisis Group under the Chairmanship of Secretary, MoEF&CC on 08.05.2020.

6. **Response of the Andhra Pradesh PCB**: The State PCB has stated that it issued statutory Consent for Establishment (CFE), Consent for Operation (CFO) and authorization under the Hazardous Management Rules, 1986 to the Company. In 2012, the Company increased its production capacity. Renewal of CFO and hazardous waste authorization was valid up to 31.12.2021 stands granted. SEIAA examined applicability of the EIA Notification for new product in the year 2017 and sought clarification from the MoEF&CC. **The Company moved the MoEF&CC for EC as per Notification dated 14.03.2017 dealing with the case of violation**. Management failed in understanding and managing the impact of changes due to lockdown. Directorate of Factories conducted investigation and gave its report dated 17.05.2020 recording the failures as follows:

> ***"V.1.A The management has failed in understanding and managing the impacts of changes due to lockdown in storage of Styrene Monomer.***
>
> ***V.1.B When the top layer of SM in the tank is more vulnerable of polymerization, the samples were kept on taking from bottom of the tank only. Even after finding the sudden rise in polymer content in SM at the bottom, no attempts were made to understand the condition at the top.***
>
> ***V.1.C There was no measurement of vapour temperature of the tank.***
>
> ***V.1.D No monitoring mechanism was provided to ensure the minimum dissolved oxygen in SM for ensuring the functioning of TBC which is very vital requirement for safety. No attempts were made for***

putting the tank in circulation with other tanks or creation of movement with nitrogen + Air mixture.

V.1.E There is no production at the time of accident therefore, no emissions from process or utilities."

(emphasis supplied)

The Board withdrew the consent to the industry and issued stop production order on 07.05.2020. The company also gave letter dated 11.05.2020 that the plant will be kept under shutdown till necessary approvals and there is no production at the company. The Board monitored the styrene concentration in the ambient air and also collected surface water and groundwater and soil samples. The State of Andhra Pradesh constituted High Powered Committee. The team of Experts from CSIR-NEERI and CBRN Expert Team of 5th Battalion NDRF was constituted by the National Crisis Management Committee, New Delhi. Central Government also deployed two-member expert team to focus on-site technical issues.

7. **Response of the Company**: The company has chosen not to file any response on merits whatsoever inspite of opportunity nor any affidavit showing any difficulty in doing so, nor responded to the stand of the MoEF&CC and the State PCB with regard to its apparent failures in complying with statutory and legal obligation and not even produced onsite and off site plans statutorily required to be prepared which is very unfortunate in the face of loss of lives, public health and environment. Faced with this, the only response of learned counsel is that it has no access to relevant record, which stand on the face of it is against facts. However, it has been stated and also noted in the order of the Supreme Court that the amount of Rs. 50 crore in terms of order of

this Tribunal has been deposited. It has filed review application No. 19/2020 seeking recall of order dated 08.05.2020 insofar as constitution of the Committee is concerned and exercise of jurisdiction by this Tribunal.

The contentions raised on behalf of the Company in substance are:

a) NGT could not have taken *suo motu* cognizance of the matter. Reliance has been placed on the orders of the Hon'ble Supreme Court dated 07.01.2019 in *Civil Appeal Nos. 12122-12123 of 2018, Municipal Corporation Greater Mumbai vs. Ankita Sinha & Anr.* and and 05.08.2019 in *Civil Appeal No. 5902 of 2019, Central Electricity Supply Utility of Odisha v. Government of India, Civil Appeal No. 5902 of 2019.* In these orders, contention has been raised that NGT does not have jurisdiction to raise *suo-motu* proceedings. Supreme Court has issued notice, and matters are pending.

b) Cognizance of the matter has already been taken by the Andhra Pradesh High Court in *W.P. (PIL) No. 112/2020* and the State Government has constituted a Committee to look into the reasons for leakage and other issues as mentioned in the order of the Hon'ble Supreme Court dated 19.05.2020 quoted above. Apart from the High Court, Committees have also been constituted by the District Magistrate, Central Government and the National Human Right Committee (NHRC). The Tribunal should not proceed with the matter.

These contentions are dealt with in the subsequent section.

Committee's Report

8. *Report of the Joint Committee constituted by this Tribunal ("the Report"), dated 28.5.2020*: The report dated 28.5.2020 has been filed by the Committee, apart from interim report dated 17.5.2020 mentioning sequence of events, causes of failure, authorities responsible for failure, remedial measures to prevent recurrence and incidental issues. In short, the Company has been found liable apart from other authorities. We will refer to the Report in later part of this order. However, further study has been suggested to quantify damage and restorations measures.

Further Petitions filed before NGT

9. Two petitions being OA 76/ 2020 and OA 80/2020, have been filed on the same issue. The said petitions were filed before the Southern Bench of the Tribunal, and have been referred to the Principal Bench on account of pendency of the *suo-motu* proceedings. Order in these petitions follows subsequently.

III. Issues for Consideration

10. In view of above resume, the following issues need to be dealt with:

A. Contentions of the Company in light of observations of Hon'ble Supreme Court in order dated 19.5.2020, and otherwise

B. Decision on merits in light of material on record.

C. Failure of monitoring mechanism and remedial measures

D. Further directions

IV. Discussion and Decision on the Issues

11. We proceed to deal with the above issues

A. Contentions of the Company in light of observations of Hon'ble Supreme Court in order dated 19.5.2020, and otherwise

12. We have heard Shri Sidharth Luthra, Senior Advocate appearing for the Company. He has pressed two main objections noted in the order of the Hon'ble Supreme Court and the Review Application which have already been noted. We do not find any merit in either objection.

a) Suo Motu Jurisdiction

13. At the outset, two petitions having been filed before this Tribunal and the objection is rendered moot. Even otherwise, the objection is against the policy and scheme of law and binding judgements of the Hon'ble Supreme Court.

14. **NGT has the purpose and power to provide relief and compensation to victims of environment damage, restitution of property, and restoration of environment. To effectuate this purpose, NGT has wide powers to devise its own procedure. In appropriate circumstances, this power includes the power to institute *suo-motu* proceedings and not keep its hands tied in the face of drastic environmental damage and serious violation of right to life, public health and damage to property. This is especially so when the victims are marginalized and/or by reason of poverty or disability or socially or economically disadvantaged position cannot approach the Tribunal. *The power is coupled with duty to exercise such powers for achieving the enumerated objects.* Failure to exercise *suo-motu* jurisdiction in such circumstances would render these victims without remedy, causing irretrievable injustice and breakdown of Rule of Law. If NGT were powerless to institute suo-motu proceedings where so warranted, as in the present**

case, it would be robbed of all its efficacy, because then the situation would be that if environmental damage causes loss of life, public health and property, the court can grant relief only if the victims found the means to approach it first. Such limitation, to a large extent, would emasculate NGT's *raison-d'etre*, and render it nugatory and futile.

15. We may refer to the scheme of the NGT Act, 2010 and the observations of the Hon'ble Supreme Court on the subject. The long title of the Act suggests that the NGT has been established *inter-alia* for enforcement of legal rights relating to environment and giving relief and compensation for damage to the persons and property in pursuance of the decisions taken at the UN Conference on Human Environment held at Stockholm in June, 1972 and UN Conference on Environment and Development held at *Rio de Janeiro* in June, 1992 and decisions of the Hon'ble Supreme Court. The statement of objects and reasons states:

> *"5. Taking into account the large number of environmental cases pending in higher courts and the involvement of multidisciplinary issues in such cases,* ***the Supreme Court requested the Law Commission of India to consider the need for constitution of specialized environmental courts. Pursuant to the same, the Law Commission has recommended the setting up of environmental courts having both original and appellate jurisdiction relating to environmental laws.***
>
> *6. In view of the foregoing paragraphs, a need has been felt to establish a specialized tribunal to handle the multidisciplinary issues involved in environmental cases.* ***Accordingly, it has been decided to enact a law to provide for the establishment of the National Green Tribunal for effective and expeditious disposal of civil cases relating to environmental protection and conservation of forests and other natural resources including enforcement of any legal right relating to environment.***
>
> *7. Accordingly, it has been decided to introduce the National Green Tribunal Bill, 2009 which inter alia provides-*

(a) *for establishment of a National Green Tribunal which shall consist of a Chairperson and such number of Judicial and Expert Members as the Central Government may notify;*
(b) *that a person who is or has been a Judge of the Supreme Court or Chief Justice of a High Court shall be eligible for appointment as the Chairperson or Judicial Member of the Tribunal;*
(c) *that a person who is or has been a Judge of a High Court shall also be eligible for appointment as a Judicial Member;*
(d) *that a person who is either an expert in physical sciences or life sciences or engineering, or who has administrative experience in dealing with environmental matters shall be qualified for appointment as an Expert Member;*
(e) ***that the Tribunal shall have the jurisdiction over all civil cases where a substantial question relating to environment (including enforcement of any legal right relating to environment), is involved and such question arises out of the implementation of the enactment specified in the Schedule I to the Bill and to grant relief and compensation to the victims of pollution and other environmental damage arising under the enactments specified in the Schedule I to the Bill and to hear appeals under certain enactments specified in the Schedule III to the Bill;***
(f) *for repeal of the 'National Environmental Tribunal Act, 1995' and the 'National Environment Appellate Authority Act, 1997."*

(emphasis supplied)

16. Section 15 of the NGT Act, 2010 enables the Tribunal to provide relief and compensation to the victims of pollution and other environmental damages, restitution of property and environment, and is as follows, in relevant part:

"15. Relief, compensation and restitution. –

1. ***The Tribunal may, by an order, provide-***

a. relief and compensation to the victims of pollution and other environmental damage arising under the enactments specified in the Schedule I (including accident occurring while handling any hazardous substance);
b. for restitution of property damaged;
c. for restitution of the environment for such area or areas, as the Tribunal may think fit."

17. The Tribunal has power to regulate its own procedure (Section 19). In case of an accident, no-fault liability principle applies (Section 17). Rule 24 of the NGT (Practice and Procedure) Rules, 2011 confers discretion to pass such order as may be necessary to secure ends of justice. This has been considered *inter-alia* by the Hon'ble Supreme Court in ***State of Meghalaya*** *v.* ***All Dimasa Students Union*** *(2019) 8 SCC 177.* In relevant part, some pertinent observations are:

> *"157. Rule 24 empowers the Tribunal to make such orders or give such directions as may be necessary or expedient to give effect to its order or to secure the ends of justice. Rule 24 gives* ***wide powers*** *to the Tribunal to* ***secure the ends of justice****. Rule 24 vests special power to Tribunal to pass orders and issue directions to secure ends of justice.* ***Use of words 'may', 'such orders', 'gives such directions', 'as may be necessary or expedient', 'to give effect to its orders', 'order to prevent abuse of process', are words which enable the Tribunal to pass orders and the above words confer wide discretion.***
>
> *159.* ***The enabling power given to the Tribunal under Rule 24 is for purpose and object to decide the subjects which are to be examined, decided and an appropriate relief is to be granted by the Tribunal. Further, subjects contain wide range of subjects which require technical and scientific inputs. The Tribunal can pass such orders as it may think fit necessary or expedient to secure ends of justice.***
>
> *160. The object for which said power is given is not far to seek. To fulfil objective of the NGT Act, 2010. NGT has to exercise a* ***wide range of jurisdiction and has to possess wide range of powers to do justice in a given case****.* ***The power is given to exercise for the benefit of those who have right for clean environment which right they have to establish before the Tribunal. <u>The power given to the Tribunal is coupled with duty to exercise such powers for achieving the objects</u>.***
>
> **(emphasis supplied)**

18. We may also refer to a three-judge bench judgment by the Hon'ble Supreme Court in ***Bhopal Gas Peedith Mahila Udyog*** *vs* ***UOI*** *(2012) 8 SCC 326* noting that this Tribunal is a statutory and

specialized forum to deal with any issues relating to environment. It was observed:

> *"40. Keeping in view the provisions and scheme of the National Green Tribunal Act, 2010 (for short "the NGT Act") particularly Sections 14, 29, 30 and 38(5), it can safely be concluded that t**he environmental issues and matters covered under the NGT Act, Schedule I should be instituted and litigated before the National Green Tribunal (for short "NGT"). Such approach may be necessary to avoid likelihood of conflict of orders between the High Courts and NGT. Thus, in unambiguous terms, we direct that all the matters instituted after coming into force of the NGT Act and which are covered under the provisions of the NGT Act and/or in Schedule I to the NGT Act shall stand transferred and can be instituted only before NGT. This will help in rendering expeditious and specialized justice in the field of environment to all concerned**.*
>
> *41. We find it imperative to place on record a caution for consideration of the courts of competent jurisdiction that the cases filed and pending prior to coming into force of the NGT Act, involving questions of environmental laws and/or relating to any of the seven statutes specified in Schedule I of the NGT Act, should also be dealt with by the specialized tribunal, that is, NGT, created under the provisions of the NGT Act. The courts may be well advised to direct transfer of such cases to NGT in its discretion, as it will be in the fitness of administration of justice."*
>
> **(emphasis supplied)**

19. It is a matter of record that pursuant to setting up of NGT, even pending matters involving environmental issues have been transferred from Supreme Court and various High Courts to NGT, in view of NGT being the appropriate forum and venue.

20. The approach of a Court in dealing with the environmental issues cannot be hyper technical, for that would defeat the ends of justice, especially in matters where Right to Life is implicated. Once patent violations affecting Right to Life are in public domain, the court cannot be debarred from remedying the same on the sole ground that the affected party has not moved the court. The court can devise its own procedure to investigate and give relief to the victims in appropriate cases. This jurisprudence can also be

discerned from the judgment of a 3-judge bench of the Hon'ble Supreme Court in **M. C. Mehta** v. **UOI** *(1987) 1 SCC 395* as follows:

> *"2.* ***.. we cannot adopt a hyper-technical approach which would defeat the ends of justice. This Court has on numerous occasions pointed out that where there is a violation of a fundamental or other legal right of a person or class of persons who by reason of poverty or disability or socially or economically disadvantaged position cannot approach a court of law for justice, it would be open to any public spirited individual or social action group to bring an action for vindication of the fundamental or other legal right of such individual or class of individuals and this can be done not only by filing a regular writ petition but also by addressing a letter to the court. If this Court is prepared to accept a letter complaining of violation of the fundamental right of an individual or a class of individuals who cannot approach the court for justice, there is no reason why these applications for compensation which have been made for enforcement of the fundamental right of the persons affected by the oleum gas leak under Article 21 should not be entertained. The court while dealing with an application for enforcement of a fundamental right must look at the substance and not the form. We cannot therefore sustain the preliminary objection raised by Mr Divan.***
>
> *3. .. ... It may now be taken as well settled that Article 32 does not merely confer power on this Court to issue a direction, order or writ for enforcement of the fundamental rights but it also lays a* ***constitutional obligation on this Court to protect the fundamental rights of the people and for that purpose this Court has all incidental and ancillary powers including the power to forge new remedies and fashion new strategies designed to enforce the fundamental rights. It is in realization of this constitutional obligation that this Court has in the past innovated new methods and strategies for the purpose of securing enforcement of the fundamental rights, particularly in the case of the poor and the disadvantaged who are denied their basic human rights and to whom freedom and liberty have no meaning****.*
>
> *4. Thus it was in S.P. Gupta v. Union of Indic[8] that this Court held that (SCC p. 210, para 17):*
>
> ***where a legal wrong or a legal injury is caused to a person or to a determinate class of persons by reason of violation of any constitutional or legal***

right or any burden is imposed in contravention of any constitutional or legal provision or without authority of law or any such legal wrong or legal injury or illegal burden is threatened and such person or determinate class of persons is by reason of poverty, helplessness or disability on socially or economically disadvantaged position, unable to approach the court for relief, any member of the public or social action group can maintain an application for an appropriate direction, order or writ in the High Court under Article 226 and in case of breach of any fundamental right of such person or class of persons, in this Court under Article 32 seeking judicial redress for the legal wrong or injury caused to such person or determinate class of persons.

This Court also held in S.P. Gupta case[3] as also in the PUDR v. Union of Indic' and in Bandhua Mukti Morcha case[2] that ***procedure being merely a hand-maiden of justice it should not stand in the way of access to justice to the weaker sections of Indian humanity and therefore where the poor and the disadvantaged are concerned who are barely eking out a miserable existence with their sweat and toil and who are victims of an exploited society without any access to justice, this Court will not insist on a regular writ petition and even a letter addressed by a public spirited individual or a social action group acting pro bono publico would suffice to ignite the jurisdiction of this Court.***

6. *So far as the power of the court under Article 32 to gather relevant material bearing on the issues arising in this kind of litigation, which we may for the sake of convenience call social action litigation, and to appoint Commissions for this purpose is concerned, we endorse what one of us namely, Bhagwati, J. as he then was, has said in his judgment in Bandhua Mukti Morcha case[2]. We need not repeat what has been stated in that judgment. It has our full approval.*

7. ***We are also of the view that this Court under Article 32(1) is free to devise any procedure appropriate for the particular purpose of the proceeding, namely, enforcement of a fundamental right and under Article 32(2) the court has the implicit power to issue whatever direction, order or writ is necessary in a given case, including all incidental or ancillary power necessary to secure enforcement of the fundamental right****. The power of the court is not only injunctive in ambit, that is, preventing the infringement of a fundamental right, but it is also remedial in scope and provides relief against a breach of the fundamental right already committed vide Bandhua Mukti Morcha*

*case[2]. **If the court were powerless to issue any direction, order or writ in cases where a fundamental right has already been violated, Article 32 would be robbed of all its efficacy, because then the situation would be that if a fundamental right is threatened to be violated, the court can injunct such violation but if the violator is quick enough to take action infringing the fundamental right, he would escape from the net of Article 32. That would, to a large extent, emasculate the fundamental right guaranteed under Article 32 and render it impotent and futile. We must, therefore, hold that Article 32 is not powerless to assist a person when he finds that his fundamental right has been violated.** He can in that event seek remedial assistance under Article 32. The power of the court to grant such remedial relief may include the power to award compensation in appropriate cases. We are deliberately using the words "in appropriate cases" because we must make it clear that it is not in every case where there is a breach of a fundamental right committed by the violator that compensation would be awarded by the court in a petition under Article 32. The infringement of the fundamental right must be gross and patent, that is, incontrovertible and ex facie glaring and either such infringement should be on a large scale affecting the fundamental rights of a large number of persons, or it should appear unjust or unduly harsh or oppressive on account of their poverty or disability or socially or economically disadvantaged position to require the person or persons affected by such infringement to initiate and pursue action in the civil courts. Ordinarily, of course, a petition under Article 32 should not be used as a substitute for enforcement of the right to claim compensation for infringement of a fundamental right through the ordinary process of civil court. It is only in exceptional cases of the nature indicated by us above, that compensation may be awarded in a petition under Article 32. This is the principle on which this Court awarded compensation in Rudul Shah v. State of Bihar'. So also, this Court awarded compensation to Bhim Singh, whose fundamental right to personal liberty was grossly violated by the State of Jammu and Kashmir[6]. If we make a fact analysis of the cases where compensation has been awarded by this Court, we will find that in all the cases, the fact of infringement was patent and incontrovertible, the violation was gross and its magnitude was such as to shock the conscience of the court and it would have been gravely unjust to the person whose fundamental right was violated, to require him to go to the civil court for claiming compensation."*

(emphasis supplied)

There is no reason to not follow the above approach in the context of exercise of NGT jurisdiction. Section 20 of the Act requires this Tribunal to enforce the principles of Sustainable Development, including Polluter Pays and Precautionary Principle. These have been held to be part of Right to Life inter-alia in **Vellore Citizens' Welfare Forum** v. **UOI** (1996) 5 SCC 647 (Para 11, 13, 16-18).

21. There is no other forum entrusted such jurisdiction exclusively. Several serious issues of environment, including air, water, soil, and other life-threatening pollution have been taken up by this Tribunal *suo-motu*. The citizens affected in these cases were unable to access their remedies and approach the Tribunal, limited by varying disabilities and handicaps. In many instances, agencies posing as "public spirited", who initially filed proceedings, then abandoned the proceedings for reasons, *bona fide* or otherwise, leaving the onus on NGT to prosecute *suo-motu* (or not at all). **If this Tribunal is prevented from instituting *suo-motu* proceedings, these issues and violations would remain unaddressed, citizens' inalienable right to life and other rights will stand jeopardized, and the serious and irreversible environment damage would continue unchecked.** No-one may raise such issues, much less the affected individuals suffering silently specially in remote areas. If even a third person claiming to be 'public spirited' can be given locus, why publicly known serious violations of environment affecting the Rule of law, human and existential rights must be objected to be protected by this Tribunal on such specious plea in the face of a clear constitutional, statutory, and international law mandate. Notwithstanding Constitutional jurisdiction of the High Courts, the Tribunal is not

debarred from dealing with substantial issues of environment for which this Tribunal has been exclusively constituted, in absence of express statutory provision or binding judicial decision. Any other view may seriously hamper environmental justice and scheme of parliamentary law and judgements of the Hon'ble Supreme Court. Issue of procedure is in discretion of this Tribunal, including initiation of *suo-motu* proceedings, unless expressly barred.

22. As regards cited orders, where notice has been issued on NGT's institution of *suo-motu* proceedings, the facts of those cases may be entirely distinguishable. The matters are pending, no decision has been made on the said contention nor binding law discussed. It cannot be taken that NGT has been debarred from instituting *suo-motu* proceedings in matters of even such grave nature as the present one. There being no stay of proceedings in this case, we find no merit in the Company's contention.

b) Pendency of proceeding before High Court and other fora

23. As regards pendency of proceedings in the High Court and other fora, and the Committees appointed by the various fora, we may note that there is no conflict on the core issue being considered by this specialized Tribunal as per mandate of law in judgements of the Hon'ble Supreme Court referred to above. The fact remains that the specialized statutory jurisdiction to award compensation is conferred on this Tribunal, which also has all and wide powers, procedure and mechanisms to resolve and award appropriate relief and remedies. Our attention has not been drawn to any other committee or court going in to the issue of compensation and restitution to the victims to the environment. Only this Tribunal

has required deposit of an amount to be used for compensation, to be disbursed under orders of this Tribunal. Even the Company has deposited the amount and cannot object to abide by further orders in this regard. Thus, without prejudice to any other proceedings, the Tribunal can perform and exercise its statutory jurisdiction. This has been made clear in order dated 08.05.2020 in Para 2 as follows:

> *"2. …* ***Without prejudice to any other proceedings, this Tribunal has to perform its statutory obligation of providing relief and compensation to the victims of "environmental damage", as statutorily enacted, and restitution of damaged property and environment.*** *With a view to deal with the issue, it is necessary to ascertain the facts relating to the extent of damage, extent of failure and consider remedial measures. The affected parties have to be given the opportunity of being heard."*
>
> **(emphasis supplied)**

24. We also find no relevance of the observations in *1986 (Supp) SCC 20, para 83,* relied upon by Shri Luthra, to the effect that when an issue is pending before a higher forum, the lower forum should not deal with the matter. The observations are in the context of a particular issue dealt with in the said judgment and not identical to the issue being dealt with herein.

25. The order of this Tribunal is not in conflict with any other orders nor the findings of the Committee are in conflict with any other committee.

26. There is a further point to be noted. The stand of the Company is that it has complied with the direction to deposit the amount of Rs. 50 crores in pursuance of order of this Tribunal dated 08.05.2020. The said deposit is to abide by orders of this Tribunal. If the

Tribunal is to close the proceedings, the Tribunal will not be able to pass any order to deal with the amount.

27. The company also submitted that the it will face inconvenience in dealing with multiple proceedings. The plea of inconvenience is absurd and untenable in the face of clear and absolute liability of the company for the loss of life, public health and the environment by its hazardous activities in violation of law.

B. Decision on merits in light of material on record

28. Heard counsel for the appearing parties. We find the Company has strict and absolute liability for the environmental damage and consequential loss including to life and public health in this case.

29. The stand of the MoEF&CC and the State PCB is unequivocal that the company did not have the requisite EC. There is also clear violation of the 1989 Rules. Liability of the company is strict and absolute in the circumstances. The report of the Joint Committee constituted by this Tribunal filed on 28.05.2020 is supported by clinching material consistent with the stand of the MOEFF&CC and state PCB. A copy of the report[1] has been uploaded on the website of CPCB and has been made available to the Company on the same date. Order dated 08.05.2020 was e-mailed to the Company on the same day. It is not disputed that the same was available. The Company made a deposit in pursuance of the said order. The Company had sufficient opportunity to respond to the issue, but has chosen to not do so. The oral plea of the learned Counsel for the Company that it does not have access to the record or has not had opportunity to respond is untenable. If the

[1] https://tinyurl.com/JtCommitteeReport

Company could approach the Hon'ble Supreme Court on 13.05.2020 and is claiming to be cooperating with other Committees, there is no reason for the Company not to give any response, except unreasonable and irresponsible attitude of avoiding patent liability on a self-serving hyper technicality. The burden of proof in such matters lies squarely on the company, as held in M.C. Mehta and Vellore Citizens Forum (*supra*).

30. We note that against the order of the High Court dated 22.05.2020 seizing the premises of the company, the Hon'ble Supreme Court vide order dated 26.05.2020 in *SLP Civil Diary No. 11636/2020*, directed:

> *"As an ad interim measure, we permit the petitioner to give a list of 30 personnel as discussed hereinabove. Upon such names being given to the District Collector,* ***those persons shall be afforded access to the plant round the clock to maintain adequate safety measures****.*
>
> *This ad interim direction will continue till the High Court considers the matter. The High Court may, thereafter, pass appropriate directions."*
>
> **(emphasis supplied)**

31. There is a statutory liability under the 1989 Rules to prepare on-site and off-site emergency plan and to maintain safety by any establishment dealing with the hazardous chemicals. It is undisputed that the company is covered by Rule 2(e) read with Entry No. 583 of Schedule-I to the Rules.

32. While liability of the company stands clearly established, we may refer to the report of the six-members Committee headed by Justice B. Seshasayana Reddy, Former Judge, A.P. High Court which supports and corroborates the liability of the company for loss of lives, public health and environment. We place on record

our gratitude to the Chairman and the members of the Committee to take this assignment as public service to advance justice even in the face of frightening disease Covid 19.

33. The Report states that due to COVID-19 situation, the Committee had to face restrictions on movement and travel. An interim report was filed on 17.05.2020 a copy of which has been annexed. The Committee has opined that the Company did not take proper care of the storage tank resulting in auto polymerization of styrene releasing excess heat which escaped from the goose-neck and dip hatch in the form of vapour. It is also mentioned that the unit was operating without the requisite EC. The State PCB had no clarity in the matter while granting the statutory consents without EC. The observations and suggestions of the Committee under relevant heads are quoted below:

> ***"2. SUMMARY OF INTERIM REPORT***
>
> *In the interim report, committee has discussed about the background/history of the industrial unit i.e. M/s L G Polymer, status of its consent under Water (Prevention & Control of Pollution) Act, 1974 & Air (Prevention & Control of Pollution), 1981, grant of Environmental Clearance (EC) under Environment (Protection) Act, 1986, followed by the chemistry of styrene monomer (chemical that got leaked) and its behaviour in the storage tank. Various GOs related to the accident and compensation given by the Govt. of AP are also discussed. A copy of the interim report is given as Annexure II.*
>
> ***The committee, prima-facie, is of the view that the styrene gas/vapour leakage from the affected tank was due to the following reasons:***
>
> 1. ***Insufficient Tertiary Butyl Catechol (IBC, used as inhibitor to ureic/polymerization at lower temperatures) concentration in styrene tank due to unavailability of IBC in the plant.***
> 2. ***There is no monitoring system for dissolved oxygen in the vapour space which might have fallen down below 6%.***
> 3. ***The tank has no provision of monitoring temperatures at lop layers of the storage.***

4. ***Refrigeration system was not being operated fir 24 hours.***
5. ***Gross human failure and negligence of the Person in-Charge of the plant and maintenance personnel of the storage tanks.***

The interim report clearly outlined the chronological details of efforts made by different stakeholders in obtaining EC. It is a fact that the unit was operating the facility without the requirement of prior EC. The expansion of the unit from time to time, continuity of its operation. efforts made by the unit in getting EC, correspondence of State Environment Impact Assessment Authority (SEIAA) in this regard, role of State Pollution Control Board, are detailed in the interim report page no 1-4. ***However, as per the correspondence of the SPCB with MoEF&CC after the incident seeking clarification on requirement of EC shows lack of clarity by the SPCB in the provisions of the EIA notification, 2006 and amendments thereof.***

*The failure of management in handling the crisis, the properties of styrene monomer, the lapses by different managerial staff in maintaining the pre and post operations were detailed in the interim report page no 5 to 10. It is stated that "****Our observations revealed that the management did not take proper care of the affected storage tank and it resulted in auto polymerization of styrene releasing excess heal which escaped from the goose-neck and dip hatch in the form of vapour****".*

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Findings and Suggestions:

a) The sequence of events

The unit was closed on March 24, 2020 and started preparations w.e.f. May 04, 2020 for its proposed resumption of operation on May 07, 2020. On the early hours of May 07, 2020 at about 03:00 AM, the tank with 1830 tons of storage had developed the leak of the STYRENE vapours from top of the tank and spread beyond the factory boundary towards the west side due to wind direction and affected the residents of five nearby areas namely, Venkatapuram, Venkatadri Nagar, Nandamuri Nagar, Pydimamba Colony and BC & SC colony. ***It appears from an examination of nearby damaged trees that the gas plume moved at a height of about 0-20 feet from the ground towards the nearby settlements. Population within a radius of about 0.5 km was evacuated by the district administration****.*

The sequence of operations carried out at the factory after the incident as per plant managers is as follows:

- *02:54 hrs: Gas detector alarm noticed in Control room (DCS).*
- *03:02 hrs: High VOC alarm noticed in Control room (DCS).*
- *03:02 hrs: Immediately DC'S operator informed to operator / safety person / Night duty officer.*
- *03:02 hrs: M6 Tank temperature started rising.*
- *03:03 hrs: Night duty Officer informed everyone about the high vapours at tank farm area.*
- *03:03 hrs: Immediately night duty Officer tried to reach the fire hydrant sprinkler valve to open it, but due to high vapour cloud it was impossible to reach it.*
- *03:04 hrs: Alerted all other members to bring Self-contained breathing apparatus (SCABA) sets to assembly point.*
- *03:07 hrs: Informed plant safety head/Director Operations& others about the emergency.*
- *03:07 hrs: Alerted security in-charge to get help from outside agencies (Fire services and Ambulance etc.). Root cause was identified as self-polymerization due to stagnant high polymer content.*
- *03:30 hrs: Director Operations& Safety heads & plant officials arrived at site.*
- *04:30 hrs: Two members went to open fire hydrant sprinklers using SCABA sets for MS /M6 /Pentane storage tank.*
- *04:32 hrs: Emergency chemicals such as NDM, TDM, Antioxidant (Eunox-76) arrangements done.*
- *05:15 hrs: Chemical inhibitors (N-Dodecly Mercaptan, Tertiary Dodecly Mercaptan and Eunox-76) dosing arrangements started immediately. About 2200 litres was pumped inside the tank.*
- *06:30 hrs: 10 tonnes and 15 tonnes of Styrene was pumped to feed preparation & feed solution tanks, respectively.*
- *07:30 hrs: 70 tonnes of Styrene pumped to one spare storage tank. Water poured through foam pourer & hydrant water sprinklers kept open for affected tank to cool down the tank.*
- *09:30 hrs: Neighbouring residential areas of Venkatapuram, Janata Colony, SC & BC Colony, Padmanabhapuram are most affected.*
- *22:45 hrs: Tank temperature reached 154°C.*
- *08.05.2020 (Friday)03:30 AM: Temperatures started reducing from 154° C to 120° C by evening. Water has been continuously poured inside & outside tank.*
- *09.05.2020 (Saturday)*
- *Water has been continuously poured inside & outside tank.*
- *At 09:00 AM tank temp reached to 100° C.*

- *As reported following chemicals were added to affected tank:*
- *Eunox-76: 289 kgs*
- *N-Dodecyl Mercaptan: 1059 kgs*
- *Tertiary Dodecyl Mercaptan: 2487 kgs*

A special aircraft was arranged for airlifting the NDRF joint team of 09 experts from Pune and Nagpur including CSIR-NEERI members. They reached on May 07, 2020, 23:00 Hrs. Apart from this, scientists from NEERI, Hyderabad also reached the site for further coordination. A central committee of Mr Shantanu Gite, an industrial expert in handling of styrene from Mumbai, and Dr Anjan Ray, Director CSIR-Indian Institute of Petroleum, Dehradun reached the affected site on evening of May 9, 2020 to assess the situation. This Central Committee made two inspections - one upon arrival and another in the morning of May 10, 2020, the latter along with the AP state-appointed committee constituted for investigating the incident.

The following industry personnel were present during the time of the accident:

S. No	***Name***	***Position***	***Education***	***Experience***
1	*Sh. M Rajesh*	*Operator*	*Diploma in Chemical*	*2 Years*
2	*Sh. N Sudhakar*	*Asst. Manager*	*M. Sc. Organic Chemistry*	*13 Years*
3	*Sh. P Balajee*	*Manager*	*M. Tech in Chemical Engg.*	*6 Years*
4	*Sh. S Atchyut*	*Engineer*	*Diploma in Chemical Engg.*	*2 Years*
5	*Sh. K Chakrapani*	*Engineer*	*B. Sc. Chemistry*	*7 Years*
6	*Sh. U V Ramana*	*Asst. Engineer*	*B. Sc. Chemistry*	*5 Years*
7	*Sh. N Jayaram*	*Jr. Engineer*	*B. Sc. Chemistry*	*4 Years*
8	*Sh. KS Kiran Kumar*	*Asst. Manager*	*Intermediate*	*30 Years*

b) Causes of failures and authorities responsible thereof.

The industrial unit has been closed since March 24, 2020 due to the COVID-19 lockdown. As on the day of lockdown, the raw material, Styrene was available in 4 storage tanks in the factory with the inventory of 1830 tons, 2725.9 tons, 242.6 tons, 242.5 tons. The unit was permitted for daily maintenance activities during the lockdown period with 15 persons per each shift with a total of 45 personnel working per day.

Govt. of Andhra Pradesh announced the resumption of operation of industries from May 04, 2020 and the management had proposed to resume their operations w.e.f. May 07, 2020. On the early hours of May 07, 2020, the tank with 1830 tons of storage had developed the leak of the styrene vapours from the top of the tank and spread beyond the factory boundary towards the west side due to wind direction and affected the residents of 5 nearby areas

namely, Venkatapuram, Venkatadri Nagar, Nandamuri Nagar, Pydimamba Colony and BC colony.

The leaked tank was old and does not have temperature sensors at middle and top surface of the tank except only provision to measure the temperature at the bottom of the tank where refrigeration is provided. Due to lockdown, the storage tank was stand still. The styrene polymerises to polystyrene even at ambient temperature, in the absence of inhibitor, which itself is an exothermic reaction with very slow reaction rates. Although the reaction rates are slower, it will cause major operating issues, because of heat liberation and blockages in the tank*. The rate of this reaction doubles every 10 °C. The combination of polymerisation- heat liberation- temperature rise- and further polymerisation can lead to rapid reaction and heating, which is called as a 'run-away reaction'. As the temperature rises, styrene starts vaporising. The pressure in the storage tank will progressively increase, and the safety valves released the styrene vapour into the atmosphere. The increase in temperature and pressure was not observed by the industry. Had the safety valve failed, the whole tank would have been exploded and still bigger catastrophe would have been happened.*

Styrene monomer with a boiling point of 145 °C, in liquid state remains monomer if it is maintained at low temperature preferably 15-18 °C. If the temperature approached 20 °C the tank must be cooled and under no circumstances the temperature should exceed 25 C. If its temperature is increased, self-polymerization starts slowly, which is an exothermic reaction, thereby liberating heat, which further increases the rate of polymerization and the chain reaction begins. This leads to exponential increase in polymerization. The monomer styrene is stored without letting self-polymerization by adding inhibitor substance like Tertiary Butyl Catechol (TBC). This inhibitor works at low temperature below 25 °C. TBC is not effective as inhibitor of monomer Styrene at high temperature. Another chemical named N dodecyl mercaptans (DDM) is used as inhibitor at high temperature. Since the content (styrene) is in closed container, rise in temperature increases the tank pressure. To avoid structural failure of tank, safety valves are provided, which gets opened at high pressure and releases the contents thereby reducing the pressure. Five valves are provided at the top of the affected tank roof. During the stagnant storage period, apparently the monomer styrene started self-polymerization leading to increase in temperature as the process is exothermic. The increased temperature further increased the rate of reaction resulting in increased pressure in the tank. Safety valves on the tank (M6) roof top got opened due to high pressure and started emitting styrene vapours. As per CCTV record, the emission started at about 02:42 hrs from M6 tank having 1830 tonnes of styrene. No alarm generated when vapour leakage

occurred and auto sensor of styrene is failed to detect the conc. in ppm.

There is no interlock system arrangement between the temperature and refrigeration system. There is no external water spray arrangement over the storage tank for exceeding ambient air temperature and also any unmanned hose arrangement.

It should be noted that in climate zones and in seasons with significant temperature difference between night and day, the styrene vapours evolved in the headspace at higher temperatures will condense on roofs, walls and internal fittings of storage tanks when it cools off The phenolic inhibitors have high boiling points and stay in the liquid phase, resulting in the condensed styrene vapours containing no inhibitor. Also, the condensation will result due to long term storage of styrene monomer during 'zero process operation' without maintaining required cooling throughout the tank. ***The leaked tank does not have any provision for measuring the vapour space temperature. Due to this, building-up of temperatures in top surface could not noticed by the industry. This reflects the clear cut case of negligence on Industry part.***

The incident is tragic but it could have been far worse had the affected tank, Tank M6, ruptured and the temperature of the tank contents had shot up far beyond the 154° C, well over the boiling point of styrene. An estimated 800 tons (8 lakh kg) of styrene escaped into the surroundings in the incident. It is reported that unit's inability to access personnel protective equipment in a timely manner, safety response preparedness of the site had impact in the early stages of safety operations. Further, the public siren system also could not be activated as it was manual and in an area rendered inaccessible by the vapour cloud else people in surrounding areas could have been alerted quickly and lives saved.

Root cause analysis showed that the problem possibly began on April 20, 2020 when the polymer concentration in Tank M6, which was idled at full capacity since March 25 post-lockdown. It is known that styrene monomer can exhibit reaction runaways because of their exothermic and auto-accelerating nature even at adiabatic conditions. The polymerization runaway "onset" temperature inversely increased with the monomer mass fraction and generally observed to be 66 C. Styrene polymerization reaction is relatively highly exothermic with a heat generation at around 71 kJ mol 1. At the same time, even without an initiator, two styrene molecules can undergo a Diels—Alder type of reaction and generate radicals to start self-polymerization upon heating. The polymerisation reaction being exothermic, if contained may become uncontrolled and the bulk styrene temperature may rise to a level at which polymerisation is self-sustaining and very rapid. This results

in evolving the release of large quantities of heat together with volumetric expansion and set off an undetected, slow but steady formation and growth of a hotspot within the tank where an exothermic (heat-generating) reaction of polymerization started. By early morning of May 7, the hotspot probably reached critical mass. Somewhere between 1:45 am and 2:40 pm, this led to a runaway reaction and the temperature shot up in the tank. However, the only two parameters being monitored in the tank - the temperature and the tank level were being measured through gauges at the bottom of the large tank (18m in diameter and 12 m in height) - presumably far from the hotspot, and these picked up the problem after it occurred at 2:40am. The first sign that anything was amiss was picked up the control room operator through a vapour release alert at 2:54 am, and the temperature alert only came 8 minutes later. ***Mitigation of the impact could have been more effective had the chillers servicing Tank M6 been running. It was switched off at 5pm earlier that evening as per routine site practice as ambient night temperatures required little or no chilling. There was also no automated sprinkler arrangement for vapour loss as this had never been anticipated; the fire water sprinklers had to be manually activated. Another reason for the accident, TBC (inhibitor of the polymerization reaction) is not effective after liquid styrene temperature in storage rises above 52° C. Under these conditions, a short-stopper chemical should be added. It seems LG Chem did not consider this possibility. Also, no TBC was topped up in the affected tank M6 since April I since there was no stock at site and the tested TBC level of the contents was apparently in range. Clearly, it can be realized that the TBC level is not a good indicator of safety margins; the polymer content is a better measure for an early alert. With the experience world over of Styrene, it takes considerable amount of idle time to have polymerization inside tank if effective inhibition and chilling is maintained. The unit failed to assess this situation due lack in handling experience by trained man-power****.***

The root cause thus appears to be the lack of experience of LG Polymers India and their Korean principal. LG Chem, in monitoring and maintaining full tanks of styrene that were idled for a long period of several weeks without operation. Further, M6 is an old tank in design terms and this possibly contributed to the problem. The breather vent through which the boiling styrene escaped was 8 inches in diameter, enabling very significant outflow at the high temperature and pressure generated by the runaway reaction. Operators and any industrial persons are not aware of control measures in such situation is the main cause.

The above scenarios definitely point towards the accountability for lapses on part of the Industry, which rest with Managing Director of the unit, Certified Safety Officer, Safety Department, and Production Department. The role of issuing necessary safety certificate to the industry, the periodic inspections is the primary responsibility of Department of Industries, Factories and Boilers.

c) *Extent of damage to life, human and non-human; public health; and environment — including, water, soil, air;*

The Ambient Air Quality Monitoring was carried out by APPCB for the parameter Styrene and TVOC in and around M/s L.G. Polymers from May 07, 2020 using hand held meter with minimum detection limit of 0.1 ppm styrene. Monitoring was carried out at eight locations in and around the industries. Venkatapuram village is 100m downwind of industry, Janatha Colony is 200m from opposite to industry, Gopalapatnam is 1.5 km upwind of industry and Pendurthy is around 1.5 km upwind of industry. During monitoring average wind speeds were 1.1 m/s having predominant wind direction from South West to North East. The concentrations of styrene were high at the time of accident in the villages. The concentrations could not be measured at the time as there were lethal and villages were inaccessible. Subsequently, the concentrations of styrene were measured in the ambient air at 9:30 am. The APPCB officials started the Ambient Air Quality Monitoring with handy samplers from 9.30 am on May 07, 2020 and Ambient Air Quality Monitoring was taken up on regular basis and the results are presented in the below table;

Styrene values (ppm) range recorded at various locations around M/s. LG Polymers

Station	07.05.2020		08.05.2020		09.05.2020		10.05.2020	
	Min	Max	Min	Max	Min	Max	Min	Max
Venkatapuram	0.0	46'l	0.0	374	0.0	3	0.0	1.5
Janatha Colony	0.0	1.3	0.0	6.2	0.0	0.9	0.0	0.2
Industry main gate	14.2	365	0.0	242	0.0	0.7	0.0	0.4
Gopalapatnam petro bunk	0.0	0.6	0.0	1.7	0.0	0.2	0.0	0.1
Pendurthy Road near way to LG polymers	0.0	1.2	0.0	3.0	0.0	0.2	0.0	0.2
Vepagunta	0.0	22.3	0.0	5.7	0.0	0.1	0.0	0.2
Venkatadri nagar	--	--	0.0	22.7	0.0	1.1	0.0	2.3
Storage tank	--	--	4.9	17.5	2.8	18	0.0	2.5

The team from CSIR-NEER1 Hyderabad Zonal Centre arrived at site on May 12, 2020 and conducted extensive sampling and monitoring of ambient air and water bodies of the affected area. The report is given as ***Annexure-IV.*** *From the*

data available with District Authorities, 12 people and 22 animals have died and estimated 3000 are affected. Venkatapuram village is near to the unit at a distance of 0.1 km. The committee also discussed about the extent of damage to life, human and non-human; public health; and environment - including, water, soil and air. Since the NEER' team has already conducted preliminary studies they may be engaged for further studies.

d) Steps to be taken for compensation of victims and restitution of the damaged property and environment, and the cost involved;

Compensation cost to be paid by industry shall be of two components; (i) Compensation paid by government and (ii) Environmental Compensation and restitution of the damaged property.

i) Compensation announced by Govt.

Government of Andhra Pradesh has announced Rs. 1 crore as compensation to the families of each of the deceased. Government will also compensate victims on ventilator support with Rs. 10 lakhs, and victims hospitalized but not on life-support with Rs. I lakh each. This will be provided in addition to the entire expenses of their hospitalization, critical care and recovery, which will be borne by the government.

Victims, who received primary care treatment due to surface injuries arising out ofthis gas leak, will be given Rs. 25,000 each. Many animals had also died after inhaling the gas, the government will give compensation of Rs. 20,000 per animal to their owners.

ii) Environmental Compensation and restitution of the damaged property

An elaborate scientific study is required to calculate the actual cost for environmental damage and restoration. The services of NEERI may be utilised since they have conducted the preliminary studies and also have such expertise.

iii) Deposit of Rs. 50 crores by NIA LG Polymers P Ltd

M/s LG Polymers Pvt Ltd failed to deposit Rs. 50 crores as per the Hon'ble NGT order. It is reported that the unit has approached Hon'ble Supreme Court seeking exemption in payments.

e) Styrene Transportation after the incident;

In consultation with LG Chem, South Korea, Govt. of AP, East India Petroleum Private Ltd, who maintain the facility at onshore, with NDRF team started transfer of

approx. 12800 tons of Styrene from T-2, T-23, (onshore tanks of 5500 KL capacity and 7300 KL capacity) M5, 111A & 111B tanks at Vizag port and LG Polymers plant in Vizag into vessels, which will carry them to South Korea.

On May 12, 2020, approx. 7900 tons of Styrene was loaded on a vessel and transported to South Korea. Till May 15, 2020 morning, out of 3000-tonStyrene at LG Polymers plant, 2143 tons has been transported to Vizag sea port tank. Remaining 857 tons is being transported. Sea Port storage tank at Vizag holds 4043 tons of Styrene. Once all the Styrene reaches Sea port storage tank from LG Polymers plant, a Second vessel will carry all this remaining 4900 tons Styrene to South Korea. For the complete transparency and accountability of the process, the permissions obtained to send the material back to South Korea, actual quantity and protocol followed shall be submitted immediately by Govt. of Andhra Pradesh, industries department, APPCB and District Magistrate.

f) Suggestions for restoration:

1. *The affected tank poses no further risk but the polymerised mass has to be taken out and disposed at TSDF preferably incinerated. Alternate arrangements for converting to useful products may be explored after consultation with experts in the field so that incineration impact can be lowered.*

2. *Suggested to have all styrene inventories in the storage tanks of LGPI, including two outsourced shore tanks, having no chilling facility.*

3. *The unit shall he directed to empty all storage tanks with other chemicals, waste-residues, hazardous wastes, spill-material, intermediates, by-products and final product. The unit must share the material safety data sheets of the hazardous chemicals handled by it to concerned departments.*

g) Remedial measures to prevent recurrence;

1) *Hazard identification and evaluation in a local community, Preparation of Guiding Principles for Accident Prevention, Preparedness and Response for onsite and offsite emergency plans has to be reviewed.*
2) *A detailed study of the risk assessment and disaster management studies to he carried out by the industry*
3) *The styrene metabolites are of genotoxic and can cause carcinogenic health impacts to the population exposed based on different factors. It is suggested that the industry shall prepare a*

comprehensive health monitoring programme along with reputed hospitals for the suspected population at least for five years. Based on the data and health results of the study the monitoring may further continued. The District Administration shall monitor the whole programme for its proper implementation.

4) *Preparation of a comprehensive E1A report in accordance with the MoEF&CC guidelines.*

5) *Safety audit to be conducted by certified third party regularly for onshore facilities under Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 (MSIFIC Rules) for styrene import.*

6) *The distancing criteria for Storage tank of styrene has to be followed as per schedule 1 of MSIHC Rules, 1989.*

7) *Installation of the automatic siren when any parameter goes out of control. The siren needs to be done within and outside the industry so that the villages around are alarmed about the same*

8) *Emergency ambulance services to be arranged in the industry premises along with an experienced doctor.*

9) *Awareness campaigns in the villages around the industry to make them aware of the measures to be taken in case of any accident/ damage from the industry to the area around the industry.*

10) *Readymade PPE to be placed at the emergency points in case of any accident.*

11) *Separate safety manual to be prepared for each equipment along with the accidental management plan.*

12) *Periodic inspection by Department of Factories & Safety to assess the safety measures and documents maintained by the industry. If failed, necessary action shall be initiated against the industry.*

13) *API RP 575 protocol should be followed for inspection.*

14) *Design of storage tank should fulfil MoEF&CC notification dated 09.11.2012 with vapour control system.*

15) *Automatic styrene sensor should be installed in the different direction and residential with minimum detection limit of 1 ppm.*

16) *Carbon steel and stainless steel are suitable for handling styrene and Blanketing of tanks for fire protection should be considered.*

17) *The tank must have the capacity to contain the styrene product as well as enough volume for adding diluents to quench the reaction.*

I8) *The administrative failures such as not obtaining Environmental Clearance from MoEF&CC. not implementing the recommendations of APPCB and factories of inspectors in time (based on inspection reports), failure of replacing the old storage tanks and having no safety measures for*

temperature recordings, no safety audit reports are to he further investigated.

19) *The role of factories and inspectors to be specified and their inspection protocol are to be assessed Pan-India. Since safety aspects are part of their mandate an independent audit is required in the light of many accidents reported due to failure of safety measures and lack of training.*

20) *In order to prevent such accidents, a District Crisis Group (DCG) needs to be established under the chairmanship of District Collector. This group has to meet every 45 days to review the safety and hazard issues of each and every industry. Similarly, State Crisis Group (SCG) needs to be established under Chief Secretary. This committee should meet every 3 months and review the onsite/offsite District emergency plan prepared by DCG and suggest the measures to be taken to minimize the accidents. Both DCG and SCG should make plans to create awareness among the people living in the surrounding area of the industry about chemical hazards and measures to be taken for accidents.*

21) *It is suggested that each State shall take responsibility in implementing the Chemical Disasters Management, protocol (March 2009 publication) and NIHIDC remedial measures and submit Action taken Report.*

22) *Responsibility Matrices for Disaster Risk Mitigation as per National Disaster Management Plan (May 2016) has to be taken up and assess the implementation schedule by each States and UTs.*

h) Any other incidental or allied issues found relevant;

The NGT Committee members conducted a public consultation meeting on May 12, 2020 at 10:30 hrs in GVMC Conference Hall with NGOs, residents from affected villages and Industrialists. The Committee requested to offer suggestions/representations/remarks on the mishap of LG Polymers Styrene gas leakage issue and further consequences in that locality including preventive measures.

The Committee has taken opinion of the participants by interacting with each and every individual, and the main observations of the participants are stated below.

1. *The compensation must be paid both by the company and the Government since company is responsible for the accident. Compensation shall be based on Global Compensation norms.*
2. *The Company should conduct local public awareness campaigns about Do's/ Don'ts during, emergency.*
3. ***Since the NEERI team have already conducted preliminary studies and a report has been prepared,***

it is suggested to engage the services of NEERI, for studies related to environment including water, soil and air.

4. *Adjacent to the L.G. Polymers company, VUDA approved layouts also there, hence habitations are developed around the company over a period of time. District administrations shall take more care in approving such layouts.*
5. *Material auditing, safety inspection reports shall be made online for public*
6. ***All the affected families should be given identity cards and Health cards by the Government and the expenditure on medical bills shall be borne by the unit. District Administration shall make necessary instructions and coordination.***
7. *In the R.R. Venkatapuram surrounding villages, pregnant women also affected, hence the government has to take necessary monitoring mechanism for the pregnant woman.*
8. *At the time of gas leakage, the villagers started to run away towards Vizanagaram, but the Police at Kothavalasa check post stopped all the people and directed them to stay in the nearby school.* ***Lack of coordination between the district administrations of Visakhapatnam and Vizianagaram Districts was clearly visible during the incident.***
9. ***The L.G. Polymers company management should be prosecuted under relevant sections Cr.P.C.***
10. *All factories should be monitored through C.0 cameras. The Companies as well as the Government neglected the Community Based Disaster Response system.*
11. ***The Government should ensure that hereafter all companies should take precautions and not to repeat such incidents. Awareness programme should be conducted in the surrounding areas of the industry.***
12. *The first information was given by civilians to the police control room, but not by the company.*
13. *Why should building plan approvals given in 200 metres radius adjacent to the Factory. The Urban Development is also responsible for this incident.*
14. *All companies should have Public Addressing system, so that the public can be warned during the Disaster.*
15. *The Representatives of industry and CII have stated that The Government should take action for brining World Class Disaster Management system.*
16. *Many people opined that neither the Inspector of Factory nor Fire officials are aware how to deal with chemical disasters.*
17. *Maintenance of buffer zone for all industries, stoppage of encroachments and policy of not allocating residential houses near to industry should be strictly followed.*
18. *The mapping has to be made for the Risk Assessment. It may be gas leakage, solvent firing, explosion etc.*
19. *Sensitization of public to deal with emergency in local and factory premises.*

20. All factories should have mitigation plans for gas leakage solvent fire and should have emergency ward with medical staff for treatment.

The NGT Committee visited all five affected villages (R R Venkatapuram/Venkatapuram, Nandamuri Nagar, Janatha Colony, SC/BC colony and Kancharapalem and physically seen the extent of damage at all places. Also, the committee interacted with local people about the sequence of events due to gas leakage.

i) Scope for further studies;

CSIR-NEERI, Hyderabad Zonal (HZC) has already taken up an independent research study and the sampling work for various environmental components conducted from May 12-16, 2020. Since the NEERI team have already conducted preliminary studies and a report has been prepared, the services of NEERI may be utilised for further studies for calculating the cost of environmental damages related to flora and fauna. ***The other suggested scope for studies are:***

a) Monitoring of the environmental parameters viz., air, groundwater, surface water, soil for the next 10-12 months to assess the long term concentration of styrene
b) Vapour cloud dispersion studies
c) Assessment of the environmental components for styrene concentration
d) Remedial measures for contaminated soil, water
e) Risk assessment studies for the accident
f) Prediction of the effect of the accident over long term and short term through modelling studies
g) Bio-assay test to understand the level of toxicity in the water."

(emphasis supplied)

34. The observations of the Committee are based on site inspection by independent experts of unquestioned credibility. Observations to the extent of holding that the Company is liable for the damage caused on account of leakage of gas to the life, public health and the environment corroborate the stand of the MoEF&CC and the State PCB. The company has operated without EC and the State PCB on account of its ignorance of law or otherwise gave 'Consent to Establish' and 'Consent to Operate' in violation of law. There is

violation of 1989 Rules. Liability of the Company is strict and absolute under the law. Burden of proof to show that it has no liability is on the company. Overwhelming material establish the liability of the company. The amount deposited has thus to be appropriated towards part liability and interim compensation subject to further orders after giving further opportunity to the company. This is without prejudice to final liability being quantified based on further study and proceedings under any other law.

C. <u>Failure of Authorities and need for remedial measures</u>

35. We are of the view that further remedial action needs to be taken in the matter of bringing to justice erring officers of authorities in the State of Andhra and liability of the State or officers being further gone into. There is also need for rehabilitation plan utilizing the interim and further compensation. Lastly regulatory framework needs to be reviewed and strengthened, apart from identifying steps to ensure compliance of laid down safety norms and laying down further norms and procedure to avoid recurrence of such failures in future.

36. Safety of citizens and environment are of prime concern. Any economic or industrial activity, however necessary, has to be consistent with the safety of human beings and the environment. The damage to human life, human health and environment has to be restored by applying the 'Sustainable Development' principle, of which 'Precautionary' and 'Polluter Pays' principles are part. In this regard, significant role has to be played by the statutory authorities constituted under the Water (Prevention and Control of

Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981 and the Environment (Protection) Act, 1986.

37. Dealing with environmental issues, including unfortunate incidents, the Tribunal has found need to revamp the existing regulatory framework quantitatively and qualitatively. The Tribunal has noted the observations of the CAG and parliamentary Committees on the subject. Reference may be made to order dated 22.11.2019 in *O.A. No. 837/2018, Sandeep Mittal vs. Ministry of Environment, Forests & Climate Change & Ors.* after noting the status of current monitoring mechanism of the MoEF*:*

> *"5. Further affidavit has been filed on 25.09.2019 on behalf of the MoEF&CC stating as follows:-*
>
> *"1 to 6 xxx xxx xxx*
>
> *7.* ***That according, if only the projects issued EC during 2013-2019 are taken, then the best case scenario in terms of their monitoring could be 2.5 yrs with 50% enhancement in sanctioned staff strength and worst case scenario would be 4.5 years with Man in Position (MIP) which is 32 at present across the ten (10) ROs in the country. Accordingly, the repeat inspection of a unit can only happen after 2.5 yrs and 4.5 yrs, respectively in the above two scenarios. That if all the projects issued EC since 1994 onwards are taken then the best case scenario is 6.5 yrs with 50% enhancement in sanctioned staff strength and worst case scenarios is 13 years with MIP indicating that. The repeat inspection of a unit can only happen after 2.5 yrs and 4.5 yrs, respectively in these two scenarios.***
>
> *8. That for Category 'B' projects for which compliance monitoring has been directed to be responsibility of SEIAA and SPCB, following to be taken note of:*
>
> *a.* ***Sanctioned staff strength and MIP of SEIAAs and SPCBs/PCCS are still not available.***
> ***b.*** ***SEIAA and SPCBs are under the administrative control of State Government.***
> ***c.*** ***There is ambiguity with respect to their present involvement in monitoring of EC conditions.***
> ***d.*** ***Accordingly, it has been difficult to speculate the timeframe for taking up and completion of monitoring of Cat B projects at present.***

e. *The SEIAAs and SPCBs have been asked to provide information so that the above timeframe may be calculated.*

9. *That as directed, a Six Monthly Action Plan has been prepared to reduce the timeline, enhance coverage and transparency, reduce requirement of additional human resources while ensuring comprehensive compliance of environmental conditions, thereby resulting in greater protection of the environment on a continuing basis. The Six Monthly Action Plan is placed at Annexure R-2.*

10. *That as enumerated in the Action Plan, the Ministry plans to carry out a thorough assessment of the quantum of work involved and available human resources and accordingly take up the initiatives for comprehensive refining of the existing monitoring mechanism. Based on this exercise the following action are to be undertaken:*

a. ***Filling up of vacant posts wherever applicable.***
b. ***Creation of additional posts in all the agencies to be involved in monitoring and compliance viz. ROs, CPCB, SEIAA and SPCBs; if required.***
c. ***Hiring of young processionals as per feasibility.***
d. ***Creation of new ROs, if required.***
e. ***Utilizing services of CPCB and SPCBs to effectively discharge responsibilities of monitoring.***
f. ***Strengthening Monitoring Cell within the Ministry.***
g. ***Develop web based online mechanism to automate the entire process of inspection and compliance monitoring.***

11. *That the Action Plan provides a detailed roadmap for the coming months which includes:*

a. ***Hiring of an Independent Agency to assess the work requirement.***
b. ***Constitution of Monitoring Evaluation Committee (MEC) to steer and supervise a new monitoring mechanism.***
c. ***Engagement of Consultant for development of web based mechanism for end to end digitization.***

12. *That in the interim, till the larger Action Plan is implemented, in order to improve the monitoring process, following actions has been/ will be taken up:*

a. ***Filling up on nine vacant posts of Scientists in the ROs.***
b. ***Strengthening the Monitoring Cell in the Ministry.***
c. ***Delegation of the action on monitoring reports of Category 'B' projects to SEIAA as per the***

Notification no. SO 637 (E) dated 28th February 2014.

d. Evolving a mechanism for online maintenance of monitoring and compliance data with regard to Category-A and Category-B projects and integrating it with the existing PARIVESH portal of the Ministry."

6. *We have considered the above averments as well as contents of annexures R-I and R-II giving data of the projects and 'six monthly action plan'. We are of the view that the mandate of law is not complied with by the above stand of the MoEF&CC.* ***It is well acknowledged that there is rampant violation of the Environmental Clearance (EC) conditions. This Tribunal has, in order dated 21.11.2019, noticed serious violations of EC conditions with respect to A Category 'housing projects' in Haryana and found monitoring of conditions of EC ineffective.[2] The said order also refers to earlier orders wherein similar serious violations have been noticed. The violations include absence of scientific management of sewage and solid waste, not having open spaces, illegal drawal of ground water, construction in excess of sanctioned plan etc. It is difficult to say such violations are limited to State of Haryana. In absence of adequate mechanism, such rampant violation are bound to continue defeating the environmental principle of precautionary and sustainable development. In this regard, it is apt to note that this aspect was considered by the Hon'ble Supreme Court in T.N. Godavarman Thirumulpad Vs. Union of India & Ors. (2014) 4 SCC 61. Reference was made to the observations in Lafarge Umiam Mining Private Limited Vs. Union of India, (2011) 7 SCC 338 that power of the regulator under Section 3(3) of the Environment (Protection) Act, 1986 is coupled with duty and that the monitoring mechanism for the clearance conditions was not satisfactory. The Hon'ble Supreme Court also referred to a report on 'Scope, Structure and Processes of National Environment Assessment and Monitoring Authority (NEAMA)' for the Ministry of Environment and Forests, Government of India prepared by Department of Management Studies, Indian Institute of Technology, Delhi. Therein it was found that there are huge gaps in monitoring and enforcement of clearance conditions which defeats the purpose of Environmental Clearance process***. *The said finding quoted in the judgment is as follows:*

> ***"Several studies have pointed toward the poor monitoring of the clearance conditions. Huge gaps in monitoring and enforcement of clearance conditions actually defeats the very purpose of grant of conditional environmental clearance."[3]***

[2] Order dated 21.11.2019, O.A. No. 506 / 2019, Mukund Dhote v. UOI & Ors.
[3] Para 10

7. ***We also note the observations from Report of the Comptroller and Auditor General of India on Environmental Clearance and Post Clearance Monitoring 2016 that there are shortfalls in monitoring of environmental parameters. Reasons for such shortfalls are inadequate staff, inadequate database, not assigning clear responsibility for post EC monitoring, absence of monitoring at regular intervals particularly for critically polluted areas.***

8. ***Thus, there is dire need for revamping the monitoring mechanism by MoEF&CC as well as SEIAAs, CPCB and State PCBs Post EC monitoring processes need revamping in quantitative as well as qualitative terms. There is need to prioritize the projects where potential environmental degradation is high on account of nature of activity as well as area being ecologically sensitive. In respect of such projects and in such areas, monitoring may have to be more intensive and at higher frequency. In no case frequency of monitoring should be less than once in a year.***

9. ***The present scenario of monitoring once in 4.5 years and planned modification resulting in monitoring in 2.5 years is farce and does not meet the requirement of law by any standards. As already observed monitoring has to be, as far as possible, quarterly and in no case less than twice a year.***

10. ***Data of environmental degradation in the form of air, water and soil pollution reflected in the form of 351 polluted river stretches, 122 non-attainment cities and 100 polluted industrial clusters is eloquent testimony of such degradation and failure of monitoring mechanism. Statistics of deaths and diseases on account of such degradation are well known and need not be elaborated here.***

11. ***On being asked, learned counsel for MoEF&CC is unable to even mention the percentage of compliance as according to him there is no such data available, which is shocking. With a view to plan such monitoring, the percentage of compliance must be ascertained. Trend over a period of time in terms of increase in compliance or otherwise must be studied so that there can be corresponding review of mechanism based on correct data. Experience so far shows that with the increasing developments, in absence of adequate monitoring mechanism it would be difficult to check such violations thereby defeating 'precautionary' principle.***

12. ***In view of the above, remedial action may be planned at the earliest. The plan should cover all the sub categories of projects, including B category.***

Monitoring mechanism needs a also to be evolved for SEIAAs, regional offices of the MoEF&CC and the regional offices of CPCB. Since these steps are inalienable constitutional obligations, steps need to be taken to suitably augment the requisite manpower in these establishments for effective monitoring by MoEF&CC, CPCB and SEIAAs.

13. There is no information about the result of steps taken in terms of 'six monthly action plan' so far. Making of such plan may be of no value unless it is resulting in improvement of the ground situation in terms of strengthening of monitoring, which is not shown to be happening. Expressing difficulties in improving the situation is not a solution. If there is an EC regime, compliance has to be monitored. The principle of Sustainable Development and the Precautionary principle, which have been held to part of 'Right to Life' require that EC conditions are fully complied.

14. No satisfactory mechanism exists at present, as shown by the above affidavit itself. It is stated that, at present, it takes 4.5 years for monitoring which means that for such long period the non-compliance continues making mockery of law. There has to be speedy monitoring and speedy action, wherever necessary. There has to be a robust plan for the purpose which is the responsibility of the concerned Government Departments. We place on record our disapproval for the present sorry state-of-affairs and expect meaningful improvement.

15. We are, thus, of the view that for meaningful monitoring, all Category A projects are monitored not less than twice in a year and all Category projects are monitored not less than once in a year.

*16. Let the Secretary, MoEF&CC and Chairman, CPCB hold a meeting with such other experts as may be found necessary and establish and/or augment the institutional setups in MoEF&CC, CPCB and SEIAAs for meaningful monitoring of Category A and B projects in the light of the above observations. Compliance report may be filed before this Tribunal by e-mail at judicial-ngt@gov.in by MoEF&CC and CPCB. The MoEF&CC may also furnish compliance status by SEIAAs.***"**

(emphasis supplied)

38. Similarly, vide order dated 11.01.2019 in *O.A. No. 95/2018, Aryavart Foundation vs. M/s Vapi Green Enviro Ltd. & Ors.*, following observations may be noted:

"*37. ..The SPCB has not shown that it took any stringent action as required which can act as deterrent against violation of pollution norms. Simply issuing notice has not brought about the desired results. No closures have been ordered, nor prosecution launched nor other adequate preventive and remedial measures, including assessment and recovery of damages taken. In this respect, there is failure of GPCB. We may only observe that even a regulatory authority may be held accountable if it colludes with polluters by being required to pay damages or errant officers being held liable for action, including prosecution.* ***Frequent failures of regulatory bodies need to be remedied for meaningful enforcement of environmental norms.*** *This Tribunal in Threat to life arising out of coal mining in South Garo Hills district Vs. State of Meghalaya & Ors.*[4]*, held that* ***State machinery is also required to compensate for their negligence and failure which may act as deterrent against the officers who neglected their basic duty of protecting the environment or colluded with the polluters and law violators. The polluters as well as colluding officers are to be made accountable not only by prosecution or closure of industry but also by assessing and recovering such damages for loss to the environment as it may not only compensate the environment or victims but also act as deterrent to prevent further damage****.*

38. It is well acknowledged that there is serious threat to the environment in this country. Studies show huge number of pollution related deaths and diseases[5]*. Any violation of laid down environmental norms has to be seriously viewed and sternly dealt with.*

39. It was in the year 1974 that the Water (Prevention and Control of Pollution) Act, 1974 was enacted after noticing that problem of pollution of rivers and streams had assumed considerable importance and urgency on account of growth of industries, threatening the sources of drinking water, the aquatic life and sources of irrigation. After considering the Expert Committee reports on the subject, the statutory framework was adopted giving enormous powers to the Pollution Control Boards (PCBs) for closure, prohibition or regulation of any industries operation or process as well as filing of complaints for prosecution. Minimum sentences have been laid down for violation of the norms. Polluter Pays Principle is an accepted norm

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[4] O.A. No. 110(T_{HC})/2012 Order dated 04.01.2019 para 28-29

[5] https://niti.gov.in/writereaddata/files/new_initiatives/presentation-on-CWMI.pdf- India ranks 120th in 122 countries in Water Quality Index as per Niti Ayog Report, https://www.thehindu.com/sci-tech/energy-and-environment/india-ranked-no-1-in-pollution-related-deaths-report/article19887858.ece- Most pollution-linked deaths occur in India, https://www.hindustantimes.com/india-news/delhi-world-s-most-polluted-city-mumbai-worse-than-beijing-who/story-m4JFTO63r7x4Ti8ZbHF7mM.html- Delhi's most polluted city, Mumbai worse than Beijing as per WHO; http://www.un.org/waterforlifedecade/pdf/global_drinking_water_quality_index.pdf- WHO Water Quality Index.

within the purview of regulatory regime. The statutory functions of the PCBs, include programs for prevention, abatement and control of pollution and exercise all incidental powers. The CPCB has powers to issue directions to the State Boards. Needless to say, that similar provisions have been made for protection of air quality under the Air (Prevention and Control of Pollution) Act, 1981 as well as for other environmental issues under the Environment (Protection) Act, 1986.

40. *As already noted, the SPCB is equally accountable for its failure and in appropriate cases can be prosecuted for conspiracy or collusion with other offenders causing pollution. The pollution cannot be allowed to be profitable activity and deterrent action must be taken wherever pollution is found so as to render causing of pollution unprofitable and unacceptable to prevent damage to the health and lives of the citizens. Any polluter must be subjected to heavy and deterrent economic sanctions. Unfortunately, this is not happening as expected for which failure the regulatory authority cannot disown their responsibility.*

41. ***We note that the State of Environment in the country, even as per official figures, is alarming. As many as 351 river stretches have been declared to be polluted by the CPCB. Vide order dated 20.09.2018 in Original Application No. 673/2018, News item published in 'The Hindu' authored by Shri. Jacob Koshy Titled "More river stretches are now critically polluted: CPCB", this Tribunal considered the issue of such polluted stretches and noticed the directions of the Hon'ble Supreme Court from time to time for stopping discharge of untreated sewage and effluents in water bodies. Such discharge causes serious diseases, including Cholera and Typhoid. Sewage treatment capacity was disproportionate to the sewage generated. As per some studies noted in the order, 75 to 80% water is polluted in India. Pollution of River Yamuna[6], Ganga[7], Hindon[8], Ghaggar[9], Sutlej and Beas[10], Son[11], Subarnarekha[12], Ami[13] were also noted. The States were directed to prepare action plans to make the water of the polluted river stretches atleast fit for bathing within six months from the dates of preparation of approved action plans. When the matter was reviewed on 19.12.2018, it was found that only 16 States had***

[6] Manoj Mishra Vs. Union Of India O.A. No. 6/2012 order dated 26.07.2018
[7] M.C. Mehta vs. Union of India O.A. No. 200/2014 order dated 06.08.2018
[8] Doaba Paryavaran Samiti vs. State of U.P. and Ors. O. A. No. 231/2014 Order dated 08.08.2018
[9] Stench Grips Mansa's Sacred Ghaggar River (Suo-Motu Case) and Yogender Kumar O.A. No. 138/2016 Order dated 07.08.2018
[10] Sobha Singh and Ors. Vs. State of Punjab and Ors. O.A. No. 916/2018 Order dated 14.11.2018
[11] Amarshakti vs. State of Bihar and Ors. O.A. No. 596/2016 Order dated 24.08.2018
[12] Sudarsan das vs. State of West Bengal and Ors. O.A. No. 173/2018 Order dated 04.09.2018
[13] Meera Shukla vs. Municipal Corporation, Gorakhpur and Ors. O.A. No. 116/2014 Order dated 25.10.2018

prepared action plans, most of which were not complete. The direction was issued for payment of environmental compensation per month by every State/UT for failure to prepare action plan and also to furnish Performance Guarantees for execution of the action plans within the stipulated time.

42. ***This Tribunal in News Item Published in "The Times of India' Authored by Shri Vishwa Mohan Titled "NCAP with Multiple timelines to Clear Air in 102 Cities to be released around August 15"[14] has dealt with the issue of 102 air polluted cities identified by the CPCB. Taking into account eminent threat to human health as a result of air pollution, this Tribunal directed all the States/UTs with non-attainment cities to prepare action plans for bringing down the standards of air quality within the prescribed norms within six months. The Tribunal further constituted the Air Quality Monitoring Committee to ensure implementation of such action plans. The CPCB and the SPCBs were entrusted with the responsibility to design a robust nation-wide ambient air quality monitoring program to strengthen the existing monitoring network.***

43. ***In re: Compliance of Municipal Solid Waste Management Rules, 2016[15], the Tribunal directed preparation of action plans for solid waste management consistent with the Solid Waste Management Rules, 2016 in view of the fact that as per annual report of the CPCB prepared in April 2018, most of the States were not complying with the statutory rules.***

44. ***As already noted earlier, this Tribunal considered the matter of polluted industrial clusters in News Item published in "The Asian Age" Authored by Sanjay Kaw titled "CPCB to rank industrial units on pollution levels" vide order dated 13.12.2018. It was noted that 43 industrial clusters in 16 States were identified as Critically Polluted Areas and 32 industrial clusters were categorized as Seriously Polluted Areas. In 2017-18, the number of identified polluted industrial clusters went upto 100. Accordingly, the Tribunal directed the State Pollution Control Board to finalize time bound action plan to restore the environmental quality as per the norms laid down by the CPCB and directed CPCB and SPCBs to take coercive measures against the violators on the basis of 'Precautionary Principle' and 'Polluter Pays Principle'.***

[14] Original Application No. 681/2018 Order dated 08.10.2018
[15] Original Application No. 606/2018 Order dated 31.08.2018

45. In Techi Tagi Tara Vs. Rajendra Singh Bhandari & Ors.[16], the Hon'ble Supreme Court noted that the State Pollution Control Boards (SPCBs) continued to be manned by persons not having expertise or professional experience. The State Governments were not able to appoint qualified, impartial, and politically neutral persons of high standing to the crucial regulatory posts. Political appointments were being made in blatant violation of Apex Court guidelines to debar favorable persons being appointed.[17] The appointments being made did not inspire the confidence of the people. The Hon'ble Supreme Court directed all the States to frame guidelines and recruitment rules within six months. It may be pertinent to lay emphasis on the following observations of the Hon'ble Supreme Court in the aforesaid judgment:

"Unless corrective measures are taken at the earliest, the State Governments should not be surprised if petitions are filed against the State for the issuance of a writ of quo warranto in respect of the appointment of the Chairperson and members of the SPCBs. We make it clear that it is left open to public spirited individuals to move the appropriate High Court for the issuance of a writ of quo warranto if any person who does not meet the statutory or constitutional requirements is appointed as a Chairperson or a member of any SPCB or is presently continuing as such."

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[16] (2018) 11 SCC 734 para 3-4, 28-34: The judgment takes into consideration various Committees appointed laying down guidelines for the functioning of SPCBs viz.,

(a) Bhattacharya Committee (1984) proposed that the structural organization of SPCBs should consist of technical services, scientific services, planning, legal services, administrative services, accounts, training cell and research and development.

(b) The Belliappa Committee (1990) - Recommended (i) introducing elaborate monitoring, reporting and organizational systems at the national level along with four regional centres and one training cell in each Board, (ii) effecting suitable changes in the Boards recruitment policy to enable them induct persons with suitable academic qualifications, and (iii) ensuring that the Chairman and Member-Secretary are appointed for a minimum of three years.

(c) The Administrative Staff College of India (1994) - Recommended, inter alia, that (i) the SPCBs be reoriented for implementing the instrument mix of legislation and regulation, fiscal incentives, voluntary agreements, information campaigns and educational programmes.

(d) The Menon Committee – Recommending that the State Governments should not interfere with recruitment policies of the SPCBs, especially where the Boards are making efforts to equip their institutions with more and better trained engineering and scientific staff.

[17] *Ibid*. The judgment notes the report of the Tata Institute of Social Sciences published in 2013 titled "Environmental Regulatory Authorities in India: An Assessment of State Pollution Control Boards" which stated about the appointments to the SPCBs that time and again across state governments have not been able to choose a qualified, impartial, and politically neutral person of high standing to this crucial regulatory post. The recent

appointments of chairpersons of various State Pollution Control Boards are in blatant violation of the Apex Court guidelines. The primary lacuna with this kind of appointment was that it did not evoke any trust in the people that decisions taken by an ex-official of the State or a former political leader, appointed to this regulatory post through what appeared to be a totally non-transparent unilateral decision. Many senior environmental scientists and other officers of various State Pollution Control Boards have expressed their concern for appointing bureaucrats and political leader as Chairpersons who they feel not able to create a favourable atmosphere and an effective work culture in the functioning of the Board.

46. In addition to this, the Parliamentary Standing Committee on Science and Technology, Environment and Forest, August 2012 in its recommendations on the working of the SPCBs was perturbed to note that the SPCBs were not performing their duties vigilantly and recommended that MoEF&CC must ensure proper and effective coordination between the CPCB and SPCBs and take necessary steps to make the Pollution Control Boards functional and ensure that the discharge their duties effectively and efficiently.[18]

47. During the hearing it was stated by the learned Counsel for the GPCB that guidelines in terms of Techi Tagi Tara (supra) have been issued and thus, the judgment has been complied with. However, he has not been able to dispute that the persons appointed are not having technical or professional qualifications or background as expected.

48. This Tribunal, on 20.07.2018, in Satish Kumar vs. U.O.I & Ors.[19] also observed that persons of judicial background may be required in key position in PCBs as several functions of the SPCBs are quasi-judicial.

49. The order of this Tribunal dated 07.08.2018 in Stench Grips Mansa's Sacred Ghaggar River (Suo-Moto Case)[20] noted that a task force must be constituted in every district and State to give reports on the environmental issues which should be published on the websites.

50. The Tribunal in the order on 08.08.2018 in Doaba Paryavaran Samiti Vs. State of U.P. & Ors.[21] noted that statutory authorities had miserably failed and were required to be held accountable for their failure.

51. In view of the fact clean environment, apart from other statutory provisions, is a mandate of Article 21 of the Constitution, causing of pollution having serious implications on health of the citizens cannot be accepted and no responsible authority could simply throw its hands in despair.[22]

52. Thus, there being far from satisfactory governance on the part of the SPCBs, as depicted by the compiled data, resulting in large number of deaths and diseases in the country, remedial measures are required. Lack of effective governance in the present case is patent from absence of

[18] Accessible at: http://164.100.47.5/newcommittee/reports/EnglishCommittees/Committee%20on%20S%20and%20T,%20Env.%20and%20Forests/230.pdf
[19] O.A No. 56 (THC) of 2013
[20] O.A. No. 138/2016 (T_{NHRC})
[21] O.A. No. 231/2014
[22] *Supra* note 18

steps for prosecution of the guilty persons or recovery of damages for restoration of the environment which is primary responsibility of the SPCB. Appointment process does contribute to such ineffectiveness.

53. There is, thus, urgent need to review the qualification and appointment procedure so as to realistically comply with the mandate of the judgment of the Hon'ble Supreme Court. There is also need to carry out performance audit of functioning of all the Pollution Control Boards and Pollution Control Committees in the country and to identify remedial steps required in manning and functioning of SPCBs and PCCs or otherwise. Unless strong effective regulatory regime is in place, and shortcomings identified and remedied to expect clean environment would be unrealistic and merely a dream."

(emphasis supplied)

39. Vide order dated 28.08.2019 in *O.A. No. 95/2018, Aryavart Foundation vs. M/s Vapi Green Enviro Ltd. & Ors.*, following observations may be noted:

"13. Report dated 10.07.2019 filed by the CPCB is on the subject of performance audit of the State PCBs/PCCs. The report merely ranks the PCBs/PCCs, without proper assessment of the functioning.

14. ***What is expected is performance audit on issues such as adequacy with regard to environmental monitoring, efficacy of regulatory setup/mechanisms, staffing both technical and scientific manpower, scientific equipments, logistics support, competence etc. rather than ranking the States. Let the same be done and state-wise reports submitted based on thorough analysis in terms of statutory functions. CPCB may devise an appropriate mechanism for the purpose. We also direct that all vacant positions in the SPCBs/PCCs may be filled up at the within four months and the Chief Secretaries of the States/UTs may ensure that there is no embargo in doing so, so that effective steps for protection of environment can be taken. It is also necessary to direct that the laboratories established by the SPCBs/PCCs, at headquarters as well as regional centers, are duly recognized for purposed of enforcement of environmental laws. The concerned authorities may take further steps accordingly. The CPCB may compile a report and file before the next date. SPCBs/PCCs may utilize the funds available with them, under EC/Consents or other heads instead of approaching other authorities and on that pretext***

not performing their essential function. The MoEF&CC may consider constituting an appropriate authority for the purpose with representatives from Central and State authorities on the pattern of Compensatory Afforestation Fund Management and Planning Authority (CAMPA) or otherwise. A compliance report be filed by the MoEF&CC before the next date.

….. … ….

Directions:

iii. Performance audit be done with reference to issues such as adequacy with regard to environmental monitoring, efficacy of regulatory setup/mechanisms, staffing both technical and scientific manpower, adequacy of laboratories and scientific equipments, logistics support, competence etc. rather than ranking the States and state-wise reports submitted along with recommendations based on thorough analysis in terms of statutory functions before the next date. CPCB may devise an appropriate mechanism for the purpose. CPCB and MoEF&CC may file a compliance report with reference to observations in para 14 above."

(emphasis supplied)

D. <u>Further Directions:</u>

40. In view of above, we issue following directions in the matter:

i. The amount of Rs. 50 crores deposited by the Company with the District Magistrate, Vishakhapatnam will stand appropriated towards part liability and interim compensation to be spent for restoration of the environment and compensation for victims in accordance with the restoration plan to be prepared.

ii. Restoration plan may be prepared by a Committee comprising two representatives each of MoEF&CC, CPCB and three representatives of State Government to be named by the Chief Secretary, including the District Magistrate, Vishakhapatnam and such other concerned Departments

within two months from today. MoEF&CC will be the nodal agency for the purpose.

iii. Final quantification of compensation may be assessed by a Committee comprising representatives of MoEF&CC, CPCB and NEERI. The said Committee will be at liberty to associate/co-opt any other expert institution or individual. The Secretary, MoEF&CC may ensure constitution of such Committee within two weeks from today. The Committee may give its report within two months thereafter. MoEF&CC will be the nodal agency for the purpose.

iv. The Chief Secretary, Andhra Pradesh may identify and take appropriate action against persons responsible for failure of law in permitting the Company to operate without statutory clearances within two months and give a report to this Tribunal

v. In view of the stand of the State PCB and the Company that it will not recommence its operation without requisite statutory clearances, we direct that if any such statutory clearances are granted and the Company proposes to recommence, this aspect must be brought to the notice of this Tribunal so that compliance of law is ensured.

vi. The MoEF&CC may also constitute an Expert Committee to suggest ways and means to revamp monitoring mechanism to check and prevent violation of environmental norms and preventing any such recurrence in future in any of the establishments dealing with hazardous chemicals. A special

drive may be initiated in this regard. An action taken report may be furnished within three months from today.

vii. This order will not prejudice any criminal or other statutory proceedings in accordance with law.

41. A copy of this order be sent to the Chief Secretary, Andhra Pradesh, MoEF&CC, CPCB, District Magistrate, Vishakhapatnam and NEERI by e-mail.

42. Reports may be furnished by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/OCR Support PDF and not in the form of Image/PDF.

List for further consideration on 03.11.2020.

Original Application No. 76/2020 (Earlier Original Application No. 68/2020 (SZ))
EAS Sarma vs. Union of India & Ors.

43. According to the averments in the application, the applicant is a former Secretary to the Government of India residing at Vishakapatnam. This application was filed on 07.05.2020 before the Southern Zone Bench of this Tribunal at Chennai with following prayers:

"i. Direct for immediate closure of the plant of respondent No.04.

ii. Direct the fixing of Responsibility of the officials of Respondent No.3 and direct further for action to be taken against them for permitting Environment Pollution in connivance with the Unit/Project Proponent-Respondent No.4

iii. Direct the Project Proponent-Respondent No. 4 to pay environmental damages for polluting the environment.

iv. Direct for setting up of a Committee for settling of claims of local inhabitants who are victims of the Pollution caused by unit-Respondent No.4"

Case of the applicant is that respondent no. 04 (L.G. Polymers India Pvt. Ltd.) was operating without requisite EC. During its operation, inherently dangerous gas called styrene (PVC gas) leaked resulting in death of about 10 persons and disease of about 1000 persons. The said company was thus liable to compensate the victims and the environment. The State PCB was negligent in permitting the unit to operate. The applicant relied upon newspaper reports and photographs.

44. The Southern Bench of this Tribunal took up the matter on 13.05.2020 and noted that this Tribunal was considering the issue in *suo moto* proceedings in O.A No. 73/2020. Accordingly, the Bench directed that the matter be referred to the Principal Bench for further action.

45. Since this present application does not raise any additional issue, it is not necessary to pass any further order at this stage. However, if it becomes necessary, further order will be passed later in due course.

List again on 03.11.2020.

Original Application No. 80/2020 (Earlier Original Application No. 73/2020 (SZ))
Centre for Wildlife and Environmental Litigation Foundation vs. Union of India & Ors.

46. This application also involves the same issue as *O.A 76/2020* with no additional issue or material.

List again on 03.11.2020.

Adarsh Kumar Goel, CP

Sheo Kumar Singh, JM

Dr. Nagin Nanda, EM

June 1, 2020
Original Application No. 73/2020
and other connected matters
DV

F.No.11/20/2020-HSMD
Government of India
Ministry of Environment, Forest and Climate Change
(HSM Division)

2nd Floor, Vayu Wing
Indira Paryavaran Bhawan
Jorbagh Road, New Delhi

Date: July 21, 2020

Office Order

Sub: Hon'ble NGT matter OA 73/2020 & connected matters related to Gas Leak incident at M/s LG Polymers Limited, Visakhapatnam (Andhra Pradesh) - Constitution of Committee(s) in compliance with order dated 01.06.2020 for 'Preparation of Restoration Plan' and 'Final Quantification of Compensation' - reg.

This refers to the chemical accident occurred at M/s LG Polymers India Pvt. Limited, Vishakhapatnam, Andhra Pradesh during early morning (around 2:45 AM) on intervening night of 06.05.2020 & 07.05.2020 due to leakage of Styrene gas. The Hon'ble National Green Tribunal had taken *suo moto* cognizance of the gas leakage incident on 08.05.2020 as per OA 73/2020 and other connected matters. The Hon'ble Tribunal, thereafter, constituted an Expert Committee and tasked it to look into various aspects of the incident including cause of failure, extent of damage, steps for compensation and remedial measures to prevent recurrence, and submit a report to it. The Expert Committee filed an interim report on 17.05.2020 and a detailed report was filed on 28.05.2020. The Hon'ble Tribunal, after considering the responses of various parties and report of Expert Committee, passed an order on 01.06.2020.

2. In pursuance of the orders dated 01st June 2020 of Hon'ble National Green Tribunal in OA No. 73/2020 (In re: Gas Leak at LG Polymers Chemical Plant in RR Venkatapuram Village, Visakhapatnam in Andhra Pradesh) & connected matters viz. Review Application No. 19/2020 of M/s LG Polymers India; OA No. 76/2020 (Earlier OA No. 68/2020 (SZ)) in the matter of EAS Sarma Vs Union of India & Ors.; OA No. 80/2020 (Earlier OA No. 73/2020 (SZ)) in the matter of Centre for Wildlife and Environmental Litigation Foundation Vs. Union of India & Ors., the Government of India, Ministry of Environment, Forest and Climate Change hereby constitutes the following Committee(s) (along with mentioned Scope of Work) for 'Preparation of Restoration Plan' and 'Final Quantification of Compensation', in terms of Hon'ble Tribunal's order dated 01.06.2020 and detailed report submitted to it by Expert Committee on 28.05.2020:

S. No.	Purpose	Committee and Scope of Work
1.	The Preparation of Restoration plan shall have two following two components: • Plan for Restoration of environmental media viz. air, water and soil quality	MoEF&CC Nodal Committee for Restoration Plan 1. Dr. S.C. Garkoti, Adviser, MoEF&CC, Chairman 2. Shri. A.K. Pateshwary, Director, IA (Industry-II), MoEFCC. 3. Dr. Prashant Gargava, Member Secretary, CPCB. 4. Additional Director, CPCB (handling matters related to chemical safety)....*to be nominated by Chairman, CPCB.* 5. Representative of APPCB... *to be nominated by Chief Secretary, AP.*

S. No.	Purpose	Committee and Scope of Work
	• Restoration and Compensation plan for damage to property, health, crops, livestock etc.	6. Representative of Chief Inspector of Factories, Govt. of Andhra Pradesh... *to be nominated by Chief Secretary, AP.* 7. District Magistrate (DM), Vishakhapatnam. 8. Dr. Dharmendra Kumar Gupta, Scientist-F/Director, HSM Division – Member Convener. <u>Sub-component 1 i.e. Plan for Restoration of Environmental Media viz. air water and soil</u> • CPCB, being the technical arm of MoEFCC advising on environmental pollution prevention as well as remediation related matters, is directed to submit a detailed 'Restoration Plan' to MoEF&CC, within the stipulated time frame of 2 months. • CPCB Expert Panel shall utilize the environmental compensation and damage assessment guidelines prepared by it along with the norms and methodology devised for considering damage for violation projects. • CPCB Expert Panel shall be at liberty to choose experts, if need be, in preparation of Restoration Plan. <u>Sub-component 2 i.e. Plan for Restoration and Compensation for damage to health, property, crops, livestock etc.</u> • A sub-committee, under the chairmanship of DM, Vishakhapatnam, is constituted comprising of representatives from APPCB/Environment/Factories/ Health/ Agriculture Department etc. • The Sub-Committee shall work out 'Compensation for Damage Assessment' in line with the suggestions/ recommendations made in report of the Expert Committee and submit a detailed 'Compensation Plan' to MoEFCC, within the stipulated time frame of 2 months. • The DM, Vishakhapatnam shall be at liberty to constitute a committee or choose experts, if need be, in preparation of a Compensation Plan. The plans submitted by DM, Vishakhapatnam and CPCB shall be reviewed/examined by MoEF&CC Nodal Committee for Restoration.
2.	Final quantification of compensation	<u>MoEF&CC Nodal Committee for Finalization of Compensation</u> 1. Dr. Prashant Gargava, Member Secretary, CPCB, Chairman. 2. Shri. Raghu Kumar Kodali, Scientist-F/Director, IA Division (Violation Projects), MoEF&CC. 3. Representative, CSIR-NEERI (*to be nominated by Director, CSIR-NEERI).* 4. Any other Co-opted Expert Member *(To be nominated)*

S. No.	Purpose	Committee and Scope of Work
		5. Dr. Dharmendra Kumar Gupta, Scientist-F/Director, HSM Division– Member Convener. The Committee shall consider the Consolidated Restoration-cum-Compensation Plan and finalize the plan including compensation. The Committee shall be at liberty to choose expert institutions or individual to finalize the quantification of compensation.

3. The other 'Terms of Reference' for the above mentioned Committees would be as under:

i. As far as possible, the Expert Panel/Committee(s) shall assess the compensation in line with the prevailing rules and guidelines of State Government/Central Government. However, it shall duly cover the suggestions/ recommendations made by NGT Expert Committee in its report w.r.t. restoration plan and compensation, and address the same in the final plan prepared by it.

ii. The Expert Panel/Sub-Committee shall be free to take references from various Committee/ Expert reports, which were duly constituted by various Central/ State Government agencies in reference to the gas leakage incident. However, the CPCB guidelines of environmental compensation and damage assessment and methodology devised for assessing damage to violation projects shall form the basis of arriving at environmental damage and compensation.

iii. The Sub-Committee of DM, Vishakhapatnam and CPCB Expert Panel shall submit a detailed report, as per Scope of work, within two months of the issue of this order.

iv. The MoEF&CC Nodal Committee shall examine/ review the plan(s) submitted by CPCB Expert Panel and DM, Vishkhapatnam and communicate its observations for improvement, if any, within 15 days of receiving reports from CPCB Expert Panel and Sub-Committee of DM. Vishakhapatnam.

v. The MoEF&CC Nodal Committee(s)/CPCB Expert Panel/Sub-committee shall be free to undertake site visits, if need be.

4 The SPCBs shall make necessary arrangement for field visits/ inspections of various locations identified by the MoEF&CC Nodal Committee(s)/CPCB Expert Panel/Sub-committees.

5. The Expert Panel/Sub-Committee shall furnish its report within two (2) months of the issuance of this order or as per directions issued by the Hon'ble NGT from time to time, if any.

6. Joint Secretary (IA-Monitoring) is requested to provide a compliance report on the aspect of revamp of monitoring mechanism as the Hon'ble Tribunal in its judgment dated 01.06.2020 has directed as follows:

.....The MoEF&CC may also constitute an Expert Committee to suggest ways and means to revamp monitoring mechanism to check and prevent violation of environmental norms and preventing any such recurrence in future in any of the establishments dealing with hazardous chemicals. A special drive may be initiated in this regard. An action taken report may be furnished within three months from today.....

7. The expenses towards TA/DA, for independent expert members, shall be as per the Government norms. All payments to be made as per the OM of the Department of Expenditure dated 12.04.2017 (or amended thereafter). The official members may claim TA/DA, if applicable, from their respective organizations.

8. The Integrated Finance Division, MoEF&CC has also concurred the above proposal vide E-135407/ AS&FA dated 20.07.2020 with the following conditions:

- TA/DA to non-official members, as and when nominated, will be regulated as per SR.190;
- Entitlement may be restricted to actuals.
- Relaxation for Air journey, if any, will be as per instruction issued in the Ministry.
- Air Tickets may be purchased directly from Airlines website/booking counters/office or authorized travel agents viz. M/s Balmer Lawrie & Company Limited, M/s Ashok Travels & Tours and IRCTC.
- Declaration of 'No conflict of interest certificate' may be obtained in respect of Non-Official members for adoption in the Committee for ensuring accountability.
- The nomination of Non-Official member(s) in the Committee may be submitted to IFD for concurrence along with the Bio-data of the proposed Member.
- No duplication in payment, and.
- Payment be made through e-transfer only.

9. This issues with the approval of Secretary (EF&CC).

21/7/20

(Dr. Dharmendra Kumar Gupta)
Scientist-F/Director(s)

To:

All Members (As per the list)

Copy for information to:
PS to MEFCC/ PPS to Secretary (EF&CC)/ PPS to AS (RSP)/ PS to JS (GM)/ IFD/ GC/ SO (HSMD)/ Guard file

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL,

PRINCIPAL BENCH, NEW DELHI

Original Application No. 73 of 2020 and connected matters viz. RA No. 19/2020; OA No. 76/2020 (Earlier OA No. 68/2020 (SZ)); OA No. 80/2020 (Earlier OA No. 73/2020 (SZ))

In re: Gas Leak at LG Polymers Chemical Plant in RR Venkatapuram Village Visakhapatnam in Andhra Pradesh

REPLY AFFIDAVIT ON BEHALF OF MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

MOST RESPECFULLY SHOWETH:

I, Dr. Dharmendra Kumar Gupta, currently working as Scientist- F/ Director in the Hazardous Substances Management Division of the Ministry of Environment, Forest and Climate

Change (MoEF&CC), New Delhi, do hereby solemnly affirm and state as under: -

1. That I, in my official capacity of Scientist-F/ Director, Hazardous Substances Management Division, MoEF&CC, New Delhi (who is one of the Respondents in the above mentioned matter), am fully conversant with the facts and circumstances of the case on the basis of official records available, and as such authorized and competent to swear this affidavit on behalf of MoEF&CC.

2. That, I submit at the very outset that the instant respondent denies each averment and/ or submission made by other respondents, which are contrary to, and inconsistent with the averments made and facts stated in the present reply. It is submitted that only those facts, which have been expressly admitted by the instant Respondent in the present reply, be considered as an official position on behalf of the MoEF&CC.

3. That, the affidavit is being filed by the answering respondent highlighting the following aspects:

i. Regulatory framework administered by it;

ii. Status of the actions undertaken in response to the directions of the Hon'ble NGT vide its order dated 01.06.2020 in consultation with other stakeholders; and

iii. Other associated actions taken/ under consideration of this Ministry related to the incident of Styrene gas leakage at M/s LG Polymers, Vishakhapatnam (hereafter referred as 'the industry').

4. That, the answering respondent craves leave and liberty to file additional as well as detailed Affidavit/ Counter Affidavit as may be required during the course of proceedings or as directed by the Hon'ble Tribunal in reference to the aforesaid application, as and when required.

Background

5. That, in the instant matter Hon'ble Tribunal took *suo moto* cognizance of a chemical (industrial) accident that occurred at M/s LG Polymers India Pvt. Limited

Vishakhapatnam, Andhra Pradesh during early morning (around 3:45 AM) on 07.05.2020 due to leakage of Styrene gas from one of the storage tanks. The unit used styrene gas as a raw material for its industrial operations.

6. That, life of 12 persons were lost during the accident period (i.e. from the time in the intervening night of 6th & 7th May, 2020 when the leakage started, till such time when the leakage was brought under full control) and 585 persons were hospitalized, besides causing loss of livestock and damage to environment. The State Govt. of Andhra Pradesh, District Administration, Vishakhapatnam and National/ State Disaster Response Force facilitated in evacuation of inhabitants up to a distance of 3 km radius.

MoEF&CC's Regulatory Framework

7. That, MoEF&CC is the nodal Ministry under Govt. of India mandated to take steps for pollution control and environmental conservation, among other things. To achieve its mandate, the MoEFCC administers various acts including Environment (Protection) Act, 1986.

8. That, two sets of rules have been notified to put in place a regulatory mechanism aimed at avoiding chemical accidents in industrial units viz. Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 [MSIHC Rules, 1989] and Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 [CAEPPR Rules, 1996]. Key responsibilities have been assigned to various State Government/ Central Government Departments under the provisions of MSIHC Rules, 1989 and CA(EPPR) Rules, 1996 with the objective to prevent major chemical accidents arising from industrial activities and limiting the effects of such accidents on human health and environment.

9. That, the MSIHC Rules, 1989 require the occupier to provide necessary information that is likely to cause major accidents and affect general public during a major accident at the site which include submission of information on usage/ storage/ manufacture of hazardous chemicals, seek approval of sites, prepare on-site emergency plan and safety reports, undertaking safety audits and mock-drills

etc. The occupier is required to comply with above mentioned rule provisions with concerned authorities designated under Schedule-5 of the rules.

10. That, to complement the provisions of MSIHC Rules, 1989, the CAEPPR Rules, 1996 provide statutory backup for setting up a Crisis Management framework and associated organizational support in the country. The Chemical Accidents (EPPR) Rules, 1996 envisage a Four-tier Crisis Management System in the country at the Central, State, District and Local levels. A Central Crisis Group has been constituted in compliance with Rule 3 under the chairmanship of Secretary (EF&CC). A Central Crisis Group Alert System i.e. Red Book has also been brought in compliance with Rule 4 to facilitate quick information exchange during chemical emergencies. The Red Book contains name, address and contact details of Central and State Nodal authorities, relevant national agencies/ institutes pertaining to chemical (industrial) disaster management. The Red Book is hosted on the website of MoEFCC and being updated regularly. A virtual crisis control

room is also set-up in the MoEFCC to coordinate with State Authorities during chemical (industrial) accident emergencies.

11. That, Styrene is listed at S.No. 583 of Part-II of Schedule 1 signifying it as a hazardous chemical. Further as per Schedule 4, the Polymerization operation/ process is identified as a notified 'industrial activity'. Hence, the operations of the industry fall under listed 'industrial activity' and the accident of styrene gas leakage qualified as a 'major accident' under MSIHC Rules, 1989.

12. That, the Ministry previously filed affidavit 14.05.2020 before the Hon'ble Tribunal in the matter mentioning the MSIHC Rules, 1989 and the CAEPPR Rule, 1996 provisions including division of responsibilities among various Central/ State Authorities as per the Schedule 5 of MSIHC Rules, 1989. It was also submitted before the Hon'ble Tribunal that among all authorities, the State Chief Inspector of Factories (CIFs) (appointed under the Factories Act, 1948) are the nodal agencies that have been assigned

responsibilities in line with their mandatory obligations under the Factories Act, 1948 for addressing issues related to operational safety. The role of Petroleum and Explosives Safety Organization (PESO), established under the Explosives Act, 1884, was also brought to the knowledge of the Hon'ble Tribunal, as the nodal agency to approve the sites of industrial installation and isolated storages with regard to hazardous chemicals. A copy of the Affidavit is attached for reference. ***[Annexure-A]***

Action by MoEF&CC

13. That, the Ministry, in its earlier affidavit, has mentioned the action undertaken by it which primarily comprised of follow-up and coordination with the concerned State Government Departments viz. Andhra Pradesh State Pollution Control Board, Directorate of Industrial Safety and Health (DISH)/ Chief Inspector of Factories as well as Central Pollution Control Board (CPCB). ***[Annexure-A]***

14. That, to contain the situation of gas leakage at the site of the industry, the MoEF&CC had convened the meeting of

Central Crisis Group (CCG), constituted under CA(EPPR) Rules, 1996 on 08.05.2020 under the Chairmanship of Secretary (EF&CC). During the meeting, suggestions were sought from all stakeholders, including chemical experts. The above fact has already been brought to the notice of Hon'ble Tribunal in previous affidavit. ***[Annexure-A]***

15. That, the Central Government i.e. MoEF&CC and other stakeholders *viz.* Central Pollution Control Board (CPCB), Department of Chemical and Petro-chemicals) and National Disaster Management Authority (NDMA) had issued advisories to the State Governments, from time to time, to comply with the regulations/ statutes already notified to ensure chemical safety. It was further advised to undertake measures to deal with issues arising out of operational safety and chemical accidents. ***[Annexure-B]***

Cognizance of matter/ Order by Hon'ble Tribunal

16. That, the Hon'ble NGT took *suo motu* cognizance of the styrene gas leakage incident on 08.05.2020 and

constituted a 6-member Committee comprising of the following members:

a. Justice B. Seshasayana Reddy, Former Judge, A.P. High Court;

b. Prof. Ch V Rama Chandra Murthy, Former Vice Chancellor, Andhra University, Vizag;

c. Professor Pulipati King, Head of Chemical Engineering Department, Andhra University, Vizag;

d. Member Secretary, Central Pollution Control Board;

e. Director, CSIR-Indian Institute of Chemical Technology; and

f. Head, National Environmental Engineering Research Institute, Vizag

17. That, the Committee was asked to report the following:

i. The sequence of events;

ii. Causes of failure and persons and authorities responsible therefor;

iii. Extent of damage to life, human and non-human; public health; and environment – including, water, soil, air;

iv. Steps to be taken for compensation of victims and restitution of the damaged property and environment, and the cost involved;

v. Remedial measures to prevent recurrence;

vi. Any other incidental or allied issues found relevant.

The Committee was asked to visit the site and submit report on the above-mentioned points and was given liberty to take assistance of experts, individuals and institutions as may be considered necessary.

18. That, the Committee submitted its report to the Hon'ble Tribunal on 28.05.2020, which was duly considered. Based on the report, the Hon'ble tribunal passed further directions

and asked various Central/ State authorities to comply with the directions. The following directions were passed by Hon'ble Tribunal:

- *The amount of Rs. 50 crores deposited by the Company with the District Magistrate, Vishakhapatnam will stand appropriated towards part liability and interim compensation to be spent for restoration of the environment and compensation for victims in accordance with the restoration plan to be prepared.*

- *Restoration plan may be prepared by a Committee comprising two representatives each of MoEF&CC, CPCB and three representatives of State Government to be named by the Chief Secretary, including the District Magistrate, Vishakhapatnam and such other concerned Departments within two months from today. MoEF&CC will be the nodal agency for the purpose.*

- *Final quantification of compensation may be assessed by a Committee comprising representatives of MoEF&CC, CPCB and NEERI. The said Committee will be at liberty to associate/co-opt any other expert institution or individual. The Secretary, MoEF&CC may ensure constitution of such Committee within two weeks from today. The Committee may give its report within two months thereafter. MoEF&CC will be the nodal agency for the purpose.*

- *The Chief Secretary, Andhra Pradesh may identify and take appropriate action against persons responsible for failure of law in permitting the Company to operate without statutory clearances within two months and give a report to this Tribunal.*

- *In view of the stand of the State PCB and the Company that it will not recommence its operation without requisite statutory clearances, we direct*

that if any such statutory clearances are granted and the Company proposes to recommence, this aspect must be brought to the notice of this Tribunal so that compliance of law is ensured.

- *The MoEF&CC may also constitute an Expert Committee to suggest ways and means to revamp monitoring mechanism to check and prevent violation of environmental norms and preventing any such recurrence in future in any of the establishments dealing with hazardous chemicals. A special drive may be initiated in this regard. An action taken report may be furnished within three months from today.*

19. That, apart from the proceedings being heard in the matter of M/s LG Polymers, the Hon'ble tribunal has linked the following matters to be heard along with the matter of M/s LG Polymers being similar in nature i.e. cases related to chemical (industrial) accident:

The common issue requiring deliberations in all the mentioned cases was related to action taken by MoEFCC w.r.t. revamping of monitoring mechanism and action taken to ensure the safety of operations in industries dealing with hazardous chemicals.

Follow-up Action by MoEFCC

20. That, to comply with the order/ directions passed by Hon'ble Tribunal, the Ministry examined the order in detail and based on the core competencies and technical expertise available with various stakeholders, a methodology was devised to execute the work directed vide order dated 01.06.2020. Further, it was also noted that the orders of the Hon'ble Tribunal were challenged in the Hon'ble Supreme Court by M/s LG Polymers, and the apex Court, upon hearing the matter, had stayed the operation of Para 40 of the order for a brief period of time. Thereafter, in consultation with the legal cell of the MoEFCC, follow-up action was initiated in the matter.

W.r.t. 'Preparation of Restoration Plan' and 'Finalization of Compensation'

21. That, In pursuance of the orders dated 01st June 2020 of Hon'ble Tribunal in OA No. 73/2020 (In re: Gas Leak at LG Polymers Chemical Plant in RR Venkatapuram Village, Visakhapatnam in Andhra Pradesh) & connected matters viz. Review Application No. 19/2020 of M/s LG Polymers India; OA No. 76/2020 (Earlier OA No. 68/2020 (SZ)) in the matter of EAS Sarma Vs Union of India & Ors.; OA No. 80/2020 (Earlier OA No. 73/2020 (SZ)) in the matter of Centre for Wildlife and Environmental Litigation Foundation Vs. Union of India & Ors., the Competent Authority in the MoEF&CC i.e. Secretary (EF&CC) had approved the constitution of two Committee(s) for the purpose of 'Preparation of Restoration Plan' and 'Final Quantification of Compensation'. Both the Committees were given specific 'Scope of Work', in terms of Hon'ble Tribunal's order dated 01.06.2020. A copy of the 'Committee constitution order' dated 21.07.2020 is placed for reference of Hon'ble Tribunal. ***[Annexure-C]***

22. That, pursuant to the receipt of nominations from various agencies, the composition of the committees constituted by MoEF&CC was in line with the directions of the NGT, as follows:

Committee for 'Finalization of Restoration Plan'

- Dr. S. C. Garkoti, Adviser, MoEFCC - Chairman
- Shri A. K. Pateshwary, Director, IA (Industry-II), MoEFCC
- Dr. Prashant Gargava, Member Secretary, CPCB
- Shri Dinbandhu Gouda, Divisional Head (IPC-I) & Additional Director, CPCB
- Shri Bharat Sharma, Addl. Director and Incharge, CPCB Regional Directorate, Pune
- Shri A Ramchand, Chief Environmental Engineer, APPCB
- Shri D. Chandra Sekhara Varma, Director of Factories, Govt. of Andhra Pradesh

- Shri V. Vinay Chand, District Magistrate (DM), Vishakhapatnam

- Dr. Dharmendra K. Gupta, Director, HSM Division – Member Convenor

Committee for 'Finalization of Compensation'

- Dr. Prashant Gargava, Member Secretary, CPCB – Chairman

- Dr. Hemant Bherwani, Sr. Scientist, NEERI

- Shri Amardeep Raju, Addl. Director/ Scientist-E, MoEFCC (handling violation projects)

- Dr. Dharmendra K. Gupta, Director, HSM Division – Member Convenor

23. That, as per the order dated 21.07.2020, the work related to 'Preparation of Restoration plan' was sub-divided into two parts i.e. 'Plan for Restoration of environmental media viz. air, water and soil quality' and 'Plan for Restoration and Compensation plan for damage to property, health, crops,

livestock etc.' The CPCB *(technical arm of the MoEF&CC)* was made nodal agency for preparation of 'Plan for Restoration of environmental media viz. air, water and soil quality' and the District Administration headed by District Collector was made nodal agency for 'Plan for Restoration and Compensation plan for damage to property, health, crops, livestock etc.'.

24. That, the CPCB as well as District Administration, Vishakhapatnam was asked to submit respective 'Restoration Plans' to MoEFCC for compilation/ integration, review and examination, and based on the suggestions of the Committee constituted for 'Finalization of Restoration Plan' under the chairpersonship of Dr. Satish C. Garkoti, Adviser, MoEFCC, the plans shall be finalized.

25. That, after the preparation of a 'Final Restoration Plan', the Committee constituted for 'Finalization of Compensation' under the chair-personship of Dr. Prashant Gargava, Member Secretary, CPCB shall consider the consolidated Restoration-cum-Compensation Plan and finalize the

compensation on certain criteria (to be arrived), and make its recommendations to the MoEFCC, which shall be further submitted to Hon'ble Tribunal for its perusal.

26. That, the First (1st) meeting of the Committee constituted for 'Preparation of Restoration Plan' was convened under the chairmanship of Dr. Satish C. Garkoti, Adviser, MoEFCC on 17.08.2020 at 3 P.M. through video-conferencing. All the members of the Committee attended/ represented in the meeting. The Committee in its deliberations discussed the technical aspects with regard to the availability of technical/ scientific data available w.r.t. pollution of environmental media as well as need for further data collection. The Committee also deliberated on the extent of area to be covered for preparation of restoration plan as well as identify the compensation coverage. The Committee took cognizance of the fact that detail modelling/ technical studies have been carried out by the High Power Committee constituted by State Govt. of Andhra Pradesh, which has established that the impact zone is about 3kms of the unit, with majority of the impact in windward side. The

Committee also considered that in view of the expertise required for assessment of environmental damages and preparation of the restoration plan for air, water, soil components, CPCB may onboard CSIR-NEERI. The Minutes of the said meeting are annexed.***[Annexure-D]***

27. That, CPCB vide its letter dated October 09, 2020 had informed that it has initiated the process of on-boarding CSIR-NEERI and awarded a project to CSIR-NEERI with the following objectives:

- To collect and analyse the baseline and post impact data of air, water and soil pollution parameters
- To collect data related to population impact due to the leak
- To collate and finalize various economic methods which can be utilized for monetary damage assessment

- To collect data for primary assessments related to economic assessments and utilization of econometric tools for finalization normalized value

- To compute environmental damages in monetary terms

- To assess existing environmental quality data for air, water soil

- To monitor ambient air quality, surface water, ground water and soil within the industry and in surrounding villages within 3 km region for styrene

- To assess the microbiological diversity (bacteria and fungi) of soil within and surrounding villages (within 3 km) of industry

- To collect primary health and secondary health data from the primary health centers (PHCs)/ hospitals and personal questionnaire data on human health in the study area

- To assess the impacts on environmental media w.r.to air, water and soil due to the uncontrolled Styrene vapor release

- To prepare a Plan for Restoration of Environmental Media viz. air, water and soil quality. ***[Annexure-E]***

28. That, the representative of APPCB, vide email dated 18.09.2019 had informed that the District Collector, Vizag has constituted a sub-committee for preparation of restoration and Compensation plan for damage to property, Health, Crops, Livestock etc. The sub-committee met on 14.09.2020 requested for 15 days more time for submitting the report. ***[Annexure-F]***

29. That, vide letter dated 19.10.2020 (Received on 28.10.2020), the District Collector, Vizag submitted the Report on 'Restoration and Compensation Plan for damage to health, property, crops, livestock etc. (Sub Component-2) to the Ministry of Environment Forest and Climate Change. ***[Annexure-G]***

30. That, the first (1st) meeting of the MoEFCC Nodal Committee constituted for 'Finalisation of Compensation' was convened under the chairmanship of Dr. Prashant Gargava, Member Secretary, CPCB on 10.09.2020 at 11 A.M. During the deliberation, the Committee noted that finalizing the compensation is a follow-up activity and can be undertaken once the 'Final Restoration Plan' is in place. The Committee also noted that for finalization of compensation specific skill, expertise would be required, and hence, independent experts can be on-boarded to support and guide the Committee. During the meeting, CPCB and CSIR-NEERI informed that the study would take at least five (5) months to complete. In view of the time required for completion of activities, the Committee further asked MoEF&CC to seek additional time from the Hon'ble Tribunal. ***[Annexure-H]***

<u>W.r.t. revamping of monitoring mechanism</u>

31. That, requisite inputs were sought from IA (Monitoring) Division of MoEF&CC w.r.t. revamping of monitoring

mechanism and applicability of M/s LG Polymers. It was conveyed that the unit falls in Category 'A' under the EIA Notification, 2006. The unit had been operating without EC and the company has applied for EC in 2018 to the SEIAA under the 'Violation ' category. As per the Hon'ble Tribunal Order dated 01.06.2020, 'Failure of Monitoring mechanism' was one of the issue under consideration. It is further, submitted that this Ministry is handling the revamping of monitoring mechanism in OA No 837 of 2018 in the matter of Sandeep Mittal vs UoI and the same is under formulation.

W. r. t. consideration of EC of M/s LG polymers by MoEF&CC

32. That, requisite inputs were sought from IA (Violation) Division of MoEF&CC handling EC related case of LG Polymers. It was conveyed that, under the Environment (Protection) Act, 1986 read with Environment (Protection) Rules, 1986, Ministry of Environmental Forest and Climate Change has issued a Notification number S.O. 1533(E) dated 14.09.2006**.** **U**nder the provision of the EIA

Notification, 2006*, all new projects or activities listed in the Schedule to the EIA Notification 2006* or *the expansion or modernization of existing projects or activities listed in the Schedule to the EIA Notification 2006 with addition of capacity beyond the limits specified for the concerned sector, that is, projects or activities which cross the threshold limits given in the Schedule, after expansion or modernization* or *any change in product –mix in an existing manufacturing unit included in Schedule beyond the specified range*, shall be undertaken, only after receipt of the prior environment clearance from the Central Government (Ministry of Environment, Forest and Climate Change) or by the State Level Environment Impact Assessment Authority ("SEIAA"), as the case may be. It is submitted that, the Central Government under sub section (3) of section 3 of the Environment (Protection) Act, 1986, in accordance with the procedure specified in the EIA Notification, 2006, duly constitutes SEIAA in the States.

Categorization of Projects and activities: -

33. All projects and activities are broadly categorized into two categories- Category A and Category B, based on the spatial extent of potential impacts and potential impacts on human health and natural and man-made resources.

    All projects and activities included as Category 'A' in the Schedule, including expansion and modernization of existing projects or activities and change in product mix, shall require prior environmental clearance from the Central Government in the Ministry of Environment and Forests (MoEF) on the recommendations of an Expert Appraisal Committee (EAC) constituted by the Central Government for the purpose of this notification.

34. All projects or activities included as Category 'B' in the Schedule, including expansion and modernization of existing projects or activities, but excluding those which fulfil the General Conditions (GC) stipulated in the Schedule, will require prior environmental clearance from the State/Union Territory Environment Impact Assessment Authority (SEIAA). The SEIAA shall base its decision on the

recommendations of a State or Union Territory Level Expert Appraisal Committee (SEAC). In the absence of a duly constituted SEIAA or SEAC, a Category 'B' project shall be considered at the Central Level.

35. That, under the provisions of the EIA Notification, 2006, Environment Clearance for Petrochemical based processing (process other than cracking reformation and not covered under the complexes) are covered under entry 5 (e) of the Schedule to the EIA Notification, 2006. The entry 5(e) of the Schedule of EIA Notification 2006 provides as follows;

	Project or Activity	Category with threshold limit		Conditions, if any
		A	B	
5	**Manufacturing/Fabrication**			
(1)	(2)	(3)	(4)	(5)
5 (e)	Petroleum products and	Located outside the	Located in a notified	General as well as

	petrochemical based processing such as production of carbon black and electrode grade graphite (process other than cracking & reformation and not covered under the complexes)	notified industrial area/estate	industrial area/ estate.	specific condition shall apply. Note: Manufacturing of products from polymer granules is exempt

36. It is submitted that the projects or activities or the expansion or modernization of existing projects or activities requiring prior environmental clearance under the Environment Impact Assessment Notification, 2006 entailing capacity addition with change in process or technology or both undertaken in any part of India without obtaining prior environmental clearance from the Central Government or by the State Level Environment Impact Assessment Authority, as the case may be, duly constituted by the Central Government under sub-section (3) of Section 3 of the said Act, shall be considered a case of violation of the Environment Impact Assessment Notification, 2006. The Ministry of Environment Forest and Climate Change (MOEF&CC) issued Notification S.O 804 (E) dated 14.03.2017 to bring such projects and activities (case of violation) in compliance with the environmental laws at the earliest point of time, rather than leaving them unregulated and unchecked, which will be more damaging to the environment.

37. It is further submitted that the MOEF&CC Vide Notification dated 14.03.2017 opened a window of 6 months (14.03.2017 to 13.09.2017) and further one-month window (14.03.2018 to 13.04.2018) in compliance to Hon'ble High Court of Madras order dated 14.03.2018 for the projects which failed to obtain prior environmental clearance in accordance with EIA Notification, 2006.

38. That, M/s. LG Polymers India Private Limited located at Sy. No.s 29 to 45, 83/1 and 83/3, Industrial Zone, RR Venkatapuram Village, Pendurti Mandal, Visakhapatnam District, Andhra Pradesh, had undergone expansion of the existing unit without obtaining prior Environmental Clearance. M/s. LG Polymers India Private Limited had filed the application to SEIAA, seeking Environmental Clearance under Ministry's Notification S.O. 804 (E) dated 14.03.2017. Application was submitted to SEIAA on 12.04.2018 as Category B project (Proposal No. SIA/AP/IND2/24594/1900) covered under item 5 (e) of the Schedule to the EIA Notification, 2006.

39. M/s. LG Polymers India Private Limited submitted the proposal to SEIAA for manufacturing of Polystyrene and Expandable polystyrene. Proposal was considered by the SEAC and SEIAA in the 128th and 120th meetings, respectively.

40. The project proponent (M/s. LG Polymers India Private Limited) in the said meetings informed that they have filed their application to the SEIAA, Andhra Pradesh instead of filling to the MoEF&CC as their project comes under Category 'A' and requested to transfer the file to MoEF&CC. The SEIAA recommended transferring this proposal to the MoEF&CC, Government of India, New Delhi for further processing. Accordingly, SEIAA vide letter dated 07.01.2020 transferred the proposal to the Ministry, which was received in the Ministry in March 2020. Proposal was considered on 19.05.2020 in 33rd meeting by the Expert Appraisal Committee (EAC), constituted for regularization of proposals submitted under violation of EIA Notification, in terms of the provisions of the Notification dated 14.03.2017.

41. EAC in the said meeting after detailed deliberations and thorough examination of the proposal, recommends the instant proposal to be deferred till the outcome of Hon'ble NGT, Hon'ble High Court of AP and reports of Committees constituted by NGT, MOEFCC, Govt. of AP, NDRF, CPCB, NDMA and NEERI is made available to the committee for facilitating proper appraisal of the project which will be restricted to existing production capacity (415 TPD) being operated without prior Environmental Clearance

<u>W.r.t. addressing safety related issues in industries handling hazardous chemicals</u>

42. That, apart from the directions given by the Hon'ble Tribunal, the MoEF&CC has been examining the recommendations of the High Power Committee (HPC) constituted by State Govt. of Andhra Pradesh. A representative was also nominated in this regard to the HPC on behalf of MoEFCC/ CPCB. The HPC covered four aspects in its recommendations viz.

    i. About operation of M/s LG Polymers;

ii. Technical suggestions regarding Styrene industries;

iii. *Technical suggestions regarding Hazardous Chemical Industries; and*

iv. *Technical suggestions regarding Hazardous Chemical Industries located close to Residential areas/habitations*, besides other suggestions. The summary of recommendations w.r.t. above four aspects is also attached. ***[Annexure-I]***

43. That, it is submitted that while the stakeholders have been engaged in the coordinating the matters related to M/s LG Polymers, Vishakhapatnam and other accident issues, the ongoing pandemic situation coupled with restrictions on meetings/ movements/ work from home directions/ COVID infections in the work-space, has severely impacted the normal conduct of business. In such ongoing scenario, the pace of execution of activities is also hampered. However, sincere efforts are made to not only comply with the directions of the Hon'ble Courts/ Tribunals but also handle

increasing number of accident cases and issues arising out of it.

44. That, after the incident of chemical accident (styrene gas leakage) at M/s LG Polymers, Vishakhapatnam, there has been a series of major/ minor chemical accidents across the country which has immensely increased the official coordination issues (like court matters/ RTI/ grievances etc.) to be dealt by the same set of officials/ agencies at Central/ State level.

45. That, in light of the foregoing and considering that the studies to be convened for preparation of 'Restoration plan' are highly skilled and technical, it is prayed that Hon'ble Tribunal may take a lenient view and **condone the delay in favor of stakeholder agencies for not meeting the deadlines prescribed vide order dated 01.06.2020**. However, considering that, the work has been going on and CSIR-NEERI has been on-boarded and District Agencies have also sought additional time, **Hon'ble Tribunal may like to grant additional time for completion of the rest**

of the activities and subsequent consideration of the 'Restoration Plan' by the committees constituted by MoEF&CC for finalizing the compensation. In the meantime, the Ministry would also deliberate on the recommendations of the HPC to make technical recommendations on the 'operation of industries dealing in hazardous chemicals'. The Hon'ble Tribunal shall be apprised about the action status and apprise the about the same.

46. That, in view of the aforementioned facts, circumstances and action initiated by MoEF&CC in coordination with other stakeholders, this Hon'ble Tribunal may kindly be pleased to pass appropriate order(s).

DEPONENT

VERIFICATION

I, the above named deponent do hereby verify that the contents of the above affidavit are true and correct on the basis of official

record maintained by the Respondent No. 1 in daily course of its business, no part of it is false and nothing material has been concealed there from.

Verified at ……..on this the ……..day of October, 2020.

DEPONENT

B-29014/IPC-I/ MSIHC/2020 May 08,2020

To

The Chairman
All State Pollution Control Board /Pollution Control Committee
(As per enclosed list)

Sub: Strict safety precautions to be taken before resuming operation of units – Reg.

Sir,

Some serious cases of chemical leakages, industrial mishaps have been reported recently. In view of this, all State Pollution Control Boards (SPCBs) and Pollution Control Committees (PCCs) should ensure immediate compliance of the following:

1) A proper safety and hazard audit should be undertaken by all units before resuming operation. The SPCB/PCCs shall direct all the units that manufacture, store or import hazardous chemicals to resume their operations after COVID 19 lockdown, only after they have taken adequate and necessary steps to prevent the occurrence of any chemical leakage / accident.

2) The SPCBs/PCCs shall ensure that pollution control equipment, connectivity of OCEMS with CPCB/SPCB servers, effluent treatment plants including safety equipment and it machineries shall be kept in good operable conditions before resuming operation in present COVID-19 situation.

3) The SPCBs/PCCs shall ensure that all the units shall take utmost care in handling hazardous chemical by using trained manpower.

4) The SPCBs/PCCs shall closely monitor the situation and ensure that the environmental norms are not violated by any unit.

5) The SPCBs/PCCs will direct all such units to ensure safety of workers and residents in vicinity.

6) The SPCBs/PCCs shall ensure that any unit involved in the Manufacture, Storage and Import of Hazardous Chemicals shall comply with the stipulated provisions of The Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 and The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 without fail.

Yours faithfully

(Ravi S. Prasad)
Chairman, CPCB

9c

ADDRESS LIST OF SPCBs/PCCs

S.N.	Address
1.	Andhra Pradesh State Pollution Control Board D.No. 33-26-14 D/2, Near Sunrise Hospital, Pushpa Hotel Centre, Chalmvari Street, Kasturibaipet, Vijayawada- 520010
2.	Arunachal Pradesh State Pollution Control Board 'ParyavaranBhavan', Yupla Road, PappuNallah, Naharlagun – 791110 Arunachal Pradesh
3.	Assam State Pollution Control Board Bamunimaidan, Guwahati – 781021 Assam
4.	Bihar State Pollution Control Board PariveshBhawan, Plot No.N-B/2, Patliputra Industrial Area Patna-800023
5.	Chhattisgarh Environment Conservation Board ParyavasBhawan, North Block Sector-19 NayaRaipur – 492 002 Chhattisgarh
6.	Goa State Pollution Control Board, Nr. Pilerne Industrial Estate, Opp. Saligao Seminary, Saligao - Bardez Goa - 403511
7.	Gujarat State Pollution Control Board Sector 10-A, Gandhi Nagar – 382043 Gujarat
8.	Haryana State Pollution Control Board C-11, Sector 6, Panchkula, Haryana 134109 Haryana
9.	Himachal Pradesh State Pollution Control Board ParyavaranBhavan, Phase III, New Shimla – 171009 Himachal Pradesh
10.	J&K State Pollution Control Board, Parivesh Bhawan, Shiekh-ul-Campus, behind Govt. Silk Factory, Raj Bagh, Srinagar(J&K)

ADDRESS LIST OF SPCBs/PCCs

11.	Jharkhand State Pollution Control Board T.A Building, HEC Campus, P.O. Dhurwa Ranchi – 834004 Jharkhand
12.	Karnataka State Pollution Control Board ParisaraBhavan, 4th & 5th floors Church Street, Bangalore – 560 001 Karnataka
13.	Kerala State Pollution Control Board Plamoodu Junction, Pattam Palace P.O. Thiruvanathapuram – 695004 Kerala
14.	Maharashtra State Pollution Control Board Kalpataru Point, 3rd & 4th floors Sion Matunga Scheme Road No. 6 Opp. Cine Planet, Sion Circle, Sion (E), Mumbai 400 022 Maharashtra
15.	Madhya Pradesh State Pollution Control Board ParyavaranParisar, E-5 Arera Colony Bhopal – 462016 Madhya Pradesh
16.	Manipur State Pollution Control Board Lamphelpat, Imphal West D.C. Office Complex – 795004 Manipur
17.	Meghalaya State Pollution Control Board Arden, Lumpyngngad, Shillong – 793014 Meghalaya
18.	Mizoram State Pollution Control Board New Secretariat Complex, Khatla, Thlanmual Peng, Aizwal Mizoram- 796001
19.	Nagaland State Pollution Control Board Signal Point, Dimapur, Nagaland – 797112 Nagaland
20.	Odisha State Pollution Control Board ParibeshBhawan A-118, Nilakanta Nagar, Unit –VIII, Bhubaneshwar – 751012. Odisha

ADDRESS LIST OF SPCBs/PCCs

21.	Punjab State Pollution Control Board Nabha Road, ITI Rd, Adarsh Nagar, Prem Nagar, Patiala - 147001. Punjab
22.	Rajasthan State Pollution Control Board A-4 Institutional Area, JhalaneDungri Jaipur – 302004. Rajasthan
23.	Sikkim State Pollution Control Board State land Use & Environment Cell Govt. of Sikkim, Deorali, Gangtok, Sikkim
24.	Tamil Nadu State Pollution Control Board No. 76, Mount Salai, Guindy, Chennai - 600032. Tamil Nadu
25.	Telangana State Pollution Control Board ParyavaranBhavan A-3, Industrial Estate, Sanath Nagar, Hyderabad – 500 018. Telangana
26.	Tripura State Pollution Control Board PariveshBhawan Pt. Nehru Complex, Gorkhabasti P.O., Kunjaban, Agartala, West Tripura - 799 006. Tripura
27.	Uttarakhand Environment Protection & Pollution Control Board Gaura Devi Bhawan, 46 B IT Park Sahastradhara, Dehradun, Uttarakhand- 248001
28.	Uttar Pradesh State Pollution Control Board 3rd floor, PICUP Bhavan, VibhutiKhand, Gomti Nagar, Lucknow– 226010. Uttar Pradesh
29.	West Bengal Pollution Control Board, Paribesh Bhavan, 10A, Block-L.A., Sector III, Bidhan Nagar, Kolkata - 700 106
30.	Andaman & Nicobar Islands Pollution Control Committee Department of Science & Technology Dollyganj Van Sadan, Haddo P.O., Port Blair-744102 Andaman & Nicobar

ADDRESS LIST OF SPCBs/PCCs

31.	Chandigarh Pollution Control Committee ParyavaranBhawan Madhya Marg, Sector - 19 B, Chandigarh – 160019.
32.	Daman, Diu & Dadra Nagar Haveli Pollution Control Committee Office of the Deputy Conservator of Forests Moti Daman, Daman – 396220. Daman & Diu
33.	Delhi Pollution Control Committee 4th floor, ISBT Building, Kashmeri Gate, Delhi - 110006. Delhi
34.	Lakshadweep Pollution Control Committee Lakshadeweep Administration Department of Science, Technology & Environment Kavarati – 682555. Lakshadweep
35.	Puducherry Pollution Control Committee Department of Science, Technology & Environment Housing Board Complex, 3rd floor, Anna Nagar,Pondichery – 600 005

278612/2020/SECY OFFICE-MOEFCC

सचिव
भारत सरकार
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
SECRETARY
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

सत्यमेव जयते

आर पी गुप्ता
R P Gupta

D.O. No. 12/146/2019-HSM

June 21, 2020

Dear Chief Secretary/Administrator,

At the outset, I would like to express my concern on the damage to public life and property due to several chemical industrial accidents in recent past in various parts of the country.

2. In this regard, I would like to reiterate that a regulatory framework to deal with such issues is in the place vide the Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 [MSIHC Rules, 1989] and Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 [CAEPPR Rules, 1996]. The key objective of these rules is to prevent major chemical accidents arising from industrial activities and limiting the effects of such accidents on human health and environment.

3. The Department of Industrial Safety and Health/Office of Chief Inspector of Factories, of State Governments have been assigned the key responsibilities under the MSIHC Rules, 1989 including assisting the District Collector in preparation of an Off-site Emergency Plan.

4. In view of the present scenario wherein industries are now reopening after an extended period of lock-down, there is an urgent need to undertake preliminary assessment of the operations w.r.t. safety and maintenance aspects so that accident can be avoided. The NDMA has also brought 'Guidelines for restarting of manufacturing industries after an extended lockdown' for ensuring safe operation of industries

5. I would request you to ensure regular and periodic inspections of industrial and chemical sites. Safety audit and sharing of information with local authorities, must also be ensured. Regular filing of reports and stringent action against violations may be take. The relevant government departments, agencies and district administration should be vigilant and take all required steps to prevent such incidents and follow protocols and standard procedure as per rules.

6. I, therefore, urge you to utilize the above-referred mechanisms in managing the risks associated with operation of chemical industries and ensure close working of various authorities to avert possible chemical accident situations in the future.

Yours sincerely,

(R P Gupta)

To

All the Chief Secretaries of States and UT Administrators

इंदिरा पर्यावरण भवन, जोर बाग रोड़, नई दिल्ली-110 003, फोन : (011) 24695262, 24695265 फैक्स : (011) 24695270
INDIRA PARYAVARAN BHAWAN, JOR BAGH ROAD, NEW DELHI-110 003, TEL. :(011) 24695262, 24695265 Fax :(011) 24695270,
E-mail : secy-moef@nic.in, Website : moef.gov.in

F.No.11/20/2020-HSMD
Government of India
Ministry of Environment, Forest and Climate Change
(HSM Division)

2nd Floor, Vayu Wing
Indira Paryavaran Bhawan
Jorbagh Road, New Delhi

Date: July 21, 2020

Office Order

Sub: Hon'ble NGT matter OA 73/2020 & connected matters related to Gas Leak incident at M/s LG Polymers Limited, Visakhapatnam (Andhra Pradesh) - Constitution of Committee(s) in compliance with order dated 01.06.2020 for 'Preparation of Restoration Plan' and 'Final Quantification of Compensation' - reg.

This refers to the chemical accident occurred at M/s LG Polymers India Pvt. Limited, Vishakhapatnam, Andhra Pradesh during early morning (around 2:45 AM) on intervening night of 06.05.2020 & 07.05.2020 due to leakage of Styrene gas. The Hon'ble National Green Tribunal had taken *suo moto* cognizance of the gas leakage incident on 08.05.2020 as per OA 73/2020 and other connected matters. The Hon'ble Tribunal, thereafter, constituted an Expert Committee and tasked it to look into various aspects of the incident including cause of failure, extent of damage, steps for compensation and remedial measures to prevent recurrence, and submit a report to it. The Expert Committee filed an interim report on 17.05.2020 and a detailed report was filed on 28.05.2020. The Hon'ble Tribunal, after considering the responses of various parties and report of Expert Committee, passed an order on 01.06.2020.

2. In pursuance of the orders dated 01st June 2020 of Hon'ble National Green Tribunal in OA No. 73/2020 (In re: Gas Leak at LG Polymers Chemical Plant in RR Venkatapuram Village, Visakhapatnam in Andhra Pradesh) & connected matters viz. Review Application No. 19/2020 of M/s LG Polymers India; OA No. 76/2020 (Earlier OA No. 68/2020 (SZ)) in the matter of EAS Sarma Vs Union of India & Ors.; OA No. 80/2020 (Earlier OA No. 73/2020 (SZ)) in the matter of Centre for Wildlife and Environmental Litigation Foundation Vs. Union of India & Ors., the Government of India, Ministry of Environment, Forest and Climate Change hereby constitutes the following Committee(s) (along with mentioned Scope of Work) for 'Preparation of Restoration Plan' and 'Final Quantification of Compensation', in terms of Hon'ble Tribunal's order dated 01.06.2020 and detailed report submitted to it by Expert Committee on 28.05.2020:

S. No.	Purpose	Committee and Scope of Work
1.	The Preparation of Restoration plan shall have two following two components: • Plan for Restoration of environmental media viz. air, water and soil quality	MoEF&CC Nodal Committee for Restoration Plan 1. Dr. S.C. Garkoti, Adviser, MoEF&CC, Chairman 2. Shri. A.K. Pateshwary, Director, IA (Industry-II), MoEFCC. 3. Dr. Prashant Gargava, Member Secretary, CPCB. 4. Additional Director, CPCB (handling matters related to chemical safety)....*to be nominated by Chairman, CPCB.* 5. Representative of APPCB... *to be nominated by Chief Secretary, AP.*

S. No.	Purpose	Committee and Scope of Work
	• Restoration and Compensation plan for damage to property, health, crops, livestock etc.	6. Representative of Chief Inspector of Factories, Govt. of Andhra Pradesh… *to be nominated by Chief Secretary, AP.* 7. District Magistrate (DM), Vishakhapatnam. 8. Dr. Dharmendra Kumar Gupta, Scientist-F/Director, HSM Division – Member Convener. <u>Sub-component 1 i.e. Plan for Restoration of Environmental Media viz. air water and soil</u> • CPCB, being the technical arm of MoEFCC advising on environmental pollution prevention as well as remediation related matters, is directed to submit a detailed 'Restoration Plan' to MoEF&CC, within the stipulated time frame of 2 months. • CPCB Expert Panel shall utilize the environmental compensation and damage assessment guidelines prepared by it along with the norms and methodology devised for considering damage for violation projects. • CPCB Expert Panel shall be at liberty to choose experts, if need be, in preparation of Restoration Plan. <u>Sub-component 2 i.e. Plan for Restoration and Compensation for damage to health, property, crops, livestock etc.</u> • A sub-committee, under the chairmanship of DM, Vishakhapatnam, is constituted comprising of representatives from APPCB/Environment/Factories/ Health/ Agriculture Department etc. • The Sub-Committee shall work out 'Compensation for Damage Assessment' in line with the suggestions/ recommendations made in report of the Expert Committee and submit a detailed 'Compensation Plan' to MoEFCC, within the stipulated time frame of 2 months. • The DM, Vishakhapatnam shall be at liberty to constitute a committee or choose experts, if need be, in preparation of a Compensation Plan. The plans submitted by DM, Vishakhapatnam and CPCB shall be reviewed/examined by MoEF&CC Nodal Committee for Restoration.
2.	Final quantification of compensation	<u>MoEF&CC Nodal Committee for Finalization of Compensation</u> 1. Dr. Prashant Gargava, Member Secretary, CPCB, Chairman. 2. Shri. Raghu Kumar Kodali, Scientist-F/Director, IA Division (Violation Projects), MoEF&CC. 3. Representative, CSIR-NEERI (*to be nominated by Director, CSIR-NEERI).* 4. Any other Co-opted Expert Member *(To be nominated)*

S. No.	Purpose	Committee and Scope of Work
		5. Dr. Dharmendra Kumar Gupta, Scientist-F/Director, HSM Division– Member Convener. The Committee shall consider the Consolidated Restoration-cum-Compensation Plan and finalize the plan including compensation. The Committee shall be at liberty to choose expert institutions or individual to finalize the quantification of compensation.

3. The other 'Terms of Reference' for the above mentioned Committees would be as under:

i. As far as possible, the Expert Panel/Committee(s) shall assess the compensation in line with the prevailing rules and guidelines of State Government/Central Government. However, it shall duly cover the suggestions/ recommendations made by NGT Expert Committee in its report w.r.t. restoration plan and compensation, and address the same in the final plan prepared by it.

ii. The Expert Panel/Sub-Committee shall be free to take references from various Committee/ Expert reports, which were duly constituted by various Central/ State Government agencies in reference to the gas leakage incident. However, the CPCB guidelines of environmental compensation and damage assessment and methodology devised for assessing damage to violation projects shall form the basis of arriving at environmental damage and compensation.

iii. The Sub-Committee of DM, Vishakhapatnam and CPCB Expert Panel shall submit a detailed report, as per Scope of work, within two months of the issue of this order.

iv. The MoEF&CC Nodal Committee shall examine/ review the plan(s) submitted by CPCB Expert Panel and DM, Vishkhapatnam and communicate its observations for improvement, if any, within 15 days of receiving reports from CPCB Expert Panel and Sub-Committee of DM. Vishakhapatnam.

v. The MoEF&CC Nodal Committee(s)/CPCB Expert Panel/Sub-committee shall be free to undertake site visits, if need be.

4 The SPCBs shall make necessary arrangement for field visits/ inspections of various locations identified by the MoEF&CC Nodal Committee(s)/CPCB Expert Panel/Sub-committees.

5. The Expert Panel/Sub-Committee shall furnish its report within two (2) months of the issuance of this order or as per directions issued by the Hon'ble NGT from time to time, if any.

6. Joint Secretary (IA-Monitoring) is requested to provide a compliance report on the aspect of revamp of monitoring mechanism as the Hon'ble Tribunal in its judgment dated 01.06.2020 has directed as follows:

.....The MoEF&CC may also constitute an Expert Committee to suggest ways and means to revamp monitoring mechanism to check and prevent violation of environmental norms and preventing any such recurrence in future in any of the establishments dealing with hazardous chemicals. A special drive may be initiated in this regard. An action taken report may be furnished within three months from today.....

7. The expenses towards TA/DA, for independent expert members, shall be as per the Government norms. All payments to be made as per the OM of the Department of Expenditure dated 12.04.2017 (or amended thereafter). The official members may claim TA/DA, if applicable, from their respective organizations.

8. The Integrated Finance Division, MoEF&CC has also concurred the above proposal vide E-135407/ AS&FA dated 20.07.2020 with the following conditions:

- TA/DA to non-official members, as and when nominated, will be regulated as per SR.190;
- Entitlement may be restricted to actuals.
- Relaxation for Air journey, if any, will be as per instruction issued in the Ministry.
- Air Tickets may be purchased directly from Airlines website/booking counters/office or authorized travel agents viz. M/s Balmer Lawrie & Company Limited, M/s Ashok Travels & Tours and IRCTC.
- Declaration of 'No conflict of interest certificate' may be obtained in respect of Non-Official members for adoption in the Committee for ensuring accountability.
- The nomination of Non-Official member(s) in the Committee may be submitted to IFD for concurrence along with the Bio-data of the proposed Member.
- No duplication in payment, and.
- Payment be made through e-transfer only.

9. This issues with the approval of Secretary (EF&CC).

24/7/20

(Dr. Dharmendra Kumar Gupta)
Scientist-F/Director(s)

To:

All Members (As per the list)

Copy for information to:
PS to MEFCC/ PPS to Secretary (EF&CC)/ PPS to AS (RSP)/ PS to JS (GM)/ IFD/ GC/ SO (HSMD)/ Guard file

'Records of Discussion' of the 1st meeting of the MoEFCC Nodal Committee constituted for Preparation of Restoration Plan in reference to the order passed by Hon'ble NGT in the matter of OA 73/2020 & connected matters related to Gas Leak incident at M/s LG Polymers Limited, Visakhapatnam (Andhra Pradesh)

A meeting of the MoEFCC Nodal Committee constituted for Preparation of Restoration Plan was convened under the chairmanship of Dr. Satish C Garkoti, Sceintist 'G', MoEFCC on 17.08.2020 at 3 P.M. through video-conferencing. All the members of the Committee attended the meeting in person, except Shri V Vinay Chand, District Magistrate, Vishakhapatnam, who was represented by the Joint Collector, Vishakhapatnam. The followings were present:

- Shri A. K. Pateshwary, Director, IA (Industry-II), MoEFCC
- Shri R Govinda Rao, Joint Collector (represented District Magistrate, Vishakhapatnam)
- Dr. Prashant Gargava, Member Secretary, CPCB
- Shri Dinbandhu Gouda, Divisional Head (IPC-I) & Additional Director, CPCB
- Shri Bharat Sharma, Addl. Director and In-charge, CPCB Regional Directorate, Pune
- Shri A Ramchand, Chief Environmental Engineer, APPCB
- Shri D. Chandra Sekhara Varma, Director of Factories, Govt. of Andhra Pradesh
- Dr. Dharmendra K. Gupta, Director, HSM Division – Member Convenor

2. At the outset, Chairman welcomed all the participants and meeting began with brief round of introduction. The Chairman also informed that this meeting is convened to get status update from the sub-committees constituted under the order dated 21.07.2020, wherein Central Pollution Control Board (CPCB) and State Government (District Magistrate, Vishakhapatnam) were directed to submit detailed plan to MoEFCC w.r.t. restoration of environmental media viz. air, water and soil and restoration and compensation plan with regard to the damages done to health, property, crops, livestock etc.

3. The Committee took note of the fact that after the incident of gas release many agencies like National Disaster Response Force (NDRF), National Environmental Engineering Research Institute (CSIR-NEERI), Andhra Pradesh Pollution Control Board (APPCB), Department of Industrial Safety and Health (DISH) etc. have undertaken separate studies with regard to the incident. In addition, the Govt. of Andhra Pradesh had constituted a High Power Committee (HPC), who had prepared/ submitted a comprehensive report to the State Govt. along with Annexures. The floor was thereafter opened for discussion.

4. The APPCB representative informed that extensive field monitoring/ sample analysis was done by APPCB since the accident took place. A detailed report *(running into more than 300 pages)* was submitted to the court as well as HPC, which could form the basis of preparing an environmental restoration plan. The Member Secretary, CPCB informed that apart from APPCB, the CSIR-NEERI had also undertaken sampling and analysis work

during the incident. It was informed that the APPCB Zonal Office, Vishakhapatnam and CSIR-NEERI Office, Hyderabad had played a pivotal role during the initial sampling and monitoring phase and are well versed with the situation emerged after the incidence. It was, therefore, suggested to involve NEERI in the preparation of the plan for restoration of environmental media.

5. With regard to impact zone due to incidence, Dr Bharat Sharma, CPCB *(who also happened to be a nominated member of HPC on behalf of MoEFCC/ CPCB)* informed that the Experts from Andhra University had assessed the styrene gas impact zone through modelling. The modelling data indicated the impact zone as approximately 3 kms, wherein majority of impact was found in the windward side. It was further informed that the impact of styrene leakage in air has now been degraded; however, the monitoring done during the accident phase would be helpful in indicating the extent of its concentration in the ambient environment during that period. Similarly, samples of ground water, surface water and soil were collected by APPCB and CSIR-NEERI also. The Joint Collector represented the office of DC, Vishakhapatnam during the meeting informed that they are in the process of undertaking the assigned task.

6. Dr. Dharmendra K. Gupta, Director and Member Convenor emphasized that Hon'ble NGT had given the task of preparation of restoration plan to a group of agencies considering the need/ requirement of expertise and adequate coordination among them. The Ministry, after careful examination of the task to be performed, had decided to assign roles to various agencies based on their core-expertise. However, to further support the identified agencies, provisions have been made to rope-in other experts, if needed, for preparation of restoration plan. The Committee noted that while the plan was to be prepared within two months; it is apparent that activities are yet to be started by agencies. With specific submission of CPCB regarding the need to on-board CSIR-NEERI (an expert agency) for the task, the Chair informed that CPCB can suitably look in to it, as provisions have already been made in the order dated 21.07.2020, issued by the Ministry with the approval of Secretary (EF&CC).

The meeting ended with vote of thanks to and from the Chair.

*****

Email/Speed Post

B-29016/CPCB/IPC-I/ October 09,2020

To

Dr Shaik Basha, Scientist & Head
CSIR-NEERI Zonal Center
CSIR-National Environmental Engineering Research Institute
IICT Campus, Tarnaka,
Hyderabad-500007
Telangana

Sub: Award of Work to NEERI "Assessment of Environmental Damages and Preparation of restoration plan for air, water and soil environment due to styrene gas leakage incident at Visakhapatnam" in the Hon'ble NGT matter OA 73/2020 – regarding

Ref: Email dated October 01,2020

Sir,

The undersigned is pleased to inform you that the Competent Authority of the Central Pollution Control Board has accorded approval of project on "**Assessment of Environmental Damages and Preparation of restoration plan for air, water and soil environment due to styrene gas leakage incident at Visakhapatnam"** to NEERI, Hyderabad with a cost of ₹ 54,51,900/- (Fifty-four lakhs fifty-one thousand nine hundred) plus GST as **Grant in Aid** (GIA) basis.

You are, hereby requested to start the study/project work, immediately, in co-ordination with all the stakeholders and submit two signed copies of the "Memorandum of Understanding" along with "Integrity Pact", to the undersigned.

Yours faithfully

9/10/20

(Dinabandhu Gouda)
Additional Director & DH-IPC-I Division

Copy to

1. Dr Dharmendra Kumar Gupta, Director (Scientist-F)
   Hazardous Substances Management Division
   Ministry of Environment, Forest and Climate Change
   Indira Paryavaran Bhawan,
   Jorbagh Road, New Delhi - 110003
2. The Regional Director (Chennai),
   Central Pollution Control Board,
   77-A, Second Floor
   South Avenue Road,
   Ambattur Industrial Estate,
   Ambattur Taluk, Thiruvallur District,
   Chennai - 600 058
3. DH- F&A Division, CPCB

9/10/20

(Dinabandhu Gouda)

Project Proposal

Assessment of Environmental Damages and Preparation of restoration plan for Air, Water and Soil Environment due to styrene gas leakage incident at Visakhapatnam

For
Central Pollution Control Board (CPCB)

CSIR-National Environmental Engineering Research Institute (NEERI)
(Council of Scientific and Industrial Research)
Nagpur & Hyderabad Zonal Center (HZC)

September 17, 2020

Assessment of Environmental Damages and Preparation of restoration plan for Air, Water and Soil Environment due to styrene gas leakage incident at Visakhapatnam

Part A: Technical Component

1.0 Preamble

M/s LG Polymers India Pvt Ltd manufactures Expandable Polystyrene using Styrene (C_8H_8), Pentane (C_6H_{12}) and HCl as main raw materials. It merged with M/s Mc Dowell & Co. Ltd. of UB Group in 1978. It was taken over by LG Chem (South Korea), Hindustan Polymers was renamed as LG Polymers India Private Limited (LGPI) in July, 1997.

An accident occurred in M/s. L.G Polymers India Pvt Ltd, Visakhapatnam at 03:02AM on 07.05.2020. The company has stored styrene monomer in vertical MS storage tanks of 2500 KL and 3500 KL capacity provided with internal cooling system through refrigeration. From one storage tank of 2500 KL, styrene vapor has leaked and spread to surrounding villages of Venkatapuram, Padmanabhapuram, SC & BC Colony. An accident occurred in M/s. L.G Polymers India Pvt Ltd, Visakhapatnam at 03:02AM on 07.05.2020. The company has stored styrene monomer in vertical MS storage tanks of 2500 KL and 3500 KL capacity provided with internal cooling system through refrigeration. From one storage tank of 2500 KL, styrene vapor has leaked and spread to surrounding villages of Venkatapuram, Padmanabhapuram, SC & BC Colony.

The Hon'ble National Green Tribunal had taken *suo moto* cognizance of the gas leakage incident and constituted an Expert Committee and tasked it to look in to various aspects of the incident including causes of failure, extent of damage, steps for compensation and remedial measures to prevent recurrence and submit a report. The Expert Committee filed a detailed report on 28.05.2020. The Hon'ble Tribunal after

consideration of the responses of various parties and report of Expert Committee, passes an order on 01.06.2020.

In pursuance of the orders of Hon'ble NGT dated 01.06.2020, the Ministry of Environment, Forest and Climate Change (MoEFCC) constituted various committees on July 21, 2020. The 1st meeting of the MoEFCC Nodal Committee (constituted for the preparation of restoration plan for the incident occurred at LG Polymers) was held on August 17th, 2020, while the first meeting on Environmental Damages and Compensation held on 9th September 2020. In both the meetings, it was proposed in the meeting to engage CSIR-NEERI for assessment of environmental damages and preparation of the restoration plan for air, water, soil components. In this regard, CPCB approached CSIR-NEERI, Nagpur and Hyderabad Zonal Centre to conduct environmental damages cost assessment and prepare a Plan for Restoration of Environmental Media viz. Air, Water and Soil. Accordingly, the following objectives and scope of work are proposed.

2.0 Objectives

Assessment of Environmental Damages in Monetary Terms

- To collect and analyse the baseline and post impact data of air, water and soil pollution parameters
- To collect data related to population impact due to the leak
- To collate and finalize various economic methods which can be utilized for monetary damage assessment
- To collect data for primary assessments related to economic assessments and utilization of econometric tools for finalization normalized value
- To compute environmental damages in monetary terms

- To assess existing environmental quality data for air, water soil
- To monitor ambient air quality, surface water, ground water and soil within the industry and in surrounding villages within 3 km region for styrene
- To assess the microbiological diversity (bacteria and fungi) of soil within and surrounding villages (within 3 km) of industry
- To collect primary health and secondary health data from the primary health centres (PHCs)/hospitals and personal questionnaire data on human health in the study area

- To assess the impacts on environmental media w.r.to air, water and soil due to the uncontrolled Styrene vapor release
- To prepare a Plan for Restoration of Environmental Media viz. air, water and soil quality.

3.0 Scope of Work & Methodology

The study will be carried out in two parts:

Part I: Assessment and prediction due to the LG Polymers incident as well as Assessment of Environmental Damages in Monetary Terms

Part III: Preparation of the restoration plan based on the assessment and prediction

Part – I:

Assessment and prediction due to the LG Polymers incident

3.1 Assessment of Air, Water and Soil Quality

Secondary data collection on ambient air, surface water, groundwater and soil quality within the study area will be made from available sources. The primary data on ambient air, surface water, groundwater and soil quality within the study area will be collected at identified locations.

A. Ambient air quality

- Collection of ambient levels of Volatile Organic Compounds (VOCs) and Styrene in the study area from the available resources like Report of the High Power Committee (HPC) constituted by Govt. of AP, Hon'ble National Green Tribunal (NGT) Report and primary data collected by different agencies like CSIR-NEERI and APPCB during the period immediately after the Styrene gas accident

B. Ground water/surface water Quality

- Collection of the existing groundwater data state groundwater board, CGWB and delineation of groundwater hydrology and geology based on secondary data will be carried out.

- Identification and establishment of available water bodies (surface as well as groundwater) existing in the study area around LG Polymers will be carried out.
- Groundwater/surface water and Sediment samples will be collected from the identified location for the physico-chemical parameters, DO, COD, BOD and heavy metals, oil & grease, styrene.
- Bioassay test of surface water samples to understand the level of toxicity
- Sediment remedial option will be addressed as most of the Styrene might have accumulated in the sediments of surrounding water bodies.

C. Soil quality

- Collection of Site specific data & surrounding study area information through observations/consultation during Reconnaissance Survey
- Collection of secondary data w.r.t soil types Topography, Soil profile, soil Map & Land use pattern of the study area from various departments.
- Soil sampling from different depths in the study area by soil boring/ excavation including in areas where contamination is expected (hot spots).
- Soil samples will be collected in the study region and analyzed for Styrene and Physico- Chemical Parameters viz. pH, Conductivity, Porosity, available NPK, water holding capacity, soil texture, organic matter and trace elements (As, B, Ba, Cd, Co, Cr, Cu, F, Fe, Hg, Mn, Ni, Pb, Zn)
- Soil remedial option also will be delineated if Styrene or its metabolites still persists in the soil matrix

D. Soil microbial diversity

- The structure of soil microbial composition will be studied and the diversity of beneficial (such as nitrogen fixers, phosphate solubilizers, etc) and harmful microbial flora (pathogens) will be analyzed.
- Styrene resistant or Styrene degrading strains if identified, will be mass cultivated for soil and sediment cleanup activities.

3.2 Predictive Assessment due to the accident

- Impacts on ambient air quality due to the styrene accident over the study area will be assessed based on the results of modeling studies and impact zone in

terms of the threshold values given in the report of the High Power Committee (HPC) constituted by Govt. of AP

- Impacts on surface and ground water bodies in the study area
- Impact on soil environment and soil microbial diversity by soil characterization w.r.t physico chemical and Microbial properties.

3.3. Assessment of Environmental Damages in Monetary Terms

Based on the baseline data generated in Part I, the assessment related to environmental impacts can be carried out. Following aspects shall be studied in terms of environment:

3.3.1 Air: The styrene gas leak would have created substantial disruption in terms of air quality. The same can be linked to various health impacts created in the region through survey and the reports which were generated during the time of accident. Impacts including but not limited to health, mortality, morbidity, aesthetics, infrastructure shall be assessed. Suitable economic methods such as contingent valuation method, value of statistical life and so on shall be used to arrive at the final economic damage. Suitable surveys may be designed to collect primary data related to morbidity, mortality, treatment and disability costs, if any.

3.3.2 Water Pollution: After establishing the baseline and post impact data, the assessment in terms pollution load discharged into the atmosphere can be valued using various methods such value transfer method, direct pricing method and/or contingent value method. The difference in terms of pollution parameters including BOD, COD, Nitrogen, Phosphorous and heavy metals can be valued using various economic methods.

3.3.3 Soil Pollution: Similar to water, assessment of monetary value of damages in soil can also be carried out,

3.3.4 Ecological Impact: In order to assess the damages in ecological environment, the impact on flora, fauna, microbial ecosystems is to be made evident for various tools to be used for economic valuation. National and international databases may be utilized to assess the services provided by the various affected ecological components and hence conduct the valuation.

Given above various approaches, it is important that detailed analysis in terms of impact measurement is done, as indicated in Part I, so that the actual load on environment can be established due to this accident. Once this is done, it becomes easier to calculate the attribution factors and apply economic methods for assessment of damages in monetary terms.

Part- II

Preparation of the restoration plan based on the assessment and prediction

3.4 Preparation of Restoration Plan

The restoration plan for air, water and soil will be prepared based on the assessment and prediction of the primary data. The restoration plan will be prepared based on the short term and long-term measures. The plan involved in the preparation of the restoration plan will be as follows:

i. Assessment of impacts on air, water and soil quality in the study area and delineation of mitigation measures in comparison with respective Indian National standards.
ii. Delineation of Plan for Restoration of Environmental Media viz. Air, Water and Soil Quality

Air Environment:

- Evaluation of adequacy of existing air pollution control equipment
- Implementation of WAYU/ambient air purification systems in and around the area for ambient air
- Suggestions on control of fugitive emissions at the source for styrene
- Risk mitigation and associated cost

Water Environment:

- Pump and treatment for deteriorated water quality
- Implementation of various treatment technologies like advanced oxidation processes etc for surface water

Soil/Ecological Environment:

- Identification and introduction of local species of flora and fauna for adaptation and green belt development
- As a short-term measure top layer contaminated soil, shall be carefully excavated and shall be disposed off at an authorized TSDF, in accordance with the prevailing hazardous waste management rules and regulations.
- Styrene-degrading bacteria could potentially be used in bioremediation of styrene pollution as a long-term measure
- Impacts on health, animals, microbial flora and vegetation

4.0 Reporting

Draft Report: Draft report will be submitted within 3 months after completion of field studies.

Final Report: Final report will be submitted within 1 month after receiving comments/ suggestions from CPCB, New Delhi on draft report.

5.0 Inputs by the Sponsor

Following information and assistance is required to be provided by the Sponsor:

- All the permissions/assistance for CSIR-NEERI staff to enter in to LG Polymers Industry and surrounding area during sampling work.
- Assistance from local APPCB office at Visakhapatnam in logistics during field studies
- Details of storage tanks like capacity, height, diameter, storage conditions, type of chemical stored, MSDS of chemicals, etc
- Hourly meteorological data collected at the site for past one year
- Any other information available that is in interest of use for conducting studies

6. Activity Gantt Chat

Activity	Month 01	Month 02	Month 03	Month 04
Reconnaissance Survey, identification of study area and collection of primary data on air, water and soil environment at identified locations				
Secondary data collection on ambient air quality, groundwater, soil and geology, bio-diversity and health from available resources				
Analysis of air, water and soil samples and assessment				
Assessment of impacts due to styrene accident on air, water and soil environment in the study area and interpretation with human health, vegetation and animals				
Monetary Evaluation of Environmental Impacts				
Preparation of plan for restoration of air, water and soil quality				
Draft and final report preparation				

Email **d.runiwal@gov.in**

APPCB - ZO - VSP - Hon'ble NGT matter O.A. 73/2020 - Restoration and Compensation plan for damage to property, Health, Crops, Live stock etc., - Extension of time for submission of report - Requested - Reg.

From : T.Rajendra Reddy JCEE <zovsp-jcee@appcb.gov.in> Mon, Oct 19, 2020 07:27 PM

1 attachment

Subject : APPCB - ZO - VSP - Hon'ble NGT matter O.A. 73/2020 - Restoration and Compensation plan for damage to property, Health, Crops, Live stock etc., - Extension of time for submission of report - Requested - Reg.

To : Dinesh Runiwal <d.runiwal@gov.in>

Cc : commissioner gvmc <commissioner_gvmc@yahoo.co.in>, jcvizagaw@gmail.com, Andhra Medical College <amc_vsp@nic.in>, jdahvizag@gmail.com, agrivis@gmail.com, factories dcifvskp <factories.dcifvskp@gmail.com>, dcifvskp@gmail.com, rdo vsp <rdo.vsp@gmail.com>,

adrnczone1983@gmail.com,
kghsuperintendent@gmail.com,
ccpgvmc@gmail.com,
collectorpeshivizag@gmail.com, RO Visakhapatnam <rovsp-ee1@appcb.gov.in>,
zovspappcb@gmail.com

Sir,

Please find the report of sub-committee constituted under the Chairmanship of the District Magistrate for preparation of 'Restoration and Compensation Plan for damage to health, property, crops, livestock etc.' (Sub Component-2) as per the Ministry of Environment, Forest and Climate Change(HSM Division), Government of India, office order dt: 21.07.2020 from the following link.

https://we.tl/t-jDjJqKn8R6

Submitted for favour of kind information and necessary action.

Regards,
Joint Chief Environmental Engineer,
A.P. Pollution Control Board,
Zonal Office, Visakhapatnam.

From: "Dinesh Runiwal" <d.runiwal@gov.in>
To: "T.Rajendra Reddy JCEE" <zovsp-jcee@appcb.gov.in>, jc1factoriesap@gmail.com
Cc: "Dharmendra Kumar Gupta" <gupta.dharmendra@gov.in>, collectorpeshivizag@gmail.com, "Member Secretary APPCB" <membersecy@appcb.gov.in>
Sent: Saturday, October 17, 2020 9:07:07 PM
Subject: Re: APPCB - ZO - VSP - Hon'ble NGT matter O.A. 73/2020 - Restoration and Compensation plan for damage to

property, Health, Crops, Live stock etc., - Extension of time for submission of report - Requested - Reg.

Sir,

Kindly refer trailing mails.

In this regard, it is requested to provide the copy of order issued by DM, Vizag, duly constituting the sub-committee; Minutes of the meeting held on 14.09.2020 and the status of work undertaken so far.

regards,
Dinesh Runiwal
Additional Director
MoEFCC

This may be treated on PRIORITY please.

From: "Dharmendra Kumar Gupta" <gupta.dharmendra@gov.in>
To: "Dinesh Runiwal" <d.runiwal@gov.in>
Sent: Monday, September 21, 2020 1:37:42 PM
Subject: Fwd: APPCB - ZO - VSP - Hon'ble NGT matter O.A. 73/2020 - Restoration and Compensation plan for damage to property, Health, Crops, Live stock etc., - Extension of time for submission of report - Requested - Reg.

This is the mail.....

From: "T.Rajendra Reddy JCEE" <zovsp-jcee@appcb.gov.in>
To: "Dharmendra Kumar Gupta" <gupta.dharmendra@gov.in>
Sent: Friday, September 18, 2020 1:25:47 PM
Subject: APPCB - ZO - VSP - Hon'ble NGT matter O.A. 73/2020 - Restoration and Compensation plan for damage to property, Health, Crops, Live stock etc., - Extension of time for submission of report - Requested - Reg.

Sir,

Your attention is invited to the Office order dt. 21.07.2020 issued in pursuance of the orders dt. 01.06.2020 of Hon'ble NGT in O.A. No. 73/2020 (Gas Leak at L.G. Polymers). In compliance to the office order dt. 21.07.2020 of MoEF & CC, the District Magistrate, Visakhapatnam District constituted a sub committee for preparation of plan restoration and Compensation plan for damage to property, Health, Crops, Live stock etc.,. As per the office order, the sub committee shall submit the report within two months from the date of issue of order. The sub committee during its review meeting held on 14.09.2020 requested for 15 days more time for submitting the report.

Hence, it is requested to kindly consider the request of the sub committee for giving 15 days more time for submitting the report.

With regards,
JCEE,
ZO-VSP.





District Collector Ltr 19.10.2020

140

619 KB

Report of the sub-committee constituted under the chairmanship of the District Magistrate, Visakhapatnam for preparation of **'Restoration and Compensation Plan for damage to health, property, crops, livestock etc.'** (Sub Component-2) as per the Ministry of Environment, Forest and Climate Change(HSM Division), Government of India, office order dt: 21.07.2020 issued in pursuance of the Order dated 01st June 2020 of Hon'ble National Green Tribunal in OA No. 73 of 2020 related to Gas leak incident at M/s.LG Polymers India Pvt. Ltd,, R.R. Venkatapuram Village, Visakhapatnam, Andhra Pradesh.



Submitted to

Ministry of Environment, Forest and Climate Change
(HSM Division), Government of India

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II. The Principal, Andhra Medical College, Visakhapatnam and District Medical and Health Officer, Visakhapatnam report dated 18.09.2020 - **(Annexure-II).** 17

III. The Joint Director of Agriculture, Visakhapatnam report dated 23.09.2020 - **(Annexure-III).** 67

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Preface

An accident of uncontrolled release of Styrene vapour occurred at M/s.LG Polymers India Pvt. Ltd, RR Venkatapuram Village, Pendurthi Mandal, Visakhapatnam District, Andhra Pradesh in the early hours of 7th May 2020 from one of the Styrene storage tanks. The hazardous Styrene vapours spread beyond the factory premises, affecting the populace of five villages / habitations leading to death of 12 persons and hospitalization of several citizens.

The Hon'ble National Green Tribunal had taken suo-moto cognizance of the gas leakage incident at M/s.L.G Polymers India Pvt. Ltd in R.R. Venkatapuram Village, Visakhapatnam in Andhra Pradesh on 08.05.2020 as per O.A No.73/2020 and other connected matters. The Hon'ble National Green Tribunal, thereafter constituted an expert committee and tasked it to look into various aspects of the incident including cause of failure, extent of damage, steps for compensation and remedial measures to prevent recurrence, and submit a report to it. The Expert Committee filed an interim report on 17.05.2020 and a detailed report was filed on 28.05.2020. The Hon'ble National Green Tribunal, Principal Bench, New Delhi passed an order on 01.06.2020 in OA No. 73 of 2020.

In pursuance of the directions in the Hon'ble NGT Order dt: 01.06.2020 in O.A No. 73 of 2020, the Ministry of Environment, Forest and Climate Change(HSM Division), Government of India, vide office order dated 21.07.2020, constituted the sub -committee under the chairmanship of District Magistrate, Visakhapatnam comprising of representatives from APPCB / Environment / Factories / Health / Agriculture Department etc for preparation of Restoration and Compensation Plan for damage, to health, property, crops, livestock etc(Sub-component-2).

The MoEF&CC, GOI suggested to work out the Compensation for Damage Assessment in line with the suggestions / recommendations made in report of the Expert Committee and to submit a detailed 'Compensation Plan' to MoEF&CC within stipulated time frame of 2 months.

The District Magistrate constituted the Sub-Committee to work out Restoration and Compensation plan for damage to property, health, crops, livestock, etc. The Sub-Committee has taken up elaborate field study and assessed the damage caused due to release of styrene vapour and prepared long term requirements

for restoration under each component and submitted compensation plan as per terms of reference. The Restoration Plan prepared by the Sub-Committee envisages to bring back the normalcy in all the components taken up for study.

1.0. Introduction:

On 07th May 2020 an incident of uncontrolled styrene vapour release into the atmosphere occurred at M/s.L.G Polymers India Pvt. Ltd, R.R Venkatapuram, Pendurthy Mandal, Visakhapatnam from one of the styrene storage tank(M6 tank). The accident took the life of 12 persons in the immediate subsequent period and 585 people had to undergo treatment in hospitals, besides causing loss of livestock and vegetation.

1.1 Orders of the Hon'ble National Green Tribunal

The Hon'ble National Green Tribunal had taken suo-moto cognizance of the gas leakage incident at M/s.L.G Polymers India Pvt. Ltd on 08.05.2020 as per O.A No.73/2020 and other connected matters. The Hon'ble National Green Tribunal, thereafter constituted an expert committee and tasked it to look into various aspects of the incident including cause of failure, extent of damage, steps for compensation and remedial measures to prevent recurrence, and submit a report to it. The Expert Committee filed an interim report on 17.05.2020 and a detailed report was filed on 28.05.2020. The Hon'ble National Green Tribunal, Principal Bench, New Delhi passed an order on 01.06.2020 in OA No. 73 of 2020. The following directions with regard to preparation of restoration plan and compensation were issued by the Hon'ble Tribunal:

i. The amount of Rs. 50 crores deposited by the Company with the District Magistrate, Vishakhapatnam will stand appropriated towards part liability and interim compensation to be spent for restoration of the environment and compensation for victims in accordance with the restoration plan to be prepared.

ii. Restoration plan may be prepared by a Committee comprising two representatives each of MoEF&CC, CPCB and three representatives of State Government to be named by the Chief Secretary, including the District Magistrate, Vishakhapatnam and such other concerned Departments within two months from today. MoEF&CC will be the nodal agency for the purpose.

iii. Final quantification of compensation may be assessed by a Committee comprising representatives of MoEF&CC, CPCB and NEERI. The said

Committee will be at liberty to associate/co-opt any other expert institution or individual. The Secretary, MoEF&CC may ensure constitution of such Committee within two weeks from today. The Committee may give its report within two months thereafter. MoEF&CC will be the nodal agency for the purpose".

1.2 Directions of the Ministry of Environment, Forest and Climate Change

a. As per the Hon'ble NGT Orders dt: 01.06.2020 in OA No. 73 of 2020, the Ministry of Environment, Forest and Climate Change(HSM Division), Government of India vide office order dt: 21.07.2020 constituted the committee(s) for the 'Preparation of Restoration Plan' and 'Final Quantification of Compensation'. The preparation of restoration plan was divided into the following two sub-components:

   i. Plan for restoration of environmental media viz., air, water and soil quality.
   ii. Restoration and Compensation Plan for damage to property, health, crops, livestock etc.

b. The scope of work specified by MoEF&CC for sub component-2 i.e., plan for restoration and compensation for damage to health, property, crops, livestock etc is as follows:

   i. A sub-committee, under the chairmanship of District Magistrate, Visakhapatnam is constituted comprising of representatives from APPCB / Environment / Factories / Health / Agriculture Department etc.

   ii. The sub-committee shall work out 'Compensation for Damage Assessment' in line with the suggestions / recommendations made in report of the Expert Committee and submit a detailed 'Compensation Plan' to MoEF&CC within the stipulated time frame of 2 months.

   iii. The DM, Visakhapatnam shall be at liberty to constitute a committee or choose experts, if need be, in preparation of a compensation plan.

1.3 Constitution of the Sub-Committee

a. The District Magistrate, Visakhapatnam constituted the following Sub-committee to work out 'Compensation for Damage Assessment':

i. The Commissioner, GVMC, Visakhapatnam.
ii. The Joint Collector (Asara & Welfare), Visakhapatnam.
iii. The Joint Director of Agriculture Department, Visakhapatnam.
iv. The Joint Director of Animal Husbandry Department, Visakhapatnam.
v. The Principal, Andhra Medical College, Visakhapatnam.
vi. Experts from the Regional Agriculture Research Station, Anakapalli, Visakhapatnam.
vii. The Joint Chief Inspector of Factories, Visakhapatnam.
viii. The Revenue Divisional officer, Visakhapatnam.
ix. The Environmental Engineer, A.P.Pollution Control Board, Visakhapatnam.

b. The following expert scientists are nominated by Associate Director of Research, Regional Agricultural Research Station, (RARS), Anakapalle:

i. Dr. K.V. Ramana Murthy, Principal Scientist (Agronomy), RARS, Anakapalle, Visakhapatnam District.
ii. Dr. Ch. Sitha Ramalakshmi, Senior Scientist (Soil Science), RARS, Anakapalle, Visakhapatnam District.
iii. Dr. Ch. Mukunda Rao, Principal Scientist (Crop Physiology), RARS, Anakapalle, Visakhapatnam District.
iv. Dr. G. Manasa, SMS (Home Science), Krishi Vigyan Kendra, Kondempudi, Visakhapatnam District.

2.0 Scope of work and working methodology of the Sub-Committee

a. The Copies of the report of the Expert Committee constituted by the Hon'ble NGT, High Power Committee constituted by the Govt. of A.P along with the orders of the Hon'ble NGT dt: 01.06.2020 and the MoEF&CC Office Order dated:21.07.2020 were circulated to the members of the Sub-Committee.

b. The Sub-Committee held its meeting on 15.09.2020 under the chairmanship of the District Magistrate, Visakhapatnam to finalize the working plan for 'Compensation for Damage Assessment' in line with the suggestions / recommendations made in report of the Expert Committee constituted by Hon'ble NGT and the High Power Committee constituted by Government of Andhra Pradesh.

2.1 Recommendations of the Expert Committee constituted by the Hon'ble NGT

The following suggestions / recommendations made in report of the Expert Committee are discussed in Sub-Committee meeting:

a) Steps to be taken for compensation of victims under restitution of the damaged property and environment, and the cost involved.

b) Compensation cost to be paid by industry shall be of two components (i) Compensation paid by government and (ii) Environmental Compensation and restitution of the damaged property.

c) For Environmental Compensation and restitution of the damaged property an elaborate scientific study is required to calculate the actual cost for environmental damage and restoration. The services of National Environmental Engineering Research Institute (NEERI) may be utilised since they have conducted the preliminary studies and also have such expertise.

d) Final quantification of compensation may be assessed by a committee comprising representatives of MoEF&CC, CPCB and NEERI.

2.2 Findings and suggestions of the High Power Committee constituted by the Government of A.P

The Government of A.P constituted a High Power Committee(G.O. RT.No.803, dt:08.05.2020) to probe into the causes behind the gas leak and suggest measures to improve the protocol for industrial safety of similar type of plants. The High Power Committee findings and suggestions are discussed in the Sub-Committee meeting:

a) Nearly 20,000 people from 17,000 houses/residences of RRV Puram, Nandamuri Nagar, Kamparapalem, Padmanabha Nagar, SC/ BC Colony, Meghadripeta Colony evacuated, and arrangements were made at 23 rehabilitation centres maintained by GVMC as well as Simhachalam Devasthanam authorities.

b) The GVMC reported disruption in the drinking water supply due to toxic contamination scare because of release of Styrene vapour. Accordingly, GVMC took immediate remedial measures to sanitise the 6318 houses (HH) in the affected areas with mobile water tankers on 11th May 2020, when the evacuated residents returned. On 12th May 2020, Godavari drinking water was made available from 2000 KL GLSR and was released to the public of 5 affected villages, after conducting disinfection and sanitization in all distribution main lines and reservoirs.

c) As reported by the Animal Husbandry Department, a total of 34 animals died due to the effect of Styrene vapour between 7th May 2020 and 9th May 2020.

d) The joint team of NEERI & CBRN, NDRF31 reported that all the trees near the M6 Tank have turned either fully or partially dry. The team observed that wherever the relatively heavy mixture of monomer and polymer Styrene flooded green plants, they got dried. All the trees were dried up to the level of Styrene vapour engulfing the affected area.

e) As reported by the Agriculture Department, there were no crops in the agriculture fields except few vegetables and agro-forestry crops like casuarina and eucalyptus in the neighboring villages adjoining LG Polymers.

f) In addition, the scientists from Rural Agriculture Research Station (RARS), Anakapalli conducted an assessment to study suitability of soil for cultivation after the accident. The team analysed soil quality pH ranges from 6.9 to 8.7 i.e., slightly Alkaline and the electrical conductivity ranges from 0.08 to 0.2 milli mhos, which is normal. It has been advised that Paddy, Vegetables and other crops should be cultivated by reclaiming the soil.

g) The Horticulture Department has analysed the impact of Styrene vapour on the horticulture crop pattern around the company for 5 km radius area. It is reported that 50% of crop damage, i.e., charred and rotting symptoms were observed in vegetable crops, 90% in papaya and no damage in Banana, Drumstick, Sapota, Mango, Cashew, Tamarind and Coconut. The farmers were advised to destroy the crop and not to sell the produce as they were not safe for consumption.

h) The District Collector constituted a group comprising of 10 Doctors under the Chairmanship of Principal, Andhra Medical College for conducting long term study on the health effects on the 585 people who got affected and had received treatment in the hospital and the others living in the vicinity of the factory.

i) Indian Council for Medical Research (ICMR) may be entrusted with the task to study the long-term effects of Styrene monomer vapour on the health of the people. ICMR may also look into the various parameters of affected patients, a spectrum of symptoms reported by the exposed people, the impact of acute inhalation of Styrene during the period of the accident and its impact on the vulnerable group like pregnant women, new-born and children and senior citizens. The ICMR can also study impact on the reproductive system, Styrene-induced genetic disorders and also conduct epidemiological study.

j) A study needs to be conducted by the Animal Husbandry experts to find out the long-term impact on the livestock and animals due to exposure to Styrene vapour.

2.3 Action points for the Sub-Committee

The following component wise action points were decided in the Sub-Committee meeting:

S. No.	Scope of work	Action points	Responsible member of the Sub-Committee
1.	Damage to the property	a. Assessment of physical damage to movable and immovable property. b. Identification of loss of movable property during the time of incident i.e., Theft of valuables and vehicles as per the FIRs registered, spoiled consumables like food grains, etc. c. Compensation plan for above items. a. Ex-gratia paid to the deceased persons and affected population by the Government of A.P to be enumerated and included in the compensation plan.	The Commissioner, GVMC and RDO, Visakhapatnam.
2.	Public Health	a. Identification of duration and no. of health camps required for affected population including pregnant women and assessment of cost involved. b. Establishment of a hospital of required bed strength and assessment of capital and recurring cost. c. Assessment of cost involved for conduct of long term health surveys & restoration of health.	Principal, Andhra Medical College, Visakhapatnam and DM&HO, Visakhapatnam.
3.	Agriculture	a. Assessment of crop damage during the gas leakage incident.	Joint Director,

		b. Long term research study of the impact of styrene gas accumulation on the agriculture and horticulture crops.	Agriculture Department and Regional Agriculture Research Station, (RARS), Anakapalle
4.	Live Stock	a. Assessment of cost involved for conduct of long term veterinary health camps. d. Identification of loss of milk, replacement of live stock, feed and fodder support during the time of incident. b. Long term monitoring and surveillance of the health of animals. c. Compensation plan for above items.	Joint Director, Animal Husbandry.

3.0 Findings of the Sub-Committee

The Sub-Committee members carried out individual field investigations as per the scope of the work and action points identified in the meeting held on 15.09.2020. The restoration and compensation plan for damage to the property was submitted by the Revenue Divisional Officer, Visakhapatnam. The restoration and compensation plan for damage to the health was submitted by the Principal, Andhra Medical College, Visakhapatnam and District Medical and Health Officer, Visakhapatnam. The restoration and compensation plan for damage to the crops was submitted by the Joint Director of Agriculture, Visakhapatnam. The restoration and compensation plan for damage to the livestock was submitted by the Joint Director, Animal Husbandry, Visakhapatnam.

3.1 The restoration and compensation plan for damage to the property

The report submitted by the Revenue Divisional Officer (RDO), Visakhapatnam is annexed (Annexure-I). The RDO and GVMC Officials carried out damage assessment of the property in the affected area. The report of the damage assessment of the property and the compensation for restoration was prepared taking into consideration the compensation paid to the victims under various heads by Government of A.P, theft amounts as per FIRs, food grains spoiled and discarded by households and the damage to the goods stored in the petty shops. The Component wise assessment of damage and compensation for restoration is tabulated below:

S. No.	Component	Cost estimated in Rs.
i.	Compensation paid by the Government of Andhra Pradesh for Deceased Cases, Medical treatment to the Victims, Dead Animals and Individuals in affected Area	37,17,80,000/-
ii.	Theft amount assessed as per the cases filed in the police stations	2,03,500/-
iii.	The enumeration of the petty shop has been taken up and assessed the damage	5,12,585/-
iv.	Compensation for contamination of food grains / consumables losses Rs.2000/- per each family (Total no.of families-6503).	1,30,06,000/-
	Total	**38,55,02,085/-**

3.2 The restoration and compensation plan for damage to the health

The report submitted by the Principal, Andhra Medical College, Visakhapatnam and District Medical and Health Officer, Visakhapatnam is annexed (Annexure-II). The report of the damage assessment of the health and the compensation for restoration was prepared taking into consideration the establishment of 10 bedded hospital for monitoring the health of the affected public for five years, baseline investigations, research studies on accidental exposure, mental health assessment & restoration of health. The Component wise assessment of damage and compensation for restoration is tabulated below:

S. No.	Component	Cost estimated in Rs.
i.	Establishment of 10 bedded hospital	13,79,17,776/-
ii.	Baseline investigations suggested by general medicine, paediatrics, gastroenterology and pathology.	4,78,98,000/-
iii.	Three research projects were proposed to be carried out by the faculty of Andhra Medical College. a. Cytogenetic effects of accidental exposure to styrene monomer vapour – a population based cohort study b. To study the effect of accidental exposure to high concentration styrene gas on pregnancy and its outcomes. c. Mental health assessment and restoration of health in Styrene affected villages	 99,49,250/- 30,24,000/- 89,16,000/-
iv.	Speciality treatment and unforeseen expenditure in hospital attached to Andhra Medical College	2,00,00,000/-
	Total	**22,77,05,026/-**

3.3 The restoration and compensation plan for damage to the Crops

The report submitted by the Joint Director of Agriculture, Visakhapatnam is annexed (Annexure-III). The Joint Director of Agriculture Department, Visakhapatnam and a team of scientists of Regional Agricultural Research Station, (RARS), Anakapalle along with officials from Horticulture

Department & Revenue Department carried out filed inspection in the surrounding area on 17.09.2020. It was felt by the team of scientists that the data on yield at the time of harvest of the Kharif crop (Nov-Dec, 2020) along with the essential soil parameters can be taken for long term study of the impact of "styrene gas" accumulation, if any, on crop performance. Soil and underground water quality needs to be monitored at regular intervals for a period of 1-2 years to monitor the effect of styrene gas on soil and water quality. The report of the damage assessment of the crops and the compensation for restoration was prepared taking into consideration organic inputs and other expenses for restoration of crop in affected villages and analysis of soil and irrigation water. The Component wise assessment of damage and compensation for restoration is tabulated below:

S. No.	Component	Cost estimated in Rs.
i.	Estimated cost for inputs for adoption of Best Management practices(Organic + Inorganic)	5,98,840/-
ii.	Charges towards Testing parameters including visits of Scientists	59,500/-
iii.	Compensation Enumerated horticulture crop damages	1,98,938/-
	Total	**8,57,278/-**

3.4 The restoration and compensation plan for damage to the Livestock

The report submitted by the Joint Director, Animal Husbandry, Visakhapatnam is annexed (Annexure-IV). The report of the damage assessment of the livestock and the compensation for restoration was prepared taking into consideration the livestock profile in the affected villages, value of milk discarded during 30 days, amount for replacement of livestock, feed and fodder support and long term monitoring and surveillance. The Component wise assessment of damage and compensation for restoration is tabulated below:

S.No.	Component	Cost estimated in Rs.
i.	The estimated value of milk discarded during 30 days after incident Interim relief	17,42,400/-
ii.	Amount required for providing replacement of animals	9,00,000/-
iii.	Cost estimated for feed and fodder support for	62,33,472/-

	180 days	
iv.	For conducting veterinary Health camps	3,00,000/-
	Total	**91,75,872/-**

4.0 Conclusions

The damage assessment and the compensation required for restoration of property, health, crops & livestock was taken up by the Sub-Committee consisting of the concerned departments who have taken up elaborate field study and assessed the long term requirements for restoration under each head and submitted compensation plan with the following cost estimate:

The total Compensation for Damage Assessment is Rs. 62,32,40,261/-

S. No.	Component	Cost estimated in Rs.
1.	The restoration and compensation estimate for property	38,55,02,085/-
2.	The restoration and compensation estimate for Health	22,77,05,026/-
3.	The restoration and compensation estimate for crops	8,57,278/-
4.	The restoration and compensation estimate for Livestock	91,75,872/-
	Total	**62,32,40,261/-**

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Annexure-I

Rc.No.1252/2020/K dt. -09-2020.

Revenue Divisional Office,
Visakhapatnam.

From

K.Penchala Kishore, B.Tech, MBA.,
Revenue Divisional Officer,
Visakhapatnam.

To

The District Collector,
Visakhapatnam.

Sir,

Sub:- Industrial Accident – Visakhapatnam Dist. & Division – Gopalapatnam Mandal – Venkatapuram Village – Styrene Gas leakage incident occurred on early hours at about 3.00 PM on 07-05-2020 – Hon'ble National Green Tribunal order dt.9-6-2020 – Committee for "Final Quantification of Compensation" – Sub Committee Meeting held on 15-09-2020 – Enquiry conducted - Report submitted -Reg.

Ref:-1. Minutes of the meeting & Instructions of the District Collector, Visakhapatnam on submission of report of damages for Preparation of Restoration Plan held on 15-09-2020

* * *

I invite kind attention to the reference cited.

I submit that on 07.05.2020 at about 3.00 AM, Styrene gas leakage occurred in LG Polymers Ltd., at R.R. Venkatapuram Village, Gopalapatnam mandal; resultantly the surrounding villagers are affected.

I submit that in the above incident 12 persons were died and hundreds of the people suffered with ill-health due to consumption of styrene gas. The Govt. of Andhra Pradesh have paid compensation as detailed below:

Sl.No	Category	No	Amount released	Total Amount
1	Deceased Cases	12	Rs. 1.00 Crore	Rs.12,00,00,000/-
2	Hospitalized cases			
	a) Free Medical Care to all the Victims who are identified in all the Hospital under YSR Aarogyasri Scheme			
	b) Ventilator Treatment	1	Rs.10.00 Lakhs	Rs.10,00,000/-
	c) 2-3 Days Hospitalized	479	1 Lakh	Rs.4,79,00,000/-
	d) People Undergone Primary Treatment	72	Rs.25,000	Rs.18,00,000/-
3	Dead Animals	25 Animals (8 Owners)		Rs.8,75,000/-
4	Individuals in affected Area	19876	Rs,10,000/-	Rs.19,87,60,000/-
Total Amount				**Rs. 37,03,35,000/-**

I submit that the District Collector, Visakhapatnam has convened a meeting on 15-9-2020 and instructed to submit the report on physical damages occurred due to above incident at Venkatapuram Village for reparation of Restoration Plan to arrive at Final Quantification of Compensation. As per the instructions of the District Collector, Visakhapatnam myself along with the Tahsildar, Gopalapatnam, the Zonal Commissioner, Zone-V have visited the habitations to assess the physical damages occurred to the properties in connection with the incident.

During the enquiry it was brought to notice that, on while rescues operations are under progress few miscreants entered in to the houses and taken away few valuable belongings of the victims. Many of the houses kept unlocked as the villagers ran away to save their life's. It is submitted as ascertained that 6 theft cases were filed by the Police Department FIRs also registered and investigation is in progress. Among six cases one case found not genuine and reoffends false. The details of five theft cases are furnished here under:

1. Crime No.216/2020 U/s 457, 380 IPC occurred in between 26-3-2020 at 09 :00 hrs to 09-5-2020 at 21:00 hrs at D No 8-272- 6/1, Flat no 86, VUDA Colony, Gopalapatnam and reported on 10-5-2020 at 13:30 hrs where in the complainant Bokam Nagamani W/o Chinnodu, age 25, Caste by K Velama, R/o D no 8- 272-6/1, Flat no 86, VUDA Colony, Gopalapatnam reported that she was living in above address with her family. On 26-03-2020 morning at 09:00 hrs she went to her mother's house at Kancharapalem. Again she came on 09.05.2020 at 21:00 hrs and noticed that some unknown person broke the lock entered into her house and committed theft of Sony TV, HP Gas Cylinder. Total worth 6000/-. She requested for necessary action. Hence the FIR. **Case is UI for want of clues**

2. Crime No. 217/2020 U/S 457,380 IPC occurred in between 06-05-2020 at 11:00 hrs to 10-5-2020 at 18:00 hrs at D no 2- 173/1, Venkatapuram, RRV Puram Gopalapatnam and reported on 10-5-2020 at 22:00 hrs where in the complainant Piridi Venkata Sathish S/o Someswarrao, age 33, Caste by Rajaka, R/o D no 2-173/1, Venkatapuram, RRV Puram Gopalapatnam reported that he was living in Venkatapuram with his family last 2 months. On 7-5-2020 morning at 04:00 hrs some Gas was leaked from L.G. Polymers Company, due to fear he along with his family members left the house and went to his relatives' house at Karasa. On 08.05.2020 morning at 1100 hrs he came to his house and took his Gold and important items and cash in his room. Again he came on 10-5-2020 at 17:00 to his house and noticed that some unknown persons entered into his house and committed theft of ¼ Tulas Ear studs -2 Pairs, ¼ Tulas Gold Rings-3 and One Tula Gold Ring-1 and cash 13,000/-. Total worth 69,500/- which were kept in his mother's Iron Almarah. Therefore he presented a report for taking necessary action. **Case is UI for want of clues.**

3. Crime No. 218/2020 U/S 454,380 IPC occurred in between 07-05-2020 at 04:30 hrs to 14-5-2020 at 08:00 hrs at D no 1-36, Venkatapuram, Gopalapatnam and reported on 14-5-2020 at 17:30 hrs where in the complainant Seerapu Varaprasad Reddy S/o Apparao, age 27, Caste by Reddy, R/o D no 1-36, Venkatapuram, Gopalapatnam reported that he was living in Venkatapuram with his family. On 7-5-2020 morning at 0430 hrs some Gas was leaked from L.G. Polymers Company, due to fear he along with his family members left the house and went to his friend's house at Adavivaram. Again he came on 14.05.2020 morning at 0800 hrs and noticed that some unknown person entered into his house and committed theft of Two pairs ear studs-2 Tulas, Small Gold Piece -1, Fast Track watch-1, One pair Silver anklets -14 Tulas, One silver spoon, and Silver Harathi stand etc., which were kept in his Iron Almarah. Total worth 60,000 /-. Therefore he presented a report for taking necessary action. During the course of Investigation. Accused A1) Meesala Parameswara Rao @ Paramesh , S/o Late Appalanaidu , A2) Palavalasa Manikanta @ Mani S/o Lakshmanarao , A3) Neduri Sai Kumar @ Siva S/o Eswara Rao , A4) Badiyala Venkatarao @ Mahesh S/o Mangaraju , A5) Badiyala Anith Kumar @ Kumar S/o Mangaraju Was arrested and CICL Nekkinti Vinay S/o late Kishore was apprehended on 18.05.2020 and sent for Remand. **This case u/s 457, 380 IPC(HB by Night) was altered to u/s 454 ,380 IPC(HB by Day). Case was Charged. CC NO.2142/2020.**

4. Crime No. 219/2020 U/S 454,380 IPC occurred in between 07-05-2020 at 04:00 hrs to 15-5-2020 at 11:00 hrs at D no 4-49, Gollaveedhi, venktapuram, Gopalapatnam and reported on 15-5-2020 at 19:30 hrs where in the complainant Sarvasiddhi Lakshmi w/o sunnybabu, age 35, caste by yadava R/o D no 4-49, Gollaveedhi, venkatapuram, Gopalapatnam,Visakhapatnam City reported that she was living in venkatapuram with her family. On 7-5-2020 morning at 04:00 hrs some Gas was leaked from L.G. Polymers Company, due to fear she along with her family members left the house and went to KGH Hospital for medical treatment. After treatment she came to her house on 15.05.2020 morning at 11:00 hrs and noticed that some unknown person entered into his house and committed theft of an amount of Rs.40,000/- which were kept in his Iron Almaraih.

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Therefore she presented a report for taking necessary action. Hence the FIR. During the course of Investigation Accused A1) Meesala Parameswara Rao @ Paramesh , S/o late Appalanaidu , A2) Palavalasa Manikanta @ Mani S/o Lakshmanarao , A3) Neduri Sai Kumar @ Siva S/o Eswara Rao , A4) Badiyala Venkatarao @ Mahesh S/o Mangaraju , A5) Badiyala Anith Kumar @ Kumar S/o Mangaraju Was arrested and CICL Nekkinti Vinay S/o late Kishore was apprehended on 18.05.2020 and sent for Remand. **This case u/s 457,380 IPC(HB by Night) was altered to u/s 454,380 IPC(HB by Day). Case was Charged. CC NO.2142/2020.**

5. Crime No. 220/2020 U/S 454,380 IPC occurred in between 07-05-2020 at 03:30 hrs to 15-5-2020 at 15:00 hrs at D no 3-54/1, Venugopalaswamy temple, venkatapuram, Gopalapatnam and reported on 15-5-2020 at 20:30 hrs where in the complainant Ellapu vasu S/o Kanakaraju, age 27, caste by kapu R/o at D no 3-54/1, Venugopalaswamy temple, venkatapuram, Gopalapatnam reported that he was living in venkatapuram with his family. On 7-5-2020 morning at 03:30 hrs some Gas was leaked from L.G. Polymers Company, due to fear he along with his family members left the house and went to Relatives house at Narava. Again he came to his house on 15.05.2020 morning at 15:00 hrs and noticed that some unknown person entered into his house and committed theft of an amount of Rs. 28,000/- which were kept in his Iron Almarah. Therefore he presented a report for taking necessary action. Hence the FIR. During the course of Investigation Accused A1) Meesala Parameswara Rao @ Paramesh , S/o late Appalanaidu , A2) Palavalasa Manikanta @ Mani S/o Lakshmanarao , A3) Neduri Sai Kumar @ Siva S/o Eswara Rao , A4) Badiyala Venkatarao @ Mahesh S/o Mangaraju , A5) Badiyala Anith Kumar @ Kumar S/o Mangaraju Was arrested and CICL Nekkinti Vinay S/o late Kishore was apprehended on 18.05.2020 and sent for Remand. This case u/s 457, 380 IPC(HB by Night) was altered to u/s 454, 380 IPC(HB by Day). Case was Charged. CC NO.2142/2020.

In all these above 5 cases the worth of damage is as follows:

Sl No.	Crime No. and details	Value of damage in Rs
1	216/2020	6000/-
2.	217/2020	69500/-
3.	218/2020	60000/-
4	219/2020	40000/-
5.	220/2020	28000/-
		2,03,500/-

(Rupees two lakhs three thousand five hundred only)

I further submit that due to the heavy ness of the styrene Gas vapors' settled down in the village especially in Venkatapuram habitations. Due to this the food grains and other food items were got effected. The villagers have thrown away these grains and food items into dust bins. In this way it can be assessed that at least 2,000/- of worth of food grains and other consumable were got damaged. So each family can be given Rs.2,000/- of compensation towards food grains / consumable losses. 6503 families exist in the effected zone.

I also submit that the petty vendors/Kirana shops are also affected due to this Styrene Gas leakage. The stocks which they have purchased and stored in their shops were also got damaged. These shop keepers have thrown away their damaged stocks into dust bins as they become hazardous. The enumeration of the petty shop has been taken up and assessed the damage. The details are furnished here under:

Sl. No.	Name of the Kirana Shop	Estimated Damage Amount in Rs.
	Venkatapuram-1	
1	Sri laxmi durga shop	16,163/-
2	Nooka raju kirana shop	30,000/-
3	Venkata padma kirana and general stores	12,630/-
	TOTAL	58,793/-

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	Venkatapuram -2	
4	Gandam siva general stores	38,885/-
5	pavan venkat teja kirana shop	3,800/-
6	venkat satya sai kirana and general stores	49,422/-
7	Sri rajesawri kirana and general stores	52,366/-
8	mahadhanalaxmi kirana	19,290/-
9	Sri satyakirna and general stores	24,075/-
10	ellapu appalanarsamma (small shop)	4,005/-
11	S.L.V bengalore bakery	1,10,300/-
12	Godla srinivasurao Sai pan shop	20,845/-
13	vimalakirana general stores	19,204/-
14	palavaralaxmi (tiffin shop)	3,910/-
15	satyanaryana chicken center	8,900/-
16	sridurga chips company	6,600/-
17	kotiyadaJyothi food centre	10,005/-
18	vamsi hot food centre	10,640/-
19	balajisatyavatikiran store	15,640/-
20	srilaxmiganapati manufacturing noodles	5,550/-
21	sivakotivaralaxmi (small shop)	2,760/-
22	pydimaba hot chat	4,750/-
24	chinntalabaddi	445/-
25	tegalachinnitalli small shop	1,440/-
26	srivijayadurgabavani daily parlour	9,300/-
27	venkatarama and general stores	27,330/-
	TOTAL	**4,53,792/-**
	Grand Total (Rupees five lakhs twelve thousand five hundred and eighty five only)	**Rs. 5,12,585/-**

The copies of FIRs and record of enquiry is submitted for kind perusal.

Yours faithfully

Revenue Divisional Officer,
Visakhapatnam

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Annexure-II

ANDHRA MEDICAL COLLEGE

Affiliated to Dr.NTR University of Health Sciences, Vijayawada, Andhra Pradesh
Recognised by Medical Council of India, New Delhi
Maharanipeta, Visakhapatnam, Andhra Pradesh, INDIA 530002

Dr.P.V.Sudhakar,
M.S., M.Ch, DNB,FAIS,FICS.
Principal

Date:- 18.9.2020

To
The Collector & District Magistrate
Visakhapatnam

Sir,

Sub: Styrene gas leak at LG Polymers RR, Venkatapuram, Visakhapatnam – Plan for restoration and compensation for damage to health – submitted

Ref: Committee meeting on restoration and compensation for damage to health, Property, Crops, Livestock etc., dated: 15.9.2020.

As per the instructions received during the above meeting and as per the MoEF & CC office order subcomponent – 2, I am here with submitting the plan for restoration and compensation for damage to health. The plan for restoration of health as submitted by the DM&HO is incorporated in this report. The budget requirements for research activities under Andhra Medical College, Visakhapatnam for the long term benefits of the population in the affected villages is submitted for your kind perusal and necessary action.

Thanking You Sir,

Yours faithfully

18.9.2020
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Andhra Medical College
Visakhapatnam

ANDHRA MEDICAL COLLEGE

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Styrene Gas leak at LG polymers Chemical plant in RR Venkatapuram, Visakhapatnam

Plan for restoration and compensation for damage to health

In the wee hours of 7th May, 2020 uncontrolled Styrene gas release took place from LG Polymers, RR Venkatapuram Village, Visakhapatnam.

This is the first incident of Styrene gas leakage from India. Victims were admitted to King George Hospital, Visakhapatnam, CHC, Pendurthi, CHC, Gopalapatnam & CHC Aganampudi and various private hospitals. There were 12 deaths before reaching the hospitals and 585 patients were admitted as shown below. All the patients admitted to the hospitals survived and discharged after treatment.

Details of Admissions and Discharges

Sl. No.	Type of Hospital	Admissions			Discharged
		On Ventilator	General	Total	
1	Government Hospital	0	418	418	418
2	Private Hospital	1	166	167	167
Total		**1**	**584**	**585**	**585**

People in RR Venkatapuram and neighboring villages were evacuated to safer places. Once the patients were discharged they have returned home.

Medical camps were conducted daily in all the 6 villages by qualified doctors and Paramedics from 11.05.2020 to 06.07.2020. Approximately 5000 patients were examined and treated.

To have continuous monitoring of the health status of people in RR venkatapuram and neighboring villages an expert committee was formed under the Chairmanship of Principal, Andhra Medical College as follows.

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Sno.	Committee Member	Designation	Role
01	Dr. P.V. Sudhakar	Principal, AMC	Chairman
02	Dr. K.V.V. Vijaya Kumar	Prof & HoD, Pulmonology	Member
03	Dr. P. Venu Gopal	Prof & HoD, Pediatrics	Members
04	*Dr. VVL Narasimha Rao	Suptd of REH	Member
05	Dr. G. Butchi Raju	Prof & HoD, Neurology	Member
06	Dr. L.R.S. Girinath	I/c Prof Gastroentrology	Member
07	Dr. B. Devi Madhavi	Prof & HoD, SPM	Member
08	**Dr. B. Purushotam Rao	Prof of Gen Med	Member
09	Dr. A. Bhagya Lakshmi	Prof & HoD Pathology	Member
10	Dr. K.V. Leela	Assoc Prof of Biochemistry	Member

*Dr.V.Rajeswara Rao, Superintendent REH, is included in place of Dr. VVL Narasimha Rao who retired from service.

**Dr.D.Radha Krishna, Professor of General Medicine is included in place of Dr.B.Purushotam Rao who expired due to COVID-19

The following recommendations were given by the expert committee.

1. Baseline study of the population and establishment of registry with different cohorts.
2. Data analysis of all the patients admitted in KGH and other hospitals.
3. Establishment of hospital at RR Venkatapuram.
4. Baseline investigations suggested by departments of General Medicine, Pediatrics, Gastroenterology and Pathology:
   A. Haemogram
   B. LFT
   C. RFT
   D. X- Ray

   Specific advanced tests as and when required.

   a. Neurology:
      i. To Study post trauma stress disorder (Psychological Analysis)
      ii. Cognitive dysfunction – Psychometric Test for children
      iii. CNS – EEG, MRI Brain if required
      iv. PNS – NCV if required

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b. **Pulmonology** :

i. Baseline respiratory status (COPD)

ii. Symptomatic patients will be followed with X Ray and CT Thorax if required

c. **Ophthalmology** :

i. Symptomatic patients to undergo slit lamp examination.

ii. Neurological examination for visual defects.

5. Monitoring of pregnant women with outcome of pregnancy and 1 year follow up of newborns

Dr.Y.S.R. Clinic : A dedicated facility with 10 beds was established on 07.07.2020 and patients being monitored with adhoc staff.

Health cards were distributed for 10,000 population of all the affected villages for continuous monitoring of health of affected people. (Annexure I)

The District Medical & Health Officer was requested for carryout the baseline investigations of all the card holders.

Way Forward :

1. Individual departments of Andhra Medical College will monitor the change in health status of individuals in affected villages and will compare with health status of public in unaffected villages. Weekly camps by two departments will be conducted at Dr YSR health Clinic located at RR Venkatapuram village.
2. Patients requiring specialized treatment will be treated in various teaching hospitals attached to Andhra Medical College.
3. Three research projects were proposed to be carried out by the faculty of Andhra Medical College. The details are given in Annexure II

A. CYTOGENETIC EFFECTS OF ACCIDENTAL EXPOSURE TO STYRENE MONOMER VAPOUR – A POPULATION BASED COHORT STUDY.

B. To Study the Effect of Accidental Exposure to High Concentration Styrene Gas on Pregnancy and Its Outcomes.

C. Mental health assessment and restoration of health in Styrene affected villages of Visakhapatnam District, Andhra Pradesh.

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BUDGET REQUIREMENTS

YSR CLINIC – STYRENE GAS LEAK - VENKATAPURAM

PROPOSED EXPENDITURE FOR THE 10 BEDDED HOSPITAL FOR 5 YEARS

S. No	POST	Number of Persons	Salary for Each Person	Total Salaries for one month	Total Salaries for 1st year	Total Salaries for 2nd year	Total Salaries for 3rd year	Total Salaries for 4th year	Total Salaries for 5th year	TOTAL
1	Doctors	03	54,000	1,62,000	19,44,000	40,82,400	62,40,240	84,00,024	1,05,60,002	3,12,26,666
2	Staff Nurse	03	34,500	1,03,500	12,42,000	26,08,200	39,86,820	53,66,682	67,46,668	1,99,50,370
3	Pharmacists	02	28,000	56,000	6,72,000	14,11,200	21,57,120	29,03,712	36,50,371	1,07,94,403
4	Lab Tech.	02	28,000	56,000	6,72,000	14,11,200	21,57,120	29,03,712	36,50,371	1,07,94,403
5	Attenders	04	15,000	60,000	7,20,000	15,12,000	23,11,200	31,11,120	39,11,112	1,15,65,432
6	Night Watchman	02	10,000	20,000	2,40,000	5,04,000	7,70,400	10,37,040	13,03,704	38,55,144
7	Sweepers	02	10,000	20,000	2,40,000	5,04,000	7,70,400	10,37,040	13,03,704	38,55,144
8	Thoty	02	10,000	20,000	2,40,000	5,04,000	7,70,400	10,37,040	13,03,704	38,55,144
9	OEO	01	15,000	15,000	1,80,000	3,78,000	5,77,800	7,77,780	9,77,778	28,91,358

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10	Clerk	01	18,000	18,000	2,16,000	4,53,600	6,93,360	9,33,336	11,73,334	34,69,630
11	Drugs & Disposables			50,000	6,00,000	12,60,000	19,26,000	25,92,600	32,59,260	96,37,860
12	Lab Consumables			15,000	1,80,000	3,78,000	5,77,800	7,77,780	9,77,778	28,91,358
	Total				**71,46,000**	**1,50,06,600**	**2,29,38,660**	**3,08,77,866**	**3,88,17,786**	**11,47,86,912**

(Contd)

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YSR CLINIC – STYRENE GAS LEAK - VENKATAPURAM

PROPOSED EXPENDITURE FOR THE 10 BEDDED HOSPITAL

S. No	POST	No. of Persons	Salary for Each Person	Total Salaries for one month	Total Salaries for 1st year	Total Salaries for 2nd year	Total Salaries for 3rd year	Total Salaries for 4th year	Total Salaries for 5th year	TOTAL
	BF				71,46,000	1,50,06,600	2,29,38,660	3,08,77,866	3,88,17,786	11,47,86,912
13	Maintanance i.e. power ,Internet and Telephone			15,000	1,80 ,000	3,78,000	5,77,800	7,77,780	9,77,778	28,91,358
14	**Ambulance Maintanance**									
	Drivers	02	20,000	40,000	4,80,000	10,08,000	15,40,800	20,74,080	26,07,408	77,10,288
	Helpers	02	15,000	30,000	3,60,000	7,56,000	11,55,600	15,55,560	19,55,556	57,82,716
15	Fuel			30,000	3,60,000	7,56,000	11,55,600	15,55,560	19,55,556	57,82,716
16	Vehicle Maintenance			5,000	60,000	1,26,000	1,92,600	2,59,260	3,25,926	9,63,786
	Grand Total				**85,86,000**	**1,80,30,600**	**2,75,61,060**	**3,71,00,106**	**4,66,40,010**	**13,79,17,776**

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PROPOSED EXPENDITURE FOR INVESTIGATIONS

S.No.	Test	No. of People to be covered	Rate (INR)	No. of times	Total
1	Routine tests	10,000	720	6	4,32,00,000
2	CT scan	1,000 (10% of population)	1200	1	12,00,000
3	USG abdomen	2,000 (20% of population)	699	1	13,98,000
4	MRI Brain	500 (5% of population)	1700	1	8,50,000
5	EEG	500 (5% of population)	1500	1	7,50,000
6	NCS	500 (5% of population)	1000	1	5,00,000
				Grand Total	4,78,98,000

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PROPOSED EXPENDITURE FOR RESEARCH ACTIVITY

(A)CYTOGENETIC EFFECTS OF ACCIDENTAL EXPOSURE TO STYRENE MONOMER VAPOUR – A

(B) POPULATION BASED COHORT STUDY

Budget Head	1st year	2nd year	3rd Year	Total
a. Staff	2 Lab technicians @ 25,000/-per month (6,00,000/ P.A)			18,00,000/-
b. Contingency	1,00,000/- (P.A)			3,00,000/-
e. Chemicals & Consumables **Cytogenetic Investigations** **MN & SCE(700 samples)** **Chromosomal Aberrations (350 samples)**	700*1285/- = 8,99,500/-	350*1285/- = 4,49,750/-		13,49,250/-
Molecular Investigations (700 samples)			2000*700 =14,00,000	14,00,000/-
Hematological & Biochemical Investigations	(700 samples * 4 times testing= 2800 samples) 2800*1500 = 42,00,000/-			42,00,000/-
d. LOGISTICS	Vehicle for carrying samples			9,00,000/-
TOTAL				**99,49,250/-**

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B. To Study the effect of accidental exposure to high concentration Styrene Gas on Pregnancy and its Outcomes

Budget Head	Split	1st year	2nd year	3rd year	Total
Staff salaries	4 health works	4 * 20000 = 80000	4 * 20000 =80000	4 * 20000 =80000	**240000**
Contingency	2 supervisors	2 * 30000 =60000	2 * 30000 =60000	2 * 30000 =60000	**180000**
Stationery		50000	50000	50000	**150000**
		25000	25000	25000	**75000**
Logistics					
Transport for health care staff	500 per visit	500 * 10 = 5000	500 * 10 = 5000	500 * 10 = 5000	**15000**
Transport for mothers for TIFFA scan and other Investigations	500 per person	500 * 120 = 60000	-		**60000**
TIFFA scan	3000 per person	3000 * 120 =360000	-	-	**360000**
Chemicals for Cytogenetics RPMI Medium With L-Glutamine, FBS, PHA-M, Penicillin, Streptomycin and Sodium bicarbonate 1X Liquid Karyotyping Medium Colchicine Solution KCL Methanol and Glacial acetic acid(fixative) Giemsa Stain and Trypsin 5-Bromo-2'-deoxyuridine (BrDu) Cytochalasin B DPS mount	1000 per sample MN and SCE for both cases and controls Chromosomal aberrations analysis will be done only for	120 * 1000 = 120000	-		**120000**

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	cases				
Chemicals for Biochemical & Molecular Investigations DNA isolation Kits Primers Ladders Agarose Gel	3214 per sample	120 * 3214 = 385680	-	-	**385680**
Chemicals for Hematological Investigations	857 per sample	857 * 360 * 2 = 617040	857 * 360 * 2 = 617040	857*120*2 =204240	**1438320**
Total					**30,24,000/- INR**

(C) Mental health assessment and restoration of health in Styrene affected villages of Visakhapatnam District, Andhra Pradesh

BUDGET:				
Sl No.	**Particulars**	**1st Year (In Rs.)**	**2nd Year (In Rs.)**	**3rd Year (In Rs.)**
A	**Non-Recurring**			
1	Office establishment	5,00,000	-	-
2	Equipment's	5,00,000	-	-
3	Furniture	5,00,000	-	-
B.	**Recurring**			
1.	**Manpower**			
a	Project Manager No. 1 @ Rs. 54,000 p.m	2,48,000	2,48,000	2,48,000
b	Field Investigators (6 months) No. 5 @ Rs. 20,000 p.m.	6,00,000	-	-
c	Medico social Worker			

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	No. 1 @ Rs. 20,000 p.m.	2,40,000	2,40,000	2,40,000
d.	Counsellor No. 1 @ Rs. 20,000 p.m.	2,40,000	2,40,000	2,40,000
e.	Multitasking worker No. 1 @ Rs. 12,000 p.m	1,44,000	1,44,000	1,44,000
f.	Data Entry Operator No. 1 @ Rs. 20,000 p.m	2,40,000	2,40,000	2,40,000
2.	**Miscellaneous Expenses**			
	Hiring of Building	1,80,000	1,80,000	1,80,000
	Power and Internet	1,80,000	1,80,000	1,80,000
3.	Consumables	1,00,000	1,00,000	1,00,000
4.	Contingencies	2,00,000	2,00,000	2,00,000
5.	Transport	3,00,000	3,00,000	3,00,000
6.	Report Writing	2,00,000	2,00,000	2,00,000
	Total	**43,72,000**	**22,72,000**	**22,72,000**
	Grant Total (1st Year + 2nd Year + 3rd Year)	**89,16,000**		

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PROPOSED BUDGET FOR SPECIALIST TREATMENT AND UNFORESEEN EXPENDITURE IN HOSPITALS ATTACHED TO ANDHRA MEDICAL COLLEGE : 2CR

Abstract of budget requirements

S.No.	HEAD	INR
1	Expenditure for 10 bedded hospital for 5 years	13,79,17,776
2	Investigations	4,78,98,000
3	Research project 1	99,49,250
4	Research project 2	30,24,000
5	Research project 3	89,16,000
6	To Andhra Medical College	2,00,00,000
	Total	22,77,05,026

(RUPEES TWENTY TWO CRORES SEVENTY SEVEN LAKHS FIVE THOUSAND AND TWENTY SIX ONLY)

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ANNEXURE I



Dr YSR HEALTH CLINIC

HEALTH CARD FOR STYRENE GAS AFFECTED POPULATION

NAME :

AGE/ SEX :

ADDRESS :

ADHAR NUMBER :

CONTACT NUMBER :

IP NO OF DISCHARGE :

ANTENATAL STATUS : YES/NO

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NEW BORN : YES/NO

COMORBID CONDITIONS: DIABETES/HYPERTENSION/ CAD/

THYROID – HYPO/HYPER/ COPD/

BRONCHIAL ASTHMA

PRESENTING COMPLAINTS:

PHYSICAL EXAMINATION:

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FIRST VISIT: 1ST WEEK

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

15

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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FIRST VISIT: 2ND WEEK

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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SECOND VISIT: IST MONTH

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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THIRD VISIT: 3RD MONTH

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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FOURTH VISIT: 6TH MONTH

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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FIFTH VISIT: 9TH MONTH

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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SIXTH VISIT: ONE YEAR

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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UNSCHEDULED VISIT

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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ANNEXURE II : Research Projects

(A)

Title : CYTOGENETIC EFFECTS OF ACCIDENTAL EXPOSURE TO STYRENE MONOMER VAPOUR – A POPULATION BASED COHORT STUDY.

1.	Investigator	**Dr P.V. Sudhakar, M.S, M.Ch., DNB,FAIS,FICS,** **Principal, AMC.**
2.	CO-I's	**Dr A. Bhagyalakshmi, MD** Professor & HoD, Department of Pathology, AMC **Dr B. Devi Madhavi** Professor & HOD, Dept of Community Medicine,AMC **Dr K .V. Leela** Associate Professor, Department of Biochemistry, AMC **Dr K. Satya Sri** Associate Professor, Department of Pathology, AMC **Dr A. Anuradha** Research Scientist, Multidiscplinary Research Unit (MRU),AMC

INTRODUCTION: Exposure to styrene mainly occur via inhalation during the industrial accident. About 90% of inhaled styrene is absorbed by the lung and undergoes biotransformation to Styrene-7,8-Oxide (SO) via cytochrome P-450s. The product is then hydrolysed by microsomal epoxide hydrolase, followed by metabolism to the main final metabolites, mandelic acid (MA) and phenylglyoxylic acid (PGA). Styrene-7,8-Oxide (SO) can also be conjugated with glutathione giving rise to mercapturic acids. Styrene has been shown to induce single-strand breaks (SSBs) in human white blood cells as well as cytogenetic damage including chromosome breaks, aneuploidy, sister chromatid exchanges (SCEs) and micronuclei (MN) in several cell systems in

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vitro and in lymphocytes of exposed workers. International Agency for Research on Cancer classified styrene as possibly carcinogenic to humans and Styrene-7,8-Oxide (SO) as probably carcinogenic to humans. However, there is a little literature regarding the association between styrene and cancer.

These genotoxic biomarkers (MN and SCEs) provide information about normal and pathological states of population and also used for monitoring different aspects of a disease such as: prevention,diagnosis, treatment and progression of the disease.These also helps to assess the environmental and epidemiological risk measurement.

Since the induction of SCEs and MN represent sensitive cytogenetic endpoints for the detection of genotoxic activity of environmental mutagens and carcinogens (WHO, 2014), these two assays will be employed in the present study to monitor a group of subjects accidentally exposed to styrene at LG Polymers,Visakhapatnam.

Primary Objectives:

1.To compare the DNA damage assessed in the form of MicroNuclear(MN) assay and Sister Chromatid Exchanges (SCEs) in people exposed to styrene with that of unexposed people.

2. To compare the frequency of MN and Sister Chromatid Exchanges (SCEs) chromosomes in subjects and unexposed people with respect to their habits(smoking and alcohol).

3. To analyze correlation between age and MN.

Secondary Objectives:

1.To observe the chromosomal aberrations among the individuals with high scores of MN & SCE's.

2.To assess whether genetically determined individual variations in xenobiotic metabolizing capacity might modify individual susceptibility to potential genotoxic effects following styrene exposure. Individuals will be genotyped for several genes involved in the metabolic fate of styrene including GSTM1 and GSTT1 (gene deletions), GSTP1 (Ile105Val), EPHX1 (Tyr113His and His139Arg), and CYP2E1 (DraI polymorphism in intron 6 that identifies a Thr7668Ala substitution).

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3. To evaluate correlation between genetic polymorphisms and biomarkers of effect(MN and SCE).

MATERIAL & METHODS

Hypothesis: It is assumed that the people exposed to styrene monomer vapour leak have genotoxic effects.

Null hypothesis: The people exposed to styrene monomer vapour leak will not have genotoxic effects.

Altenative hypothesis: The people exposed to styrene monomer vapour leak will have genotoxic effects.

Study Design: The study is a Cohort study.

Study period : The study will be carried out for a period of **3years**.

Study population : Exposed group & Unexposed group

The **Exposed group** are the villagers who are residents of place where the LG Polymers company is located and have been admitted to KGH on the day of industrial accident.

Unexposed group will be the residents residing in same geographic conditions with similar levels of air pollutants will be recruited for cytogenetic study.

Sampling frame:-

Sample size: The sample size consists of 350 individuals in exposed group or 350 individuals in unexposed group and the recruited random sample will be tested for Hematological parameters ,MN and SCEs in the first year.

Sample technique: Stratified sampling in which the population is divided into stratums/groups i.e.,

Group 1(5-18yrs)

Group 2(19-64yrs)

Study tools: The demographic data will be collected in the form of structured questionnaires.

Place Of Work : Andhra Medical College, King George Hospital, Visakhapatnam.

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Exposed Group:

Inclusion criteria :

1. Individuals of nearby villagers who are exposed to the industrial accident at LG Polymers on 7th May 2020 will be recruited.

2. Aged between 5 to 60 years.

Exclusion criteria :

1. Patients without informed consent and assent.

2.People under cancer ,prolonged usage of immune suppressors and Chronic Kidney failure treatment are excluded.

Unexposed Group:

Inclusion criteria :

1.Age and sex matched Individuals residing in similar geographic conditions with similar levels of air pollutants will be recruited.

2. Aged between 5 to 60 years.

Exclusion criteria :

1.Patients without informed consent and assent.

2.People under cancer, prolonged usage of immune suppressors and Chronic Kidney failure treatment are excluded.

Methodology:

At enrollment, investigator collects information on demographic characteristics, current illness, and medical history.

After taking the written informed consent; clinical and medical history will be noted on a predesigned proforma along with three generation pedigree to assess any history of disease and consanguinity.

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MicroNuclear(MN) assay

Aliquots of 2.5ml of heparinized whole blood are cultured in 4.5ml Hams F10 medium supplemented with 24% foetal calf serum (Sigma), penicillin (100IU/ml) (Sigma), streptomycin (100g/ml) (Sigma), 1% l-glutamine (Sigma) and 1% heparin (50IU/ml) (B. Braun). Lymphocytes are stimulated using 80µl of phytohaemaglutinin (Gibco BRL) and incubated at 37◦C. **Cytochalasin B** (Sigma) is added after 44h at a final concentration of 6g/ml (Fenech and Morley, 1985). After a total of 72-h culture, cells are harvested by centrifugation, treated twice with 5ml of a mixture (pH 7.2) of RPMI, supplemented with 2% foetal calf serum, for 7min.

The cells are again centrifuged and submitted to a mild hypotonic treatment in a mixture (pH 7.2) of RPMI 1640:deionized water 1:4, supplemented with 2% foetal calf serum, for 5min. The centrifuged cells will be placed on dry slides and smears are performed. After air-drying, the slides are fixed with freshly prepared and cold methanol:acetic acid (3:1 v/v) for 20min. One day later the slides are stained with 4% Giemsa in phosphate buffer, pH 6.8 for 7min. For each subject, 1000 binucleated (BN) lymphocytes with well-preserved cytoplasm are scored blindly by the same reader. MN are identified according to the criteria of Caria et al. (1995) using a 500× magnification for detection and a 1250× magnification for confirmation.

Sister Chromatid Exchanges (SCEs) assay

Aliquots of 2.5ml of heparinized whole blood are cultured as described above and 4.5l of **5-bromo-deoxyuridine** (BrDu) solution at a final concentration of 10g/ml was added at 24hr. Lymphocytes were incubated at 37◦C for 72h in the dark and colcemide (0.11g/ml) is added for the last hour; cells are prepared by standard procedures with hypotonic treatment followed by fixation with methanol:acetic acid (3:1 v/v). Slides are stained for SCE detection by the fluorescence-plus-Giemsa procedure (Perry and Wolff, 1974) for differential chromatid staining. A minimum of 25-s division metaphases will be scored for SCE per subject on coded slides by a single observer.

Hematological Parameters: 3 ml venous blood sample was collected in EDTA (Ethylenediaminetetraacetic acid) vacutainer tubes.The sample will be thoroughly, but gently mixed with the anticoagulant immediately after filling the tube. Blood samples will be tested within 4 hours on an automated 5 part differential cell counter for hemoglobin, WBC and platelet counts.

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Genotyping :

DNA will be isolated from lymphocytes using a commercially available kit according to the manufacturer's instructions (QIAamp DNA extraction kit; Qiagen, Hilden, Germany). CYP2E1, GSTT1, GSTP1, GSTM1, and EPHX1 polymorphisms will be determined as described by Teixeira et al. (2004).

Biochemical Analysis:
Urinary metabolites of styrene, namely, MA and PGA, will be measured in all subjects by using kits.
And lastly genetic counseling will be done to all families .
The study will be approved by ethical committee of the Andhra Medical College.

Results & Data analysis:
Project-specific case report forms will be used for data collection.
Prior to the study, a questionnaire will be supplied concerning health status, smoking habits, alcohol consumption, medication, and occupational history. The control group will be matched for gender, age, smoking, and lifestyle habits. The normality of variables will be evaluated by the Kolmogorov–Smirnov test. When no significant departure from normality found, Student's t-test will be applied for comparison between group means. Nonparametric tests will be applied when data distribution significantly deviated from normality, and are referred to when results are presented. When no test is specified, Student's t-test and parametric analysis will be applied. Spearman correlation analysis will be used for the estimation of correlations between parameters. A value of $p < .05$ will be used as the criterion of significance. Multifactorial analysis was performed to evaluate the contribution of potential confounding factors (sex, age, smoking) to the response variables considered.
Microsoft Excel and SPSS will be used for validation and cleaning, for all analyses.

Microsoft Excel will be used for validation and cleaning, for all analyses.

LIMITATIONS : As the study is scheduled for a limited period of time, the results may vary when we change the no. of subjects and study period.

ETHICAL CONSIDERATIONS:

Prior permission will be taken from Institutional Ethics Committee, Andhra Medical College, Visakhapatnam.

Prior informed consent will be taken from each individual of the study.



Proposed Budget:

Budget Head	1st year	2nd year	3rd Year	Total
b. Staff	2 Lab technicians @ 25,000/-per month (6,00,000/ P.A)			18,00,000/-
b. Contingency	1,00,000/- (P.A)			3,00,000/-
c. Chemicals & Consumables **Cytogenetic Investigations** **MN & SCE(700 samples)** **Chromosomal Aberrations (350 samples)**	700*1285/- = 8,99,500/-	350*1285/- = 4,49,750/-		13,49,250/-
Molecular Investigations (700 samples)			2000*700 =14,00,000	14,00,000/-
Hematological & Biochemical Investigations	(700 samples * 4 times testing= 2800 samples) 2800*1500 = 42,00,000/-			42,00,000/-
d. LOGISTICS	Vehicle for carrying samples			9,00,000/-
TOTAL				**99,49,250/-**

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(B)

PROJECT TITLE:

To Study the Effect of Accidental Exposure to High Concentration Styrene Gas on Pregnancy and its Outcomes

Investigator **Dr P.V. Sudhakar, M.S, M.Ch., DNB,FAIS,FICS,**
Principal, AMC.

CO-I's **Dr B. Devi Madhavi**
Professor & HOD,
Dept of Community Medicine,AMC
Dr A. Bhagyalakshmi, MD
Professor & HoD,
Department of Pathology, AMC
Dr.T.Nagamani
Prof. & HOD,
OBG, AMC
Dr.G.Ganga Bhavani
Associate Professor,
Department of Community Medicine, AMC
Dr.L.Siva Kumar
Assistant Professor,
Department of Community Medicine, AMC
Dr.G.Raja Lakshmi
Assistant Professor,
OBG ,AMC

AIM:

To study the genotoxic effects among antenatal women who are accidentally exposed tohigh concentrations styrene gas and its impact on pregnancy outcomeat the LG polymers styrene gas leak accident in Visakhapatnam in May 2020.

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OBJECTIVE:

1. To assess the impact of styrene gas exposure on pregnancy outcome in the form of miscarriage, still births, low birth rate, congenital anomalies in the new born both morphologic and genetic.
2. To assess the susceptibility to genotoxicity in antenatal mothers who were accidentally exposed to styrene.
3. To compare the pregnancy outcomes among the exposed antenatal women with and without exposure to styrene gas.
4. To follow the children born to mothers exposed to styrene up to a period of two years for growth and developmental assessment.

DELIVERABLES:

1.Early detection of genetic damage is crucial to implement the necessary measures to reduce or suppress the exposure to deleterious agent (styrene) when the damage is still reversible, thus reduce the risk to suffer diseases. Therefore, genotoxicity tests should be considered as essential tools for a complete medical surveillance of people potentially exposed to styrene and, in order to prevent the occurrence of diseases to styrene exposure. On the other hand, the application of these tests is useful to detect possible long-term effects of substances that are encountered by an industrial accident without knowing their capacity to affect human and environmental health.

2. This work provides new data about the ante natal exposure to styrene and helps to create a baseline data which can assist the physicians by increasing their awareness to determine the health risks that they may present as it is a unique incident.

3. Helps further in the search of information about ante-natal health for future interventions and genetic counselling.

METHODOLOGY

Study design - Cohort study

Study setting - within 3 km radius from LG polymers plant, the people who got accidentally exposed to styrene

Study population - All the pregnant mothers who got exposed to styrene gas within 3km radius from the LG polymers plant.

Study duration - August 2020 toAugust 2023. Which is 36 months.

Sample size- 60 pregnant women who were exposed to styrene gas on May 10 2020.

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Data collection method: Exposed pregnant women are recruited within three Kilometre radius of LG polymers where styrene gas leak has occurred. Pregnant women who are registered by the local ASHA /ANM by house to house survey are line listed and taken into the study after informed consent. Controls are taken from nearby PHC who are not exposed and willing to participate in the study in the ratio of 1:2. These are matched on the basis of age, trimester and nutrition.

Necessary investigations (lymphocyte micro nuclei frequency, CBMN ASSAY, Sister Chromatid)

One time new born investigations for assessing congenital anomalies(TIFFA Scan)

Growth follow up using Trivandrum development scale, length, weight up to 2 years.

congenital anomalies

Miscarriage, IUD, still birth

Preterm delivery

Testing for genotoxicity in both pregnant and new-born

BUDGET:

Budget Head	Split	1st year	2nd year	3rd year	Total
Staff salaries	4 health works	4 * 20000 = 80000	4 * 20000 =80000	4 * 20000 =80000	**240000**
Contingency	2 supervisors	2 * 30000 =60000	2 * 30000 =60000	2 * 30000 =60000	**180000**
Stationery		50000	50000	50000	**150000**
		25000	25000	25000	**75000**
Logistics					
Transport for health care staff	500 per visit	500 * 10 = 5000	500 * 10 = 5000	500 * 10 = 5000	**15000**
Transport for mothers for TIFFA scan and other Investigations	500 per person	500 * 120 = 60000	-		**60000**
TIFFA scan	3000 per person	3000 * 120 =360000	-	-	**360000**

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Chemicals for Cytogenetics RPMI Medium With L-Glutamine, FBS, PHA-M, Penicillin, Streptomycin and Sodium bicarbonate 1X Liquid Karyotyping Medium Colchicine Solution KCL Methanol and Glacial acetic acid(fixative) Giemsa Stain and Trypsin 5-Bromo-2'-deoxyuridine (BrDu) Cytochalasin B DPS mount	1000 per sample MN and SCE for both cases and controls Chromosomal aberrations analysis will be done only for cases	120 * 1000 = 120000	-		**120000**
Chemicals for Biochemical & Molecular Investigations DNA isolation Kits Primers Ladders Agarose Gel	3214 per sample	120 * 3214 = 385680	-	-	**385680**
Chemicals for Hematological Investigations	857 per sample	857 * 360 * 2 = 617040	857 * 360 * 2 = 617040	857*120*2 =204240	**1438320**
Total					**30,24,000/- INR**

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(C)

Mental health assessment and restoration of health in Styrene affected villages of Visakhapatnam District, Andhra Pradesh.

Investigator — Dr P.V. Sudhakar, M.S, M.Ch., DNB,FAIS,FICS,
Principal, AMC.

CO-I's — Dr B. Devi Madhavi
Professor & HOD,
Dept of Community Medicine,AMC

Dr.S.Radha Rani
Professor of Psychiatry,
Department of Psychiatry, AMC

Dr.T.S.N.Raju
Assistant Professor of Psychiatry,
Department of Psychiatry, AMC

Dr.Kiran Kumar
Assistant Professor,
Department of Community Medicine, AMC

Dr.L.Siva Kumar
Assistant Professor,
Department of Community Medicine, AMC

Introduction:

Studies conducted in the aftermath of environmental disasters such as Chernobyl and Bhopal, as well as studies of less well-known contamination cases, have documented a variety of important psychosocial impacts (1-10). These psychosocial impacts range from increased levels of distress to severe social disruption and conflict. In addition, some studies have suggested that the psychosocial impacts of environmental accidents can be quite long lived (1).There is a growing body of literature and research focused on understanding these psychosocial impacts, much of it dealing with clinical issues and implications. Up to this point, however, far less attention has been focused on program and policy issues connected with efforts to plan and deliver psychosocial assistance to victims of chemical and nuclear accidents. Because environmental accidents are expected to be a continuing problem incoming decades (11), and because psychosocial services are certain to be a crucial part of the public health and human service response, there is a pressing need for these program and policy issues to be more fully considered.

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In view of above studies under taken after accidents, this current study is propose to assess the psychosocial wellbeing through a base line survey & to provide services for psychosocial wellbeing, also to access the prevalence of Post trauma stress disorder due to styrene gas release in the Visakhapatnam area.

Objectives:

1. To assess the psychosocial wellbeing through a base line survey.
2. To assess the prevalence of Post trauma stress disorder.
3. To provide services for psychosocial wellbeing
4. To establish a centre for counseling for assessment of psychological wellbeing will be done using a standardized questionnaire.

Methodology:

A base line survey will be taken over for 6 months by the field investigators for a population of 20,000 people. A centre will be established for the next 2 ½ years for counseling the population to access the prevalence of Post trauma stress disorder due to styrene gas release & provide necessary psychological wellbeing services to the population.

Expected Deliverables:

1. Prevalence of PTSD (Post trauma stress disorder) among the affected community.
2. Improvement in mental health



BUDGET:				
Sl No.	**Particulars**	**1st Year (In Rs.)**	**2nd Year (In Rs.)**	**3rd Year (In Rs.)**
A	**Non-Recurring**			
1	Office establishment	5,00,000	-	-
2	Equipment's	5,00,000	-	-
3	Furniture	5,00,000	-	-
B.	**Recurring**			
1.	**Manpower**			
a	Project Manager No. 1 @ Rs. 54,000 p.m	2,48,000	2,48,000	2,48,000
b	Field Investigators (6 months) No. 5 @ Rs. 20,000 p.m.	6,00,000	-	-
c	Medico social Worker No. 1 @ Rs. 20,000 p.m.	2,40,000	2,40,000	2,40,000
d.	Counsellor No. 1 @ Rs. 20,000 p.m.	2,40,000	2,40,000	2,40,000
e.	Multitasking worker No. 1 @ Rs. 12,000 p.m	1,44,000	1,44,000	1,44,000
f.	Data Entry Operator No. 1 @ Rs. 20,000 p.m	2,40,000	2,40,000	2,40,000
2.	**Miscellaneous Expenses**			
	Hiring of Building	1,80,000	1,80,000	1,80,000
	Power and Internet	1,80,000	1,80,000	1,80,000
3.	Consumables	1,00,000	1,00,000	1,00,000
4.	Contingencies	2,00,000	2,00,000	2,00,000
5.	Transport	3,00,000	3,00,000	3,00,000
6.	Report Writing	2,00,000	2,00,000	2,00,000
	Total	**43,72,000**	**22,72,000**	**22,72,000**
	Grand Total (1st Year + 2nd Year + 3rd Year)	**89,16,000**		

PRINCIPAL
Andhra Medical College
Visakhapatnam

From
Dr.K.Vijaya Lakshmi
District Medical and Health officer,
Visakhapatnam.

Date: 18.9.2020.

To
The Principal
Andhra Medical College
Visakhapatnam.

Sir,

Sub:- Styrene Gas leak –LG Polymers, RR Venkatapuram - Estimation of budget for running health centre- submitted

Ref:- Committee meeting on restoration and compensation plan for damage to health, property, crops live stock etc. dt.15.9.2020.

*****

With reference to above subject, I wish to submit the estimated budget requirement for running Health Center (Dr.YSR Health Clinic) established in RR Venkatapuram on 07.7.2020.

I request you to incorporate the estimate under Sub component – 2 as per the MoEF & CC orders.

Thanking you Sir,

Yours faithfully,

18/9/2020

(Dr.K.Vijaya Lakshmi)
District Medical & Health Officer
Visakhapatnam

BUDGET REQUIREMENTS

YSR CLINIC – STYRENE GAS LEAK - VENKATAPURAM

PROPOSED EXPENDITURE FOR THE 10 BEDDED HOSPITAL FOR 5 YEARS

S. No	POST	Number of Persons	Salary for Each Person	Total Salaries for one month	Total Salaries for 1st year	Total Salaries for 2nd year	Total Salaries for 3rd year	Total Salaries for 4th year	Total Salaries for 5th year	TOTAL
1	Doctors	03	54,000	1,62,000	19,44,000	40,82,400	62,40,240	84,00,024	1,05,60,002	3,12,26,666
2	Staff Nurse	03	34,500	1,03,500	12,42,000	26,08,200	39,86,820	53,66,682	67,46,668	1,99,50,370
3	Pharmacists	02	28,000	56,000	6,72,000	14,11,200	21,57,120	29,03,712	36,50,371	1,07,94,403
4	Lab Tech.,	02	28,000	56,000	6,72,000	14,11,200	21,57,120	29,03,712	36,50,371	1,07,94,403
5	Attenders	04	15,000	60,000	7,20,000	15,12,000	23,11,200	31,11,120	39,11,112	1,15,65,432
6	Night Watchman	02	10,000	20,000	2,40,000	5,04,000	7,70,400	10,37,040	13,03,704	38,55,144
7	Sweepers	02	10,000	20,000	2,40,000	5,04,000	7,70,400	10,37,040	13,03,704	38,55,144
8	Thoty	02	10,000	20,000	2,40,000	5,04,000	7,70,400	10,37,040	13,03,704	38,55,144
9	DEO	01	15,000	15,000	1,80,000	3,78,000	5,77,800	7,77,780	9,77,778	28,91,358
10	Clerk	01	18,000	18,000	2,16,000	4,53,600	6,93,360	9,33,336	11,73,334	34,69,630
11	Drugs & Disposables			50,000	6,00,000	12,60,000	19,26,000	25,92,600	32,59,260	96,37,860
12	Lab Consumables			15,000	1,80,000	3,78,000	5,77,800	7,77,780	9,77,778	28,91,358
	Total				**71,46,000**	**1,50,06,600**	**2,29,38,660**	**3,08,77,866**	**3,88,17,786**	**11,47,86,912**

District Medical & Health Officer
Visakhapatnam

YSR CLINIC – STYRENE GAS LEAK - VENKATAPURAM

PROPOSED EXPENDITURE FOR THE 10 BEDDED HOSPITAL

S. No	POST	Number of Persons	Salary for Each Person	Total Salaries for one month	Total Salaries for 1st year	Total Salaries for 2nd year	Total Salaries for 3rd year	Total Salaries for 4th year	Total Salaries for 5th year	TOTAL
	BF				**71,46,000**	**1,50,06,600**	**2,29,38,660**	**3,08,77,866**	**3,88,17,786**	**11,47,86,912**
13	Maintanance i.e. power,Internet and Telephone			15,000	1,80,000	3,78,000	5,77,800	7,77,780	9,77,778	28,91,358
14	**Ambulance Maintanance**									
	1) Drivers	02	20,000	40,000	4,80,000	10,08,000	15,40,800	20,74,080	26,07,408	77,10,288
	2) Helpers	02	15,000	30,000	3,60,000	7,56,000	11,55,600	15,55,560	19,55,556	57,82,716
15	Fuel			30,000	3,60,000	7,56,000	11,55,600	15,55,560	19,55,556	57,82,716
16	Vehicle Maintanance			5,000	60,000	1,26,000	1,92,600	2,59,260	3,25,926	9,63,786
	Grand Total				**85,86,000**	**1,80,30,600**	**2,75,61,060**	**3,71,00,106**	**4,66,40,010**	**13,79,17,776**

I.C.U 18/9/2020

District Medical & Health Officer
Visakhapatnam

From
Dr.K.Vijaya Lakshmi
District Medical and Health officer,
Visakhapatnam.

Date: 18.9.2020.

To
The Principal
Andhra Medical College
Visakhapatnam.

Sir,

Sub:- Styrene Gas leak –LG Polymers, RR Venkatapuram - Budget requirement for Lab tests- submitted.

Ref:- Committee meeting on restoration and compensation plan for damage to health, property, crops live stock etc. dt.15.9.2020.

*****

With reference to above subject, Laboratory tests are contemplated for needy 10000 populations in the affected villages. A detailed exercise of required tests was done and quotations were called from laboratories and finalized the rates.

In this connection, I am herewith submitting the detailed budget proposals for carrying out the tests.

Hence I request you to incorporate the proposal in the Sub component – 2 as per the MoEF & CC office order.

Thanking you Sir,

Yours faithfully,

18.9.2020

(Dr.K.Vijaya Lakshmi)

District Medical & Health Officer
Visakhapatnam

PROPOSED EXPENDITURE FOR INVESTIGATIONS

S.No.	Test	No. of People to be covered	Rate (INR)	No. of times	Total
1	Routine tests	10,000	720	6	4,32,00,000
2	CT scan	1,000 (10% of population)	1200	1	12,00,000
3	USG abdomen	2,000 (20% of population)	699	1	13,98,000
4	MRI Brain	500 (5% of population)	1700	1	8,50,000
5	EEG	500 (5% of population)	1500	1	7,50,000
6	NCS	500 (5% of population)	1000	1	5,00,000
				Grand Total	**4,78,98,000**

18/9/2020

District Medical & Health Officer
Visakhapatnam

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Annexuer-III

DEPARTMENT OF AGRICULTURE

From
Smt. G.S.N.S.Leelavathi, M.Sc(Ag),
Joint Director of Agriculture,
Visakhapatnam.

To
The Joint Chief Environmental Engineer
A.P. Pollution control board
Visakhapatnam

Sir,

File No.AGRI-CAL/ /2020-JA(T1)-AGRLVSKP, Dated 23.09.2020

Sub:- Disaster Management – Gas leakage tragic incident- Visakhapatnam district-styrene vapours released from m6 storage tank of LG Polymers India Pvt. Ltd.- submission of input assessment report – Regarding.

Ref:- 1. AGRI-CAL/ 2020-SA(T1)-AGRLVSKP, Dated 19.09.2020, of this office
2. Roc.No.A/2037/2020, Dt.21.09.2020, ADR, RARS, Anakapalli
3. Rc. No. H(1) 16/2020, Dt. 23-09-2020, ADH, Visakhapatnam

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It is submitted that, in continuation to the restoration plan for damage to the crops village level a report submitted (as per ref. 1st cited), The Associate Director of Research has furnished the information on input requirement for adoption of best management practices in paddy crop and other expenses towards visit of the scientist has been submitted (ref.2nd cited), The Assistant Director of Horticulture has submitted the enumerated crop damages at the time of incident (ref 3rd cited) is herewith enclosed.

In this connection I submit the abstract of report towards supply of Inputs for adoption of Best Management practices both Organic and Inorganic, expenses towards visit of scientists and also compensation enumerated horticulture crop damages.

Estimated cost for inputs for adoption of Best Management practices (Organic + Inorganic) (Rupees)	598840
Charges towards Testing parameters including visits of Scientists	59500
Compensation Enumerated horticulture crop damages	198938
Grand total	857278

Hence submitted for necessary information.

Yours faithfully

23/9/2020
Joint Director of Agriculture
Visakhapatnam

Copy submitted to the District collector, Visakhapatnam for favour of kind information
Copy submitted to the Commissioner of Agriculture, A.P., Guntur for favour of kind information
Copy submitted to ADR, RARS, Anakapalli
Copy submitted to ADH, Visakhapatnam

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s of Inputs and other expenses for restoration of crop in L.G.Polymers affected village
Agriculture Department

	Particulars	Qty per Ha	unit rate (Rs.)	Amount per Ha.
	Organic Inputs			
1	FYM	10 MTs	650	6500
2	Boifertilizers (3types per lit)	1.25 Lit	300	1125
3	Neem cake	500Kg	10	5000
4	Greenmanure	37.5 kg	50	2000
5	Trichocards (4releases)	10 cards	50	500
	Inorganic inputs			
1	Urea	263Kg	296/- (per 50kg bag)	1555
2	SSP	375 kg	500/- (per bag)	3750
3	MOP	100 kg	950/- (per bag)	1900
	Plant protection chemicals (Need based)			
1	Monocrotophos	1000ml	272/500ml	540
2	Tricyclazole	300gm	255/120gm	637.5
3	Hexaconazole	1000ml	245/400ml	612.5
4	Carbendizm	750gm	200/300gm	500
5	Cartaphydrochloride	20kg	650/5kg	2600
		Total cost per ha		27220
The villages affected in the L.G.Polymers incident are mostly living habitations, the only village with cropping area is R.Venkatapuram. As per the report given by MAO, there is an extent of 22Ha paddy in kharif grown in the endowment lands of the village, hence the estimated cost for inputs (Rupees)		1)		598840

	Additional Testing parameters	Rs. Per sample	As per recommendation samples	
1	soil sample	600	6000	
2	plant sample	1000	11000	
3	grain sample	1000	10000	
4	irrigation water	250	2500	
5	earthworm count	1000	10000	
6	Microbial Count			
7	soil sample collection charges per visit (5 visits)	1000	5000	
8	POL Charges (for scientist visits) per visit (5 visits)	3000	15000	
		2)	59500	
	Total estimation (Inputs + testing parameters)		(1+2)	658340

Total estimated enumerated Horticulture crop damages	3)	198938
GRAND TOTAL	(1+2+3)	857278

23/3/2020
Joint Director of Agriculture
Visakhapatnam

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DEPARTMENT OF AGRICULTURE

From
Smt. G.S.N.S.Leelavathi, M.Sc(Ag),
Joint Director of Agriculture,
Visakhapatnam.

To
The Joint Chief Environmental Engineer
A.P. Pollution control board
Visakhapatnam

Sir,

File No.AGRI-CAI/ /2020-JA(T1)-AGRI.VSKP, Dated 22.09.2020

Sub:- Disaster Management – Gas leakage tragic incident- Visakhapatnam district-styrene vapours released from m6 storage tank of LG Polymers India Pvt. Ltd.- submission of input assessment report - Regarding.

Ref:- 1. AGRI-CAL/ 2020-SA(T1)-AGRI.VSKP, Dated 19.09.2020, of this office
2. Roc.No.A/2037/2020, Dt.21.09.2020, ADR, RARS, Anakapalli

It is submitted that, in continuation to the restoration plan for damage to the crops village level a report submitted (as per ref. 5th cited), The Associate Director of Research has furnished the information on input requirement for adoption of best management practices in paddy crop and other expenses towards visit of the scientist has been submitted (ref.6th cited) is herewith enclosed.

Hence submitted for necessary information.

Yours faithfully

22/9/2020
Joint Director of Agriculture
Visakhapatnam

Copy submitted to the District collector, Visakhapatnam for favour of kind information
Copy submitted to the Commissioner of Agriculture, A.P., Guntur

Details of Inputs and other expenses for restoration of crop in L.G.Polymers affected villages- Agriculture Department

S.No.	Particulars	Qty per Ha	unit rate (Rs.)	Amount per Ha.
	Organic Inputs			
1	FYM	10 MTs	650	6500
2	Boifertilizers (3types per lit)	1.25 Lit	300	1125
3	Neem cake	500Kg	10	5000
4	Greenmanure	37.5 kg	50	2000
5	Trichocards (4releases)	10 cards	50	500
	Inorganic inputs			
1	Urea	263Kg	296/- (per 50kg bag)	1555
2	SSP	375 kg	500/- (per bag)	3750
3	MOP	100 kg	950/- (per bag)	1900
	Plant protection chemicals (Need based)			
1	Monocrotophos	1000ml	272/500ml	540
2	Tricyclazole	300gm	255/120gm	637.5
3	Hexaconazole	1000ml	245/400ml	612.5
4	Carbendizm	750gm	200/300gm	500
5	Cartaphydrochloride	20kg	650/5kg	2600
		Total cost per ha		27220
The villages affected in the L.G.Polymers incident are mostly living habitations, the only village with cropping area is R.Venkatapuram. As per the report given by MAO, there is an extent of 22Ha paddy in kharif grown in the endowment lands of the village, hence the estimated cost for inputs (Rupees)				598840

	Additional Testing parameters	Rs. Per sample	As per recommendation samples	
1	soil sample	600	6000	
2	plant sample	1000	11000	
3	grain sample	1000	10000	
4	irrigation water	250	2500	
5	earthworm count	1000	10000	
6	Microbial Count			
7	soil sample collection charges per visit (5 visits)	1000	5000	
8	POL Charges (for scientist visits) per visit (5 visits)	3000	15000	
			59500	
Total estimation (Inputs + testing parameters)				658340

Joint Director of Agriculture
Visakhapatnam

GOVERNMENT OF ANDHRA PRADESH
DEPARTMENT OF HORTICULTURE

From
Smt.K.Sailaja
Asst. Director of Horticulture
Visakhapatnam

To
The Joint Director of Agriculture
Visakhapatnam

Rc. No. H(1) 16/2020, Dt. 23-09-2020

Madam,

Sub:- M/s LG Polymers - Styrene Gas Leakage – Damage to Horticulture crops - - Compensation to farmers from M/s LG Polymers – Request-Regarding.

Ref:- 1. Rc.No. 360/2020/B/dt 4-6-2020O/o Tahsildar, Gopalapatnam
2. Rc.No. 190/2020/C/dt 6-6-2020O/o Tahsildar, Pendurthi
3. Study report of Dr. YSR. Horticulture University Scientists, Venkataramannagudem, West Godavari, district

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With references to 1st and 2nd cited above, it is submitted that Mandal level teams of Gopalapatnam and Pendurthi have enumerated Horticulture crop damages in R.Venkatapuram village of Gopalapatnam Mandal and Vepagunta village of Pendurthi Mandal due to Styrene gas leakage from M/s LG Polymers.

Further, submitted that, both the Tahsildars have certified that the lands belong to Sri SVLN Devastanam and are unsettled villages. As the compensation cannot be released to farmers in unsettled inam villages by the Government, the compensation detailed below may be recommended from M/s LG Polymers.

The recommended compensation to affected farmers is as detailed below.

Sl.No	Crop	Extent damaged in Acres/No. Of trees	Estimated loss per acre/ fruit crops in (Rs)	Recommended compensation per acre @ 75 % (Rs)	Estimated Total amount (Rs)
1	Vegetables	4.25 ac	40000	30000	127500
2	Banana	0.30 ac	49000	36750	11025
3	Papaya	0.15 ac	200000	150000	22500
4	Mango	400 trees	22500	-	16875
5	Cashew	100 trees	9000	-	6750
6	Sapota	40 trees	18000	-	13500
7	Coconut	30 trees	1050	-	788
	Grand Total				**198938**

Vide ref 3rd cited, team of Horticulture Scientists from Dr.YSR Horticulture University, Venkataramannagudem, West Godavari, district have concluded that there is no adverse effect on soil, hence horticulture crops can be cultivated during succeeding seasons.

In this, connection, it is requested to recommend compensation of crop loss to affected farmers in Inam lands from M/s LG Polymers

Submitted for favour of information.

Yours faithfully

Asst. Director of Horticulture,
Visakhapatnam

ACHARYA N.G.RANGA AGRICULTURAL UNIVERSITY

ANGRAU

Dr. M. Bharathalakshmi,
M.Sc.(Ag.) Ph.D.
Associate Director of Research

Regional Agricultural Research Station,
Anakapalle – 531 001,
Visakhapatnam Dist
Ph : 08924-223370 (O), 9989625211
e-mail : adrnczone1983@gmail.com

Roc. No. A/ 2037 /2020, Dated.21-09-2020

To
The Joint Director of Agriculture
PM Palem
Visakhapatnam

Respected Madam,

Sub : Regional Agricultural Research Station, Anakapalle-Information on input cost for best management of paddy crop per unit area and other expenses in R. Venkatapuram village, M/s LG polymers Gas leakage affected area – Submission – Reg.

Ref : Telephonic discussion with the Joint Director of Agriculture, Visakhapatnam on 20.09.2020

***

In the light of above mentioned subject and as per the telephonic discussions held with the Joint Director of Agriculture, Visakhapatnam on 20.09.2020, I am herewith furnishing information on Input requirement for adoption of best management practices in paddy crop and other expenses towards visit of Scientist and chemicals pertaining to soil, plant and irrigation water sample analysis in R. Venkatapuram village, M/s LG polymers Gas leakage affected area for favour of information.

Details of input cost per unit area and other expenses:

S.No.	Particulars	Qty. per ha	Unit rate (Rs.)	Amount per ha (Rs.)	Remarks
	Organic Inputs				
01	Farm Yard Manure	10 T	650	6500	Any one of the organic source can be utilized
02	Vermi compostper Tonne	2 T	3000	6000	
03	Biofertilizers per Lt (3 types of biofer.)	1.25 Lt	300	1125	
04	Neem cake	500 kg	10	500	
05	Green manure (Diancha/Sunhemp seed)	37.5 kg	50	2000	
06	Trichocards (4 releases)	10 cards	50	500	
	Inorganic inputs				
07	Urea	263 kg	296/bag	1555	Recommended dose of
08	Single Super Phosphate	375 kg	500/bag	3750	

09	Muriate of Potash	100 kg	950/bag	1900	fertilizers
10	Monocrotophos	1000 ml	272/500 ml	540	Need based plant protection chemicals
11	Tricyclozole	300 g	255/120 g	637.5	
12	Hexaconazol	1000 ml	245/400 ml	612.5	
13	Carbendazim	750 g	200/300 g	500	
14	Cartop Hydrochloride granules	20 kg	650 /5 kg	2600	
15	Seedling cost for Agroforestry (Seedlings from Department of Forestry)				
	Testing charges (per sample)	Rs. Per sample			
15	Soil sample analysis (per sample)	600		Analysis for soil and Irrigation water will be taken up before and after the crop season and plant sample will be taken up at maturity stage (For every 5 acres of land one sample is the optimum sample size). The heavy metal analysis has to be taken by the Pollution Control Board.	
16	Plant sample analysis (per sample)	1000			
17	Grain sample analysis (per sample)	1000			
18	Irrigation water analysis (per sample)	250			
19	Earthworm count	1000			
20	Microbial count (will be done at ARS, Amaravathi)				
	Other Miscellaneous charges				
21	Sample collection charges per visit	1000			
22	POL charges (Conveyance to scientist visits) per visit	3000			

This is submitted for favour of kind information and further necessary action.

Yours faithfully

21/9/2010

Associate Director of Research

DEPARTMENT OF AGRICULTURE

From
Smt. G.S.N.S.Leelavathi, M.Sc(Ag),
Joint Director of Agriculture (FAC),
Visakhapatnam.

To
The Joint Chief Environmental Engineer
A.P. Pollution control board
Visakhapatnam

Sir,

File No.AGRI-CAI/2020-SA(T1)-AGRLVSKP, Dated 19.09.2020

Sub:- Disaster Management – Gas leakage tragic incident- Visakhapatnam district-styrene vapours of LG Polymers India Pvt. Ltd.- preparation of the restroration plan and compensation for damage to the crops – Regarding.

Ref:- 1. High Power Committee on Investigation Of Styrene Vapour Leak From LG Polymers India Pvt. Ltd., Visakhapatnam report Dt.15.06.2020
2. NGT (Sesha Sainareddy) report Dt.,28.05.2020
3. Lr.no.Gen/PCB/RO-VSP/NGT/2020- Dt.31.08.2020, APPCB, Visakhapatnam
4.F.No.11/20/2020, Dt21.07.2020, MoEF &CC office order
5. File No.AGRI-CAL/2020-JA(T1)-AGRLVSKP, Dated 01.06.2020 of this office.
6. Analysis reports from VIMTA labs Dt.07.06.2020
7. Analysis reports of microbial population dynamics, ARS, Amaravathi, Dt.22.06.2020
8. Roc. No.A/1587/2020, Dt.16.07.2020, RARS, Anakapalli
9. File No.AGRI-CAL/2020-JA(T1)-AGRLVSKP, Dated 01.08.2020 of this office
10. Lr.No.2937/Dr.YSRHU/Res.I/2020, Dt.14.09.2020, Dr.YSR Horticulture University, Venakatarammannagudem.
11.Lr. from RARS, Anakapalli, Dt18.09.2020

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It is submitted that vide ref. 9th cited a report has been submitted stating that, At the time of gas leakage incident there were no field crops existing in the affected area except few vegetable crops and agroforestry. But to study the affect of styrene on the soil, 63 soil samples were collected on 13.05.2020 and analysed for various parameters like pH, E.C, O.C, N,P, K, Zn, Fe, Mn, Cu, S, B at the Soil testing laboratory, Department of Agriculture. According to the soil health reports, the pH ranges from 6.9 to 8.7 i.e., slightly Alkaline and the E.C ranges from 0.08 to 0.2 mms which are normal.

The Biological properties of soil i.e,Total bacterial population, total fungal population, Beneficial microorganisms were analysed at ARS, Amaravathi (ref. 7th cited) and also analysed for heavy metals at VIMTA, Labs Visakhapatnam (ref.6th cited). Based on these reports received from Research Scientist, ARS, Amaravathi and VIMTA- Laboratories, crop suitability assessment for cultivation has been given by Associate Director of Research, RARS Anakapalli, that it is satisfactory and the soil is suitable for cultivation of crops. (Ref. 8th cited).

It is further submitted that a team of Scientists from Dr.YSR Horticulture University, Venakatarammannagudem, has also submitted a report (Ref.10th cited) on soil quality, micro fauna, Water quality stating that there was no affect of styrene vapour on soil physiochemical and biological properties after 40days of the said incident and hence suggested that all crops can be grown by adopting good agricultural practices.

It is further submitted that, as per the instructions received in ref. 3rd and 4th cited for preparation of the restroration plan and compensation for damage to the crops a team constituting of Scientists from RARS, Anakapalli (Principal Scientist-Crop physiology, Principal Scientist-Agronomy, Senior Soil Scientist), Officers from Department of Agriculture ie., Joint Director of Agriculture, ADA® Visakhapatnam along with MAO,

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Chinagadili, Assistant Director of Horticulture, and MRO, Gopalapatnam has visited the village on 17.09.2020.

The team visited the Agricultural fields of R. Venkatapuram village and made the following observations (ref.11th cited)

1. The paddy crop is being irrigated with seepage water of Meghadrigedda reservoir mixed with municipal drainage water which was of poor quality for crop cultivation, dumped with plastic and other wastages, it may be a threat to the soil health in near future.
2. Paddy variety of BPT 5204 (Sambamahsuri) was planted with over aged seedlings of 50-60 days nursery and the crop is at active tillering stage (25-30 days after transplanting)
3. The cultivators, in general, have not adopted the timely management practices. The crop was planted with aged nursery, basal dose of fertilizers were not applied. The crop has symptoms of leaf blast and leaf folder incidence for which the plant protection chemicals were not sprayed.
4. On visual observation, **Paddy crop looked healthy** and symptoms of any adverse effect on growth due to styrene gas leak were not visible as the plant height and tillering were normal with **25-40 tillers per hill** and 40-45 cm plant height coupled with chlorophyll content of leaf at **37.4 SPAD/SCMR** value, which is a good sign of crop geometry at tillering stage for **reaping good yields.**
5. It was informed by the cultivators, that they are taking two crops in a year with the crop sequence of Paddy-Paddy and Paddy-Vegetables with available municipal drainage water.
6. The surrounding vegetation **viz.,*Casuarina*, Banana, Eucalyptus and other miscellaneous tree** vegetation were also observed to **be normal.**
7. It is observed that, at present there is **No abnormalities in crop condition** situated in R.Venkatapuram village and further inference can be realized after receipt of the harvesting data of paddy (Nov/Dec, 2020).

Based on the above visual observations and the soil data obtained from the Department of Agriculture/Horticulture, the team is of the opinion that reclamation of soils can be done to ward off the any possible ill effects due to styrene gas leakage on the performance of crops and for avoiding the ill effects of drainage water which is being utilized for cultivation of crops.

a. It is suggested that green manure crops like Diancha, sunhemp etc., should be invariably grown as preceding kharif crop to sustain the soil and crop productivity.
b. Application of organic manures like Farm Yard Manure, Pressmud cake, vermicompost, neem cake and other edible cakes can also be advocated for enrichment of soil organic matter content and soil health management.
c. Use of different types of biofertilizers (Azatobactor, Azospirillum, Phosphate solubilizers and Potash solubilizers) can also be suggested for improvement of crop yields through enrichment of soil beneficial microflora.
d. Irrigation with municipal drainage water for cultivation of crops can also be discouraged to curtail the soil health hazards in future.
e. Incorporation of crop residues after every cropping cycle may be made mandatory for improvement of soil health.
f. **Supply of orchard/forest seedlings** keeping in view of maintaining green vegetation for healthy livelihood as many people are residing in the vicinity of M/s LG Polymers.

Use of biocontrol tools like trichocards can also be promoted for pest control in crops to discourage chemical plant protection keeping in view of environmental safety and protection.

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It was felt by the team of scientists that data on yield at the time of harvest of the kharif crop (Nov-Dec, 2020) along with the essential soil parameters can be taken for long term study of the impact of "styrene gas" accumulation, if any, on crop performance. Similar observations at periodical intervals for at least two years may help in drawing valid conclusions on the impact of Styrene gas leakage on crop performance in the subsequent years.

This is submitted for favour of information.

Yours faithfully

19/9/2020

Joint Director of Agriculture
Visakhapatnam

19/9/2020

Copy submitted to the District collector, Visakhapatnam for favour of kind information

Copy submitted to the Commissioner of Agriculture, A.P., Guntur

Copy submitted to the Associate Director of Research, RARS, Anakapalli

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DEPARTMENT OF AGRICULTURE

From
Smt. G.S.N.S.Leelavathi, M.Sc(Ag),
Joint Director of Agriculture,
Visakhapatnam.

To
The Commissioner of Agriculture
A.P., Guntur.

Sir,

File No.AGRI-CAI/ /2020-JA(T1)-AGRI.VSKP, Dated 01.06.2020

Sub:- Disaster Management – Gas leakage tragic incident- report on News article "Ryots hit as gas leak damages, halts cultivation – Regarding.

Ref:- 1. News article – Ryots hit as gas leak damages, halts cultivation"- Indian express.
2. R.C.No.679/2020/D3, Dt.10.05.2020, District Collector Visakhapatnam
3. Lr. No.7063/PCB/ZO-VSP/Tech./2020- A.P Pollution Control board-zonal office -Visakhapatnam
4. AGRI. CAL JA(T1)- AGRIL.VSKPdt14.05.2020 & 23.05.2020 of this office
5. RC. No. H(1)16/2020, Dt01.06.2020 Department of Horticulture, Visakhapatnam
6. Reports received from the Mandal Agricultural Officers of Chinagadili and Pendurthi
7. Mail sent to RARs Anakapalli, dt 01.06.2020 from this office.
8. Report from APPCB, Zonal lab Visakhapatnam dt:01.06.2020

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It is submitted that, in response to the News article "Ryots hit as gas leak damages, halts cultivation" the facts analysed are here with reported

a) As per the orders from the District Collector received in the reference 2nd cited above to Collect the vegetables, fruits and grass etc., in the farms and handed over safely to GVMC for safe disposal in biomedical waste method for avoiding consumption and feeding of cattle around.
b) In view of the letter vide ref. 3rd cited from A.P Pollution Control board-zonal office - Visakhapatnam, the crop damage report and contamination assessment report has been submitted through ref. 4th cited. Soil samples were collected in random manner and assessed for nutrient status parameters (PH, E.C, O.C, N,P, K, Zn, Fe, Mn, Cu, S, B).
c) In response to the ref. 1st cited, Department of horticulture has submitted the assessment report stating the cropping around the affected villages, concluding that crops exposed, charred and rotten due to styrene gas affect are being destroyed through disposal in biomedical waste method. And soil samples were collected from around the 5km radius immediately after the incident,63 soil samples have been collected from Agri and Horticulture fields and analysed by Mobile testing Laboratory Visakhapatnam.
d) According to soil health reports the PH ranges from 6.9 to 8.7 i.e., slightly Alkaline and the E.C ranges from 0.08 to 0.2 mms which is normal. It is advised Paddy, Vegetables and other Plantation crops can be taken by reclamating the soil with Gypsum @ 200 kgs per acre where the PH is beyond 8.5. The report received from APPCB, Zonal lab Visakhapatnam in ref. 8th cited, has also indicated the similar results, stating that Styrene concentrations couldn't be analysed as the Styrene standard is not readily available with them and the same will be procured and the samples will be analysed in due course.

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e) As per the reference 6th cited, report submitted by Mandal Agricultural Officers China Gadili and Pendurthi, stated that Venkatapuram and Kothapalem villages comes under Venkatapuram Revenue village having 55 Acres of wet land and approximately 92 farmers are cultivating the crops which are unsettled endowment lands. The main crops are Paddy during Kharif, and Vegetables during Rabi seasons. These fields are being benefitted by the seepage water of Megadhri Gedda reservoir. At the time of incident there were no field crops existing.

f) In the Kamparapalem village 100 acres of wet land is there, with 175 farmers usually take up Paddy in Kharif, it is totally rainfed area and there is no other crop for the rest of the season. Laxmipuram village is having 30 acres of wet land with Paddy in Kharif followed by Vegetables in Rabi in an extent of 5-7 acres being cultivated by 75 farmers. There were no Agricultural crops existing in the field except Vegetables and Agro forestry crops like Casuarina and Eucalyptus at the time of incidence.

g) Meanwhile the scientists from RARS, Anakapalli have been contacted for the Parameters to be analyzed for assessment of the styrene gas affect along with the suitability of soil for cultivation and have been suggested for analyzing soil quality parameters -Chemical and physical properties like pH, E.C, Available nutrients (macro and micro nutrients), Heavy metals, Bulk Density, Hydraulic Conductivity, Infiltration rate etc. and also suggested for assessment of Biological properties of soil Total bacterial population, total fungal population, Beneficial microorganisms (Nitrogen fixers and phosphate solubilizers), Enzyme activity (Dehydrogenase, urease, acid and alkaline phosphotase). For guidance on analysis of biological properties, a letter has been addressed to Directorate of Research, microbiology, Amaravathi.

h) As the real time effect of Styrene has not reflected in the above parameters analysis and also APPCB, Visakhapatnam has informed that Styrene concentrations couldn't be analysed, A.U. Environmental Engineering Department, College of Engineering, Andhra university, Visakhapatnam are also consulted for further clarification on suitability of soil for cultivation in these areas along with analysis of soil for other parameters if any required, but due to the non-availability of required facilities with them the VIMTA, Laboratories have been contacted for analysis of heavy metals on payment basis and each sample analysis costing Rs.3500/- approximately. We have collected composite samples of 4 numbers from the affected villages which are being submitted for analysis. As informed by the laboratory the analysis report on heavy metals will be received in 5days, soon after the receipt of the same will be submitted for further necessary action.

Yours Faithfully

Joint Director of Agriculture
Visakhapatnam

Copy submitted to the District Collector for favour of information.

01/06/2020

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ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY

From:
Dr. D.V.Ramana Reddy,
Principal Scientist (SS&AC) & Head,
Agril. Research Station,
AMARAVATHI – 522 020.
Guntur (Dist.), A.P.,

To
The Joint Director of Agriculture,
Visakhapatnam-

Lr. No. ARS, AMT/Microbial analysis of soil samples/2020, dt.21.06.2020.

Sir,

Sub: Agril. Research Station, Amaravathi – Microbial analysis of soil samples-Report-Submitted-Reg.
Ref: 1. File No. AGRI-CAL/2020-JA(T1)-AGRL VSKP, Dt.01.06.2020
Joint Director of Agriculture, Visakhapatnam

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As per the reference cited above, the report of microbial analysis of the soil samples is herewith enclosed / attached.

Yours faithfully,
Dr Ramana Reddy
22/6/2020

Principal Scientist & Head
Agril. Research Station
AMARAVATHI - 522 020
Guntur (Dist.) A.P.

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Your Ref : **File No. AGRI-CAL/2020-JA(T1)-AGRL VSKP, *Dt.01.06.2020***

Joint Director of Agriculture, Visakhapatnam

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Microbial population dynamics in soil samples of the villages of Vishakhapatnam

Sample Name	Total Bacteria	Total fungi	Beneficial Population					
			KRB	PSB	*Rhizobium*	Actinomycetes	*Azospirillum*	*Azotobacter*
Kothapalem	30×10^{7}	10×10^{4}	40.6×10^{6}	30.0×10^{5}	10.0×10^{5}	93.0×10^{6}	5×10^{5}	33×10^{6}
Laxmipuram	10×10^{7}	90×10^{3}	38.0×10^{5}	38.0×10^{5}	40.0×10^{4}	108.0×10^{6}	12×10^{5}	62×10^{6}
Venkatapuram	30×10^{7}	20×10^{4}	47.0×10^{5}	10.2×10^{5}	12.0×10^{5}	74.0×10^{5}	28×10^{5}	36×10^{5}
Kampara palem	10×10^{7}	10×10^{4}	15.0×10^{5}	12.0×10^{5}	25.0×10^{4}	57.5×10^{5}	36×10^{4}	96×10^{6}

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Vimta

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Test Report

ISSUED TO :-	REPORT NUMBER :VLL/VSKP/20/00426/001
Customer Name : Joint Director of Agriculture Customer Address: Joint Director of Agriculture, P M Palem, Vizag ,AP,India	ISSUE DATE : 2020-06-07 CUSTOMER REFERENCE : TRF CUSTOMER REFERENCE DATE : 2020-06-02

Customer Provided Details :			
Sample Name :	Soil (Kancharapalem village)		
Brand Name :	NA	Batch/Lot Number :	NA
Mfg. Date :	NA	Exp .Date	NA
Test Required :	Heavy metals		
Others Details if Any	NA		
Lab provided Details :			
Sample Received Date :	2020-06-02	Sample Registration Date :	2020-06-02
Analysis Starting Date :	2020-06-05	Analysis Completion Date :	2020-06-05
Qunatity Received :	500gms X 1No		
Sampling Details :	NA		

TEST RESULTS

Sl. No.	Test Parameters	Method of Testing	UOM	Results
1	Heavy Metals			
1.a	Arsenic as As	In house	ppm (mg/kg)	0.22
1.b	Cadmium as Cd	In house	ppm (mg/kg)	<0.1
1.c	Mercury as Hg	In house	ppm (mg/kg)	<0.1
1.d	Lead as Pb	In house	ppm (mg/kg)	7.68

Results relate only to the sample tested.
Remarks: Nil

END OF THE TEST REPORT

For Vimta Labs Limited

Yesudasu.Ch
Sr.Analyst

Sample tested at and report issued by: VIMTA LABS LTD, # 9-13-45/2-9-3, 3rd floor Above Tanishq, 'N' Circle, VIP Road, Visakhapatnam-530003, Andhra Pradesh, India
Tel No: 040 67404040 Ext: 6071, 6074

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Test Report

ISSUED TO :-	REPORT NUMBER :VLL/VSKP/20/00426/002
Customer Name : Joint Director of Agriculture	ISSUE DATE : 2020-06-07
Customer Address: Joint Director of Agriculture, P M Palem, Vizag ,AP,India	CUSTOMER REFERENCE : TRF
	CUSTOMER REFERENCE DATE : 2020-06-02

Customer Provided Details :			
Sample Name :	Soil (Laxmipuram village)		
Brand Name :	NA	Batch/Lot Number :	NA
Mfg. Date :	NA	Exp .Date	NA
Test Required :	Heavy metals		
Others Details if Any	NA		
Lab provided Details :			
Sample Received Date :	2020-06-02	Sample Registration Date :	2020-06-02
Analysis Starting Date :	2020-06-05	Analysis Completion Date :	2020-06-05
Quantity Received :	500gms X 1No		
Sampling Details :	NA		

TEST RESULTS

Sl. No.	Test Parameters	Method of Testing	UOM	Results
1	Heavy Metals			
1.a	Arsenic as As	In house	ppm (mg/kg)	0.25
1.b	Cadmium as Cd	In house	ppm (mg/kg)	<0.1
1.c	Mercury as Hg	In house	ppm (mg/kg)	<0.1
1.d	Lead as Pb	In house	ppm (mg/kg)	9.36

Results relate only to the sample tested.
Remark: Nil

END OF THE TEST REPORT

For Vimta Labs Limited

Vesudasu.Ch
Sr.Analyst

Sample tested at and report issued by: VIMTA LABS LTD, # 9-13-45/2-9-3, 3rd floor Above Tanishq, 'N' Circle, VIP Road, Visakhapatnam-530003, Andhra Pradesh, India
Tel No: 040 67406042 Ext: 6071, 6074

Scanned with CamScanner

Vimta

Driven by Quality. Inspired by Science.

Test Report

ISSUED TO :-	REPORT NUMBER :VLL/VSKP/20/00426/003
Customer Name : Joint Director of Agriculture	ISSUE DATE : 2020-06-07
Customer Address: Joint Director of Agriculture, P M Palem, Vizag ,AP,India	CUSTOMER REFERENCE : TRF
	CUSTOMER REFERENCE DATE : 2020-06-02

Customer Provided Details :			
Sample Name :	**Soil (Kothapalem village)**		
Brand Name :	NA	Batch/Lot Number :	NA
Mfg. Date :	NA	Exp .Date	NA
Test Required :	Heavy metals		
Others Details if Any	NA		
Lab provided Details :			
Sample Received Date :	2020-06-02	Sample Registration Date :	2020-06-02
Analysis Starting Date :	2020-06-05	Analysis Completion Date :	2020-06-05
Qunatity Received :	500gms X 1No		
Sampling Details :	NA		

TEST RESULTS

Sl. No.	Test Parameters	Method of Testing	UOM	Results
1	Heavy Metals			
1.a	Arsenic as As	In house	ppm (mg/kg)	0.28
1.b	Cadmium as Cd	In house	ppm (mg/kg)	<0.1
1.c	Mercury as Hg	In house	ppm (mg/kg)	<0.1
1.d	Lead as Pb	In house	ppm (mg/kg)	8.87

Results relate only to the sample tested.
Remark: Nil

END OF THE TEST REPORT

For Vimta Labs Limited

Yesudasu.Ch
Sr.Analyst

Sample tested at and report issued by: VIMTA LABS LTD, # 9-13-45/2-9-3, 3rd floor Above Tanishq, 'N' Circle, VIP Road, Visakhapatnam-530003, Andhra Pradesh, Ind
Tel No: 040 67404040 Ext: 6071, 6074

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ACHARYA N.G.RANGA AGRICULTURAL UNIVERSITY

Dr. M. Bharathalakshmi
M.Sc (Ag.), Ph.D.
Associate Director of Research &
Principal Scientist (Sugarcane) i/c

Regional Agricultural Research Station,
Anakapalle - 531 001, Visakhapatnam Dist.
Ph: 08924-223150 (O), 224164 (R)
Fax:08924-224021
e-mail: adrarsanks@gmail.com

Roc.No.A/1587/ 2020,Dt:16.07.2020

To
The Joint Director of Agriculture,
Visakhapatnam District.

Sir,

Sub: RARS, Anakapalle – Department of Soil Science & Agricultural Chemistry – Soil analytical report from Gas leakage affected villages of Visakhapatnam District – Crop suitability for cultivation on affected villages – Remarks – Submitted – Reg.

Ref: 1. File No. AGRI-CAL 2020-JA (TD) – AGRI VSKP, Date. 02.07.2020 of Joint Director of Agriculture, Visakhapatnam District.
2. Note from the Principal Scientist (Soil Science & Agril. Chemistry), Date. 13.07.2020

***

With reference to the above, I am to inform that, as per the testing reports regarding the quality of soils suitability to different crops it is found that the heavy metals (Pb, Cd, AS, Hg) are in safer limits and soil beneficial microbial counts, total bacteria and total fungi are also found at satisfactory levels.

Therefore the crops which were grown hither to can be suggested for cultivation in the specified gas leakage affected village soils.

Yours faithfully,

16/7/2020

Associate Director of Research

16/7/2020 16/7/2020 16/7/2020

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Dr.Y.S.R. HORTICULTURAL UNIVERSITY
Administrative Office, Venkataramannagudem – 534 101,
West Godavari District, Andhra Pradesh

Ph. No 08818 210322
Fax No. 08818 284313

From
Dr.R.V.S.K.Reddy,
Director of Research.

To
The Commissioner of Horticulture,
Department of Horticulture,
TTPC Building, 1st Floor,
Old Market Yard,
Near Rythu Bazar,
Chuttuguntа, Guntur – 522007.

Lr.No.2937/Dr.YSRHU/Res.1/2020, Dated:14.09.2020

Sir,

Sub: Dr.YSRHU – Research – Horticulture Department – Leakage of styrene gas vapours from M/s.L.G.Polymers India Pvt. Ltd., Visakhapatnam on 07.05.2020 – Compliance report – Enclosed - Regarding.

Ref: 1. N.F.No.P&M(1) 44/2015, dtd:02.06.2020 of the Commissioner of Horticulture, A.P., Guntur.
2. Lr.No.2937/Res./2020, dtd:12.06.2020 of this office.
3. Lr.No.HRS-ABJ/147/LG Poly/Styrene/20, dt:31.08.2020 of the Prl.Sci.(Hort.) & Head, HRS, Ambajipeta.
4. Note orders of the Hon'ble Vice-Chancellor, Dr.YSRHU, dtd:11.09.2020.

*****

In accordance with the reference 1st cited, I am herewith enclosing the compliance report of "Adverse affects of styrene vapour on the soil, horticulture crops/other adverse impact existing with in 5 km vicinity of the M/s LG Polymers India Pvt. Ltd., Visakhapatnam".

This is for favour of kind information & necessary action.

Yours faithfully,

14/9/2020

DIRECTOR OF RESEARCH

Encl: Compliance Report

Cc: to PS to Hon'ble Vice-Chancellor, Dr.YSRHU, V.R.Gudem.
Copy to SF/SC.

REPORT ON ADVERSE AFFECTS OF STYRENE VAPOUR ON THE SOIL PROPERTIES, HORTICULTURE CROPS/OTHER ADVERSE IMPACT EXISTING WITHIN 5 KM VICINITY OF THE M/S LG POLYMERS INDIA PVT. LTD., VISAKHAPATNAM

Dr.Y.S.R. HORTICULTURAL UNIVERSITY
VENKATARAMANNAGUDEM
WEST GODAVARI DISTRICT
ANDHRA PRADESH

Report on adverse affects of styrene vapour on the soil, horticulture crops/other adverse impact existing within 5 km vicinity of the M/s LG Polymers India Pvt. Ltd., Visakhapatnam.

Background:

M/s LG Polymers India Pvt. Ltd. was established in 1961 as "Hindusthan Polymers" for manufacturing polystyrene and its co-polymers at Visakhapatnam, India. The industry is located at R.R.Venkatapuram, Visakhapatnam district, Andhra Pradesh. The company has stored styrene monomer in vertical MS storage of 2500 KL and 3500 KL capacity provided with internal cooling system through refrigeration to maintain below 20°C. An accident occurred at 03:02 am on 7th May 2020 where the stored styrene monomer in vertical MS storage tank of 2500 KL capacity has spread in the form of gas to the surrounding villages of Venkatapuram, Padhmanabhapuram, SC & BC Colony. The concentration of styrene was high at the time of leakage in Venkatapuram village among other surrounding villages.

With regard to the above issue, a group of scientists from Dr. YSRHU, V.R.Gudem were deputed by the Director of Research, Dr. YSR Horticultural University, Venkataramanagudem vide Lr. No. 2937/Res./2020, Dated: 12.06.2020 as per the instructions given by Hon'ble Vice-Chancellor and Commissioner of Horticulture, Dr.YSRHU, A.P with an objective to study the adverse effects of styrene vapour on different existing horticultural crops and soil properties within 5 km vicinity of LG Polymers India Pvt. Ltd., Visakhapatnam.

The following team members visited Venkatapuram village on 18.06.2020 which bore the burnt of styrene gas release,

1. Dr.B.V.K.Bhagavan, Principal Scientist (Hort.) and Head & Zonal Research Head (CZ-I), HRS, Ambajipeta
2. Dr.N.B.V.Chalapathi Rao, Principal Scientist (Ento.), HRS, Ambajipeta
3. Dr.K.Ravindra Kumar, Scientist (Hort.), HRS, Kovvuru
4. Sri. P. Raja Sekhar, Scientist (SS&AC), KVK, Pandirimamidi

During the visit, the team has observed existing crop condition of vegetables crops like Brinjal, Chilli, Okra and gourds, fruits crops like Sapota, banana and mango. Scientists have also collected the soil samples at different depths in styrene affected gardens as per standard methods for analysis of soil physio-chemical properties and also to examine the population of soil micro fauna under laboratory conditions.

Styrene Gas Leak Accident:

- An accident occurred at 03:02 am on 07.05.2020 from 2500 KL tank. The company has stored styrene monomer in vertical MS storage tanks of 2500 KL and 3500 KL capacity provided with internal cooling system through refrigeration to maintain 200 °C. Due to accident the styrene gas has spread to the surrounding villages of Venkatapuram, Padmanabhapuram, SC&BC colony.
- The concentration of styrene was high at the time of accident in the villages. The concentrations could not be measured at that time as there were lethal and villages were inaccessible.
- Subsequently the concentrations of styrene were measured in the ambient air by Andhra Pradesh Pollution Control Board (APPCB) on 07.05.2020. As per the monitoring values the styrene gas is present at low concentrations in the range of 1 to 2.5 ppm in the affected area as on 07.05.2020 at 09.30 AM.

About styrene:

Styrene is a colourless, clear liquid. It has a sweet smell and can be found in nature as well as manufactured. It can also be found in common foods and beverages, such as strawberries, coffee, cinnamon, peanuts and tobacco. Manufactured styrene has wide range of uses and is a component of many goods including polystyrene, fibreglass, packaging materials, electrical insulation, home insulation, drinking cups, food packaging, rubber and carpet backing.

Styrene is a volatile and highly in flammable compound. Styrene vapour is heavier than air and 3.25 times higher than oxygen molecular weight (32 g/mol). At concentrations normally encountered in the workplace, the air and styrene mixer is not significantly heavier than clean air. Styrene evaporates more rapidly at high temperatures (eg. the evaporation rate at 30°C is twice to that at 20°C).

Physical and Chemical Properties of Styrene (C_8H_8):

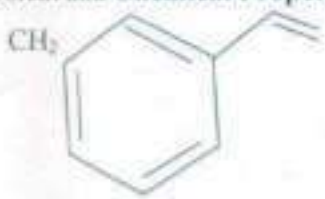


Fig. Structural formula of styrene

Parameter	Unit	Value	Remark
Molecular weight	[g.mol^{-1}]	104.15	-
Water solubility	[g.L^{-1}]	0.3	20°C
Vapour pressure	[pa]	667	20°C
Melting point	[°C]	-30.6	-
Boiling point	[°C]	145-146	-
Hydrolysis half-life	DT50 [d]	-	Styrene contains no hydrolysable groups
Photolysis half-life	DT50 [h]	< 16 hrs	Hydroxyl radicles and trophosheric ozone rapidly degraded styrene
Degradability	-	-	Readily bio-degradable

(Source: Letter report 601782017on Environmental risk limits for styrene from National Institute for Public Health and the Environment, 2009)

Sampling and Analysis:

During the visit to study site a total 22 no. of soil samples were collected randomly from 6 locations at two depths i.e. 0-15 cm and 15-30 cm in both conventionally tilled land and zero tilled land at about 0.25 km, 0.5 km, 1 km, 1.5 km, 2 km and >5 km distance towards north-east direction where the actual flow and spread of styrene gas leak was recorded. Also 3 no. of water samples were collected at 40 days after gas leak incident within the vicinity of 5 km from the LG Polymers at Venkatapuram village. The details of sampling locations where soil and water samples have been collected are given in Table 1 & 2 and the methods employed for soil and water analysis were mentioned in Table 3. Analysis of soil and water samples was carried out at Central Tobacco Research Institute, Rajahmundry and Horticultural Research Station, Ambajipeta, Dr.YSR Horticultural University.

Table 1: Details of soil sampling at Venkatapuram village under study.

S.No	Location/ Distance	Crop/ Particulars	ZT/CT*	Depth of soil sampling	Sampling Code	GPS
1	0.25 km	Casuarina plantation	ZT	0-15 cm	1-A	N 17°45.819' E 083°12.318'
				15-30 cm	1-B	
		Fallow	CT	0-15 cm	1-C	N 17°45.327' E 083°12.304'
				15-30 cm	1-D	
2	0.5 km	Brinjal	ZT	0-15 cm	2-A	N 17°45.487' E 083°12.296'
				15-30 cm	2-B	
		Brinjal	CT	0-15 cm	2-C	N 17°45.485' E 083°12.293'
				15-30 cm	2-D	
3	1 km	Bhendi	ZT	0-15 cm	3-A	N 17°45.670' E 083°12.584'
				15-30 cm	3-B	
		Fallow	CT	0-15 cm	3-C	N 17°45.512' E 083°12.442'
				15-30 cm	3-D	
4	1.5 km	Chilli	ZT	0-15 cm	4-A	N 17°45.478' E 083°12.298'
				15-30 cm	4-B	
		Fallow	CT	0-15 cm	4-C	N 17°45.462' E 083°12.302'
				15-30 cm	4-D	
5	2 km	Fallow	ZT	0-15 cm	5-A	N 17°45.074' E 083°12.066'
				15-30 cm	5-B	
		Fallow	CT	0-15 cm	5-C	N 17°45.098' E 083°12.023'
				15-30 cm	5-D	
6	>5 km	Fallow	ZT	0-15 cm	6-A	N 17°44.211' E 083°17.371'
				15-30 cm	6-B	

(Note: * ZT- Zero tilled soil after styrene gas leak, CT- Conventionally tilled soil after gas leak)

Table 2: Details of water sampling at Venkatapuram village under study.

S.No	Location/Distance	Source of irrigation water	Sampling Code	GPS
1	1.5 km	Dug well	W1	N 17°45.478' E 083°12.298'
2	2 km	Bore well	W2	N 17°45.074' E 083°12.066'
3	>5 km	Bore well	W3	N 17°44.211' E 083°17.371'

Table 3. Methods employed for the analysis of soil and water samples.

a) Soil sampling and analysis

S.No	Parameter	Method	Reference
Physico-Chemical Properties			
1	Texture	Feel method	USDA
2	pH (1:2)	Glass electrode pH meter	Jackson (1967)
3	Electrical Conductivity (dSm^{-1})	Conductometric method	Jackson (1967)
4	Organic Carbon ($g.kg^{-1}$)	Walkey and Black's wet oxidation method	Piper (1966)
5	Total Nitrogen ($kg\ ha^{-1}$)	Kjeldhal's method	Jackson (1967)
6	Available P_2O_5 ($kg\ ha^{-1}$)	Olsen's method	Watanabe and Olsen (1965)
7	Available K_2O ($kg\ ha^{-1}$)	Flame photometric method	Jackson (1967)
8	Sulphur (ppm)	Turbidity method	Piper (1966)
Soil Biological Properties			
9	Bacteria ($x10^6$)	Serial dilution plate count method	Waksman (1922)
10	Fungi ($x10^4$)		
11	Actinomycetes ($x10^5$)		

b) **Water analysis**

S.No.	Parameter	Method	Reference
1	pH (at 25°C)	Glass electrode pH meter	Jackson (1967)
2	Electrical Conductivity (dSm^{-1})	Conductometric method	Jackson (1967)
3	Chlorides (meq/l)	Mhor's method	Piper (1966)

Observations of the committee:

The observations of the above investigation are presented under the following heads.

A) Soil quality

B) Soil micro fauna

C) Water quality

A) Soil quality:

As per the summarised results given in table 4 & 5 pertaining to soil physico-chemical properties, the surface and sub-surface soils of study area are characterised with sandy loam (SL) and sandy clay loam (SCL) in texture respectively within 0.25 km, 2 km and > 5 km distance and sandy clay loam (SCL) and clay loam (CL) in texture respectively at about 0.5 km, 1 km and 1.5 km distance where the cultivated lands are being located. The analysis indicated that, soils are neutral (pH 6.79) to moderately alkaline (pH 8.66) in reaction having mean electrical conductivity of 0.38 dSm^{-1} and medium in organic carbon content (0.56 %).

With regard to soil fertility status, the soils are very low in available nitrogen (138.95 kg ha^{-1}) in surface and sub-surface soils and increased with increase in depth of soil. It may be due to more leaching of soluble nitrogen from sandy loam surface to sandy clay loam sub-surface soil and further to deeper layers resulted in retention of low nitrogen in surface soils.

Available phosphorus was recorded with low to high in content (varied from 13 to 170 kg ha^{-1}). But, maximum available phosphorus was observed in surface soils than sub-surface soils in both zero tilled (ZT) and conventionally tilled (CT) soils. This wide range of fertility status may be due to site-specific inheritance of soil and differential practices of soil fertilization and manuring in different crops being cultivated in these fields.

However, medium in available potassium (156 to 259 kg ha^{-1}) was recorded within the vicinity of 0.25 km from LG Polymers, Pvt. Ltd, Venkatapuram. But, high to very high in available potassium (ranges from 356 to 2388 kg ha^{-1}) was recorded after 0.5 km distance onwards where most of field crops and vegetables grown in the styrene affected area. Very

high potassium content was observed at about 0.5 km under zero tilled (ZT) soil, 1 km under zero tilled (ZT) & conventionally tilled (CT) soil and 1.5 km under conventionally tilled (CT) soil where the actual surface and sub-surface soils are characterised with sandy clay loam (SCL_s) and clay loam (CL_s) texture respectively than the surface and sub-surface soils of other locations with sandy loam (SL) and sandy clay loam (SCL) texture respectively. This may be due to high clay content of soils that holds the potassium effectively in interlayer spaces of clay and due to site-specific deposits of potash minerals i.e feldspars and micas in clay loam textural soils and also due to addition of potassic fertilizers in different crops grown in these fields.

It can be concluded that more potassium content was observed in affected area than unaffected area which was 5 km away from the styrene gas tank but cannot be comparable with the content of soil potassium in unaffected area as it may vary in native soil fertility status. But, the release of styrene or deposit of styrene in soil has no scientific evidence in changing any of the physicochemical properties of soil. So, this may be concluded that no effect of styrene on soil fertility status but, it is of purely inherent capacity of parent soil material that determines the distribution and availability of various macro and micro nutrients at variable concentrations in the soil profile.

Table 4. Physico -chemical properties of soil of study area.

S.No	Location/ Distance	ZT/CT*	Texture		pH (1:2)		EC (dSm^{-1})		OC (%)	
			0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30
1	0.25 km	ZT	SL	SCL	8.16	8.03	0.170	0.297	0.32	0.18
		CT	SL	SCL	6.79	7.52	0.270	0.166	0.26	0.01
2	0.5 km	ZT	SCL	CL	7.95	8.44	0.209	0.665	0.41	0.47
		CT	SL	SCL	7.89	8.05	0.236	0.213	0.44	0.41
3	1 km	ZT	SCL	CL	8.47	8.54	0.626	0.659	0.92	0.99
		CT	SCL	CL	8.46	8.66	0.758	0.573	0.82	0.37
4	1.5 km	ZT	SL	SCL	8.06	8.17	0.355	0.266	0.85	0.38
		CT	SCL	CL	7.67	8.54	0.543	0.718	1.41	0.91
5	2 km	ZT	SL	SCL	7.83	7.95	0.299	0.288	0.53	0.40
		CT	SL	SCL	8.16	7.99	0.282	0.285	0.63	0.73
6	>5 km	ZT	SL	SCL	7.36	7.83	0.146	0.260	0.45	0.41
Mean					**7.89**	**8.16**	**0.35**	**0.40**	**0.64**	**0.48**

(Note: * ZT- Zero tilled soil after styrene gas leak, CT- Conventionally tilled soil after styrene gas leak)

Table 5. Chemical properties of soil in study area.

S.No	Location/ Distance	ZT/CT*	Available N (kg/ha)		Available P (kg/ha)		Available K (kg/ha)	
			0-15	15-30	0-15	15-30	0-15	15-30
1	0.25 km	ZT	113	115	43	27	156	189
		CT	141	156	168	38	281	259
2	0.5 km	ZT	133	138	74	18	450	1721
		CT	116	166	67	69	356	356
3	1 km	ZT	167	173	45	43	2066	2197
		CT	116	141	31	27	2161	1540
4	1.5 km	ZT	121	131	67	13	1111	234
		CT	166	163	168	49	1294	2388
5	2 km	ZT	133	138	16	56	385	310
		CT	138	123	43	52	702	785
6	>5 km	ZT	133	136	170	152	657	666
Mean			**134.27**	**143.64**	**81.09**	**49.45**	**874.45**	**967.73**

(Note: * ZT- Zero tilled soil after styrene gas leak, CT- Conventionally tilled soil after gas leak)

B) Soil micro fauna:

In the study site, composite surface and sub-surface soil samples at two depths i.e. 0-15 cm and 15-30 cm were collected randomly in both conventionally tilled land and zero tilled lands at about 0.25 km, 0.5 km, 1 km, 1.5 km, 2 km and >5 km distance towards North-East direction where the actual flow and spread of styrene gas leak was recorded and brought these soil samples in sterilized new polythene packets along with sampling code to the soil biology laboratory by maintaining its field moist condition and further stored in the refrigerator at 10°C in later cases after 48 hours of sampling in order to estimate the total population of bacteria, fungi and actinomycetes. The collected soil samples have been analysed for enumeration of microbial population by following serial dilution plate count technique. The results obtained are given in table 6.

Table 6. Soil biological properties of study area.

S.No	Location/ Distance	ZT/CT*	Bacteria ($x 10^6$) (cfu)		Fungi ($x 10^4$) (cfu)		Actinomycetes ($x 10^3$) (cfu)	
			0-15	15-30	0-15	15-30	0-15	15-30
1	0.25 km	ZT	4	35	12	17	**320**	**115**
		CT	**12**	**5**	**6**	**5**	120	321
2	0.5 km	ZT	14	17	4	12	**238**	**120**
		CT	**45**	**10**	**8**	**2**	124	206
3	1 km	ZT	12	18	7	8	**192**	**107**
		CT	5	6	**21**	**5**	**118**	**54**
4	1.5 km	ZT	**27**	**13**	**29**	**8**	**235**	**216**
		CT	**21**	**6**	14	16	157	184
5	2 km	ZT	**12**	**8**	**12**	**4**	120	149
		CT	9	18	**3**	**2**	98	154
6	>5 km	ZT	**27**	**18**	**5**	**1**	21	26
Mean			**17.09**	**14.00**	**11.00**	**7.27**	**158.45**	**150.18**

As per the results obtained, minimum bacterial population (4×10^6 cfu) was recorded at a depth of 0-15 cm in zero tilled (ZT) land within the vicinity of 0.25 km from the place where gas leakage occurred and increased population (35×10^6 cfu) was recorded comparatively at a depth of 15-30 cm in the same zero tilled land (fig.2). However, the trend of less bacterial population at depths of 0-15 cm was observed as compared to the population at depths of 15-30 cm among all zero tilled (ZT) soils at about 0.25 km, 0.5 km and 1 km distances from the I.G Polymers Pvt. Ltd., Venkatapuram. It was also noticed that bacterial population at depths of 0-15 cm was more than that of 15-30 cm depth among conventionally tilled soils at about 0.25 km, 0.5 km and 1.5 km distances from the styrene tank.

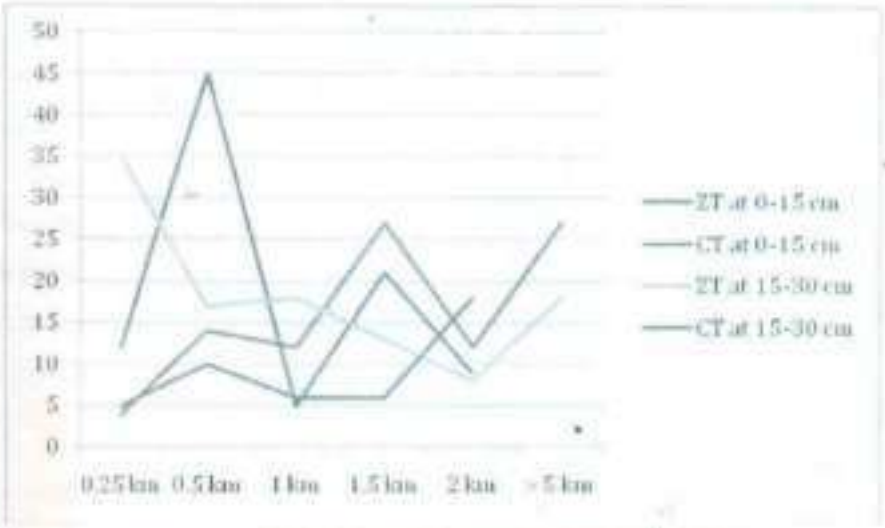


Fig.2. Bacterial population ($x10^6$) (cfu)

With regard to fungal population in the styrene affected area, the same trend was observed as that of bacterial population i.e., less population at depths of 0-15 cm as compared to the population at depths of 15-30 cm in all zero tilled (ZT) soils (fig.3). But, it was more at depths of 0-15 cm than that of soil at depths of 15-30 cm in conventionally tilled (CT) soils at about 0.25 km, 0.5 km and 1 km distance from the LG Polymers Pvt. Ltd., Venkatapuram. It indicates that fungal population was decreased with increase of soil depth among conventionally tilled (CT) soils in three sites and also vice-versa among zero tilled (ZT) soils. These observations of maximum and minimum fungal populations may be associated or influenced based on the availability of soil moisture and organic carbon content prevailed in the study site.

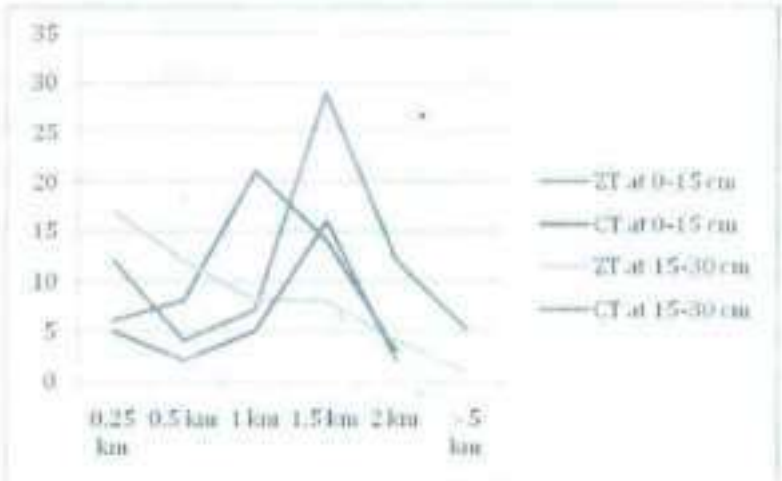


Fig.3. Fungal population ($x10^4$) (cfu)

The trend of Actinomycetes population was summarised in table 6 and shown in fig.4. Maximum population of actinomycetes (320 x 10^3 cfu) was recorded followed by (238 x 10^3 cfu) and (235 x 10^3 cfu) at depths of 0-15 cm in zero tilled (ZT) soils at a distance of 0.25 km, 0.5 km and 1 km respectively than with the minimum population (98 x 10^3 cfu) at depth of 0-15 cm in conventionally tilled (CT). Among conventionally tilled soils, it was observed that more population at depths of 15-30 cm than the population at 0-15 cm depth. However, Maximum population of actinomycetes was recorded in zero tilled (ZT) soils than that of conventionally tilled (CT) soil.

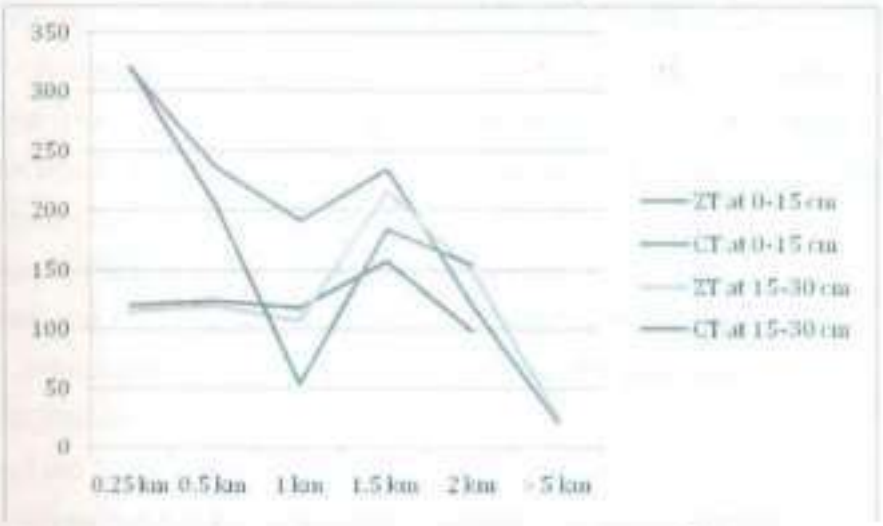


Fig.4. Actinomycetes population (x10^3) (cfu)

On the basis of mean values of microbial population it can be concluded that microbial count was more on the soil surface and decreased with increase of soil depth as usually and might not be stimulated by the effect of styrene gas spread in affected area. Fluctuation in microbial populations recorded due to site-specific soil reaction (pH), soil moisture and organic carbon content as energy source prevailed in the study site. It was also observed that more population of actinomycetes enumerated nearer to the LG Polymers within the vicinity of 0.25 km to 2 km and decreased with gradual increase of distance from LG Polymers Pvt. Ltd., Venkatapuram. These results and observations straightly indicates that there is no effect of released styrene gas on microbial population as it is readily bio-degradable by a wide variety of micro-organisms and may lead to extensive or complete destruction of the compound in soil.

C) **Water quality:**

In study site, open dug well and bore wells are the main irrigation sources to the crops being cultivated in styrene affected fields. As part of the study, total 3 no. of water samples have been collected from two irrigation sources i.e open dug well and bore well at about a distance of 1.5 km, 2 km under styrene affected area and 5 km under unaffected location from the LG Polymers Pvt. Ltd., Venkatapuram. The water samples were collected into sterilized new bottles and brought to the laboratory within 36 hours to analyse quality parameters as mentioned in table 2. The results were summarised in table 7.

Pertaining to the results obtained, the pH of water samples was neutral in reaction and on par with each of them. It indicates that irrigation water is normal in reaction and safe for plant growth as it does is not contains other elements at hazard levels. Mean electrical conductivity of water in affected area was 1.428 dS/m having 914 mg/l of average content of total dissolved salts in irrigation water and is on par with the water sample collected from unaffected area i.e > 5 km distance. It is indicative that the irrigation water has moderate salinity and requires leaching at higher range after its irrigation to sensitive crops like peas, beans etc. The chloride content of dug well and bore well water samples of affected area was 5.7 meq/l and 2.8 meq/l respectively and low in residual sodium carbonate (RSC) also. The results indicate that water from these two irrigation sources is generally safe for all plants with respect to chloride and RSC content as it is categorised as low. However, Keeping the the quality of water in view, it has moderate salinity and requires 12 to 17.5 % of leaching after its irrigation to sensitive crops.

Table 7: Details of water sampling at Venkatapuram village under study.

S.No	Location/ Distance	Source of irrigation water	Sample Code	pH (at 25°C)	EC (dSm^{-1})	Chlorides (meq/l)	RSC
1	1.5 km	Dug well	W1	7.49	1.780	5.7	Low
2	2 km	Bore well	W2	7.33	1.076	2.8	Low
3	>5 km	Bore well	W3	7.54	1.258	4.5	Low
Mean				**7.45**	**1.37**	**4.33**	~~1.45~~

Some of the salient features and observations were recorded during the visit to study site:

1. It was observed that, sufficient number of earth worm **population was present** in all the surveyed lands and was satisfactory.
2. High percent of in situ seed germination (from the fallen Okra seeds) was also observed in the affected soils.
3. Active flying and substantial population of butterflies and dragon flies were also observed.
4. In few coconut palms (nearly 10 palms) drying of lower leaves was recorded. Fronds and other younger leaves were green and healthy. Flowering, fruit setting and new spadix emergence was normal and **no abnormalities were observed.**
5. No damage symptoms were observed in fruit crops cultivated like mango, sapota, banana and also vegetables *viz.* brinjal, okra and gourds as well as fodder grass.
6. In one casuarina field drying of younger plants was observed which might be due to the effect of styrene gas but new sprouting was observed from axillary buds in dried plants.
7. No toxicity effects were recorded /observed with those persons who have eaten the vegetables and fruits from the affected area.
8. At present the residents are using the open well water and bore well water for drinking.
9. The ridge gourd fruits were collected from the field left over without harvesting and extracted the seed at HRS, Kovvur and observed more than 85% seed germination which was normal and found no effect of toxic gas.
10. It is also assumed that, due to the recent rains, the soil should have reached 100% saturation and the soil bound styrene may escape from the soil pore space.
11. Full bearing and profuse flowering was recorded in sapota orchard which is adjacent to the L.G. Polymers plant.
12. Native Earth worm activity was noticed while taking soil sample at a depth of 0-15 cm under zero tilled casuarina plantations and at depth of 15-30 cm under conventional tillage practice after gas leak at the distance of 0.5 km from LG

Polymers and also recorded 7-12 no. of adult earth worms per square foot area under zero tilled grass land at a distance of 2 km from LG Polymers site.

13. Burning effect of casuarina trees up to a height of 5-8 feet and coconut trees up to height of 10-12 feet was observed in the immediate vicinity of LG polymers where the actual flow and spread of styrene gas leak in the north-east direction.
14. Luxurious growth of weeds like *cynodon* sps (star grass), *cyperus rotundus*, *Parthenium* etc. were noticed in styrene affected fields.

Conclusion:

Further, it is to submit that based on laboratory results and other scientific findings, there is no effect of styrene vapour on soil physicochemical and biological properties during the observation at 40 days after gas leak. It can also be concluded that there is no antagonistic impact on soil micro-flora as it may readily bio-degraded by aerobic microorganisms leading to complete destruction of the compound into other degradable sub-compounds i.e CO_2 etc.

As per the quality of irrigation water, it has moderate salinity that limits the yield of various crops. But, it can be managed with the practice of leaching and good drainage after its irrigation to the crops. Based on the observations made during the visit on 18.06.2020 and results of soil biological properties, it can be concluded that there is no adverse impact on the crops to be grown in upcoming *kharif/rabi* seasons.

As per the overall observations recorded on different crops, soil physical and biological properties, the team did not find any adverse effect of styrene gas. Hence, the farmers can grow the vegetables and other horticultural crops by adopting the regular good agricultural practices.

Dr. B.V.K. Bhagavan	**Principal Scientist (Hort.) and Head & Zonal Research Head (CZ-I), HRS, Ambajipeta**	
Dr. N.B.V. Chalapathi Rao	**Principal Scientist (Ento.), HRS, Ambajipeta**	
Dr.K.Ravindra Kumar	**Scientist (Hort.), HRS, Kovvuru**	
Sri. P. Raja Sekhar	**Scientist (SS&AC), KVK, Pandirimamidi**	

Division of Crop Chemistry & Soil Science
ICAR-CTRI, Rajahmundry

SOIL ANALYSIS REPORT

Date: 06-07-2020

Name: Dr. B.K.V.Bhagavan
Principal Scientist (Hort.) & Head
Horticultural Research Station
Ambajipeta-533214
East Godavari District

S.No	Sample details	Texture (Feel method)	pH (Soil Reaction) (1:2)	E.C (dS/m)	OC (%)	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)	Available Sulphur (ppm)
1	1	SL	8.16	0.170	0.32	113	43	156	9.7
2	2	SCL	8.03	0.297	0.18	150	27	189	45.4
3	3	SL	6.79	0.270	0.26	141	168	281	5.0
4	4	SCL	7.52	0.166	0.01	156	38	259	10.5
5	5	SCL	7.95	0.209	0.41	133	74	450	7.1
6	6	CL	8.44	0.665	0.47	138	18	1721	64.9
7	7	SL	7.89	0.236	0.44	116	67	356	6.7
8	8	SCL	8.05	0.213	0.41	166	69	356	6.7
9	9	SCL	8.47	0.626	0.92	161	45	2066	64
10	10	CL	8.54	0.659	0.99	173	43	2197	66
11	11	SCL	8.46	0.758	0.82	116	31	2161	72
12	12	CL	8.66	0.573	0.37	141	27	1540	50
13	13	LS-SL	8.06	0.355	0.85	121	67	1111	12
14	14	SCL	8.17	0.266	0.38	131	13	234	5.3
15	15	SCL	7.67	0.543	1.41	166	168	1294	33
16	16	CL	8.54	0.718	0.91	163	49	2388	70
17	17	SL	7.83	0.299	0.53	133	16	385	10.4
18	18	SCL	7.95	0.288	0.40	138	56	310	13
19	19	SL	8.16	0.282	0.63	138	43	702	11
20	20	SCL	7.99	0.285	0.73	123	52	785	7.4
21	C_1	SL	7.36	0.146	0.45	133	170	657	6.25
22	C_2	SCL	7.83	0.260	0.41	136	152	666	10.2

*SL-Sandy loam *SCL-Sandy clay loam *CL-Clay loam *LS- Loamy sand

(C.CHANDRA SEKHARA RAO)
Head
Div. of Crop Chemistry & Soil Science

Microflora enumerated in the soil samples (in CFU)

Bacteria (Nutrient agar)
Fungi (Potato dextrose agar)
Actinomycetes (Kenknights and Munaier's medium)

Soil Sample No.	Bacteria (x 10^6)	Fungi (x 10^4)	Actinomycetes (x 10^5)
1.	4	12	320
2.	35	17	115
3.	12	6	120
4.	5	5	321
5.	14	4	238
6.	17	12	120
7.	45	8	124
8.	10	2	206
9.	12	7	192
10.	18	8	107
11.	5	21	118
12.	6	5	54
13.	27	29	235
14.	13	8	216
15.	21	14	157
16.	6	16	184
17.	12	12	120
18.	8	4	149
19.	9	3	98
20.	18	2	154
C1	27	5	21
C2	18	1	26

9/7/2020

MMRao
09/07/2020

Division of Crop Chemistry & Soil Science
ICAR-CTRI, Rajahmundry

WATER ANALYSIS REPORT

Date: 06-07-2020

Name : Dr. B.K.V.Bhagavan
Principal Scientist (Hort.) & Head
Horticultural Research Station
Ambajipeta-533214
East Godavari District

S.No	Sample Details	Source of water (well,borewell,pond,stream)	pH (at 25°C)	E.C (dS/m)	Chlorides (meq/l)	RSC
1	C_1	Bore water	7.49	1.780	5.7	Low
2	1	Well water	7.33	1.076	2.8	Low
3	2	Bore water	7.54	1.258	4.5	Low

(C.CHANDRA SEKHARA RAO)
Head
Div. of Crop Chemistry & Soil Science

Annexure-IV

GOVERNMENT OF ANDHRA PRADESH
ANIMAL HUSBANDRY DEPARTMENT

From
Dr.D.Ramakrishna, B.V.Sc & A.H.,
FAC. Joint Director (A.H),
Visakhapatnam.

To
The Chairman,
Collector & District Magistrate,
Visakhapatnam District.

Lr. Rc. No.1/RRT/2020 Dated 18.09.2020

Sir,

Sub: APPCB RO VSP – Hon'ble NGT Matter 73/2020 & connected matters related to gas leak incident at M/S. LG Polymers Ltd., Visakhapatnam (Andhra Pradesh) – Committee for final Quantification of compensation in compliance with Hon' ble NGT order dt.01.06.2020 – ***"Plan of Restoration and compensation for damage to livestock"*** – Submission – Regarding.

Ref: 1.This Office Proc.Roc.No.1/RRT/2020 Dt.29.05.2020 to the Joint Chief Environmental Engineer, APPCB, Visakhapatnam
2. Lr. No. Gen/PCB/RO-VSP/NGT/2020 Dated 31.08.2020 of the Environmental Engineer, APPCB, RO, Visakhapatnam.
3. Report of the High Power Committee
4. Minutes of the meeting & instructions of the Chairman (District Collector, Visakhapatnam) on submission of restoration and compensation plan for damage to livestock Dt.15.09.2020

******

In obedience to the instructions issued by the Chairman and District Collector, Visakhapatnam regarding submission of ***Plan of Restoration and compensation for damage to livestock*** vide reference 4th cited, I herewith submit the detailed plan of action pertaining to livestock sector for perusal and kind consideration:

Thanking You sir

Encl: Proposal for Restoration and compensation for damage to livestock.

Yours faithfully,

18/9/20

Joint Director (AH),
Visakhapatnam.

18/9

REPORT ON LG POLYMERS STYRENE GAS LEAK

Sub Component -2: Plan for Restoration and compensation for damage to Livestock

1. IMMEDIATE REFIEF MEASURES UNDERTAKEN:

A. Deployment of Rapid Response Teams

The Animal Husbandry Department has constituted **12 Rapid Response Teams (RRTs)** each team comprising of one Veterinarian, 1 Paravet and 2 Office Subordinates/ Gopalamitras in response to the Styrene gas leak disaster on 07.05.2020. The Assistant Director (A.H), Area Veterinary Hospital, Gopalapatnam was designated as Team leader and was entrusted the responsibility of coordinating the relief operations at field level by assigning the duties to the RRTs. A control room was also set up in the Office of the Joint Director (A.H), Visakhapatnam to receive the information from the field and report the information to the District Collector, Visakhapatnam and the Director of Animal Husbandry, A.P., Vijayawada. A Whatsapp group was also created for this purpose with the members of RRTs, Joint Director (A.H), Deputy Director (A.H), Addl. Director (A.H), Director of A.H., A.P, to monitor the relief operations effectively.

B. Handling of dead and affected animals:

A total of 27 livestock died on exposure to the styrene gas (25 livestock between 07-05-2020 and 09-05-2020 and 2 animals subsequently). The teams deployed ensured hygienic disposal of the carcasses in coordination with the GVMC and local revenue authorities duly taking all the necessary precautions to prevent spread of diseases. ***242 animals were treated*** in the affected villages by organizing Veterinary health camps. The ailing animals were provided with supportive therapy by distributing mineral mixture and supplements.

C. Laboratory Investigation

The Animal Disease Diagnostic Laboratory, Visakhapatnam has collected the blood, urine and milk samples from the ailing animals and also fodder samples and sent to "Pharmacovigilance Laboratory for Animal Feed and Food Safety" Tamil Nadu Veterinary and Animal Sciences University, Chennai for analysing the residues of Styrene gas. The test reports of the laboratory has indicated that the milk and urine samples had levels below detection limit (<0.2ppm) and the vital organs had no traces of the styrene metabolite.

D. Advisory for the Livestock owners

The livestock owners are advised not to feed the feed and fodder stocks available with them that are exposed to the gas. They are also advised not to feed the green fodder available in the fodder plots in the gas affected villages until further instructions. The farmers are advised to milk the animals but to discard the same till further instructions.

E. Monitoring and Surveillance

A total of 5 teams constituting of One Veterinarian, One Para Veterinarian and one Office Subordinate/ Animal Husbandry Assistant were deputed to the 5 gas affected villages from 12.05.2020 as per the instructions of the District Administration to create awareness on the use of feed and fodder and also regarding use of milk for human consumption in these villages.

F. Feed and Fodder support

The livestock owners were distributed with concentrate feed (20 MTs) and silage fodder (10 MTs) as an immediate relief measure to feed their animals for an amount of Rs.3,75,914/- only from the funds of Animal Husbandry Department. Besides, mineral mixture and nutritive supplements were also provided for faster recovery.

G. Compensation for deceased livestock:

As per the immediate instructions of the Hon'ble Chief Minister, the District Administration has released an amount of R.8.75 lakhs towards the ex-gratia for the 25 reported livestock deaths between 07-05-2020 to 09-05-2020. Subsequently two more livestock succumbed post exposure for which ex-gratia proposals were submitted to the District Administration.

2. RESTORATION AND COMPENSATION FOR DAMAGE TO LIVESTOCK

A. Livestock profile in the affected villages

The livestock owners in the affected villages which are in the peri-urban area mainly sustain on direct milk sales to the consumers in the city. As such the farmers maintain mostly productive animals (milk yielding animals) and very few dry animals are in their possession.

As per the survey on the livestock and their productivity, it was noted that the average daily milk yield was 6 litres for buffalo and 8 litres for cows. The selling price of buffalo milk ranges from Rs.40-50 per litre and Rs.30-40 per litre in case of cow milk.

Table I: Livestock census in the 5 affected villages

S. No.	Village	Livestock population			
		Cattle	Buffalo	Young	Total
1	Venkatapuram	29	80	38	**147**
2	Venkatadrinagar	13	3	8	**24**
3	Nandamurinagar	6	43	32	**81**
4	Pydimamba Colony	30	31	29	**90**
5	BC Colony	8	37	16	**61**
TOTAL		**86**	**194**	**123**	**403**

B. Compensation for loss of milk

On the recommendations of NEERI and upon the instructions of the District Administration, the livestock farmers were advised to discard the milk of cows and buffaloes in the affected villages. Based on the findings of the test report of **"Pharmacovigilance Laboratory for Animal Feed and Food Safety, TANUVAS, Chennai"** received on 15-07-2020 which indicated that the milk samples had no residues of Styrene metabolite i.e, ***DL - Mandelic acid***, instructions were passed for safe use of milk of the affected animals for human consumption.

It is therefore proposed to compensate the loss incurred by the livestock farmers by enumerating the volume of milk discarded and its saleable value for a period of 30 days. The financial outlay for the proposed compensation is as detailed in Table 2.

Table 2: Estimated value of milk discarded during 30 days.

S. No	Village	Lactating		Total Daily Milk yield* (Ltrs)		Value of milk discarded for 30 days # (Lakh Rs.)		Total Amount (Lakh Rs.)
		Cow	Buff	Cow	Buff	Cow	Buff	
1	Venkata puram	23	71	184	426	1.656	5.112	**6.768**
2	Venkatadri nagar	10	2	80	12	0.720	0.144	**0.864**
3	Nandamuri nagar	5	38	40	228	0.360	2.736	**3.096**
4	Pydimamba Colony	29	25	232	150	2.088	1.800	**3.888**
5	BC Colony	7	32	56	192	0.504	2.304	**2.808**
TOTAL		**74**	**168**	**592**	**1008**	**5.328**	**12.096**	**17.424**

* Avg. Milk yield of cow per day – 8 litres; buffalo – 6 litres

Saleable price of cow milk per litre @ Rs.30/- & buffalo milk @ Rs.40/-

C. Providing replacement livestock

As an immediate relief to the livestock farmers whose animals have died due to the impact of the styrene gas, 8 farmers have been provided with an ex-gratia amount of Rs.8.75 Lakhs to help him sustain due to lack of livelihood. It is therefore proposed to provide replacement livestock to the farmers who have lost their animals by grounding from the adjoining District. A total of 4 cows, 10 buffaloes and 1 cross bred Jersey heifer belonging to 8 farmers have died and the financial implication for providing animals are submitted in Table 3.

Table 3: Amount required for providing replacement animals

S. No	Name of the farmer	Village	Livestock lost	Qty	Market value + Transport # (Rs.)	Total amount (Rs.)
1	Baliji Pydi Raju	Venkata puram	Cow	3	55000	165000
2	Noonela Nooka Raju	Venkata puram	She Buffalo	3	65000	195000
3	B. Sanyasamma	Venkata puram	She Buffalo	1	65000	65000
4	Yellapu Tatarao	Venkata puram	Cow	1	55000	120000
			She Buffalo	1	65000	
5	Noonela Sagar	Venkata puram	She Buffalo	2	65000	130000
6	Ch. Nookaratnam	Venkata puram	She Buffalo	2	65000	130000
7	Pala Amaravathi	Venkata puram	She Buffalo	1	65000	65000
8	G. Atchibabu	BC colony	CB Heifer	1	30000	30000
TOTAL				**15**		**9,00,000**

 # the proposed market value of the animal including transport for cow is Rs. 55,000/- and for buffalo is Rs. 65,000/-

D. Feed and fodder support

The survey conducted by the Animal Husbandry Department to analyse the impact of the styrene vapours on the productivity of livestock has indicated that there is a drop in the milk production by 30% in cows and 60% in buffaloes 10 days post exposure.

It is therefore proposed to provide feed and fodder support to all the animals in the affected villages for a period of 6 months to help them re-coop and regain the production. It is also proposed to provide mineral and vitamin supplementation to the needy animals for improved fertility. The provision of these feeding inputs will help the animals in better reproduction and also sustained milk production in the next lactation. It is submitted that an amount of **Rs. 62, 33,472/-** is required for providing the proposed feed and fodder support.

Animal	Allowance of Concentrate feed per day	Allowance of TMR per day
Adult	4 Kg @ Rs.15.17 per kg	5 Kg @ Rs.12.60 per kg
Young	2 Kg @ Rs.15.17 per Kg	3 Kg @ Rs.12.60 per kg

Table 4: Cost estimation for feed and fodder support for 180 days

S. No	Village	Livestock population		Feeding inputs for 180 days in MTs		Cost (Rs.)		Amount Rs.
		Adult	Young	TMR	Conc.	TMR	Conc.	
1	Venkata puram	109	38	98.10	78.48	1236060	1190542	**2426602**
2	Venkatad ri nagar	16	8	14.40	11.52	181440	174758	**356198**
3	Nandamu ri nagar	49	32	44.10	35.28	555660	535198	**1090858**
4	Pydimam ba Colony	61	29	54.90	43.92	691740	666266	**1358006**
5	BC Colony	45	16	40.50	32.40	510300	491508	**1001808**
TOTAL		**280**	**123**	**252.00**	**201.60**	**3175200**	**3058272**	**6233472**

E. Long term monitoring and surveillance

The Animal Husbandry Department has deployed special teams to monitor the health of the animals in the affected villages till 30.06.2020. Thereafter, the Area Veterinary Hospital, Gopalapatnam has been providing the required Animal Husbandry services by keeping a close watch on these affected villages.

It is now proposed to organize at least one health camp per month in each of these 5 gas affected villages for a period of one year to monitor the health of the animals and also to collect the data on production and reproductive parameters to assess the long term impact on the livestock due to styrene vapours.

It is submitted that a total amount of **Rs. 3,00,000/-** is required to conduct 60 camps in one year with an estimated budget of Rs. 5000/- per camp towards drugs/medicines and logistics.

ABSTRACT OF FUNDS REQUIRED FOR PROPOSED RESTORATION AND COMPENSATION

S. No.	PROPOSAL	ESTIMATED EXPENDITURE (Rs.)
1	Compensation for milk discarded for 60 days	**17,42,400**
2	Provision of replacement animals	**9,00,000**
3	Feed and fodder support	**62,33,472**
4	Veterinary Health camps	**3,00,000**
	TOTAL	**91,75,872**

Submitted for kind perusal.

Joint Director (A.H) 9/20
Visakhapatnam.

Attendance for Sub-Committee meeting on Restoration and Compensation plan for damage to Health, Property, Crops, Livestock etc, on 15.09.2020 at 12:00 Noon

S.No.	Name of the official	Name of the Department	Email & Phone No.	Signature
1.	V. Viraj chand IAS	Dist Collector		
2.	Dr. P.V. SUDHAKAR	PRINCIPAL & SUPERINTENDENT, KGH	kghsuperintendent@gmail.com 9849903060	
3.	Dr. K. VIJAYA LAKSHMI	DM HO	9849902299	K.V 15/9/2020
4	T. Rajendra Reddy	JCLE APPCB	7172301450	
5.	R.J. Vidyullatha	Town planning, GVMC	ccpgvmc@gmail.com 9849888827	
6.	D. Rambabu	Town planning GVMC	9878998435	
7.	K.V. Bhaskar	Town Planning GVMC	9849893236	Bhaskar
8	G.S.N.S. Lakshmi	J.D. Agri	8331056469	
9	Dr. D. Ramakrishna	J.D (A.H)	9985993282	
10	Dr. K.V. Ramana Murthy	Principal Scientist RARS, Anakapalle	9849636324	
11.	Dr. Ch. S. Ramalaxmi (SSCSS)	Regional Agril. Research Station, Anakapalle.	9441210705	
12.	Sudhakar. K	Inspector of factories Visakhapatnam	9618789799	
13	K. Kochida Kishore	RDO, Vizag	9849903825	
14	A. [illegible] DO	DAO, Vizag	9849038220	
15.	R. Govinda	JC (A&W)	9849903820	
16.	G. Sujana	Commissioner GVMC.	9121223377	

'Records of Discussion' of the 1st meeting of the MoEFCC Nodal Committee constituted for Finalisation of Compensation in reference to the order passed by Hon'ble NGT in the matter of OA 73/2020 & connected matters related to Gas Leak incident at M/s LG Polymers Limited, Visakhapatnam (Andhra Pradesh)

A meeting of the MoEFCC Nodal Committee constituted for Finalisation of Compensation was convened under the chairmanship of Dr. Prashant Gargava, Member Secretary, CPCB on 10.09.2020 at 11 A.M. through video-conferencing. All the designated members of the Committee attended the meeting in person. The following members were present:

- Dr. Prashant Gargava, Member Secretary, CPCB – in Chair
- Dr. Dharmendra K. Gupta, Director, HSM Division – Member Convenor
- Shri Amardeep Raju, Addl. Director/ Scientist-E (Violation Projects), MoEFCC
- Shri Hemant Bherwani, Scientist, CSIR-NEERI

Special Invitees

- Shri Raghu Kumar Kodali, Director/ Scientist-F, MoEFCC
- Shri Dinbandhu Gouda, Divisional Head (IPC-I) & Additional Director, CPCB
- Shri Bharat Sharma, Addl. Director and In-charge, CPCB Regional Directorate, Pune

2. At the outset, Chairman welcomed all the participants and meeting began with brief round of introduction. The Member Convenor informed the Committee about the background and purpose for which it has been constituted and highlighted that the task assigned to it i.e. finalisation of compensation is a follow-up activity which needs to be undertaken once the report of 'Finalisation of Restoration Plan' is ready. The Chair supplemented that for undertaking the compensation assessment, a detailed restoration plan need to be in place covering both 'environmental restoration measures and cost' and 'assessment of damages and associated cost'. The Committee members agreed to the above.

3. The Chair mentioned that in line with the deliberations of the 1st meeting of 'Finalisation of Restoration Plan', the CPCB has further lined up with CSIR-NEERI for undertaking the work related to 'Preparation of Restoration Plan w.r.t. Environmental Media'. The scope of engagement is under discussion and would be finalised soon. It was further informed that the CSIR-NEERI report, upon finalisation, is expected to cover the damage cost as well as environmental restoration cost which would form the basis of finalisation of compensation w.r.t. environmental aspects. Similarly, an assessment with regard to damages to property, health, livestock, agriculture etc. by another sub-Committee constituted under DM, Vizag. A report from the sub-Committee constituted under the chairmanship of DM, Vizag is expected to cover the damage cost as well as restoration cost w.r.t. damage to property, agriculture, health, livestock etc. which would form the basis of finalisation of compensation. The MoEFCC nodal committee for 'Finalisation of Restoration Plan' shall examine and consider the reports from both the sub-committees and thereafter, finalise the restoration plan.

4. During the deliberations, the Committee noted that since finalisation of compensation is a skilled activity that requires experience/ expertise, services of a couple of experts can be

utilised for the same. Accordingly, the Chair requested all members, especially CSIR-NEERI expert *(having experience in handling similar issues)* to explore and suggest some experts that can guide the committee in undertaking the task assigned to it. The Director (HSMD) informed that to enable the on-boarding of experts in the committee, approval would be required from the Competent Authority and IFD, in the Ministry. Hence, members are requested to share the CVs of expert(s) and thereafter, the on-boarding shall be finalised in consultation with Chairman.

5. Environmental Restoration Plan shall be prepared based on assessment of extent of damage. Hence, project proposal shall be divide into two phases i.e. Phase-I: Damage assessment, and Phase-II: Restoration plan. During damage assessment, preliminary investigation of soil and groundwater/ surface water/sediment may be done, so that the outcome of preliminary study may be ascertained whether detailed investigation of contaminated soil, groundwater/ surface water/sediment including Risk assessment study is needed or not. Phase I report should be delivered in two month and phase II report in next three months.

6. MoEF&CC may pray Hon'ble NGT for extension of time for implementation and mentioning above technical reasons.

7. The Director (HSMD) further suggested that, if considered appropriate by members, the meetings of both the Committees can be convened jointly to have better understanding and coherence among them. The Chair, and members welcomed the suggestion and consented for a joint meeting in future.

The meeting ended with vote of thanks to the Chair.

*****

Tabulation of the technical and administrative/ regulatory recommendations made by High Power committee constituted by Govt. of Andhra Pradesh

S. No.	Item Description	Observations/ Recommendations
1.	Recommendation w.r.t. M/s LG Polymers	1. To shift the Hazardous Chemical industry of M/s LG Polymers from the present location and it may be relocated away from the human habitations preferably in the established notified industrial estates. Government/APIIC may allot suitable land in any industrial estates as per rules, for smooth shifting of the factory. 2. The present M/s LG Polymers industrial land may be used for either green or white category industry, subject to the outcome of Environment Clearance. In case this is not feasible, then conversion of the land for residential purpose/ commercial purpose may be examined. 3. The concerned Revenue Department may examine the aspect of Ceiling surplus land, which has been raised in representations. 4. The M/s LG Polymers may be asked to continue the staff employed in the White or Green category industry at the same location or may be asked to provide employment to the staff in the new factory location.
2.	Technical suggestions regarding Styrene industries	1. The tank must have a floating valve circulation or any other technology which provides circulation for Styrene. The change in design was a critical aspect in the case of LG Polymers. 2. There must be provision for mixing in case of failure of the circulation system. 3. The material of construction of the tank should be carbon steel with coating inside. 4. Tank life should be clearly defined; tank cleaning and coating should be carried out once in two years. 5. The roof of the tank should be supported with outside structures.

S. No.	Item Description	Observations/ Recommendations
		6. The number of nozzles in the tank should be kept to the minimum required. 7. All Styrene monomer tanks should have flare system or cryogenic system so that there is no Styrene vapour release even under normal circumstances. These systems will also prevent pollution of air. 8. There must be multiple continuous temperature measurement probes at different levels of the tank linked to the control room. 9. Temperature monitors and Refrigeration system should be interlinked in such a way to maintain temperature of the entire tank below 20°C at any point of time. 10. The standards for the refrigeration system in terms of pumping capacity and cooling capacity should be clearly defined for the various mass of Styrene by the industry, duly taking into account the ambient condition of the city where the factory is located. 11. In case of failure of the operating refrigeration system, standby refrigeration system shall be started automatically. 12. Automatic monitoring of inhibitor content (in ppm) and measurement at different levels of the tank with data recording and alert facility in the control room is essential. Further, the industry standards need to define clearly the quantity of inhibitor to be added depending upon the ppm level of the inhibitor content at various levels. Similarly, the industry standards should define the action to be taken in case the inhibitor content increases above the threshold level. 13. Dissolved Oxygen measurement system must be available at different levels of the tank and linked to the control room. Further, the industry needs to define clearly the action to be taken in case the Dissolved Oxygen reduces below/increases above the threshold range. 14. Polymer content measurement (in ppm) must be available at different levels of the tank and linked to the control room. The acceptable range of polymer content in ppm also needs to be clearly defined by the industry standards. Further, the

S. No.	Item Description	Observations/ Recommendations
		industry standards need to define clearly the action to be taken in case the polymer content increases above the threshold level. This was the critical gap in the case of LG Polymers. 15. Use of Siren even during minor emergencies should be made mandatory practice. 16. Safety protocol for units/factories storing/ processing Styrene Monomer must include vapour release, apart from the possibility of fire and explosion in the Emergency Plans. Besides, the possibility of leakage/spillage of liquid Styrene monomer must also be a part of the safety protocol and Emergency Plans. 17. Units/Factories storing/processing Styrene monomer must undertake an annual safety audit. 18. The PESO which has classified Styrene monomer as B category petroleum should look into this issue again and classify it as A category as it needs to be stored below 20°C, although the flashpoint is 31°C. 19. SCBAs and other equipment needed for dealing with chemical disasters should be made compulsory for the units storing/ processing Styrene monomer. 20. Vapour Detectors shall be provided at the boundary of the factory also, to indicate in DCS the Styrene vapour escape outside the factory premises. 21. The industry shall provide the Styrene detectors at unloading point, near all the vents, downwind, upwind directions and factory boundary, and the same shall be connected to the Control room with alert facility. In the case of exceedance, SMS alert shall be sent to the Plant Safety Officer, Plant Head, local Police Station and Fire Station, District Collector Control Room, Factories Department, APPCB etc. 22. Plant Control rooms shall be located at the strategically safe location and shall be made easily accessible and shall be made gas-tight and accident proof to the extent feasible. 23. Process safety management is a systematic, comprehensive approach towards various aspects of chemical safety with 19 elements; this shall be made

S. No.	Item Description	Observations/ Recommendations
		mandatory for all factories which are covered by MSIHC Rules,1989. This is a regulation in Occupational Safety and Health Administration (OSHA) brought in the year 1992 in USA with similar criteria for application as in MSIHC Rules. 24. The industry may examine the possibility that the sprinkler system is interlocked with tank internal temperature measuring devices. The sprinkler system shall start automatically whenever there are an unacceptable thermal profile (both internal tank temp as well as external ambient temperatures). 25. The industry may examine the possibility to provide detachable insulation to the Styrene storage tank, in such a way that, it can be easily removed during any emergency. 26. The industry shall ensure that there will not be any reverse pumping from the reactor / pre-mixing tank to the main storage tank. 27. There are a number of Styrene storage/processing/trading/importing units across India. It is essential that all these units should all have their safety features audited. Further, the PESO/ Government of India may also consider regulations that no unit shall sell/ trade in Styrene Monomer with any unit which does not have the required safety features for storage and handling of Styrene Monomer.
3.	Technical suggestions regarding Hazardous Chemical Industries	1. Hazard and Operability Study (HAZOP) and its compliance shall be made compulsory for all Hazardous process factory/unit wherever there is processing/storage of hazardous chemicals. 2. The industry should arrange for Annual Safety Audit and Annual Environmental Audit. The recommendations of the audit shall be meticulously complied within a reasonable timeframe. 3. Industries handling hazardous chemicals shall compulsorily appoint a senior level safety officer with prescribed technical qualifications and experience. There should be a safety officer available in each shift viz., a safety officer should be available in the factory in 24 hours in the factory. The safety officer shall

S. No.	Item Description	Observations/ Recommendations
		mandatorily undergo 1-year Diploma course on safety by recognized Institutes. 4. All officers working in regulatory departments dealing with factories shall undergo Safety course once in every 3 years. This is especially important for Fire Department and Police Department personnel posted in the areas having jurisdiction over the hazardous chemical units/factories. 5. All employees and people in the vicinity of the industry shall be made aware of the MSDS of hazardous chemicals. 6. The MSDS of the chemicals which has potential to create Offsite emergency should be displayed at the factory gate, on the website of the company and should also be informed during the Offsite emergency mock drill. 7. The hazardous industry should prepare a uniform standard format for the emergency plans with full details including the equipment and chemicals required in the event of an emergency. 8. Each State should develop a database of all industries/units handling, storing and processing hazardous chemicals as defined in MSIHC Rules,1989 including isolated storages and the respective Material Safety Data Sheets (MSDS) which should be available with the APSDMA, SDRF, Factories Department, Boilers Department, APPCB, Fire Department, Department of Industries, PESO, Transport Department etc. 9. The CPCB/MOEF, GoI shall stipulate standards for the fugitive emissions from the Tank farms and isolated storages as they are equally potential areas for release of toxic/hazardous gases/pollutants to the environment. 10. The industry shall identify Process Safety Competency-based training needs and shall develop training modules and the training to be imparted till the competency levels are improved. 11. The hazardous industry must undertake competency mapping for all the operating and maintenance staff. The gaps incompetency should not be tolerated

S. No.	Item Description	Observations/ Recommendations
		in respect of hazardous chemicals industries at all.
4.	Strengthening of Administrative/ regulatory Framework w.r.t. Factory Safety	• The major legislations dealing with industrial safety in factories are the Factories Act, 1948, Indian Boilers Act-1923, Indian Electricity Act- 1910, Petroleum Act, 1934, Explosives Act-1884, A.P. Fires services, MSIHC Rules Act, 1989; Building and Other Construction Workers Act, 1996. and different set of rules framed under these rules. • There are Factory Safety Regulatory Gaps due to the following: ▪ Multiple Agencies ▪ Multiple Strong Laws. ▪ Weak Structure of the Concerned Organization/ Department. ▪ Absence of Compliance / Third Party Verification Systems. ▪ More driven as License Permit System rather than facilitating industries. • The HPC suggested to constitute a State Factory Safety Board in each state and a Central Factory Safety Boards with a single point regulatory agency for regulating all factory safety laws, rules and regulations. a) The role of the Central Factory Safety Board would primarily be in setting up of safety norms, setting up of standards, capacity building of the state boards and dealing with certain large size hazardous factories. b) One of the special functions of the Central Factory Safety Board would be investigating each and every major factory accident, mandatorily by law. c) It is suggested to constitute the Factory Safety Board with sufficient manpower and Infrastructure, to deliver the solutions for all the existing safety aspects as a unified regulatory body.
5.	Strengthening of Administrative/ regulatory Framework w.r.t.	• To address the environmental regulatory gaps, the Committee has deliberated on the issue and suggest the following: a) All SPCBs can be constituted as authorities under Section 3(3) of the E (P) Act; with the condition that all A Category projects will be sent with the

S. No.	Item Description	Observations/ Recommendations
	Factory Safety	recommendation of the SPCB to the MoEF&CC and for B category projects, SPCB shall be the final authority. In other words, i. The SEIAA will not be separately constituted but will be part and parcel of the SPCBs. ii. However, to assist the SPCBs, there can be SEAC constituted under Section 3(3) of the E(P) Act. iii. Requirement / Grant of EC under E(P) Act and CFE / CTE under Air Act and Water Act will be simultaneously examined by the SPCB, for both categories A and B projects. For category B projects, EC and CFE shall be issued simultaneously by the SPCB. For category A projects, the SPCB shall send the recommendation for EC to the MoEFCC. It shall issue CFE for category A projects, after issue of EC by MoEFCC. iv. It will save facilitate the project proponents to get their clearances in one place. • To effectively monitor and implement the provisions of the E(P) Act and rules and notifications issued thereunder, it is essential that all the officers of SPCBs are appointed as monitoring and competent officers under Section 4 of E (P) Act for all categories of industries including category A. • Section 5 of the E(P) Act provides for action for violation. This has been presently delegated to the State Governments. It is essential to delegate this function to the SPCBs, so that they can exercise the monitoring function effectively • Environment is a matter of concern for both State and Central Governments. "Environment" subject should be included in the Concurrent list of the Constitution.

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ASSESSMENT OF ENVIRONMENTAL DAMAGES AND PREPARATION OF RESTORATION PLAN FOR AIR, WATER AND SOIL ENVIRONMENT DUE TO STYRENE GAS LEAKAGE INCIDENT AT VISAKHAPATNAM



Sponsor:
Central Pollution Control Board (CPCB), New Delhi

CSIR-National Environmental Engineering Research Institute (NEERI)
Nagpur & Hyderabad Zonal Centre, Hyderabad

July 2021

FOREWORD

An accident occurred in M/s. L.G Polymers India Pvt Ltd, Visakhapatnam at 0302hrs on 07.05.2020 styrene vapor has leaked from a storage tank of 2500KL, and spread to surrounding villages of Venkatapuram, Padmanabhapuram, SC & BC Colony.

The Hon'ble National Green Tribunal had taken *suo moto* cognizance of the gas leakage incident and constituted an Expert Committee which filed a detailed report on 28.05.2020. The Hon'ble Tribunal after consideration of the responses of various parties and report of Expert Committee, passes an order on 01.06.2020. In pursuance of the orders of Hon'ble NGT dated 01.06.2020, the Ministry of Environment, Forest and Climate Change (MoEF&CC) constituted various committees on July 21, 2020. The 1st meeting of the MoEF&CC Nodal Committee (constituted for the preparation of restoration plan for the incident occurred at LG Polymers) was held on August 17th, 2020, while the first meeting on Environmental Damages and Compensation held on 9th September 2020. In both the meetings, it was proposed to engage CSIR-NEERI for assessment of environmental damages and preparation of the restoration plan for air, water, soil components.

In this regard, CPCB approached CSIR-NEERI, Nagpur and Hyderabad Zonal Centre to conduct environmental damages cost assessment and prepare a Plan for Restoration of Environmental Media viz. Air, Water and Soil. Accordingly, CSIR-NEERI, Nagpur and Hyderabad Zonal Centre has conducted the study collecting the primary data and data from various secondary sources and accordingly estimated the environmental damages cost and prepared a Plan for Restoration of Environmental Media viz. Air, Water and Soil.

The help and cooperation extended by officials of Central Pollution Control Board, New Delhi; Andhra Pradesh Pollution Control Board, Visakhapatnam; District Collector, Visakhapatnam; Revenue and Health Departments of Govt. of Andhra Pradesh, Visakhapatnam; and the people in and around the LG Polymers, Visakhapatnam is gratefully acknowledged.

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CHAPTER I

INTRODUCTION

1.0 Introduction

M/s LG Polymers India Pvt Ltd manufactures Expandable Polystyrene using Styrene (C_8H8), Pentane (C_6H_{12}) and HCl as main raw materials. It merged with M/s Mc Dowell & Co. Ltd. of UB Group in 1978. It was taken over by LG Chem (South Korea), Hindustan Polymers was renamed as LG Polymers India Private Limited (LGPI) in July, 1997.

An accident occurred in M/s. L.G Polymers India Pvt Ltd, Visakhapatnam at 0302hrs on 07.05.2020. The company has stored styrene monomer in vertical MS storage tanks of 2500 KL and 3500 KL capacity provided with internal cooling system through refrigeration. From one storage tank of 2500KL, styrene vapor has leaked and spread to surrounding villages of Venkatapuram, Padmanabhapuram, SC & BC Colony.

The Hon'ble National Green Tribunal had taken *suomoto*cognizance of the gas leakage incident and constituted an Expert Committee which filed a detailed report on 28.05.2020. The Hon'bleTribunal after consideration of the responses of various parties and report of Expert Committee, passes an order on 01.06.2020. In pursuance of the orders of Hon'ble NGT dated 01.06.2020, the Ministry of Environment, Forest and Climate Change (MoEF&CC) constituted various committees on July 21, 2020. The 1st meeting of the MoEF&CC Nodal Committee (constituted for the preparation of restoration plan for the incident occurred at LGPolymers) was held on August 17th, 2020, while the first meeting on Environmental Damages and Compensation held on 9th September 2020. In both the meetings, it was proposed to engage CSIR-NEERI for assessment of environmental damages and preparation of the restoration plan for air,water,soil components. In this regard, CPCB approached CSIR-NEERI, Nagpur and Hyderabad Zonal Centre to conduct environmental damages cost assessment and prepare a Plan for Restoration of Environmental Media viz. Air, Water and Soil.

1.1 Objectives

Characterization or contaminated site assessment (CSA)

- To assess existing environmental quality data for air, water andsoil
- To monitor surface water, ground water and soil within the industry and in surrounding villages within 3 km region forstyrene
- To assess the microbiological diversity (bacteria and fungi) of soil withinandsurrounding villages (within 3 km) of industry
- To collect primary health and secondary health data from the primary health centres (PHCs)/hospitals and personal questionnaire data on human health in the studyarea

- To assess the impacts on environmental media w.r.to air, water and soil due to the uncontrolled Styrene vaporrelease
- To prepare a Plan for Restoration of Environmental Media viz. air, water and soilquality.

1.2 Scope of Work& Methodology

The study will be carried out in two parts:

Part I: Assessment and prediction due to the LG Polymers incident

Part II: Preparation of the restoration plan based on the assessment and prediction

Part-I: Assessment and prediction due to the LG Polymers incident

Assessment of Air, Water and SoilQuality

Secondary data collection on ambient air, surface water, groundwater and soil quality within the study area will be made from available sources. The primary data on surface water, groundwater and soil quality within the study area will be collected at identified locations.

A. Ambient airquality

- Collection of ambient levels of Volatile Organic Compounds (VOCs) and Styrene in the study area from the available resources like Report of the High Power Committee (HPC) constituted by Govt. of AP, Hon'ble National Green Tribunal (NGT) Report and primary data collected by different agencies like CSIR-NEERI and APPCB during the period immediately after the Styrene gas accident

B. Ground water/surface waterQuality

- Collection of the existing groundwater data state groundwater board, CGWB and delineation of groundwater hydrology and geology based on secondary data will be carriedout.
- Identification and establishment of available water bodies (surface as well as groundwater) existing in the study area around LG Polymers will be carried out.
- Groundwater/surface water and Sediment samples will be collected from the identified location for the physico-chemical parameters, DO, COD, BOD and heavy metals, oil &grease,styrene.
- Sediment remedial option will be addressed as most of the Styrene might have accumulated in the sediments of surrounding waterbodies.

C. Soil quality

- Collection of Site specific data & surrounding study area informationthrough observations/consultation during ReconnaissanceSurvey
- Collection of secondary data w.r.t soil types Topography, Soil profile, soil Map & Land use pattern of the study area from variousdepartments.
- Soil sampling from different depths in the study area by soil boring/ excavation including in areas where contamination is expected (hotspots).
- Soil samples will be collected in the study region and analyzed for Styrene and Physico- Chemical Parameters viz. pH, Conductivity, Porosity, available NPK , water holding capacity, soil texture, organic matter and trace elements (As, B, Ba, Cd, Co, Cr, Cu, F, Fe, Hg, Mn, Ni, Pb,Zn)
- Soil remedial option also will be delineated if Styrene or its metabolites still persists in the soilmatrix

D. Soil microbialdiversity

- The structure of soil microbial composition will be studied and the diversity of beneficial (such as nitrogen fixers, phosphate solubilizers, etc) and harmful microbial flora (pathogens) will beanalyzed.
- Styrene resistant or Styrene degrading strains if identified, will be mass cultivated for soil and sediment cleanupactivities.

Predictive Assessment due to theaccident

- Impacts on ambient air quality due to the styrene accident over the study area will be assessed based on the results of modeling studies and impact zone in terms of the threshold values given in the report of the High Power Committee (HPC) constituted by Govt. ofAP
- Impacts on surface and ground water bodies in the studyarea
- Impact on soil environment and soil microbial diversity by soilcharacterizationw.r.t physico chemical and Microbial properties.

Part-II: Preparation of the restoration plan based on the assessment andprediction

Preparation of RestorationPlan

The restoration plan for air, water and soil will be prepared based on the assessment and analysis of the primary and secondary data. The restoration plan will be prepared based on the short term and long-term measures. The plan involved in the preparation of the restoration plan will be asfollows:

- Assessment of impacts on air, water and soil quality in the study area and delineation of mitigation measures in comparison with respective Indian Nationalstandards.
- Delineation of Plan for Restoration of Environmental Media viz. Air, Water and SoilQuality

Air Environment:

- Evaluation of adequacy of existing air pollution controlequipment
- Implementation of WAYU/ambient air purification systems in and around the area for ambient air
- Suggestions on control of fugitive emissions at the source forstyrene
- Risk mitigation and associatedcost

Water Environment:

- Pump and treatment for deteriorated waterquality
- Implementation of various treatment technologies like advanced oxidation processes etc for surface water

Soil/Ecological Environment:

- Identification and introduction of local species of flora and fauna for adaptation and green beltdevelopment
- As a short-term measure top layer contaminated soil, shall be carefully excavated and shall be disposed off at an authorized TSDF, in accordance with the prevailing hazardous waste management rules andregulations.
- Styrene-degrading bacteria could potentially be used in bioremediation of styrene pollution as a long-termmeasure
- Impacts on health, animals, microbial flora andvegetation

This report is based on the primary data monitored by CSIR-NEERI- Hyderabad Zonal Centre (HZC) and secondary data collected from different sources like The HPC Report, Technical Committee findings, primary data or secondary data collected by CSIR- National Environmental Engineering Research Institute (NEERI), Chemical, Biological, Radiological and Nuclear (CBRN) wing of National Disaster Response Force (NDRF) and Andhra Pradesh Pollution Control Board (APPCB).

1.3 Layout of the report

The report is presented in the following layout:

Chapter 1: Introduction

Chapter 2: Prevailing Environmental Quality

Chapter 3: Impact Assessment of the Environment

Chapter 4: Environmental Damages Cost Assessment (EDCA) for Styrene Gas Leak

Chapter 5: Preparation of Restoration Plan

Chapter 6: Conclusion & Recommendations

CHAPTER 2

PREVAILING ENVIRONMENTAL QUALITY

2.0 Description of Environment

The primary data on ambient air in terms of Styrene, surface water/sediment, groundwater (physico-chemical parameters, DO, COD, BOD and heavy metals, oil &grease,styrene) and soil quality (StyreneandPhysico- Chemical Parameters viz. pH, Conductivity, Porosity, available NPK, water holding capacity, soil texture, organic matter and trace elements (As, B, Ba, Cd, Co, Cr, Cu, F, Fe, Hg, Mn, Ni, Pb,Zn) within the study area was collected at identifiedlocations during October 2020. The existing environmental data monitored since the accident occurred at different times monitored and reported by different agencies has been given in detail.The ambient levels of styrene, surface water and groundwater quality and soil quality are discussed in the following sections:

2.1 Air Environment

The styrene levels in ambient air are monitored and analysed by several agencies like CSIR-NEERI, CBRN, NDRF and APPCB during the period of Styrene Monomer Vapour (SMV) accident occurred on 07/05/2020 to 10/05/2020. The ambient styrene levels and TVOCs were monitored by CSIR-NEERI-HZC during 12/05/2020 to 15/05/2020 and during 28/10/2020 to 3/10/2020 within the 3 km radial distance from the LG Polymers Storage Tank as centre.

2.1.1 Ambient Levels of Styrene during May 7-10, 2020

The ambient concentrations of styrene were measured during 07/05/2020 to 08/05/2020 by various agencies are given in **Table 2.1.1**. The styrene levels in the ambient air were found to be varied from 11.2 ppm (at 07.00 P.M) to 461ppm (at 10.00 P.M) on 07/05/2020 at Venkatapuram village near to LGPL and 43 ppm (at 09.00 P.M) to 365 ppm (at 10.00 P.M) near the LGPL Main gate on 07/05/2020. However, styrene levels in ambient air have come down from 374 ppm (at 02.00 A.M) to 11.7 ppm (at 05.00 A.M) on 08/05/2020 at Venkatapuram village. Similarly, the styrene levels have reduced from 242 ppm (at 02.00 A.M) to 14.2 ppm (at 05.00 A.M) near the LGPL Main gate on 08/05/2020.

Table 2.1.1 Ambient Levels of Styrene during 07 – 08 May 2020

Location	Date	Time of Measurement	Styrene Concentration, ppm
Venkatapuram Village	07-05-2020	16.30	75.4
		17.30	151
		18.00	123
		19.00	11.2
		20.00	77
		21.00	54
		22.00	461
	08-05-2020	02.00	374
		03.00	170
		04.00	45
		05.00	11.7
LGPL Main Gate	07-05-2020	15.10	28.4
		20.00	54
		21.00	43
		22.00	365
	08-05-2020	02.00	242
		03.00	142
		04.00	37
		05.00	14.2

The ambient levels of styrene monitored by CSIR-NEERI, CERN, NDRFduring May 9-10, 2020, as per the High Power Committee (HPC) report, are given in **Table 2.1.2**. It is observed that the level of styrene was 4.9 ppm inside the LG polymers plant near office at 11.00 A.M on 09/05/2020 and 2.3 ppm near the Meghadrigadda Reservoir at 02.30 P.M on 09/05/2020.Styrene level in the ambient air was 12.8 ppmat the M6 Tank Top at 10.30 A.M and7.3 ppm at the ground level near M6 Tank at 11.30 A.M on 10/05/2020. The ambient styrene levels were found be 1.2 ppm at Venkatapuram at 11.00 A.M and 2.7 ppm at Narvakota at 03.00 P.M on 10/05/2020.

Table 2.1.2 Ambient Levels of Styrene during 09-10 May 2020

S.No	Location	Date of Sampling	Styrene in ppm
1	M6 Tank Top	May 10, 10.30 A.M	12.8
2	At ground level near M6 Tank	May 10, 11.30 A.M	7.3
3	Inside the LG Polymers plant near office	May 09, 11.00 A.M	4.9
4	Residential Area, Venkatapuram Colony	May 10, 11.00 A.M	1.2
5	Meghadrigadda Reservoir	May 09, 02.30 P.M	2.3
6	Fishpond site, Narvakota	May 10, 03.00 P.M	2.7

2.1.2 Ambient Levels of Styrene during 12 – 15, May 2020

CSIR-NEERI Hyderabad Zonal Centre (HZC) has carried out the monitoring of ambient levels of Styrene and Total Volatile Organic Compounds (TVOCs) at different locations near the LG Polymers Storage Tank and in the buffer zones of 0.5 km, 1 km, 1.5 km, 2 km and 3 km radius from the LG Polymers Storage Tanks (LGPST) as centre, using (i) sorbent tubes and analysed on GC/MS for styrene and (ii) the handheld TVOC analyser with Styrene as independent variable from 12/05/2020 to 15/05/2020. Sampling locations are shown in **Fig. 2.1.1** and details are given in **Table 2.1.3**.

The ambient air quality locations for sampling styrene are selected based on the predominant wind directions observed from daily wind data and confirmed with climatalogicalnormals. It is observed that during the summer/study period, the predominant winds are from SW, W, SSW, S directions (SW sector) as shown in **Fig. 2.1.2**, implying the impact zone shall be in NE, E, NNE, N directions (NE sector) from LGPST as centre.

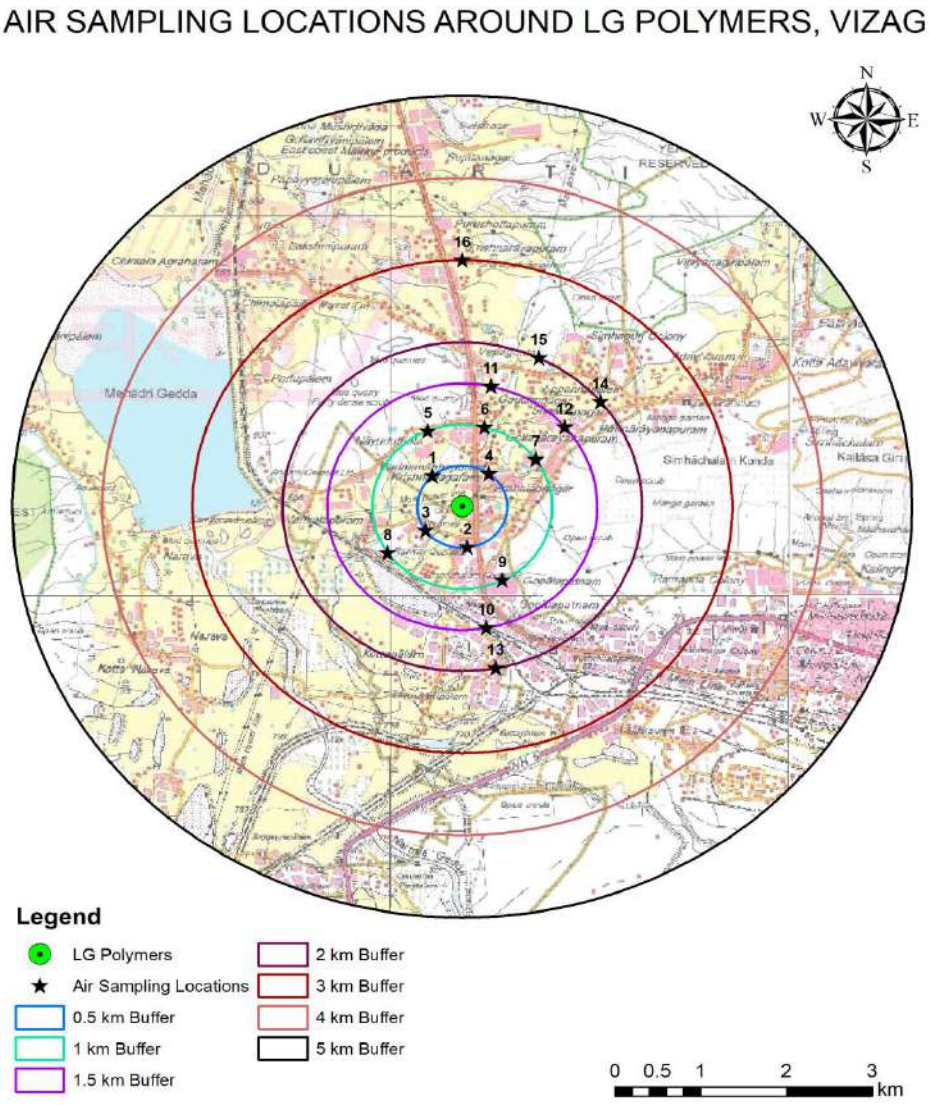


Fig. 2.1.1 Map Showing Air Sampling Locations in the Study Area

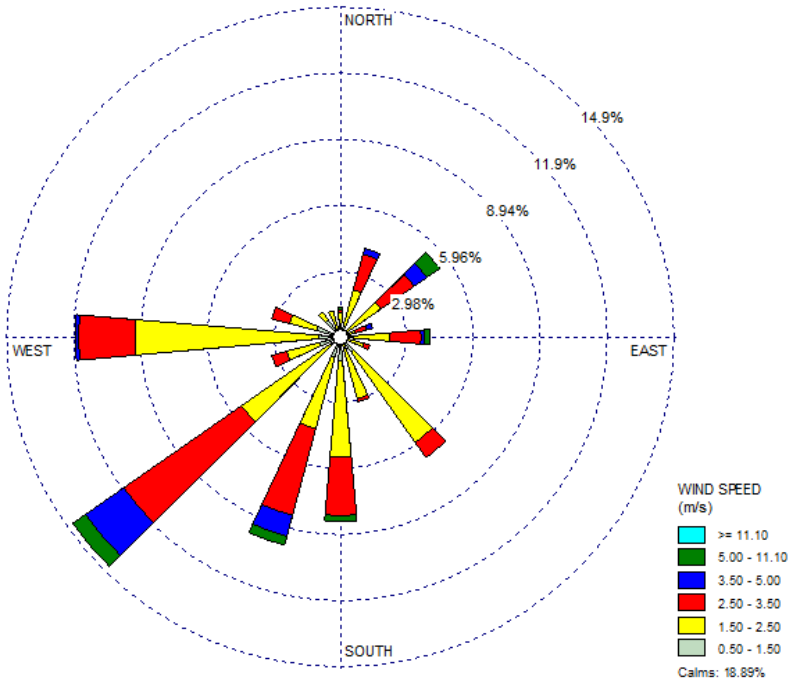


Fig. 2.1.2 Windrose for Visakhapatnam during Summer season.

Table 2.1.3: Details of Air Sampling Locations LG polymers Visakhapatnam Styrene Study (12 – 15 May 2020)

Sr. No	Location Details	Sample Code	GPS Co-ordinates
1.	Nandamuri Nagar Near Community Building	SL-1	N $17^0$45’37.4’’ E $83^0$12’38.2’’
2.	Bapuji Nagar Near Bureddy Brothers House Gopalapatnam	SL-2	N $17^0$45’11.0’’ E $83^0$12’56.9’’
3.	Venkatapuram Village Near Venugopalaswamy Temple	SL-3	N $17^0$45’27.0’’ E $83^0$12’28.7’’
4.	Krishnanagar-BRTS Road Near Vedika Function Hall	SL-4	N $17^0$45’43.0’’ E $83^0$13’02.2’’
5.	Naiduthota- VenkataSai Nagar Near Varasiddivinayaka Temple	SL-5	N $17^0$46’04.5’’ E $83^0$12’37.3’’
6.	Naiduthota-BRTS Road Near Bhashyam School	SL-6	N $17^0$46’07.8’’ E $83^0$13’02.9’’
7.	Anjanadri colony, Prahladapuram	SL-7	N $17^0$45’53.6’’ E $83^0$13’25.2’’
8.	Venkatapuram Near Railway Bridge	SL-8	N $17^0$45’19.9’’ E $83^0$12’20.7’’
9.	Santosh Nagar-Kothapalem	SL-8/9	N $17^0$44’56.7’’ E $83^0$12’26.6’’
10.	Prasanth Nagar Gopalapatnam Near Sai baba Temple Centre	SL-10	N $17^0$44’53.1’’ E $83^0$13’01.1’’
11.	Vepagunta- Prasanthi Nagar Near Lakshmi Ganapathi Temple	SL-11	N $17^0$46’24.1’’ E $83^0$13’05.7’’
12.	Srinivasanagar Simhachalam Road	SL-12	N $17^0$46’06.4’’ E $83^0$13’38.3’’
13.	Appannapalem Near JUNNRAM Colony	SL-15	N $17^0$46’34.3’’ E $83^0$13’24.3’’
14.	Krishnarayapuram - NAD Colony Near M.S. Ramayya Company	SL-16	N $17^0$47’11.0’’ E $83^0$12’57.4’’
15.	LG Polymers Near Storage Tank	SL-ST	N $17^0$45’18.8’’ E $83^0$12’33.8’’

2.1.2.1 Analysis of Results for Styrene on GC/MS

The concentrations of styrene (samples were obtainedusing sorbent tubes and analysed on GC/MS as per NIOSH1501 Method) at different locations in the study area (3 Km radius area from LG Polymers Storage Tanks (LGPST) are given in **Table 2.1.4**.

- Styrene concentrations in the ambient air was observed to be 0.25 ppm (1058.8 µg/m^3) near Storage Tank in LG Polymers using the GC/MS analysis

- Styrene concentration in the ambient air is observed to be 0.01 ppm (41.2 µg/m^3) at Venkatapuram (near Railway Bridge), i.e. < 0.5 km from the LG Polymers Storage Tank.

- Styrene was found to be below detection limit (BDL) (< 0.004 ppm or 16.7 µg/m^3, which is the lowest detection limit by the GC/MS method)at all other locations

Table 2.1.4: Styrene Concentrations in the Ambient Air at Different Locations in the Study Area (12 – 15, May 2020)

Sr. No	Sample Code	Date of Sampling	Styrene Concentration (ppm)	Date of Sampling	Styrene Concentration (ppm)
1.	SL-1	14.05.2020	BDL	16.05.2020	BDL
2.	SL-2	14.05.2020	BDL	16.05.2020	BDL
3.	SL-3	13.05.2020	BDL	16.05.2020	BDL
4.	SL-4	13.05.2020	BDL	17.05.2020	BDL
5.	SL-5	13.05.2020	BDL	15.05.2020	BDL
6.	SL-6	13.05.2020	BDL	15.05.2020	BDL
7.	SL-7	13.05.2020	BDL	18.05.2020	BDL
8.	SL-8	14.05.2020	0.01	16.05.2020	BDL
9.	SL-8/9	14.05.2020	BDL	16.05.2020	BDL
10.	SL-10	14.05.2020	BDL	16.05.2020	BDL
11.	SL-11	15.05.2020	BDL	17.05.2020	BDL
12.	SL-12	15.05.2021	BDL	17.05.2020	BDL
13.	SL-15	15.05.2022	BDL	17.05.2020	BDL
14.	SL-16	15.05.2023	BDL	17.05.2020	BDL
15.	SL-ST	14.05.2020	0.25	17.05.2020	BDL

(BDL - Below detection limit)

2.1.2.2 *Insitu* Values from TVOC Analyser

The *insitu*/spot concentrations of styrene and TVOC observed at different locations, using handheld TVOC analyser, are given in **Table 2.1.5**.

- Styrene ambient values varied from 0.3 ppm (1278 µg/m^3) to 1.4 ppm (5964 µg/m^3) near Storage Tank in LG Polymers
- TVOCs ranged from 0.4 to 3.2 ppm near Storage Tank in LG Polymers
- Styrene ambient values varied from BDL to 0.1 ppm (426 µg/m^3) in the 0.5 Km radius area from LG Polymers Storage Tank
- TVOCs varied between BDL to 0.2 ppm in the 0.5 Km radius area from LG Polymers Storage Tank
- Styrene ambient values varied between BDL to 0.1 ppm (426 µg/m^3) in the 0.5 - 1.0 Km radius area from LG Polymers Storage Tank
- TVOC ambient values varied from BDL to 0.2 ppm in the 0.5 - 1.0 Km radius area from LG Polymers Storage Tank
- Styrene ambient values observed to be BDL in the 1.0 - 3.0 Km radius area from LG Polymers Storage Tank
- TVOC ambient values ranged from BDL to 0.1 ppm in the 1.0 - 3.0 Km radius area from LG Polymers Storage Tank

Table 2.1.5: TVOC and Styrene Spot Concentrations in the Study Area (12 – 15, May 2020)

Sr. No	Sample Code	TVOC (ppm)	Styrene (ppm)	Sampling Date
1.	SL-1	BDL	BDL	14-05-2020
2.	SL-2	0.2	0.1	14-05-2020
3.	SL-3	0.2	0.1	13-05-2020
4.	SL-4	0.2	0.1	13-05-2020
5.	SL-5	0.2	0.1	13-05-2020
6.	SL-6	0.2	0.1	13-05-2020
7.	SL-7	0.2	0.1	13-05-2020
8.	SL-8	0.2	0.1	14-05-2020
9.	SL-8/9	BDL	BDL	14-05-2020
10.	SL-10	0.1	BDL	14-05-2020
11.	SL-11	BDL	BDL	15-05-2020
12.	SL-12	BDL	BDL	15-05-2020
13.	SL-15	BDL	BDL	15-05-2020
14.	SL-16	BDL	BDL	15-05-2020
15.	SL-ST	0.4	0.3	14-05-2020
		3.2	1.4	

(BDL - Below detection limit)

The results indicated that the impact of Styrene is significant near the LG Polymers and around 500 m distance from the LG Polymers Storage Tanks (LGPST) as the styrene concentrations are observed to be high up to 500 m radius area from LGPST (Tables 2.1.4 and 2.1.5). But the impact is also spread up to 1.0 Km distance where insitu/spot values of styrene are observed. The ambient values of styrene are observed up to 1.0 Km as styrene is a heavy gas and tends to settle rapidly on the ground and thus may not have reached farther distances after the measures to stop leakage of styrene gas have completed.

Also, the styrene monomer would have dispersed in the NE sector from LGPST as the predominant winds are from SW direction, but mostly the styrene monomer got dispersed in the western to south western sector from LGPST. This may be because styrene is a heavy gas and due to building downwash effect, as styrene monomer gas released from the top of the storage tank, it got descended towards ground and dispersed locally at the time of the accident.

Generally, ambient air in urban locations contains styrene at average concentrations of 0.29 to 3.8 µg/m^3, while styrene in rural and suburban air has been measured at 0.28 to 0.34 µg/m^3 (ATSDR, 1992). The styrene concentrations in the ambient air of Visakhapatnam study area during the study period are found to be exceeding the above ambient concentration

levels or standard values. Also, the styrene values are higher very close to the LGPST and up to 500 m from LGPST compared to Ontario's ambient air quality criteria of styrene equal to 400 µg/m^3 (24 hrlyaverage) for limiting effect on human health.

The odour of styrene was still persistent in near LGPST during the study period as the odour threshold for styrene is 0.32 ppm or 1363 µg/m^3 (Amoore and Hautala, 1983).

Spot concentrations of TVOCs are observed up to 3.0 Km distance from LGPST with higher values observed near LGPST and up to 500 m distance from LGPST. The higher values of TVOCs up to 3.0 Km is due to contribution from other sources like vehicles and industries in the surrounding area.

2.1.3 Ambient Levels of Styrene during 28 – 30, October 2020

Ambient levels of Styrene and Total Volatile Organic Compounds (TVOCs) were monitored at different locations near the LG Polymers Storage Tank and up to 1.0 km radius area from the LG Polymers Storage Tank as centre using (i) sorbent tubes and analysed on GC/MS for styrene and (ii) the handheld TVOC analyser with Styrene as independent variable from 28-10-2020 to 30-10-2020. The air sampling locations are given in **Table 2.1.6**.

The styrene concentrations, sampled through sorbent tubes and analysed on GC/MS, are given in **Table 2.1.7.** The styrene levels in ambient air at all locations are found to be BDL (< 0.0008 ppm or 3.3µg/m^3 in the study area. The spot concentrations of TVOC and styrene & benzene as independent variables sampled at different locations are given in **Table 2.1.8**. The spot concentrations of TVOC are found to be 0.018 ppm at the Storage Tank of LG Polymers and 0.018ppm at Styrene Unloading Area, 1221 B Tank, during the study period. The spot concentrations of styrene are found to be 0.007 ppm at the Storage Tank of LG Polymers. However, at all remaining locations, the spot concentrations of TVOC and styrene are found to be BDL. Similarly, the spot concentrations of benzene are found to be BDL at all locations in the study area.

Table 2.1.6: Details of Air Sampling Locations (28 – 30, October 2020)

Sr. No	Location Details	Sample Code	GPS Co-ordinates
1.	Nandamuri Nagar Near Temple	SL-1	N $17^0$45’ 36.7’’ E $83^0$12’ 38.02’’
2.	Bapuji Nagar	SL-2	N $17^0$45’ 01.49’’ E $83^0$12’ 58.55’’
3.	Venkatapuram Village NearVenugopalaswamy Temple	SL-3	N $17^0$45’ 26.83’’ E $83^0$12’ 28.10’’
4.	Krishnanagar-BRTS Road Near Vedika Function Hall	SL-4	N $17^0$45’ 43.0’’ E $83^0$13’ 02.2’’
5.	Naiduthota- VenkataSai Nagar Near Varasiddivinayaka Temple	SL-5	N $17^0$46’ 04.5’’ E $83^0$12’ 37.3’’
6.	Naiduthota- Adjacent to BRTS Road Near Bashyam School	SL-6	N $17^0$46’ 07.8’’ E $83^0$13’ 02.9’’
7.	Prahladapuram, Anjanadri colony	SL-7	N $17^0$45’ 53.6’’ E $83^0$13’ 25.2’’
8.	Venkatapuram Near Railway Bridge	SL-8	N $17^0$45’ 20.71’’ E $83^0$12’ 21.01’’
9.	Storage tank, LG Polymers	SL-15	N 17° 45’ 19.17” E 83° 12’ 33.86”
10.	Opposite to Pentene Storage tank	SL-16	N 17° 45’ 20.85” E 83° 12’ 35.32”
11.	Venkatapuram Village NearVenugopalaswamy Temple	SL-3D	N $17^0$45’ 26.83’’ E $83^0$12’ 28.10’’
12.	Venkatapuram Near Railway Bridge	SL-8D	N $17^0$45’ 20.71’’ E $83^0$12’ 21.01’’
13.	Back side Storage tank	-	N 17° 45’ 21.05” E 83° 12’ 33.42”
14.	Styrene Unloading area, 1221 B Tank	-	N 17° 45’ 17.68” E 83° 12’ 33.78”

Table 2.1.7: Styrene Concentrations (28 – 30, October 2020)

Sr. No	Location Details	Sample Code	Conc. µg/m^3
1.	Nandamuri Nagar Near Temple	SL-1	BDL
2.	Bapuji Nagar	SL-2	BDL
3.	Venkatapuram Village Near Venugopalaswamy Temple	SL-3	BDL
4.	Krishnanagar-BRTS Road Near Vedika Function Hall	SL-4	BDL
5.	Naiduthota- VenkataSai Nagar Near Varasiddivinayaka Temple	SL-5	BDL
6.	Naiduthota- Adjacent to BRTS Road Near Bashyam School	SL-6	BDL
7.	Prahladapuram, Anjanadri colony	SL-7	BDL
8.	Venkatapuram Near Railway Bridge	SL-8	BDL
9.	Storage tank, LG Polymers	SL-15	BDL
10.	Opposite to Pentene Storage tank	SL-16	BDL
11.	Venkatapuram Village NearVenugopalaswamy Temple	SL-3D	BDL
12.	Venkatapuram Near Railway Bridge	SL-8D	BDL

(BDL - Below detection limit)

Table 2.1.8: Spot Observations of TVOC, Styrene and Benzene (28 – 30, October 2020)

Sr. No	Sampling Location	Sample code	TVOC (ppm)	Styrene (ppm)	Benzene (ppm)
1.	Nandamuri Nagar Near Temple	SL-1	BDL	BDL	BDL
2.	Bapuji Nagar	SL-2	BDL	BDL	BDL
3.	Venkatapuram Village NearVenugopalaswamy Temple	SL-3	BDL	BDL	BDL
4.	Krishnanagar-BRTS Road Near Vedika Function Hall	SL-4	BDL	BDL	BDL
5.	Naiduthota- VenkataSai Nagar Near Varasiddivinayaka Temple	SL-5	BDL	BDL	BDL
6.	Naiduthota- Adjacent to BRTS Road Near Bashyam School	SL-6	BDL	BDL	BDL
7.	Prahladapuram, Anjanadri colony	SL-7	BDL	BDL	BDL
8.	Venkatapuram Near Railway Bridge	SL-8	BDL	BDL	BDL
9.	Storage tank, LG Polymers	SL-15	0.018	0.007	BDL
10.	Opposite to Pentene Storage tank	SL-16	BDL	BDL	BDL
11.	Venkatapuram Village NearVenugopalaswamy Temple	SL-3D	BDL	BDL	BDL
12.	Venkatapuram Near Railway Bridge	SL-8D	BDL	BDL	BDL
13.	Back side Storage tank	-	BDL	BDL	BDL
14.	Styrene Unloading area, 1221 B Tank	-	0.018	BDL	BDL

(BDL - Below detection limit)

2.1.4 Styrene Levels in Ambient Air during June 2021

APPCB has monitored styrene levels inside LGPL and outside the LGPL in the study area during June 2021. Four Samples within the LG Polymers Plant: Near M6 Tank, Near Water Reservoir (100 m away from M6 Tank), Near FCT Area (about 200 m away from M6 Tank) and Near Security Main Gate and Five samples in the surroundings of LGPL: Santosh Nagar, Residential area on the east sode towards Govindapalem, Near the main gate of LGPL, On the west side of LGPL in the residential area near Railway track and Residential area in Porlupalem village. The styrene levels in the ambient air were found BDL in the study area during June 2021.

2.1.5 Temporal Variation of Styrene in Ambient AIr

The temporal variation of styrene in ambient air is given in **Table 2.1.9** from January 2020 to June 2021.

It is observd that the styrene concnetrations monitored through CAAQMS installed at Styrene Unloading Area near M6 Tank in LGPL were observed to be varying from 0 - 91 ppm, 0 - 91 ppm, 0 - 181 ppm and 0-748 ppm, respectively, in January, February, March and April 2020 respectively, before the styrene gas accident occurred. The maximum styrene levels were observed on on 27th Jan 2020 at 18.00 h, 14th Feb 2020 at 17.14 h, 24th Mar 2020 at 13.29 - 13.37 h and on 26th & 27th Apr 2020 at 12.36 - 1300 h, respectively, before the styrene gas accident. However, the CAAQMS data shows styrene values ranged from 0 - 988 ppm during May 2020 wherein the maximum styrene levels were observed on 7th May 2020 at 03.03 - 09.30 h & 22.57 - 23.08 h on the day styrene gas accident occurred.

The styrene levels in the ambient air during 07-08, May 2020 were found to be varied from 11.2 - 461 ppm in the study area outside LGPL, wheras they are BDL in the study area outside LGPL. It is observed that the level of styrene was 4.9 - 12.8 ppm inside LGPL and it was varying from 1.2 ppm - 2.7 ppm outside LGPL in the study area during 09-10, May 2020.

The styrene levels in the ambient air during 12-15 May 2020 were found to be varied from 0.3 - 1.4 ppm side LGPL and were varying from BDL - 0.1 ppm in the study area outside LGPL. Similalry, the level of styrene was BDL - 0.007 ppm inside LGPL and it was BDL outside LGPL in the study area during 28-30 October 2020. The styrene levels observed during June 2021 are BDL both inside and outside LGPL in the study area.

Table 2.1.9 Temporal Variation of Styrene in Ambient Air

Source of Monitoring	Sampling Period	Location	Styrene (ppm)	Remarks
LG Polymers	January 2020	Styrene Unloading Area near M6 Tank	0 - 91	Max. Occurrence of Styrene on 27th Jan 2020 at 18.00 h
	February 2020		0 - 91	Max. Occurrence of Styrene on 14th Feb 2020 at 17.14 h
	March 2020		0 - 181	Max. Occurrence of Styrene on 24th Mar 2020 at 13.29 - 13.37 h
	April 2020		0 - 748	Max. Occurrence of Styrene on 26th & 27th Apr 2020 at 12.36 - 13.00 h
	01-08 May 2020		0 - 988	Max. Occurrence of Styrene on 7th May 2020 at 03.03 - 09.30 h & 22.57 - 23.08 h
HPC Report (CSIR-NEERI/NDRF/ CERN)	07-08 May 2020	Inside LGPL	-	
		Outside LGPL in the Study Area	11.2 - 461	Max. Occurrence of Styrene on 7th May 2020 at 22.00 h
	09-10 May 2020	Inside LGPL	4.9 - 12.8	
		Outside LGPL in the Study Area	1.2 - 2.7	
CSIR-NEERI-HZC	12-15 May 2020	Inside LGPL	0.3 - 1.4	
		Outside LGPL in the Study Area	BDL - 0.1	
	28-30 October 2020	Inside LGPL	BDL - 0.007	
		Outside LGPL in the Study Area	BDL	
APPCB	June 2021	Inside LGPL	BDL	Styrene levles were absent in the study area
		Outside LGPL in the Study Area	BDL	

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HPC Report, (2020): The Report of the High Power Committee on The Styrene Vapour Release Accident at M/s LG Polymers India Pvt. Ltd.

2.2 Water Environment

The groundwater and surface water quality monitoring is an effort to obtain information on chemical quality through representative sampling in different hydrogeological units.CSIR-NEERI, Hyderabad Zonal Centre had taken up an independent research study and the sampling work for water component along with ambient air, was carried out during May 12-16, 2020. The groundwater and surface water were collected from various locations few days just after the incident occurred. The initial report findings are as follows:

The groundwater samples (Dug Wells – 18 nos.) and surface water samples (Reservoir – 4 nos, Lake – 1 no, Collection Tank – 1 no, Fish Pond – 1 no, Drain – 1 no) were collected in the buffer zones of 0.5 km, 1 km, 1.5 km, 2 km, 3 km, 4 km, 5 km radius around LG Polymers Storage Tanks during the period May 12-16, 2020 (**Fig. 2.2.1**). The details about groundwater and surface water sample locations are given in **Table 2.2.1**. The groundwater and surface water locations were selected based on the elevation of the area and the drainage pattern.

2.2.1 Styrene levels in groundwater and surface water

The concentrations of styrene (water samples collected in vials and analysed on GC-MS/MS with purge and trap method) at different locations in the study area are given in **Table 2.2.2**. The detection limit of GC-MS/MS is 0.5 ppb. As per World Health Organization (WHO, 2003) guidelines for drinking water, the permissible value for styrene in drinking water is 0.02 mg/l. The guideline value indicates that the styrene may affect the acceptability of drinking water above 0.02mg/l. The USEPA standard shows that the maximum containment level (MCL) is 0.1 ppm. The following observations are being made from the analysis results of water samples:

- Styrene concentrations in water samples was observed to be less than 0.02 mg/l in all the samples except at SGL-9
- Styrene concentration of 0.0345 mg/l was recorded at SGL-9,which is at an approximate distance of 1.5 km from LG Polymers
- At all other locations, styrene concentration was less than 0.2 ppm (< 0.5 ppb, which is the lowest detection limit by the GC/MS method)

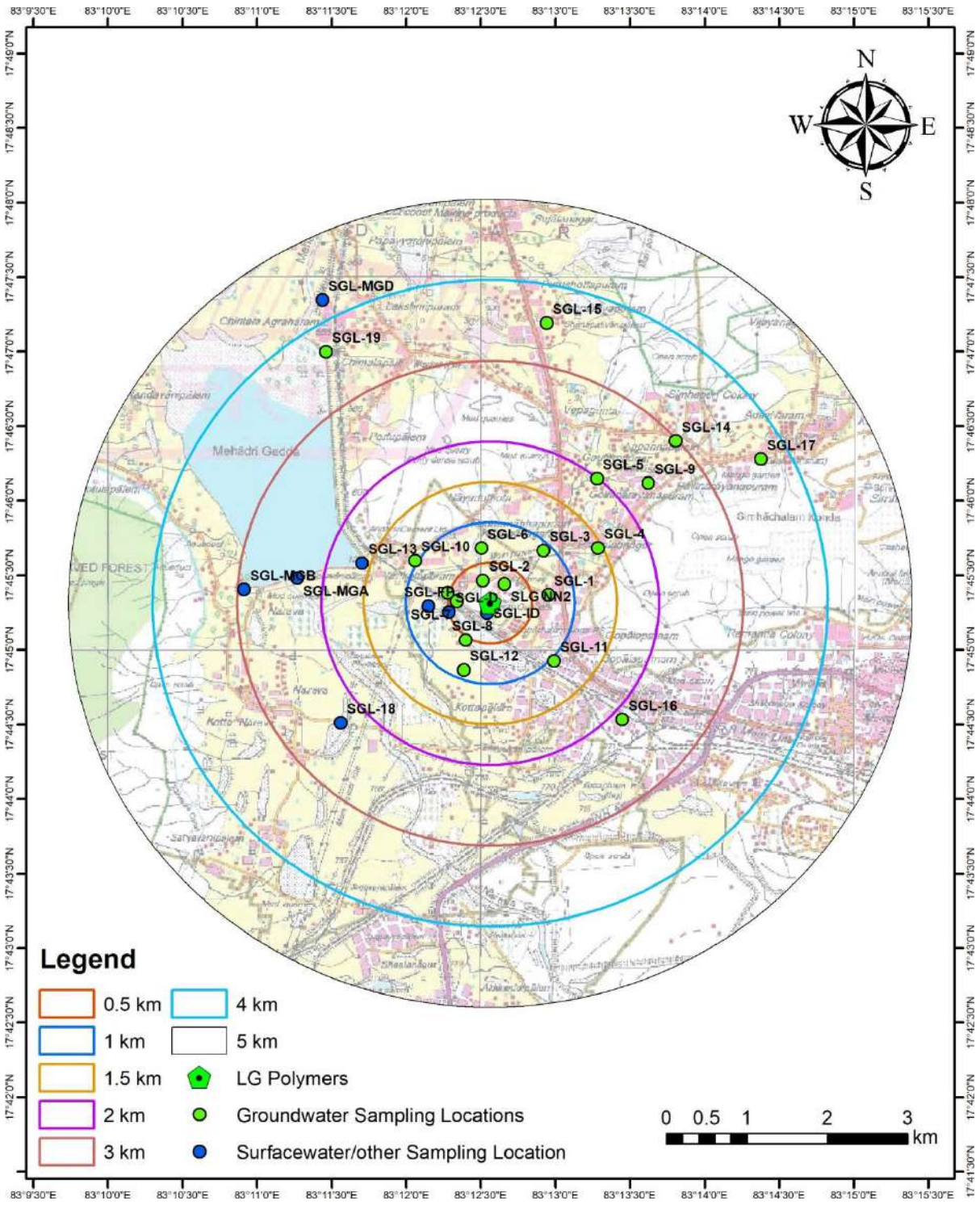


Fig. 2.2.1: Map showing groundwater and surface water sampling locations around LG Polymers, Vizag

Table 2.2.1: Groundwater and Surface water sampling locations around LG Polymers, Vizag

Sr. No	Sample Details	Sample Code	Latitude/ Longitude	Type of Source
1.	RR Venkatapuram (Adjacent to right side of LGpolymers)	SGL-1	N 17° 45' 22.1" E 83° 12'57.1"	Dug Well
2.	VenkataPuram (In house adjacent to primary school)	SGL-2	N 17° 45' 27.9" E 83° 12'30.8"	Dug Well
3.	Krishnanagar- Vepagunta (Near Durgamalleswaraswamy Temple)	SGL-3	N 17° 45' 39.9" E 83° 12'55.2"	Dug Well
4.	Virat Nagar- Prahaladapuram (H.No 15-141)	SGL-4	N 17° 45' 41.0" E 83° 13'17.2"	Dug Well
5.	Saimadhavanagar-sector II Naiduthota	SGL-5	N 17° 46' 08.9" E 83° 13'16.7"	Dug Well
6.	Padmanabhanagar (Janatanagar Colony 9th LANE)	SGL-6	N 17° 45' 40.9" E 83° 12'30.2"	Dug Well
7.	Venkatapuram (Near House of EApparao)	SGL-7	N 17° 45'19.7" E 83° 12'20.3"	Dug Well
8.	Agriculture Fields on way to Santosh Nagar –Venkatapuram	SGL-8	N 17° 45' 03.9" E 83° 12'23.8"	Dug Well
9.	Srinivasa Nagar- Simhachalam Road	SGL-9	N 17° 46' 07.1" E 83° 13'37.4"	Dug Well
10.	VenkataPuram (SC-BC Colony)	SGL-10	N 17° 45' 35.9" E 83° 12'03.5"	Dug Well
11.	Kothapalem (Santosh Nagar 3rd Lane)	SGL-12	N 17° 44' 51.9" E 83° 12'23.2"	Dug Well
12.	MeghadriGedda	SGL-13	N 17° 45' 34.9" E 83° 11'42.3"	Reservoir
13.	Appannapalem- Simhapuri Colony (H.NO-24-167/2 Gayatrinagar)	SGL-14	N 17° 46' 24.0" E 83° 13'48.4"	Dug Well
14.	Krishnarayapuram-NAD Colony (House backside of M.S. Ramayya Company)	SGL-15	N 17° 47' 11.5" E 83° 12'56.5"	Dug Well
15.	SC Colony- Old Gopalapatnam (Adjacent to Rly Track of Simhachalam North Station)	SGL-16	N 17° 44' 31.9" E 83° 13'26.9"	Dug Well
16.	Chandrapuri Colony –Old Adavivram (H.No-11-138) Simhachalam Road	SGL-17	N 17° 46' 16.7" E 83° 14'22.7"	Dug Well
17.	Kota-Narva	SGL-18	N 17° 44' 30.6" E 83° 11'33.6"	Lake
18.	ChintalaAgraharam (Near Trimatha Temple Agriculture Fields)	SGL-19	N 17° 46' 59.9" E 83° 11'27.7"	Dug Well
19.	Venkatapuram (Near Railway Bridge)	SGL-D	N 17° 45' 15.3" E 83° 12'17.3"	Drain
20.	LG Polymers- Oil Skimmer Tank	SGL-ID	N 17° 45' 14.8" E 83° 12'32.5"	Collection Tank
21.	Venkatapuram (Near the House of L Apparao)	SGL-NN1	N 17° 45' 23.0" E 83° 12'16.8"	Dug Well
22.	Inside LG Polymers	SLG NN2	N 17° 45' 26.6" E 83° 12'39.6"	Dug Well
23.	Venkatapuram (BapannaCheruvu)	SGL-FP	N 17° 45' 17.6" E 83° 12'09.0"	Fish pond
24.	MeghadriGedda	SGL-MGA	N 17° 45' 29.0" E 83° 11'16.2"	Reservoir
25.	MeghadriGedda	SGL-MGB	N 17° 45' 24.3" E 83° 10'54.8"	Reservoir
26.	MeghadriGedda Near JuthadaVillageRoad	SGL-MGD	N 17° 47' 20.8" E 83° 11'26.3"	Reservoir

Table 2.2.2: Styrene concentration in groundwater and surface water locations around LG Polymers, Vizag

Sr. No	Sample Code	Date of Sampling	Styrene (ppm)
1.	SGL-1	15.05.2020	0.0033
2.	SGL-2	14.05.2020	BDL
3.	SGL-3	14.05.2020	BDL
4.	SGL-4	15.05.2020	0.0045
5.	SGL-5	15.05.2020	0.0025
6.	SGL-6	13.05.2020	0.0073
7.	SGL-7	14.05.2020	BDL
8.	SGL-8	16.05.2020	0.0014
9.	SGL-9	15.05.2020	0.0345
10.	SGL-10	13.05.2020	BDL
11.	SGL-12	14.05.2020	BDL
12.	SGL-13	13.05.2020	BDL
13.	SGL-14	15.05.2020	0.003
14.	SGL-15	15.05.2020	0.0023
15.	SGL-16	16.05.2020	0.0016
16.	SGL-17	15.05.2020	0.0112
17.	SGL-18	16.05.2020	0.0016
18.	SGL-19	15.05.2020	0.0017
19.	SGL-D	14.05.2020	BDL
20.	SGL-ID	14.05.2020	BDL
21.	SGL-NN1	14.05.2020	BDL
22.	SLG NN2	14.05.2020	BDL
23.	SGL-FP	14.05.2020	BDL
24.	SGL-MGA	16.05.2020	0.0014
25.	SGL-MGB	16.05.2020	0.0015
26.	SGL-MGD	16.05.2020	0.0013

(BDL - Below detection limit)

2.2.2 Water Quality and Bio-assay test of MeghadriGedda Reservoir

The samples were collected from the MeghadriGedda reservoir and analysed for styrene concentration and other water quality parameters. Bio-assay test was also carried out for the same. The results are presented below:

The samples had styrene concentration in the range of BDL – 0.0015 ppm. The water quality is presented in the **Table 2.2.3**. The results revealed that pH was 7.7 which was normal. Total dissolved solids is 270 mg/l and hardness was 88 mg/l. Sodium was found to be 48 mg/l and Biological oxygen demand was 4.7 mg/l and oil and grease was found to be 10 mg/l.

Table 2.2.3: Water Quality of MegadriGedda Reservoir

Sr. No	Parameter	Unit	Value
1.	pH	-	7.7
2.	EC	µs/cm	454
3.	TDS	mg/l	270
4.	Turbidity	NTU	1.0
5.	TSS	mg/l	6.0
6.	Total Hardness (as $CaCO_3$)	mg/l	88
7.	Calcium Hardness (as $CaCO_3$)	mg/l	56
8.	Magnesium Hardness (as $CaCO_3$)	mg/l	32
9.	Magnesium	mg/l	8
10.	Sodium	mg/l	48
11.	Potassium	mg/l	7
12.	Total Alkalinity (as $CaCO_3$)	mg/l	148
13.	Sulphate	mg/l	20
14.	Chloride	mg/l	38
15.	Nitrate- Nitrogen	mg/l	2.3
16.	Nitrite-Nitrogen	mg/l	BDL
17.	Ammonical Nitrogen	mg/l	2.1
18.	Available Phosphorus	mg/l	BDL
19.	Total Phosphorus	mg/l	0.077
20.	BOD	mg/l	4.7
21.	COD	mg/l	42
22.	Oil and Grease	mg/l	10

(BDL - Below detection limit)

2.2.3 Water quality during October 2020

The conventional water quality parameters such as physical, inorganic, nutrient, demand, and metals having relevance to public health and aesthetic significance are selected to assess the prevailing groundwater and surface water quality status with special attention to the incident. The standard methods prescribed for surface and groundwater sampling and analysis of individual parameters is followed in this study.

2.2.3.1 Ground Water Quality

Samples of groundwater were collected and stored in 1 litre and 100 ml Poly Propylenebottles which were thoroughly cleaned and rinsed with distilled water before the sample collection. The collected samples were labelled properly as per the project area. 1litre bottles were analysed for general physico-chemical parameters and samples for heavy metal analysis was collected in 100 ml bottles. The 100 ml bottles are then acidified with conc. HNO_3 to retain the metals present in water samples.The determination of physico-chemical parameters of groundwater samples was carried out by adopting standard protocols given by APHA, 2012.

The groundwater (19 nos.) and surface water samples (04 nos.) were collected in the 3 km buffer around the LG polymers. The details of the groundwater samples are presented in **Table 2.2.4**. The groundwater samples were collected from hand pumps, dug wells and also bore wells. The water level in these samples varied from 0.3m to 18.5m indicating shallow water levels in the area. The ground water analysis results (physico-chemical, nutrient demand and heavy metals) are presented in **Tables 2.2.5 - 2.2.10**.

- The pH of the samples varied from 7.0 to 8.1. All the samples had pH within the range of BIS of 6.5 to 8.5.
- The total dissolved samples in the study area varied from 447mg/l to 1934mg/l. All the samples showed TDS within the limits of BIS of 2000mg/l.
- Calcium was found to be in the range of 32 to 121mg/l and all samples were within the limits of BIS
- Sodium was found to be in the range of 44- 502mg/l. The high value of sodium is due to the underlying geological rocks of the study area
- Chloride was found to be in the range of 69 – 928mg/l in the study area which was within the BIS limits of 1000mg/l.
- Silica value ranged from 10-64mg/l. Silica is inherently present in the underlying rocks which is reflected in the samples
- Fluoride was found to be within the limits of BIS
- All the samples showed all parameters values within the limits of standards.

- Styrene was found to be BLQ (Below level of Quantification of 0.5 µg/l)
- Ammonical nitrogen was BDL in all the samples
- Heavy metals such as Arsenic, Boron, Cobalt, Chromium, Copper, Manganese, Nickel, Zinc except Cadmium, Iron, Lead, Mercury were within the permissible limits of BIS
- Cadmium, iron and lead were found to be in the range of BDL to 0.027mg/l, 0.028 to 2.649mg/l and 0.005 to 0.033mg/l, respectively. All these metals occur in the underlying rocks that contribute to the groundwater.
- Mercury was found to be below detection limit of BIS in all the samples

Table2.2.4: Details of Groundwater Sampling Locations

S. No	Sample Code	Description	GPS Coordinates	Water level (m)	Source Type
1.	LGP-1	Venkatapuram, Beside LG Polymers compound wall near Railway Bridge	17°45'19.70"N 83°12'20.30"E	1.32	DW
2.	LGP-2	Venkatapuram	17°45'23.10"N 83°12'17.00"E	0.3	DW
3.	LGP-3	Venkatadri Garden, Beside the compound wall of LG polymers	17°45'22.00"N 83°12'25.00"E	1.78	BW
4.	LGP-4	RR Venkatapuram in VijayaDurga Temple, Beside the compound wall of LG polymers South Gate	17°45'29.00"N 83°12'34.70"E	2.04	HP
5.	LGP-5	Venkatapuram	17°45'30.90"N 83°12'22.70"E	1.13	DW
6.	LGP-6	Janata colony, Lane no: 8, Padmanabha Nagar	17°45'40.90"N 83°12'30.30"E	0.78	DW
7.	LGP-7	Saimadhavanagar, Sector 2 4th lane, Naiduthota	17°46'08.90"N 83°13'16.60"E	1.91	DW
8.	LGP-8	Appannapalem, Gayatri Nagar	17°46'24.40"N 83°13'48.20"E	3.02	DW
9.	LGP-9	VepaguntaPydimamba Colony	17°46'33.80"N 83°13'04.90"E	2.37	BW
10.	LGP-10	RR Venkatapuram LHS of LG Polymers Gate, Near to Gopalapatnam Main Road	17°45'22.10"N 83°12'57.00"E	2.68	DW
11.	LGP-11	Vepagunta Krishna Nagar, Ward no:94, Near DurgaMalleswaraSwamy Temple	17°45'39.90"N 83°12'55.30"E	2.97	DW
12.	LGP-12	Virat Nagar- Prahaladapuram	17°45'41.00"N 83°13'17.10"E	5.14	DW
13.	LGP-13	Indira Nagar, Gopalapatnam	17°45'08.42"N 83°10'10.63"E	18.5	BW
14.	LGP-14	In paddy Field- Backside of LG Polymers on way to Santhosh Nagar	17°45'03.88"N 83°12'23.73"E	0.30	DW
15.	LGP-15	Near Paradesiamba Temple Kothapalem Dar Nagar, ParadesiambaS temple	17°44'20.64"N 83°12'37.81"E	1.22	DW
16.	LGP-16	SC Colony, Old Gopalapatnam, Near Simhachalam North Railway Station Track	17°44'32.00"N 83°13'27.00"E	0.45	DW
17.	LGP-17	Inside LG Polymers Near admin building	17°45'26.90"N 83°12'39.40"E	1.37	DW
18.	LGP-18	Inside LG Polymers- Back side of LPG Store, Near Baniyan Tree	17°45'16.35"N 83°12'32.51"E	1.38	DW

19.	LGP-19	Piezometer near ETP area Opp to Boiler house	17°45'22.26"N 83°12'31.86"E	0.78	BW

Table2.2.5: Groundwater Quality - Physical Parameters (October 2020)

S. No	Sample Code	pH	Temperature (°C)	Turbidity (NTU)	TSS (mg/l)	TDS (mg/l)	Conductivity (µS/cm)
1.	LGP-1	7.2	30.2	0.1	0.8	1314	2310
2.	LGP-2	7.1	28.5	0.1	1.0	1574	2850
3.	LGP-3	7.5	29.8	0.3	2.6	1844	3350
4.	LGP-4	7.2	30.3	0.1	2.0	1264	2090
5.	LGP-5	7.2	28.8	0.1	0.8	904	1615
6.	LGP-6	7.5	29.7	0.1	1.8	690	1200
7.	LGP-7	7.4	29.3	0.1	0.6	447	773
8.	LGP-8	7.0	30.4	0.1	1.0	660	1142
9.	LGP-9	7.2	30.2	0.1	0.6	778	1410
10.	LGP-10	7.0	28.9	0.1	1.0	671	1080
11.	LGP-11	7.0	29.7	0.1	8.6	687	1176
12.	LGP-12	7.3	28.0	0.1	0.8	652	1088
13.	LGP-13	7.1	30.8	0.1	1.4	691	1228
14.	LGP-14	7.6	29.9	0.1	3.0	784	1366
15.	LGP-15	7.0	28.9	0.2	9.4	1355	2230
16.	LGP-16	7.5	28.6	0.1	1.4	610	1098
17.	LGP-17	7.9	27.8	0.1	1.0	459	728
18.	LGP-18	7.6	26.8	0.2	0.6	1017	1862
19.	LGP-19	8.1	32.5	0.1	3.6	1934	3440
Desirable		**6.5-**	**-**	**1**	**-**	**500**	**-**
Permissible		**NR**	**-**	**5**	**-**	**2000**	**-**

Table2.2.6: Groundwater Quality- Inorganic Parameters (October 2020)

S. No	Sample Code	Total Hardness (as $CaCO_3$)	Calcium (as Ca)	Magnesium (as Mg)	Sodium (as Na)	Potassium (as K)
		mg/l				
1.	LGP-1	463	107	47	248	53
2.	LGP-2	588	121	69	297	56
3.	LGP-3	419	58	66	502	7
4.	LGP-4	349	63	46	330	1
5.	LGP-5	322	66	38	189	21
6.	LGP-6	294	61	34	128	5
7.	LGP-7	133	44	6	98	9
8.	LGP-8	328	70	36	110	1
9.	LGP-9	424	66	62	103	7
10.	LGP-10	352	77	38	112	10
11.	LGP-11	400	80	48	98	2
12.	LGP-12	349	104	22	92	7
13.	LGP-13	352	88	32	99	5
14.	LGP-14	128	32	12	228	11
15.	LGP-15	420	64	62	328	20
16.	LGP-16	392	118	24	44	16
17.	LGP-17	223	55	21	81	3
18.	LGP-18	475	68	73	188	4
19.	LGP-19	533	83	78	478	1
Desirable		**200**	**75**	**30**	**-**	**-**
Permissible		**600**	**200**	**100**	**-**	**-**

Table2.2.7:Groundwater Quality- Inorganic Parameters (October 2020)

S. No	Sample Code	Total Alkalinity (as $CaCO_3$)	Sulphate (as SO_4)	Chloride (as Cl)	Salinity	Fluoride (as F)	Silica (as SiO_2)
		mg/l			‰	mg/l	
1.	LGP-1	476	83	369	0.7	0.82	28
2.	LGP-2	588	82	451	0.8	0.51	44
3.	LGP-3	464	75	689	1.2	0.97	60
4.	LGP-4	468	88	338	0.6	0.63	64
5.	LGP-5	436	67	178	0.3	0.90	81
6.	LGP-6	296	66	154	0.3	0.91	57
7.	LGP-7	200	23	106	0.2	0.50	27
8.	LGP-8	308	70	126	0.2	0.80	54
9.	LGP-9	328	138	132	0.2	0.95	56
10.	LGP-10	424	105	65	0.1	0.84	36
11.	LGP-11	356	29	152	0.3	1.00	23
12.	LGP-12	180	27	255	0.5	0.50	36
13.	LGP-13	282	48	186	0.3	0.72	47
14.	LGP-14	360	58	156	0.3	0.63	34
15.	LGP-15	528	94	346	0.6	0.92	34
16.	LGP-16	316	50	112	0.2	0.68	58
17.	LGP-17	272	34	69	0.1	0.62	28
18.	LGP-18	340	19	368	0.7	0.81	29
19.	LGP-19	208	65	928	1.7	0.71	10
Desirable		**200**	**200**	**250**	**-**	**1.0**	**-**
Permissible		**600**	**400**	**1000**	**-**	**1.5**	**-**

Table2.2.8: Groundwater Quality – Nutrient & Special Parameters (October 2020)

S. No.	Sample Code	Nitrate (as NO_3)	TP (as P-PO_4)	AVP (as P-PO_4)	Mineral Oil	Styrene
		mg/l				(µg/l)
1.	LGP-1	3.01	0.202	0.105	ND	BLQ
2.	LGP-2	2.93	0.211	0.084	ND	BLQ
3.	LGP-3	0.43	0.171	0.035	0.4	BLQ
4.	LGP-4	2.87	0.160	0.028	ND	BLQ
5.	LGP-5	1.88	0.155	0.028	ND	BLQ
6.	LGP-6	1.83	0.137	0.038	ND	BLQ
7.	LGP-7	1.34	0.312	0.251	ND	BLQ
8.	LGP-8	2.17	0.136	0.012	ND	BLQ
9.	LGP-9	2.33	0.139	0.008	ND	BLQ
10.	LGP-10	8.11	0.157	0.017	ND	BLQ
11.	LGP-11	2.48	0.130	0.013	ND	BLQ
12.	LGP-12	0.72	0.223	0.161	ND	BLQ
13.	LGP-13	2.19	0.137	0.017	ND	BLQ
14.	LGP-14	0.43	0.222	0.062	ND	BLQ
15.	LGP-15	1.02	0.140	0.037	ND	BLQ
16.	LGP-16	2.31	0.158	0.097	ND	BLQ
17.	LGP-17	0.19	0.125	0.091	0.4	BLQ
18.	LGP-18	0.61	0.148	0.038	1.0	BLQ
19.	LGP-19	1.05	0.204	0.090	ND	BLQ
Desirable		**45**	**-**	**-**	**0.5**	**-**
Permissible		**NR**	**-**	**-**	**NR**	**-**

BLQ- Below Quantification Limit (0.5µg/l); ND- Not Detected

Table 2.2.9: Groundwater Quality – Nutrient, Demand& Microbiological Parameters (October 2020)

Sr. No.	Sample Code	Ammonical Nitrogen	TKN	COD	MPN Index per 100ml
		mg/l			
1.	LGP-1	BDL	6.98	32	>1600
2.	LGP-2	BDL	4.48	60	>1600
3.	LGP-3	BDL	9.52	52	130
4.	LGP-4	BDL	15.1	48	>1600
5.	LGP-5	BDL	6.72	44	>1600
6.	LGP-6	BDL	3.92	40	240
7.	LGP-7	BDL	15.1	40	>1600
8.	LGP-8	BDL	2.24	36	1600
9.	LGP-9	BDL	2.80	12	1600
10.	LGP-10	BDL	2.40	24	>1600
11.	LGP-11	BDL	2.80	48	>1600
12.	LGP-12	BDL	3.92	44	420
13.	LGP-13	BDL	3.36	44	350
14.	LGP-14	BDL	3.92	44	1600
15.	LGP-15	BDL	3.36	40	130
16.	LGP-16	BDL	3.92	40	1600
17.	LGP-17	BDL	6.72	28	>1600
18.	LGP-18	BDL	3.36	56	>1600
19.	LGP-19	BDL	4.60	48	>1600
Desirable		**-**	**-**	**-**	**-**
Permissible		**-**	**-**	**-**	**-**

(BDL - Below detection limit)

Table 2.2.10: Groundwater Quality –Heavy Metals (October 2020)

Sr. No	Sample Code	As	B	Cd	Co	Cr	Cu	Fe	Mn	Ni	Pb	Zn	Hg
		mg/l											
1.	LGP-1	0.002	0.303	0.004	BDL	0.001	0.008	0.259	0.062	0.001	0.008	0.086	BDL
2.	LGP-2	0.002	0.436	0.002	0.001	BDL	0.002	0.028	0.139	0.001	0.018	0.052	BDL
3.	LGP-3	0.003	0.667	0.001	0.006	0.002	0.015	0.591	0.373	0.016	0.016	0.064	BDL
4.	LGP-4	BDL	0.721	0.008	BDL	0.001	0.004	0.211	0.103	BDL	0.014	0.087	BDL
5.	LGP-5	BDL	0.333	BDL	BDL	0.002	BDL	0.046	0.001	BDL	0.011	0.206	BDL
6.	LGP-6	0.001	0.226	BDL	BDL	0.001	BDL	0.157	0.015	BDL	0.012	0.070	BDL
7.	LGP-7	BDL	0.110	0.004	BDL	0.002	BDL	0.427	0.088	BDL	0.003	0.037	BDL
8.	LGP-8	BDL	0.174	0.002	BDL	0.001	BDL	0.056	0.031	BDL	0.011	0.158	BDL
9.	LGP-9	BDL	0.092	0.001	BDL	0.002	0.005	0.484	0.032	BDL	0.012	0.092	BDL
10.	LGP-10	BDL	0.140	BDL	BDL	BDL	BDL	0.203	0.051	BDL	0.009	0.032	BDL
11.	LGP-11	BDL	0.206	0.027	BDL	0.011	0.003	0.167	0.032	0.002	0.033	0.074	BDL
12.	LGP-12	BDL	0.239	BDL	BDL	0.005	0.002	2.649	0.045	0.010	0.015	0.087	BDL
13.	LGP-13	BDL	0.293	BDL	BDL	0.002	0.001	0.383	0.043	0.003	0.012	0.111	BDL
14.	LGP-14	0.001	0.285	0.002	BDL	0.002	0.003	0.579	0.054	0.004	0.006	0.033	BDL
15.	LGP-15	0.001	0.347	0.011	BDL	BDL	0.002	1.93	0.518	0.002	0.005	0.065	BDL
16.	LGP-16	0.002	0.060	0.001	BDL	BDL	BDL	0.173	0.015	BDL	0.005	0.034	BDL
17.	LGP-17	BDL	0.285	BDL	BDL	BDL	0.002	0.421	0.019	BDL	0.006	0.075	BDL
18.	LGP-18	0.002	0.796	0.002	BDL	BDL	BDL	1.206	0.505	BDL	0.006	0.031	BDL
19.	LGP-19	0.003	0.167	0.001	BDL	BDL	0.003	0.078	0.082	BDL	0.020	0.033	BDL
Desirable		**0.01**	**0.5**	**0.003**	**-**	**0.05**	**0.05**	**0.3**	**0.1**	**0.02**	**0.01**	**5**	**0.001**
Permissible		**0.05**	**1.0**	**NR**	**-**	**NR**	**1.5**	**NR**	**0.3**	**NR**	**NR**	**15**	**NR**

(BDL - Below detection limit)

2.2.3.2 Surface Water Quality

The surface water samples have been collected from four locations in the study area. The samples have been analysed for the physic-chemical parameters and heavy metals. The details of the surface water locations are presented in **Table 2.2.11**. The results are shown in **Table 2.2.12**. The results reveal that all the parameters were within the drinking water quality standards of BIS. The iron was found to be on a higher side due to the lateritic nature of soil. Mercury and styrene were not detected in any of the samples.

Table2.2.11: Details of Surface Water Sampling Locations

S. No	Sample Code	Description	GPS Coordinates
1.	LGP-20	Fish pond	17°45'15.70"N 83°12'10.73"E
2.	LGP-21	Meghadrigaddareserviour near dam	17°45'34.84"N 83°11'42.90"E
3.	LGP-22	Jutada village, meghadrigeddareserviour	17°47'20.96"N 83°11'26.06"E
4.	LGP-23	Narvakota lake	17°44'29.24"N 83°11'36.30"E

Table 2.2.12: Surface Water Quality

S. No	Parameters	LGP-20	LGP-21	LGP-22	LGP-23
1.	pH	7.5	8.1	8.2	7.1
2.	Temperature (°C)	31.1	30.1	29.6	29.1
3.	Turbidity (NTU)	0.8	0.3	0.2	0.5
4.	TSS (mg/l)	30.2	0.8	1.6	21.2
5.	TDS (mg/l)	696	320	330	467
6.	Conductivity (μS/cm)	1258	533	563	777
7.	Total Hardness (as $CaCO_3$) (mg/l)	298	51	59	110
8.	Calcium (as Ca) (mg/l)	60	14	16	25
9.	Magnesium (as Mg) (mg/l)	36	4	5	11
10.	Sodium (as Na) (mg/l)	130	92	89	118
11.	Potassium (as K) (mg/l)	7	6	6	10
12.	Total Alkalinity (as $CaCO_3$) (mg/l)	280	120	140	156
13.	Sulphate (as SO_4) (mg/l)	56	34	22	26
14.	Chloride (as Cl) (mg/l)	174	82	79	140
15.	Salinity	0.3	0.1	0.1	0.3
16.	Fluoride (as F) (mg/l)	0.69	0.46	0.37	0.54
17.	Nitrate (as NO_3) (mg/l)	2.90	1.19	0.422	1.35
18.	TP (as P-PO_4) (mg/l)	0.139	0.134	0.158	0.145
19.	AVP (as P-PO_4) (mg/l)	0.011	0.032	0.026	0.019
20.	Oil & Grease (mg/l)	BDL	BDL	0.4	1.6
21.	Silica (mg/l)	14	17	16	12
22.	AmmonicalNitrogen (mg/l)	BDL	BDL	BDL	BDL
23.	TKN (mg/l)	4.48	3.36	4.48	2.96
24.	COD (mg/l)	44	36	28	48
25.	DO (mg/l)	6.5	7.5	7.2	5.1
26.	BOD (mg/l)	2.2	1.9	1.8	3.3
27.	Chlorophyll-A (mg/m^3)	44.32×10^{-3}	10.68×10^{-3}	2.67×10^{-3}	20.82×10^{-3}
28.	Pheophytin(mg/m^3)	10.62×10^{-3}	10.25×10^{-3}	7.42×10^{-3}	15.80×10^{-3}
29.	TC (CFU/100ml)	80	TNC	TNC	TNC

30.	FC (CFU/100ml)	40	ND	ND	ND
31.	TVC (CFU/ml)	40×10^5	100×10^5	20×10^5	1200×10^5
32.	Arsenic (as As) (mg/l)	BDL	BDL	0.003	0.001
33.	Boron (as B) (mg/l)	0.202	0.091	0.016	0.080
34.	Cadmium (as Cd) (mg/l)	0.002	0.001	BDL	0.001
35.	Cobalt (as Co) (mg/l)	BDL	BDL	BDL	BDL
36.	Chromium (as Cr) (mg/l)	BDL	BDL	BDL	BDL
37.	Copper (as Cu) (mg/l)	0.003	0.004	0.001	0.002
38.	Iron (as Fe) (mg/l)	1.068	0.168	0.118	3.011
39.	Manganese (as Mn) (mg/l)	0.085	0.039	0.022	0.175
40.	Nickel (as Ni) (mg/l)	BDL	BDL	BDL	BDL
41.	Lead (as Pb) (mg/l)	0.006	0.004	0.001	0.005
42.	Zinc (as Zn) (mg/l)	0.543	0.037	0.005	0.069
43.	Mercury (as Hg) (mg/l)	<0.001	<0.001	<0.001	<0.001
44.	Styrene (µg/l)	BLQ	BLQ	BLQ	BLQ

BLQ- Below Quantification Limit (0.5µg/l); BDL- Below Detection Limit;
TNC-Too Numerous to Count; ND- Not Detected

2.2.3.3 Bioassay Test

Environmental bioassay is an experimental process wherein the assessment of toxicity on biological organisms is tested. The purpose of this test is to determine the acute toxicity of substances (toxicants) to fish in fresh water. Acute toxicity is an exposure test of short duration (days). Aquatic ecosystems are affected by numerous natural and chemical substances. These substances may be responsible for possible impacts on the structure and function of aquatic organisms. Since chemical analysis of pollutants does not cover all toxic substances, bioassays have been developed for bio-monitoring and evaluation of toxic substances in freshwater and natural ecosystems. Bioassays assess the potential harm of toxicants and are based on the response of living organisms to the toxicants in the water.

Test Procedure: The zebra fishes were obtained from a local aquarium. All fishes were transferred directly into a glass aquarium of 20 litres capacity for acclimatization. The fishes were acclimatized in uncontaminated (dilution) water (normal tape water) for three days before they were used. The test was performed using five glass aquariums filled with different test solution concentrations by mixing the sample and normal tap water One control experiment i.e with normal tape water was run and measurements of pH and temperature were carried out during the test. In the remaining four aquariums, five fishes were transferred directly into each glass aquariums filled with 1 litre of test water samples with minimum handling. No food was offered during the exposure period i.e. 96 hours. Fish behaviour and mortality were observed and recorded as frequently as possible during the exposure period. The Bioassay test has been carried out on four surface water samples and the results are given in **Table 2.2.13**.

Dilution/control water: Drinking-water supply, good-quality, uncontaminated natural water.
Test fish: Zebra fish (*Daniorerio*), in good health and free from any apparent malformation.
Testtype:Static(testsolutionsremainunchangedthroughthetestduration).Thetest was performed without pH adjustment because pH of test solutions were within the range 7.4-7.7
Test duration: 96 hours
Feeding: No food supplied to the test fishes during exposure period.
Aeration: None
It is to conclude that as per the bio-assay test, the fishes were found to be stable in all the concentrations of all the samples.

Table 2.2.13: Bio-assay test results and fish mortalities during exposure period

Sample ID	Concentration of test sample (% v/v)	pH	Temp (^{0}C)	No. of fish tested	Mortality percentage during exposure period						
					2 hr	6 hr	12 Hr	24 Hr	48 hr	72 hr	96 hr
Control	0	7.45	25.5	5	0	0	0	0	0	0	0
LGP 20	100	8.05	25.7	5	0	0	0	0	0	0	0
	75	7.92	25.7	5	0	0	0	0	0	0	0
	50	7.82	25.9	5	0	0	0	0	0	0	0
	25	7.63	25.9	5	0	0	0	0	0	0	0
LGP 21	100	7.83	25.8	5	0	0	0	0	0	0	0
	75	7.71	25.7	5	0	0	0	0	0	0	0
	50	7.64	25.8	5	0	0	0	0	0	0	0
	25	7.64	25.7	5	0	0	0	0	0	0	0
LGP 22	100	7.96	25.8	5	0	0	0	0	0	0	0
	75	7.80	25.7	5	0	0	0	0	0	0	0
	50	7.47	25.7	5	0	0	0	0	0	0	0
	25	7.50	25.8	5	0	0	0	0	0	0	0
LGP 23	100	7.52	25.8	5	0	0	0	0	0	0	0
	75	7.40	25.8	5	0	0	0	0	0	0	0
	50	7.25	25.7	5	0	0	0	0	0	0	0
	25	7.16	25.6	5	0	0	0	0	0	0	0

2.2.4 Water Quality during June 2021

APPCB has carried out water quality at different locations in the study area during June 2021 of which 4 Groundwater samples and 1 surface water sample. Groundwater was sampled from open wells at Santoshnagar, East side of LG Plant towards Gopalapatnam, West side of LG Plant in Residential Area (Venkatapuram (V)) and Porlupalem Village and surface water sampld from Meghadrigadda Reservoir (Near Locks). It was observed that the values of all the parameters were within the BIS standards of drinking water. All the heavy metals were also found to be within the limit of BIS. Styrene was below quantification limit (0.5µg/l) for all the samples of groundwater .

Table 2.2.14 Water Quality during June 2021 (APPCB)

Parameters	BIS norms	Range of Values
pH	6.5-8.5	7.02-7.42
Turbidity	1-5	-
TSS	-	<10
TDS	500-2000	340-1440
Ca	75-200	49.6-107.2
Mg	30-100	15.5-112.7
Na	-	-
K	-	-
Cl	250-1000	58.7-376.6
SO_4	200-400	36.5-164.3
F	1.0-1.5	0.42-1.02
NO_3	45-NR	-
Styrene	-	BDL
Heavy Metal	**BIS standard**	**Range of Values**
As	0.01-0.05	0.0001-0.0008
B	0.5-1.0	-
Cd	0.003	<0.0001
Co	-	-
Cr	0.05	0.0001-0.0004
Cu	0.05-1.5	0.0005-0.0019
Fe	0.3	0.0062-0.0218
Mn	0.1-0.3	-
Ni	0.02	0.0002-0.0006
Pb	0.01	<0.0001
Zn	5-15	0.0020-0.0044
Hg	0.001	-

2.3 Soil Quality

2.3.1 Introduction

Styrene (C_6H_5-CH=CH_2), is also commonly known as ethenylbenzene, phenylethylene, phenylethene, vinylbenzene or cinnamene. Under ambient conditions, it is a colourless, clear liquid. EU Risk Assessments have concluded that styrene is not bio-accumulative, meets the criteria for ready biodegradation and thus does not require classification for environmental effects. Persistence of styrene in the environment is very limited because of its volatility from soils and surface waters, its rapid destruction in air and its biodegradation in soils, and surface and ground waters. The half-life for volatilisation of styrene from soil surfaces was estimated to be approximately 1 min with the rate of volatilisation decreasing with increasing depth. Volatilisation from soil is slower than from water, with 26% volatilisation from a 1.5 cm depth of soil in 31 days. Styrene is expected to adsorb to solids, the degree of which is related to the organic matter content. Sorption seems to have little effect on the rate of biodegradation. Based on its low water solubility and the magnitude of its organic carbon partitioning coefficient (estimated Koc = 352), the mobility of styrene in soil is considered to be moderate to low. The CCME guideline values for styrene are 0.1 and 50mg/kg for agriculture and industrial activities of the soils respectively (https://www.plasticseurope.org/en/resources/publications/542-styrene-monomer-safe-handling-guide).

2.3.2 Soil quality in terms of styrene concentration at and around LG Polymers

Soils samples were collected at different locations within the LG Polymer industry and around the industry. Sampling was carried out immediately following the gas leak i.e. 8-14, May 2020 to determine the instant levels in soil and consequent exposure level. The sampling locations are given in **Table 2.3.1**. Styrene concentration in soil samples are depicted in **Table 2.3.2**. Styrene concentrations were found to be in the range of 109 to 5950 mg/kg in soils. The concentrations are exceeding the CCME guideline values of 0.1 mg/kg and 50mg/kg for agriculture and industrial activities of the soils respectively.

Table 2.3.1 Soil Sampling Locations(8-14 May 2020)

No.	Sample Code	Location	Date of Sampling	GPS Co-ordinates	Altitude (M)
1	LG-1	Mehandrigadda Reservoir (Surface soil)	08-05-2020	17^0 45'34.8"N 83^0 11' 42.4"E	90
2	LG-2	Mehandrigadda Reservoir (Deep soil)	08-05-2020	17^0 45'34.8"N 83^0 11' 42.4"E	90
3	LG-3	Narava Kota Reservoir Village Narava (Surface soil)	08-05-2020	17^0 45'18.6"N 83^0 12'34.5"E	71
4	LG-4	Narava Kota Reservoir Village Narava (Deep soil)	08-05-2020	17^0 45'18.6"N 83^0 12'34.5"E	71
5	LG-5	Opposite to M-6 tank of LG Polymer (Surface soil)	14-05-2020	17^0 45'26.6"N 83^0 12'40.0"E	55
6	LG-6	Opposite to M-6 tank of LG Polymer (Deep soil)	14-05-2020	17^0 45'26.3"N 83^0 12'39.0"E	59
7	LG-7	Near House of G AppaRao, Village Venkatpuram (Surface soil)	08-05-2020	17^0 45'26.3"N 83^0 12'39.0"E	59
8	LG-7	Near House of G AppaRao, Village Venkatpuram (Deep soil)	08-05-2020	17^0 45'26.3"N 83^0 12'39.0"E	59
9	LG-9	Opposite to M-6 tank of LG LG Polymers (surface)	08-05-2020	17^0 45'26.3"N 83^0 12'39.2"E	81

Table 2.3.2 Styrene Levels in soil samples (8-14 May 2020)

No.	Sample Code	Location	Styrene (mg/kg)	MCL/Guideline Value (mg/kg)
1.	LG-1	Mehandrigadda Reservoir (Surface soil)	318.1	**0.01 mg/kg (Agricultural) and 50 mg/kg (Industrial) as per Environemntal guideline for contaminated site remediation criteria by**
2.	LG-2	Mehandrigadda Reservoir (Deep soil)	444.6	
3.	LG-3	Narava Kota Reservoir Village Narava (Surface soil)	109.0	
4.	LG-4	Narava Kota Reservoir Village Narava (Deep soil)	1215.1	
5.	LG-5	Opposite to M-6 tank of LG Polymer (Surface soil)	342.7	

6	LG-6	Opposite to M-6 tank of LG Polymer (Deep soil)	827.6	**Canadian Council of Ministers of Environemnt (CCME)**
7.	LG-7	Near House of G AppaRao (Surface soil)	731.3	
8.	LG-8	Near House of G AppaRao (Deep soil)	1427.8	
9.	LG-9	Opposite to M-6 tank of LG LG Polymers (surface)	5950.1	

A second round of soil sampling was carried out during 28-30, October 2020 to estimate the persistence of styrene in soil. The sampling was carried out at different locations within the LG Polymer industry and around the industry at varying distances like 0.5, 1, 1.5, 2 and 5 Km. The sampling locations are given in **Table 2.3.3** and **Fig. 2.3.1**. All samples were analyzed for styrene, and results are shown in **Tables 2.3.4** and **Table 2.3.5**. It can be seen that styrene was below the detection limit at all the locations outside of the industry premise except PT08 (Near Vepedamm Temple at the end of the straight road), where 0.15 ppb concentration was detected. Styrene was also undetectable in the samples near the administration building. However, 4.7 ppb of styrene was detected in LGPS-3A (Near LPG cylinder storage area, opposite to styrene tank accident area). All the observed values were much less than the CCME value for styrene in soil, indicating no immediate hazard. In comparison with the values observed immediately following the gas leak, there was significant decline and styrene had virtually disappeared from most of the sites. It is in agreement with the limited persistence of styrene in the soil because of its volatility and biodegradation.

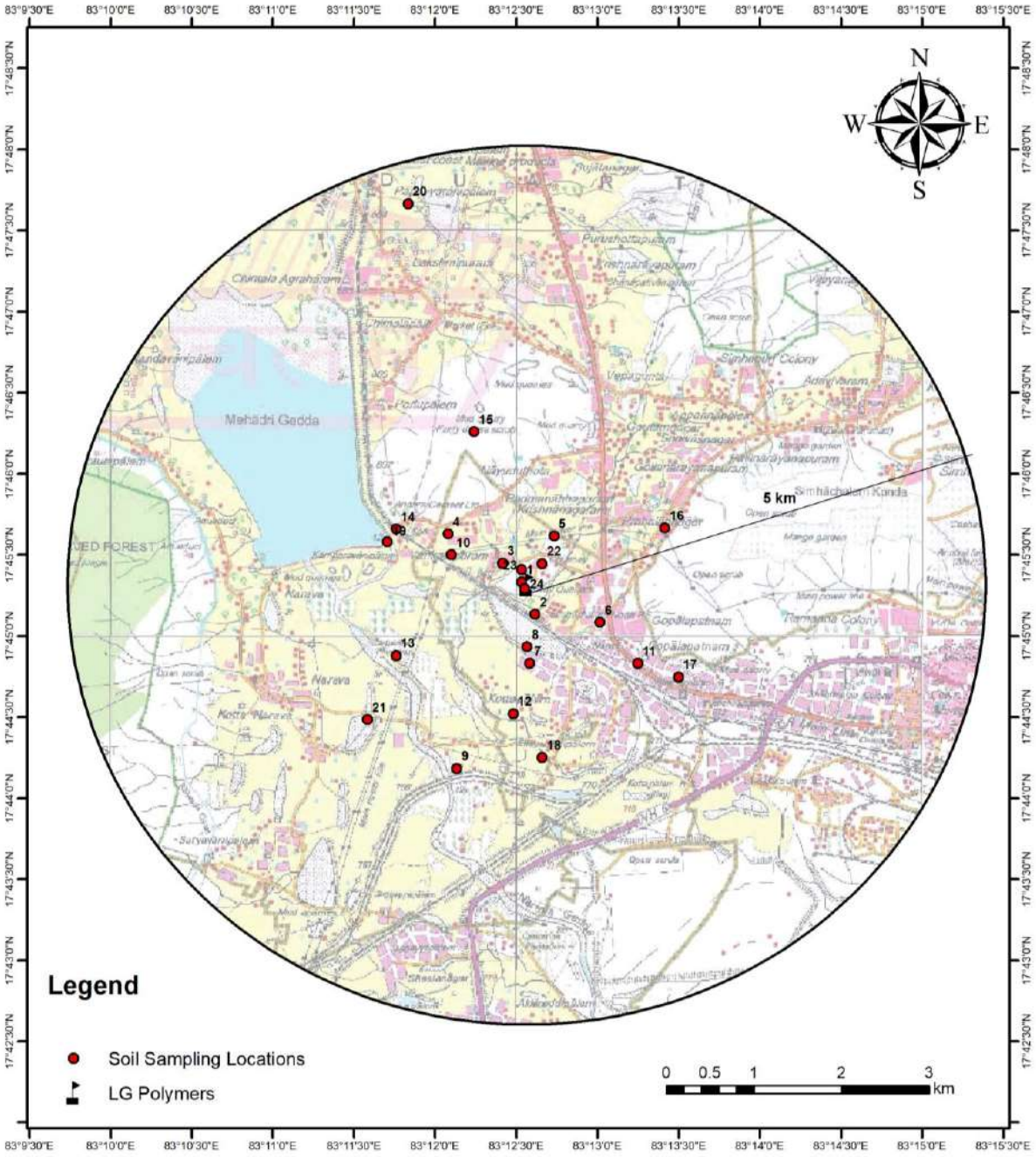


Fig.2.3.1: Soil sampling locations

Table 2.3.3 Location details of Soil Samples

Sr. No.	Location Names	GPS Co-ordinates	Sample ID	Distance from LG polymer (Kms)
1	Simachal North Railway station, Near SCMN Running Staff colony	17° 45’08” N 83° 12’37” E	PT 02	0.5
2	Venkatapuram Village NearVenugopalaswamy Temple	17° 45’27” N 83° 12 25” E	PT 03	0.5
3	East of SalupuVariVeedhii	17° 45' 37.8"N 83° 12'4.84"E	PT 04	1
4	North of Sri Devi Enterprise Drinking Water supply	17° 45' 37” N 83° 12' 44” E	PT 05	1
5	Near Gopalpattnum BSNL Regional Office	17° 45' 05” N 83° 13’ 01” E	PT 06	1
6	Near Sai Baba and Rama Mandir, Santosh Nagar	17° 44' 49.9194" N 83° 12' 34.9194" E	PT 07	1
7	Near Vepedamm Temple at the end of the straight road	17° 44' 56" N 83° 12' 34” E	PT08	1
8	Near Sri LaxmiGanapathi temple, Naidu Thota	17° 44' 11” N 83° 12' 08” E	PT 09	1
9	Hanuman temple near Venkta Swami Naidu temple Thota	17° 45' 30” N 83° 12' 06” E	PT 10	1.5
10	Near north side of Siva Layam Temple	17° 44' 49.9194" N 83° 13' 14.8794"	PT 11	1.5
11	Agricultural area with paddy field, south of Santosh Nagar	17° 44' 31.2" N 83° 12' 28.7994" E	PT 12	1.5
12	Inside of Andhra Cements limited	17° 45' 39.5994" N 83° 11' 45.5994"E	PT 14	1.5
13	East Gopalpattnum, to the south of Survey of India Office	17° 45' 39.9594" N 83° 13' 24.96" E	PT 16	2.0
14	North opposite to roadside of Gopalpattnum police station and to the south of Holy worship church	17° 44' 44.8794" N	PT 17	2.0

Sr. No.	Location Names	GPS Co-ordinates	Sample ID	Distance from LG polymer (Kms)
		83° 13' 29.9994" E		
15	Agricultural area of the opposite roadside of DhaaralammaThalli Temple	17° 44' 15" N 83° 12' 39.5994" E	PT 18	2.0
16	MehadriGedda	17 45' 34.8" N 83 11' 42.4" E	PT 19	2.0
17	Near Sun Agricultural Institute, Lakshmipuram	17 47 ' 40 '' N 83 11 ' 50" E	PT20	5.0
18	Narva Kota Fishery Reservoir	17° 44' 29" N 83° 11' 35" E	PT 21	1.5
19	LGPS-1A, 1B, 1C (Near Admin building)	N 17° 45' 26.9" E 83° 12' 39.4"	LGPS-1A, 1B, 1C	0
20	LGPS-2A (Near ETP opposite to boiler house)	N 17° 45' 24.37" E 83° 12' 31.97"		0
21	LGPS-3A, 3B, 3C (Near LPG cylinder storage area, opposite to styrene tank accident area)	N 17° 45' 17.57" E 83° 12' 33.09"	LGPS-3A, 3B, 3C	0

Table 2.3.4 Styrene Concentration in Soil Samples

Sr. No.	Location Names	Sample ID	Conc. in ppb
1	Simachal North Railway station, Near SCMN Running Staff colony	PT 02	BDL
2	Venkatapuram Village NearVenugopalaswamy Temple	PT 03	BDL
3	East of SalupuVariVeedhii	PT 04	BDL
4	North of Sri Devi Enterprise Drinking Water supply	PT 05	BDL
5	Near Gopalpattnum BSNL Regional Office	PT 06	BDL
6	Near Sai Baba and Rama Mandir, Santosh Nagar	PT 07	BDL
7	Near Vepedamm Temple at the end of the straight road	PT08	0.15
8	Near Sri LaxmiGanapathi temple, Naidu Thota	PT 09	BDL
9	Hanuman temple near Venkta Swami Naidu temple Thota	PT 10	BDL
10	Near north side of Siva Layam Temple	PT 11	BDL
11	Agricultural area with paddy field, south of Santosh Nagar	PT 12	BDL
12	Inside of Andhra Cements limited	PT 14	BDL
13	East Gopalpattnum, to the south of Survey of India Office	PT 16	BDL
14	North opposite to roadside of Gopalpattnum police station and to the south of Holy worship church	PT 17	BDL
15	Agricultural area of the opposite roadside of DhaaralammaThalli Temple	PT 18	BDL
16	MehadriGedda	PT 19	BDL
17	Near Sun Agricultural Institute, Lakshmipuram	PT20	BDL
18	Narva Kota Fishery Reservoir	PT 21	BDL

(BDL - Below detection limit)

Table 2.3.5 Styrene Concentration in Industry Soil Samples

Sr. No.	Sample ID	Conc. in ppb
19-1A	LGPS	BDL
19--1B	LGPS	BDL
19-1C	LGPS	BDL
20 -2A	LGPS	BDL
21-3A	LGPS-	4.7
21-3B	LGPS-3B	BDL
21-3C	LGPS-3C	BDL

(BDL - Below detection limit)

2.3.3 Soil Quality during June 2021

APPCB has monitored the soil quality at different location inside LGPL and outside LGPL in study area during June 2021. Samples were collected on 6th June, 2021 The samples werr collected at 6 sites: Opposite M6 Tank LG Polymers, West side of LG Plant in the Residential Area (Venkatapuram (V)), East side of LG Plant towards Gopalapatnam, Agricultural field in Porlupalem Village and Meghadrigadda Reservoir and also the sediment sample from Meghadrigadda Reservoir. The soil parametres are given in **Table 2.3.6.** No Styrene levels were recorded in the soil samples during June 2021 in the study area..

Table 2.3.6 Soil Parametrs and Styrene in Soil Samples during June 2021

Parameters	Range of Values
Physical State	Solid
pH	6.65 – 7.73
Conductivity (as µS/cm)	110 – 223
Styrene (mg/kg)	BDL (<0.0005 mg/kg)

2.4 Soil Microbial Diversity

2.4.1 Background

Soil microorganisms play important role in the soil environment. The soil microbes provide several ecosystem services for the sustenance of soil environment. Especially, the microorganisms present in soil are involved in decomposition of organic matter, biogeochemical cycle, nutrient recycling, solubilization of inorganic compounds such as phosphate, production of plant promoting nutrients, maintenance of soil pH, etc. The disturbance of soil microorganisms could affect the soil ecological processes which will ultimately lead to deterioration of soil quality. As the styrene or styrene polymers could change the soil microbial flora, it is important to know the effect of styrene gas leakage incident on soil microbial flora. The analyses of soil microbial diversity could help to evaluate the extent of damage caused by styrene gas leakage incident on soil environment thereby proper restoration plans could be proposed for improving the health of soil.

2.4.2 Methodology

The soil samples were collected within the 5 Km radius of the LG Polymers Pvt. Ltd. The sampling locations were sub-divided into three zones based on their distance from the LG Polymers Pvt. Ltd. The sampling locations were divided into three zones as zone 1 (within 1 Km radius), zone 2 (1-3 Km) and zone 3 (3-5 Km). The soil sampling locations are shown in **Fig. 2.4.1**.A total number of 12, 7 and 5 soil samples were collected in sterile tubes for zone 1, 2 and 3, respectively. All the soil samples were collected at a depth of 5- 30 cm from the surface of the soil. The samples were immediately stored in an ice-box or refrigerator and transported to the laboratory for microbiological analyses.

2.4.3 Isolation and identification of microorganism

One gram of soil sample was mixed with 1 ml of sterile distilled water and the content was mixed thoroughly. The sample was serially diluted up to 10^{-4} and 0.1 ml of sample from 10^{-4} dilution was inoculated following spread plate method on different microbiological media for the isolation of soil microorganisms. Nutrient agar media was used for the enumeration and isolation of bacteria commonly found in soil. Potato dextrose agar (PDA) was used for the isolation of fungi. Jensen's media and Norris glucose nitrogen free medium were used for the enumeration of nitrogen fixing bacteria and Chemoheterotrophic bacteria that can fix nitrogen, respectively. For the enumeration of phosphate solubilizing bacteria, Pikovskayas agar was used. The commonly found bacterial pathogens in soil were studied using Kenner-Faecal (KF) media, Thiosulfate-citrate-bile salts-

sucrose (TCBS) agar, media for E.coli (MEC) and Deoxycholate (DOC) agar. All the plates except PDA were incubated at 37^{o}C for 1-3 days whereas PDA plates were incubated at 27^{o}C for five days.

After incubation period, the colony morphology was observed and the number of colonies was counted. The fungal species were primarily identified based on the colony characteristics followed by microscopic observation after staining using the lacto-phenol cotton blue staining procedure. The bacterial colonies, isolated from nutrient agar plates, were identified following colony characteristics, Gram's staining and biochemical tests. In addition, the 16S rRNA sequence based molecular methodology was used whenever possible to identify the bacteria. Briefly, the bacterial colonies were inoculated on a nutrient agar plates or broth and incubated for 8 hours at 37^{o}C. The freshly grown pure cultures were used for colony PCR. The PCR products were then sequenced and the sequences were analyzed following standard bioinformatics protocol for the identification of bacteria.

2.4.4 Diversity of bacteria

A total number of $22x10^5$ to $371x10^5$, $22x10^5$ to $98x10^5$ and $44x10^5$ to $89x10^5$ colonies were observed per gram of soil samples collected from zone-1, 2 and 3, respectively. The distributions of total number of bacterial colonies observed per gram of soil sample in different zones are shown in **Fig. 2.4.2**. The bacteria, *Bacillus* spp. was found to be the most abundant group of bacteria in the soil samples collected from different zones. The diversity of bacteria observed in different samples for each zone is shown in **Table 2.4.1**. The Shannon-Wiener Diversity Index (SWDI) was calculated for each sample and the SWDI ranged from 0.334 to 1.618, 0.694 to 1.114 and 0.625 to 1.752 for the samples collected from zone-1, 2 and 3, respectively. The evenness index was observed to be 0.078 to 0.245, 0.149 to 0.227 and 0.126 to 0.237 for the samples collected from zone-1, 2 and 3, respectively. The distributions of SWDI and evenness index values for different zones are shown in **Fig. 2.4.3** and **Fig.2.4.4**, respectively.

The differences in bacterial diversity observed across different zones were assessed based on the total bacterial counts, number of taxa, SWDI and evenness index values. The statistical analyses showed that the bacterial diversity across three zones was not significantly different.

2.4.5 Diversity of fungi

The soil samples collected from different zones presented a similar diversity of fungi. The organism, *Aspergillus* spp. was found to be the most common fungi in all the three zones. The diversity of fungi in different soil samples collected from zone 1, 2 and 3 are given in **Table 2.4.2**. The total number of fungal colonies observed per gram of soil samples for zone-1, 2 and 3 ranged from $11x10^5$ to $30x10^5$, $14x10^5$ to $34x10^5$ and $4x10^5$ to $23x10^5$, respectively. The diversity of fungi across three different zones was not found to be significant.

2.4.6 Abundance of beneficial and harmful microbes

The analyses of nitrogen fixing bacteria showed the presence of $8x10^5$ to $40x10^5$, $9x10^5$ to $41x10^5$ and $10x10^5$ to $20x10^5$ bacteria per gram of soil in zone-1, 2 and 3, respectively. The range of nitrogen fixing Chemoheterotrophs was observed to be $22x10^5$ to $86x10^5$, $24x10^5$ to $49x10^5$ and $22x10^5$ to $123x10^5$ isolates per gram of soil in zone-1, 2 and 3, respectively. The abundance of phosphate solubilizing bacteria was found to be $109x10^5$ to $311x10^5$, $109x10^5$ to $172x10^5$ and $135x10^5$ to $273x10^5$ per gram of soil for zone-1, 2 and 3, respectively. The abundance of nitrogen fixing bacteria, nitrogen fixing Chemoheterotrophs and phosphate solubilizing organisms for each sample are given in **Table 2.4.3**. The distribution of number of beneficial microbes in different zones is shown in **Figs. 2.4.5 – 2.4.7**,respectively. The differences in distribution of nitrogen fixing bacteria, nitrogen fixing chemohetrotrphs and phosphate solubilizing microbial isolates were studied across three different zones to evaluate how the styrene gas leak incident affected the beneficial microorganisms. However, the analyses showed that there is no significant difference in the distribution of beneficial microbes across three different zones. Further, the common bacterial pathogens were analyzed and the analyses did not find any common pathogens in the samples collected from all three zones.

Table 2.4.1: Diversity and abundance of bacteria (No's x 10^5 per gram of soil) isolated from soil samples

Zone	Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1	1	--	193	--	--	--	160	--	--	18	--	--	--	--	--	--	371
1	2	--	--	--	--	--	--	1	--	21	--	--	--	--	--	--	22
1	3	--	--	25	--	--	--	--	--	2	--	--	--	--	--	10	37
1	4	--	21	--	--	--	--	7	--	--	--	--	--	--	--	--	28
1	5	--	--	14	1	4	7	4	29	7	--	--	--	--	--	--	66
1	6	--	--	3	--	--	--	--	--	20	3	--	--	--	--	3	29
1	10	--	--	27	--	--	--	--	--	--	27	--	30	--	--	--	84
1	11	--	--	--	--	--	--	33	--	27	--	--	--	--	--	--	60
1	14	37	--	--	--	4	--	--	--	--	--	--	3	--	--	2	46
1	17	--	--	--	--	--	--	12	--	--	--	--	--	--	--	22	34
1	18	12	--	7	--	--	11	--	--	--	--	--	--	--	--	5	35
1	19	67	16	--	--	--	--	--	--	31	--	--	--	--	--	6	120
1	20	--	--	--	--	--	--	--	--	--	--	--	11	--	115	--	126
2	7	--	--	--	--	13	--	--	--	27	--	--	--	--	--	--	40
2	8	36	1	--	--	--	1	--	--	--	--	--	--	21	--	--	59
2	9	--	--	--	--	--	6	24	--	--	--	--	--	--	4	1	35
2	12	--	--	43	--	21	--	--	--	--	--	--	--	--	--	--	64
2	15	--	--	--	--	--	8	--	--	--	--	--	14	--	--	--	22
2	16	--	--	--	--	--	--	23	--	35	--	--	40	--	--	--	98
2	21	43	28	--	--	--	--	--	--	--	--	--	--	--	12	--	83
3	13	--	12	--	--	--	31	--	--	--	--	--	--	1	--	--	44
3	22	--	72	--	--	--	--	14	--	--	--	--	--	3	--	--	89
3	23	--	--	--	28	--	--	--	--	14	--	--	--	--	--	11	53
3	24	--	7	16	--	--	--	--	--	--	16	7	--	--	--	--	46
3	C1	--	--	--	2	25	--	6	17	--	2	--	21	13	1	--	87

1-*Streptobacillus*sp like; 2- *Bacillusenclensis*; 3- *Bacilluspiscis*/ *B. licheniformis*/ *B. aerius*/ *B. paralicheniformis*; 4- *Bacillus subtilis*; 5- *Cytobacillusformis*; 6- Unclassified *Bacillus* sp.; 7- *Paenibacillusthiaminolyticus* / *Paenibacilluspopilliae*; 8- *Bacillus filamentosus*; 9- *Bacillus albus*/ *B. luti*; 10- *B. subtilis*substrain; 11- *Paenibacilluslautus*; 12- *Acinetobacter*sp; 13- *Bacillus licheniformis*/ *Bacillus paralicheniformis* / *Bacillus haynesii*; 14-*Exiguobacterium profundum*; 15- *Bacillus oryzaecorticis*

Table 2.4.2: Diversity of fungi (No's x 10^5 per gram of soil) isolated from different soil samples

Zone	Code	1	2	3	4	5	6	Total
1	1	27	--	1	--	--	2	30
1	2	13	3	--	--	1	--	17
1	3	4	5	1	--	1	--	11
1	4	1	1	--	3	6	1	12
1	5	1	11	--	--	1	2	15
1	6	--	15	--	--	2	1	18
1	10	23	3	--	--	--	--	26
1	11	1	1	4	--	5	1	12
1	14	--	3	8	--	1	3	15
1	17	--	15	--	--	3	1	19
1	18	2	21	--	--	1	--	24
1	19	1	--	--	17	--	3	21
1	20	1	4	--	3	8	1	17
2	7	20	1	--	--	--	--	21
2	8	9	7	3	1	--	--	20
2	9	1	12	5	--	--	--	18
2	12	--	33	--	--	1	--	34
2	15	5	1	--	7	3	10	26
2	16	1	--	2	11	--	--	14
2	21	21	--	--	--	1	--	22
3	13	3	6	1	--	2	--	12
3	22	--	3	1	--	7	12	23
3	23	1	11	--	--	2	4	18
3	24	--	6	--	3	1	3	13
3	C1	3	--	--	--	--	1	4

1. *Aspergillus* sp.
2. *A.flavus / A. proliferans*
3. *Rhizomucor*sp
4. *Candida*sp
5. *Rhizopusstolonifer*
6. *Aspergillusniger*

Table 2.4.3: Abundance of beneficial microbes, nitrogen fixing and phosphate solubilizing organisms (No's x 10^5 per gram of soil), isolated from different soil samples.

Zone	Code	1	2	3
1	1	32	86	296
1	2	34	22	156
1	3	17	64	181
1	4	39	27	161
1	5	22	32	147
1	6	13	30	124
1	10	20	27	130
1	11	40	35	183
1	14	8	31	158
1	17	16	46	166
1	18	34	50	311
1	19	16	26	109
1	20	22	43	257
2	7	20	40	118
2	8	41	39	172
2	9	13	49	159
2	12	12	38	139
2	15	9	33	136
2	16	18	37	109
2	21	25	24	150
3	13	20	41	140
3	22	20	123	273
3	23	13	60	187
3	24	10	42	135
3	C1	13	22	165

1- Nitrogen fixing bacteria; 2- nitrogen fixing chemohetrottrophs; 3- PO_4 solubilizing bacteria

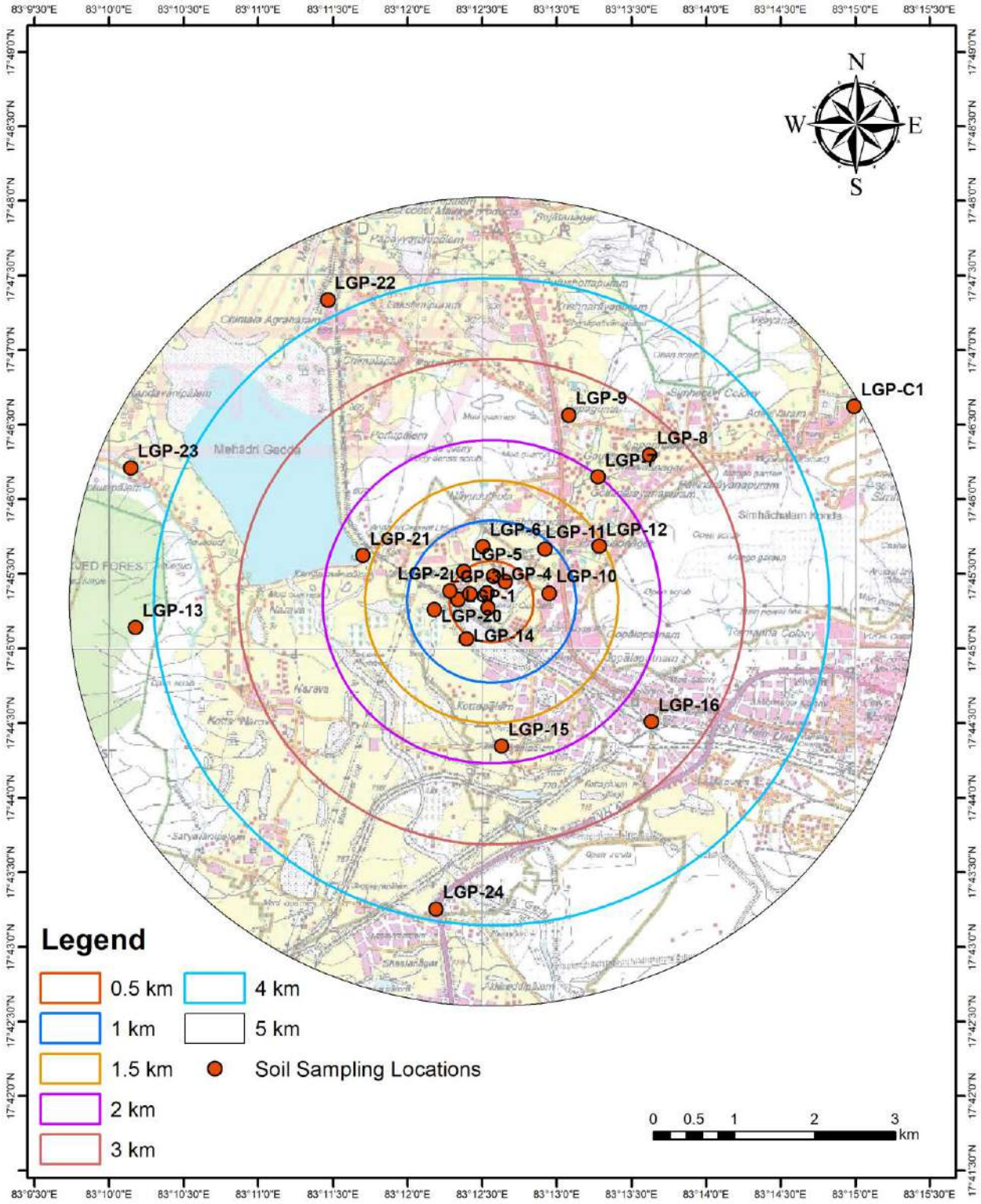


Fig.2.4.1: Soil sampling locations map

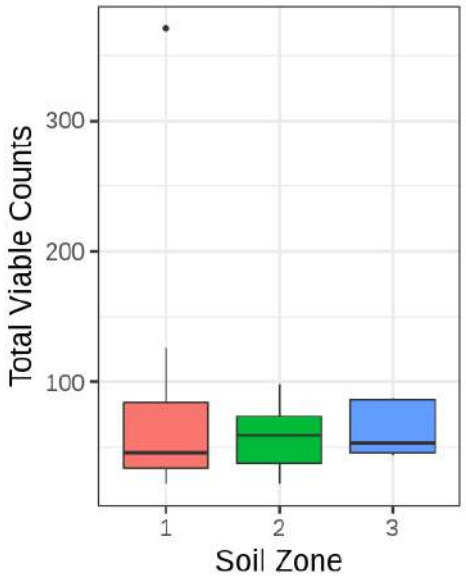


Fig.2.4.2: Distribution of total number of bacterial colonies (No's x 10^5 per 1 gram of soil) isolated from different samples in different zones

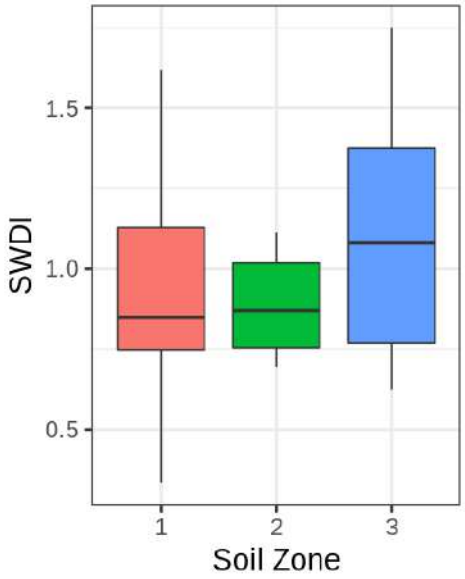


Fig. 2.4.3: Distribution of SWDI index according to different zones

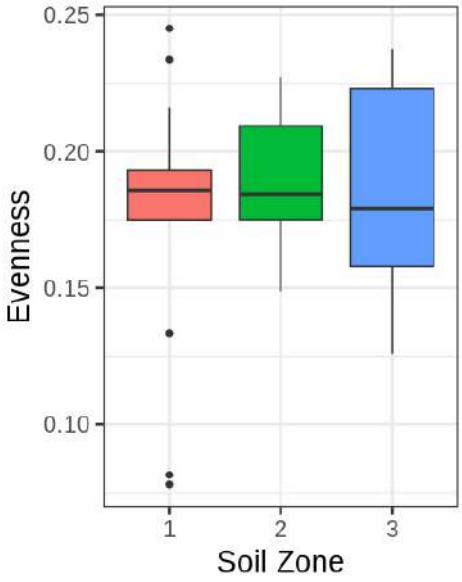


Fig. 2.4.4: Distribution of evenness diversity index according to different zones

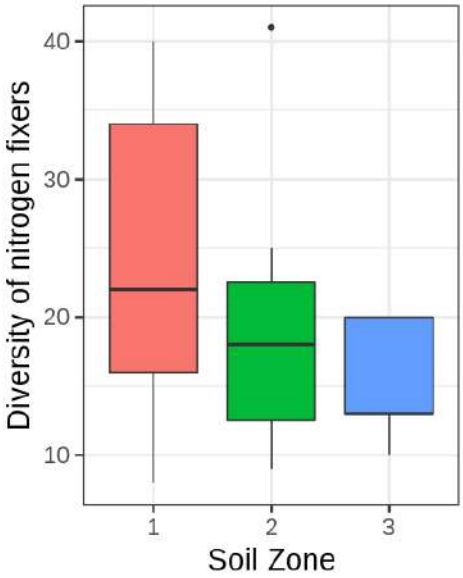


Fig. 2.4.5: Distribution of number of nitrogen fixing microbes (No's x 10^5 per 1 gram of soil) in different zones

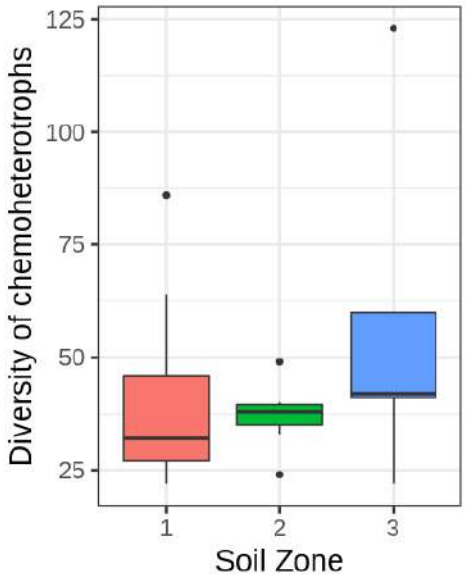


Fig. 2.4.6: Distribution of number of nitrogen fixing chemoheterotrophs (No's x 10^5 per 1 gram of soil) in different zones

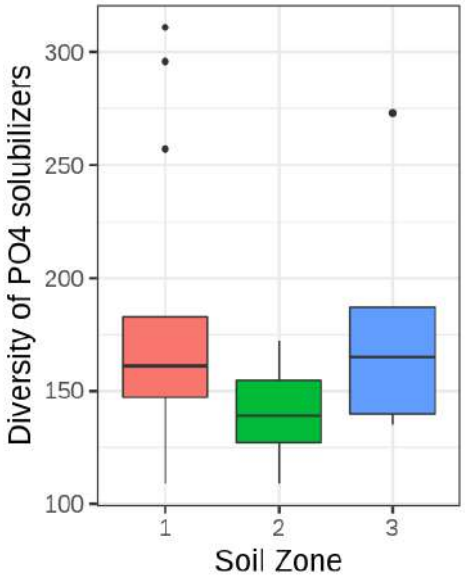


Fig. 2.4.7: Distribution of number of phosphate solubilizing organisms (No's x 10^5 per 1 gram of soil) in different zones

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2.5 Health Assessment

2.5.1 Introduction

Styrene (C_6H_5-CH=CH_2), is also commonly known as ethenylbenzene, phenylethylene, phenylethene, vinylbenzene, or cinnamene. Under ambient conditions, it is a colourless, transparent liquid. The compound is volatile and is readily absorbed following inhalation or dermal contact. The main acute hazards from human exposure to styrene are central nervous system depression and irritation of the skin, eyes, and upper respiratory tract.

2.5.2 Biological half-life and metabolism

It was reported that the biological half-life of styrene, as measured by the appearance of metabolites in urine (phenylglyoxylic acid and mandelic acid), was between eight and nine hours in humans (Bond, 1989). The styrene concentration in blood is found on decaying in a biexponential fashion typical of a two compartment kinetics model. Blood is proposed as the first component and tissues including adipose tissue as the second "slow" compartment. The half-life for styrene in blood in the initial phase is 0.58 hours and in the terminal phase 13 hours (Harkonen et al, 1978). Studies of styrene in inspired air of volunteer subjects estimated that the half-life of concentration in adipose tissue is two to four days (Engstrom et al, 1978).

The majority of the absorbed material (about 90%) in human body is metabolised in the liver by oxidation of the vinyl side group to styrene oxide. Styrene oxide is the active metabolite. The resulting significant metabolites which are excreted are mandelic acid (60-80%) and phenylglyoxylic acid (about 30%). Only very small quantities of hippuric acid are produced (IARC, 1984).

2.5.3 Toxicity in humans

Humans exposed at 376 ppm experienced rapid onset of eye and nasal irritation. The level defined as immediately dangerous to life or health is 5000 ppm (Heiselman and Cannon, 1990). Inhalation Lowest Lethal Concentration is 10000 ppm/30 min, while the Inhalation Lowest Toxic Concentration is 600 ppm (Sax and Lewis, 1989).

2.5.4 Acute toxicity

Acute poisoning after ingestion has not been described in humans. Based on animal studies, nausea, vomiting and diarrhoea might be expected.

Inhalation is one of the most important routes of styrene poisoning. Described symptoms are: conjunctivitis, throat irritation, increased nasal secretion, metallic taste, drowsiness, vertigo, ataxia, nystagmus, loss of coordination, and memory (Ellenhorn and Barceloux, 1988).

Skin contact may produce skin irritation, burns, and acute dermatitis. One single prolonged exposure may not result in absorption of harmful amounts (Baselt and Cravey, 1990).

After eye contact, conjunctival irritation was found in 22% of a group of 345 workers and correlated with intensity of exposure to styrene. Splash contact has resulted in moderate hyperaemia of the conjunctiva and slight injury of the corneal epithelium (Grant, 1986).

2.5.5 Chronic toxicity

Some workers exposed to styrene inhalation showed symptoms of CNS depression (decreased coordination and concentration) and abnormal EEG patterns (O'Donoghue 1985). As to the respiratory system, studies are not conclusive. Forced expiration volume in one second (FEV1) was significantly decreased in 20% of a group of workers exposed to styrene (Stewart et al, 1968). Styrene sickness in industry describes a clinical picture after heavy exposure to styrene and other solvents (O'Donoghue, 1985).

Skin contact may produce persisting itching and erythematous papular dermatitis (Heiselman and Cannon, 1990).

Chronic eye exposure was not related to significant eye disease (Grant, 1986). Toxic retrobulbar neuritis was suspected after chronic exposure to styrene (Pratt-Johnson, 1964).

Chronic poisoning by ingestion has not been described in humans.

2.5.6 Primary health data

The CSIR-NEERI team collected primary health data in the most affected five villages i.e. Kamparpalam, Nandmurinagar, SCBC Colony, Padmanabh Nagar and Venkatapuram. These villages are located nearby LG Polymer plant. The villagers were contacted for a primary health survey. The questionnaire consisted of demographic information such as name, age, gender, height, weight, and the list of complaints observed during and after the gas leak. Informed consent was obtained from the participants before the survey.

Village: Kamparpalam

Two hundred seventy four people participated in the primary survey from Kamparpalam village. Their age distribution is given in **Table 2.5.1** and **Fig. 2.5.1**. It shows that majority of respondents were 36-50 years old.

Table 2.51: **Distribution of respondents according to age - Kamparpalam**

Age group (in years)	Number	Percentage
≤ 20	39	14.23
21-35	75	27.37
36-50	98	35.77
51-65	52	18.98
>65	10	3.65

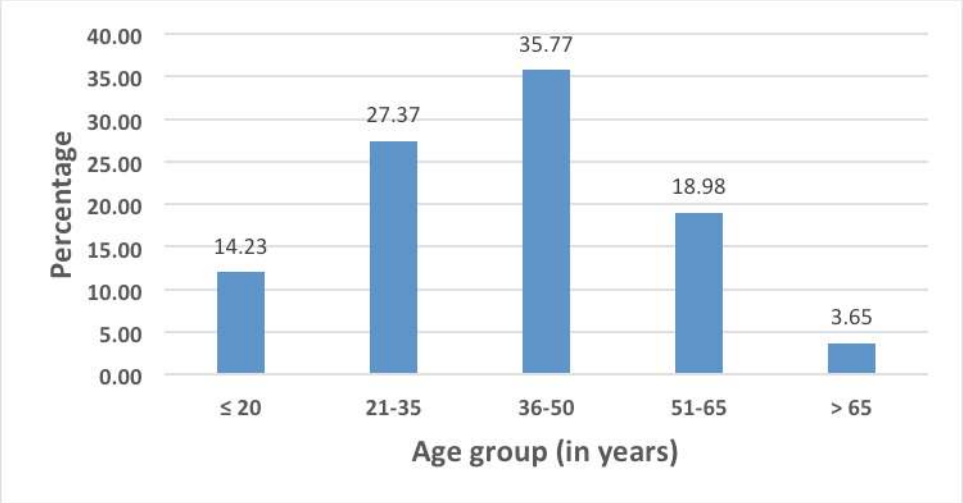


Fig. 2.5.1: Distribution of respondents according to age –Kamparpalam

Out of the 274 respondents, more than half were female (68%) and remaining were male participants. **Fig. 2.5.2 and Table 2.5.2** give the distribution of participants according to gender. The representation of females was significantly higher in the sample.

Table 2.5.2: Distribution of respondents according to gender - Kamparpalam

Gender	Number	Percentage
Male	86	31.39
Female	188	68.61
Total	274	100

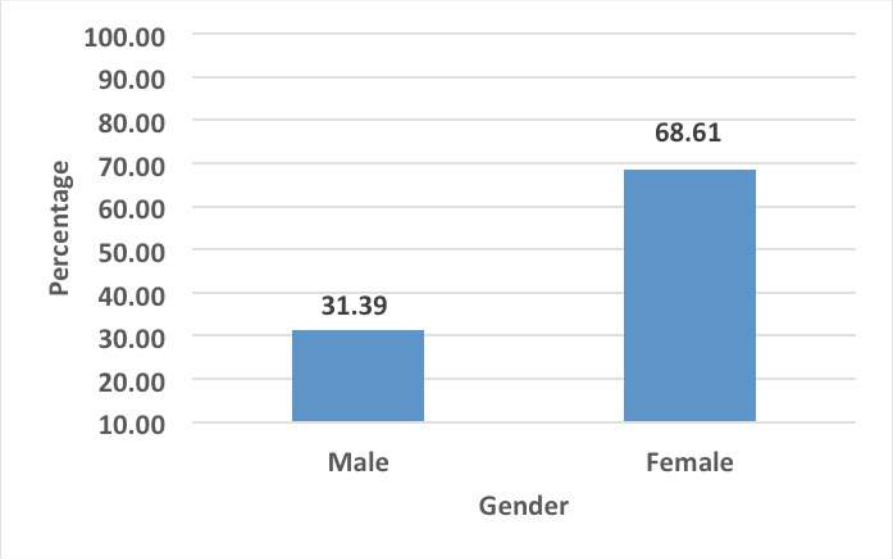


Fig. 2.5.2: Distribution of respondents according to gender–Kamparpalam

Following **Table 2.5.3 and Fig. 2.5.3** show the complaints observed immediately after the gas leakage. Most people experienced headache, skin irritation and breathing problem as significant complaints, while vomiting and body pain was present at lower frequencies. Many people experienced multiple complaints, as apparent from the percentage values. These complaints are known to be caused by acute styrene exposure, and reflect potential styrene contact.

Table 2.5.3: Distribution of respondents according to chief complaints - Kamparpalam

Sr. no.	Complaints	Number	Percentage
1	Neurological problems	0	0.00
2	Headache	205	74.82
3	Skin irritation	150	54.74
4	Breathing Problem	146	53.28
5	Eye irritation	182	66.42
6	Vomiting	59	21.53
7	Body Pain	34	12.41

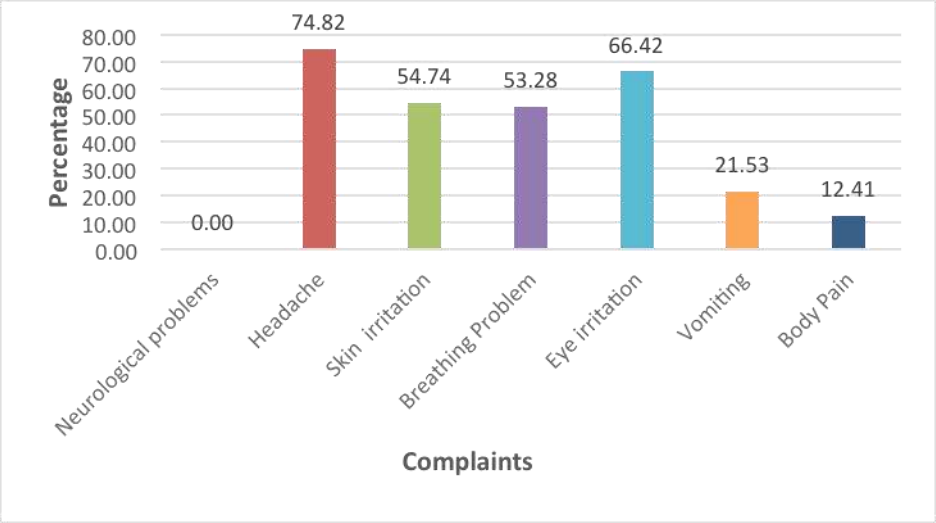


Fig. 2.5.3: Distribution of respondents according to chief complaints – Kamparpalam

Among 274 participants, it was observed that about 40% were hospitalized after the gas leak **(Table 2.5.4 and Fig. 2.5.4).** Thus, significant percentage of participants needed medical attention after the gas leak, indicating exposure to styrene.

Table 2.5.4: Distribution of respondents according to hospitalization – Kamparpalam

	Number	Percentage
Hospitalized	112	40.87
Not Hospitalized	162	59.12
Total	274	100

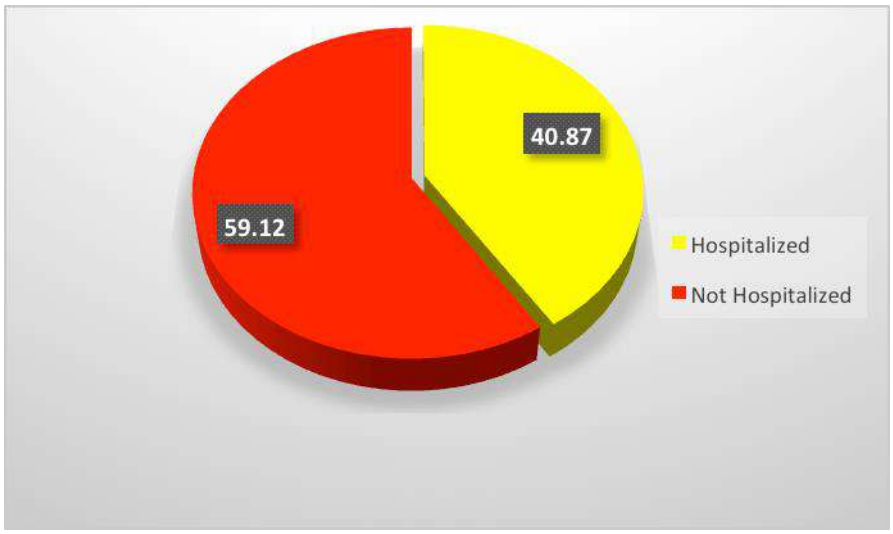


Fig. 2.5.4: Distribution of respondents according to hospitalization – Kamparpalam

Village: Nandmurinagar

Two hundred and fortypeople participated in the primary survey from Nandmurinagar village. Their age distribution is given in **Table 2.5.5** and **Fig. 2.5.5**. It shows that majority of respondents were 36-50 years old.

Table 2.5.5: **Distribution of respondents according to age - Nandmurinagar**

Age group (in years)	Number	Percentage
≤ 20	68	28.33
21-35	64	26.67
36-50	78	32.50
51-65	25	10.42
> 65	5	2.08

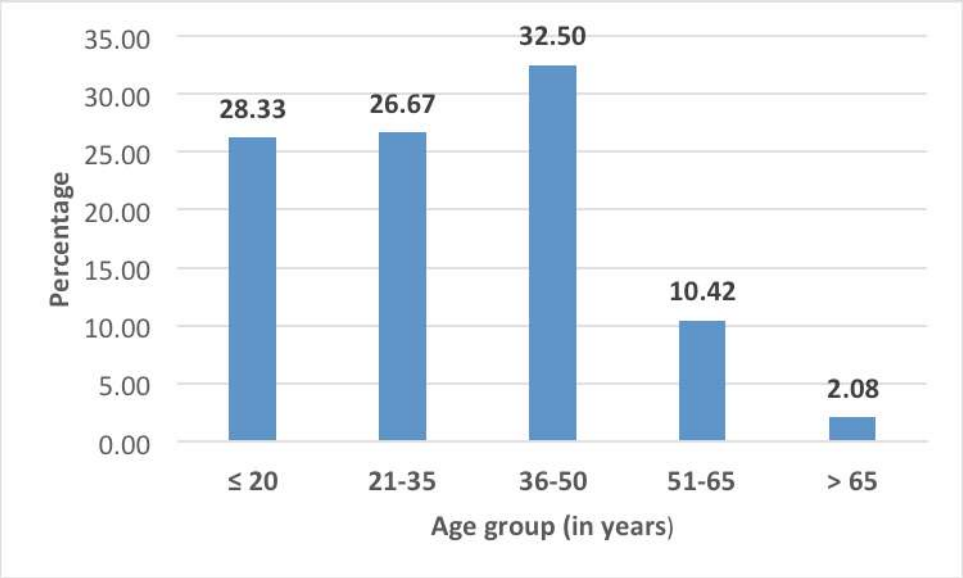


Fig. 2.5.5: Distribution of respondents according to age –Nandmurinagar

In Nandmurinagar, participation of males and females was roughly similar in the health survey, indicating equal representation of the genders (**Table 2.5.6, Fig. 2.5.6**).

Table 2.5.6: Distribution of respondents according to gender–Nandmurinagar

Gender	Number	Percentage
Male	119	49.58
Female	121	50.42
Total	240	100

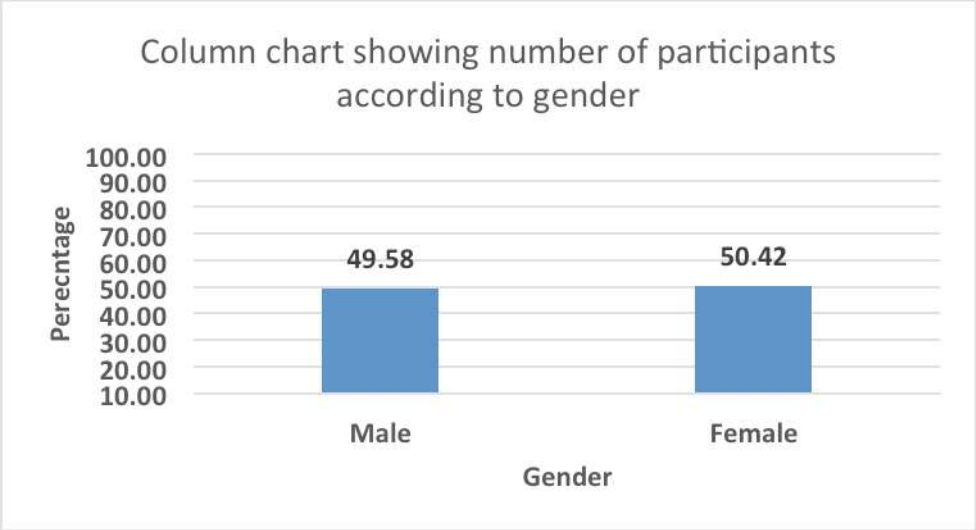


Fig. 2.5.6: Distribution of respondents according to gender–Nandmurinagar

Table 2.5.7 and Fig. 2.5.7 show the complaints observed immediately after the gas leakage. 57% participants complained about headache while body pain was present at lower frequency. The potential problems induced by acute styrene exposure were observed ion the population, although at lower level as compared to Kamparpalam.

Table 2.5.7: Distribution of respondents according to chief complaints - Nandmurinagar

Sr.No.	Complaints	Number	Percentage
1	Neurological problems	1	0.42
2	Headache	139	57.92
3	Skin irritation	69	28.75
4	Breathing Problem	90	37.50
5	Eye irritation	94	39.17
6	Vomiting	55	22.92
7	Body Pain	7	2.92

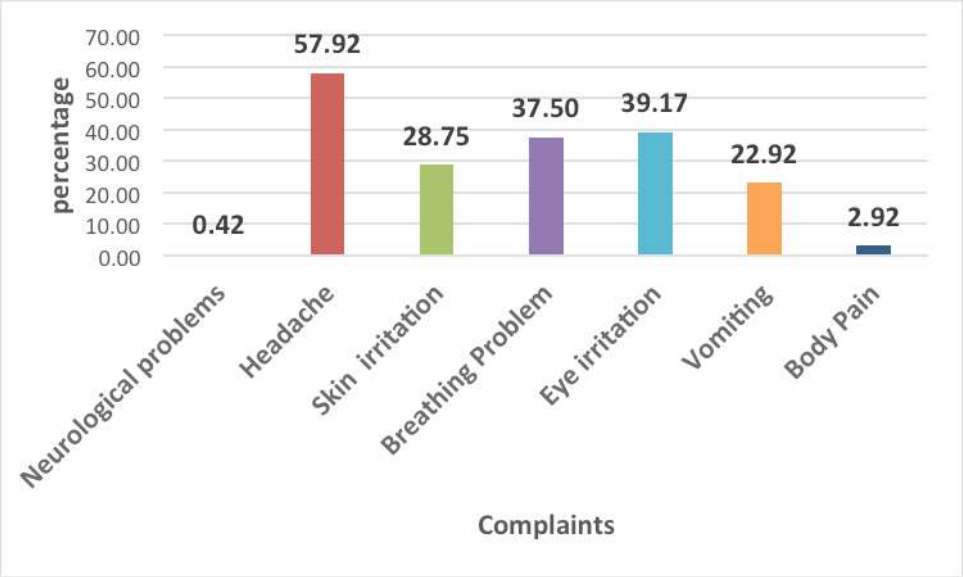


Fig. 2.5.7: Distribution of respondents according to chief complaints – Nandmurinagar

Out of the 240 participants, 50% were hospitalized in government & private hospitals. **Fig 2.5.8 and Table 2.5.8** show the percentage of hospitalized people. Thus, very high percentage needed medical attention after the exposure.

Table 2.5.8: Distribution of respondents according to hospitalization - Nandmurinagar

	Number	Percentage
Hospitalized	122	50.83
Not	118	49.17
Total	240	100

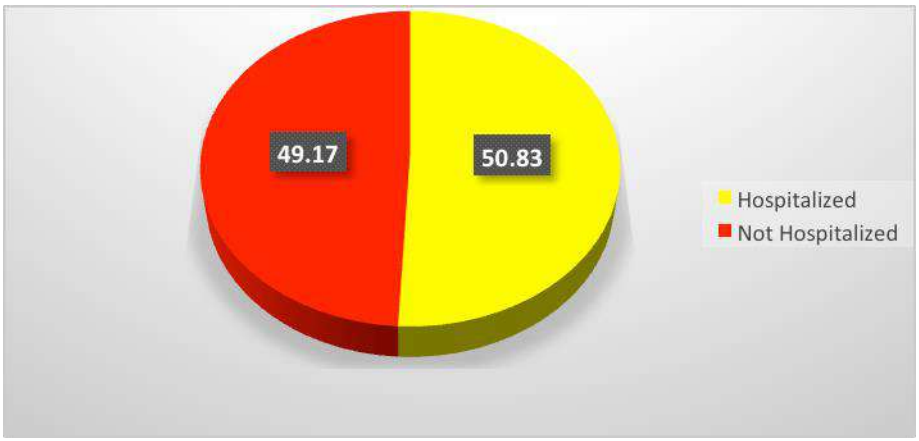


Fig. 2.5.8: Distribution of respondents according to hospitalization - Nandmurinagar

Village: SC BC Colony

191 people participated in the primary survey from SC BC Colony village. Their age distribution is given in **Table 2.5.9** and **Fig. 2.5.9**. It shows that majority of respondent were 36-50 years old.

Table 2.5.9: **Distribution of respondents according to age - SC BC Colony**

Age group (in years)	Number	Percentage
≤ 20	47	24.61
21-35	55	28.80
36-50	58	30.37
51-65	27	14.14
> 65	4	2.09

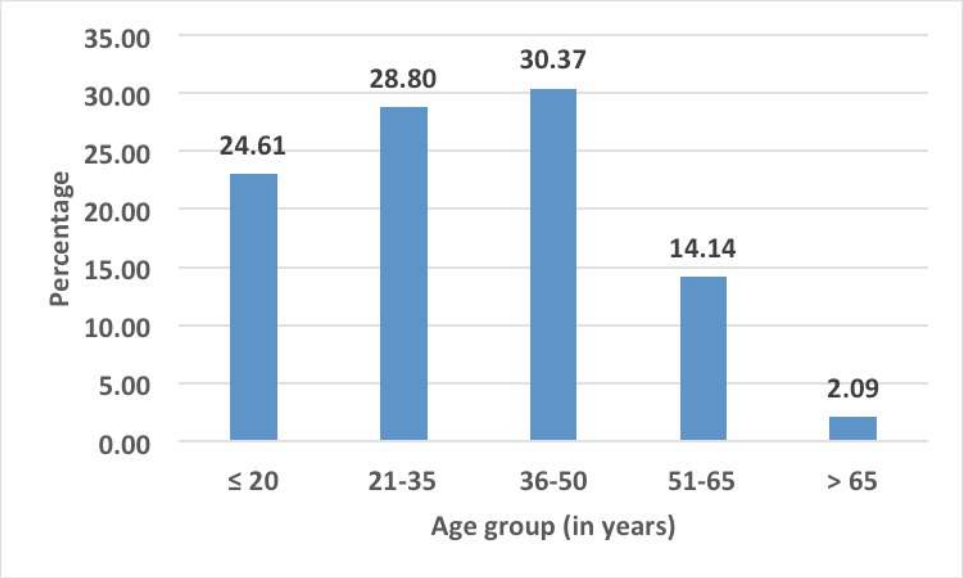


Fig. 2.5.9: Distribution of respondents according to age -SC BC Colony

In SC BC Colony, males and females both equally participated in the health survey. **Fig. 2.5.10 & Table 2.5.10** give the distribution of participant according to gender. Thus, the sample was gender-unbiased.

Table 2.5.10: Distribution of respondents according to gender–SC BC Colony

Gender	Number	Percentage
Male	94	49.21
Female	97	50.79
Total	191	100

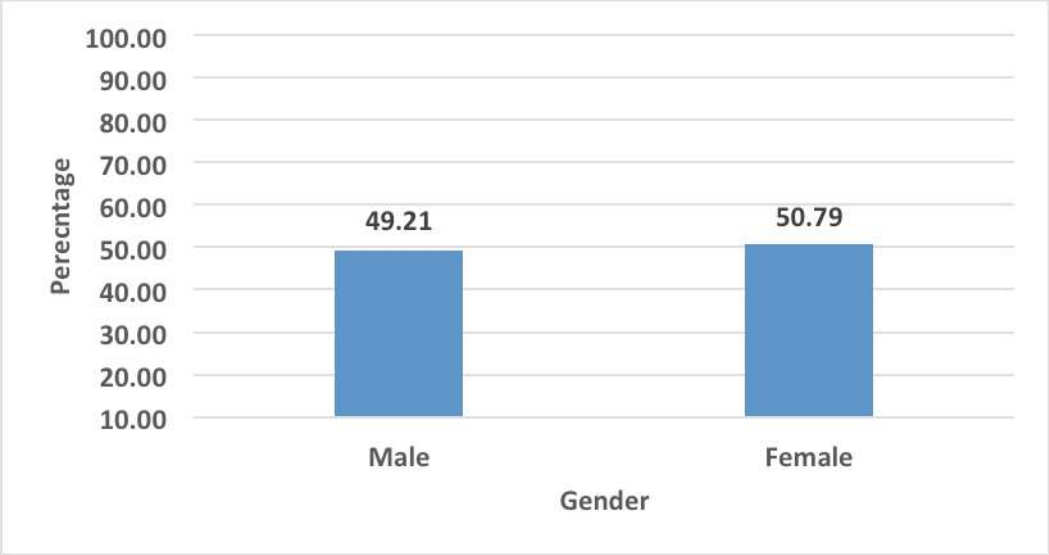


Fig. 2.5.10: Distribution of respondents according to gender–SC BC Colony

Following **Table 2.5.11 & Fig. 2.5.11** show the complaints observed immediately after the gas leakage. Here headache was the major complaint, followed by skin irritation, eye irritation, breathing problems & vomiting. Thus, potential styrene-induced health effects were reported by the villagers.

Table 2.5.11: Distribution of respondents according to chief complaints - SC BC Colony

Sr.No.	Complaints	Number	Percentage
1	Neurological problems	0	0
2	Headache	88	46.07
3	Skin irritation	56	29.32
4	Breathing Problem	48	25.13
5	Eye irritation	55	28.80
6	Vomiting	42	21.99
7	Body Pain	0	0

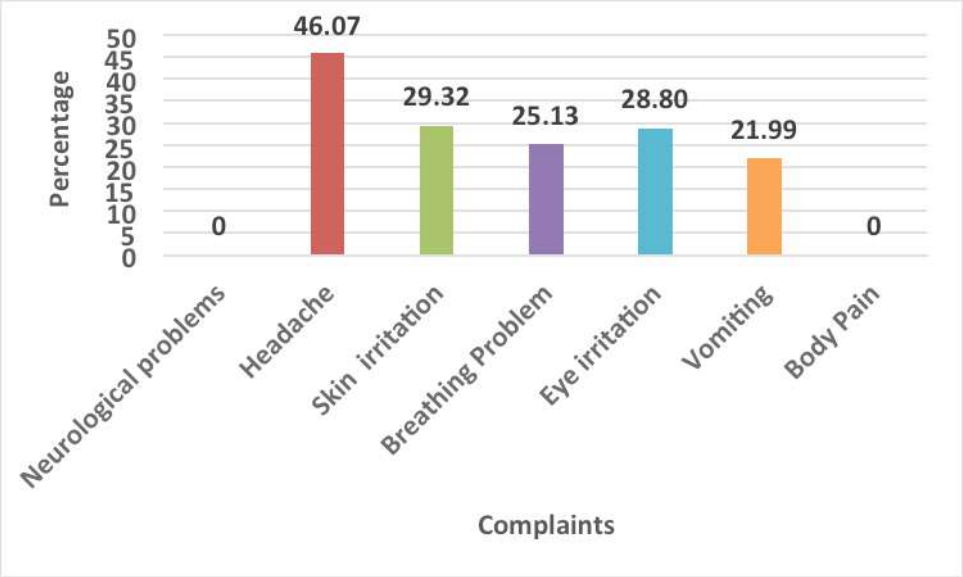


Fig. 2.5.11: Distribution of respondents according to chief complaints-SC BC Colony

Out of 191 participants, 31% were hospitalized in government & private hospitals. **Fig. 2.5.12** and **Table 2.5.12** show the percentage of hospitalized people. Thus, high percentage of people needed medical attention after gas leak.

Table 2.5.12: Distribution of respondents according to hospitalization-SC BC Colony

	Number	Percentage
Hospitalized	61	31.94
Not	130	68.06
Total	191	100

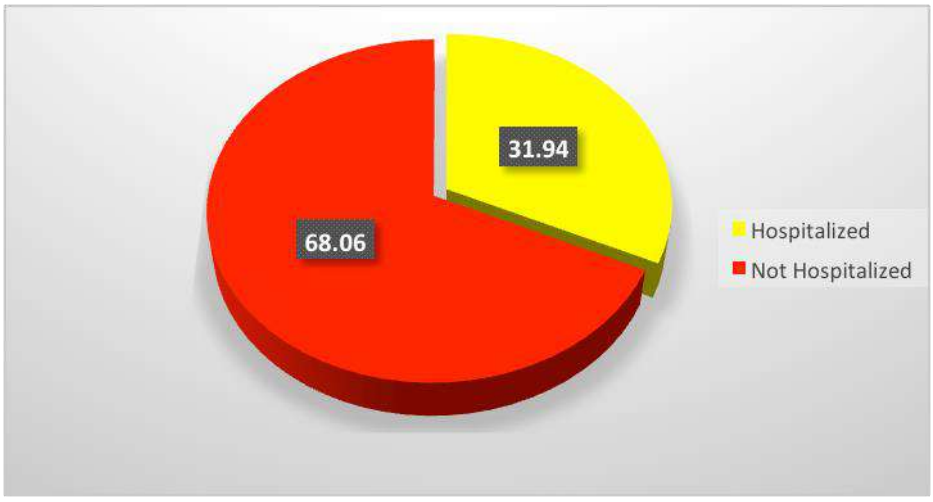


Fig. 2.5.12: Distribution of respondents according to hospitalization -SC BC Colony

Village: Padmanabh Nagar

174 people participated in the primary survey from Padmanabh Nagar village. Their age distribution is given in **Table 2.5.13** and **Fig. 2.5.13**. It shows that majority of respondent were 21-35 years old.

Table 2.5.13: **Distribution of respondents according to age -Padmanabh Nagar**

Age group (in years)	Number	Percentage
≤ 20	45	25.86
21-35	49	28.16
36-50	45	25.86
51-65	30	17.24
> 65	5	2.87

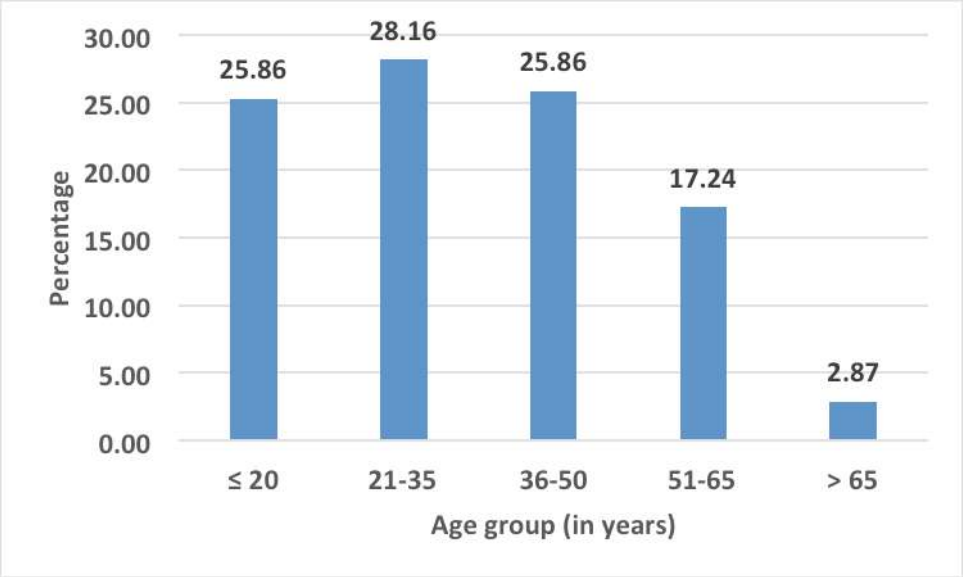


Fig. 2.5.13: Distribution of respondents according to age - Padmanabh Nagar

From total of 174 participants, male percentage was 54% & female was 45%. **Fig. 2.5.14 & Table 2.5.14** give the distribution of participant according to gender. According to chi square statistical test, the representation of males and females was similar.

Table 2.5.14: Distribution of respondents according to gender–Padmanabh Nagar

Gender	Number	Percentage
Male	94	54.02
Female	80	45.98
Total	174	100

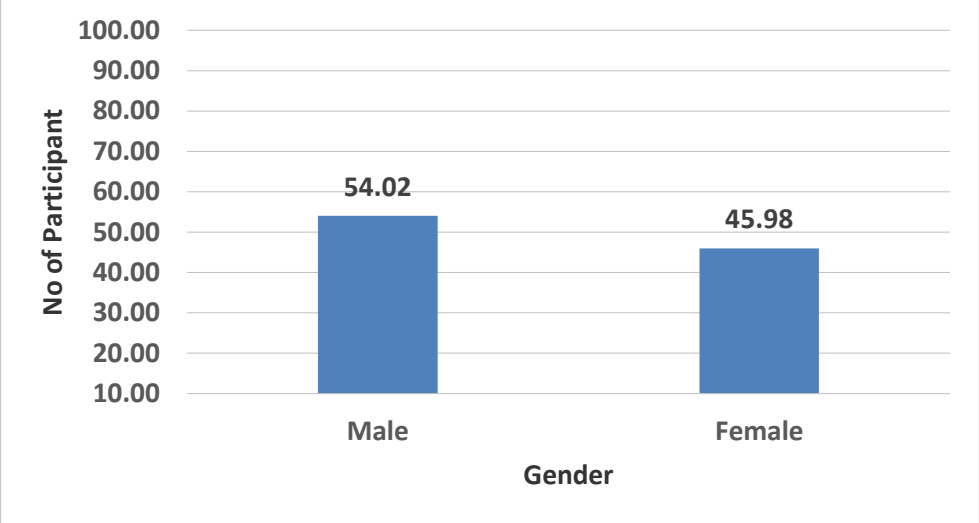


Fig. 2.5.14: Distribution of respondents according to gender–Padmanabh Nagar

Following **Table 2.5.15 & Fig. 2.5.15** show the complaints observed immediately after the gas leakage. Most of people showed headache as major problem (66.09%), while body pain was present at the lowest frequency. Thus, gas leak-induced problems were reported by high number of the participants.

Table 2.5.15: Distribution of respondents according to chief complaints - Padmanabh Nagar

Sr.No.	Complaints	Number	Percentage
1	Neurological problems	0	0
2	Headache	115	66.09
3	Skin irritation	92	52.87
4	Breathing Problem	93	53.45
5	Eye irritation	81	46.55
6	Vomiting	41	23.56
7	Body Pain	1	0.57

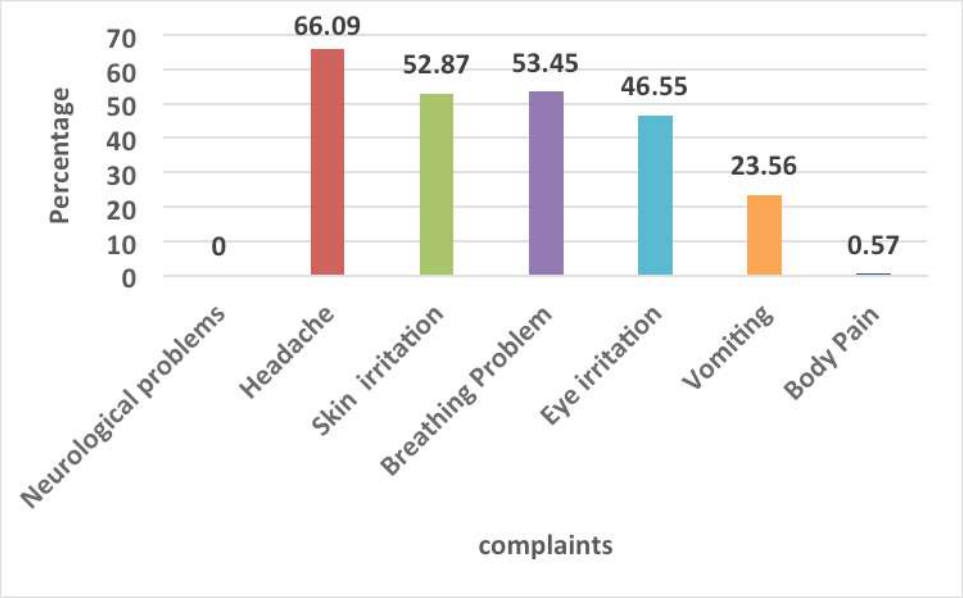


Fig. 2.5.15: Distribution of respondents according to chief complaints – Padmanabh Nagar

From 174 participants 48% were hospitalized in government & private hospitals. **Fig. 2.5.16** and **Table 2.5.16** show the percentage of hospitalized people. Thus, significant proportion of the participants required medical care after gas leak.

Table 2.5.16: Distribution of respondents according to hospitalization -Padmanabh Nagar

	Number	Percentage
Hospitalized	85	48.85
Not Hospitalized	89	51.15
Total	174	100

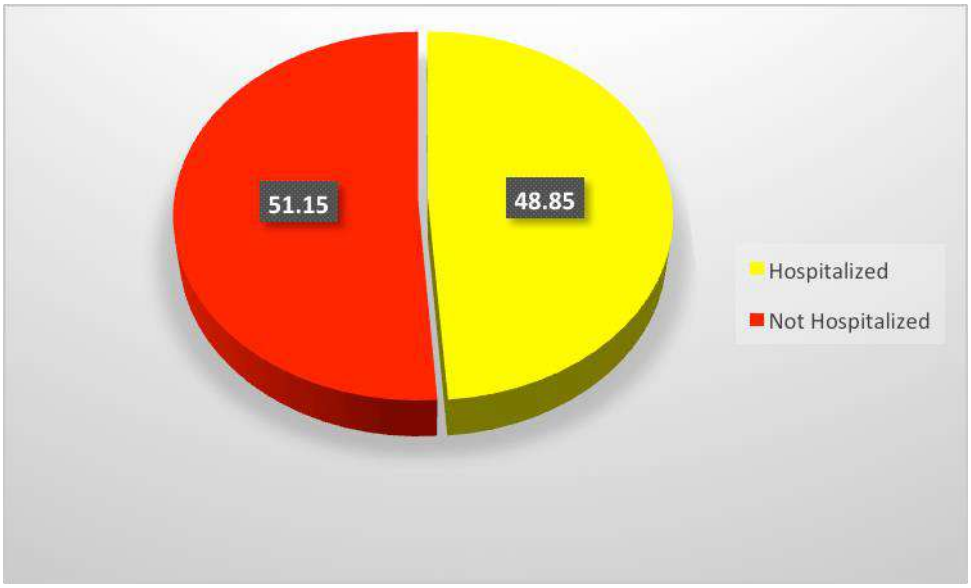


Fig. 2.5.16: Distribution of respondents according to hospitalization -Padmanabh Nagar

Village: Venkatapuam

300 people participated in the primary survey from Venkatapuam village. Their age distribution is given in **Table 2.5.17** and **Fig. 2.5.17**. It shows that majority of respondent were 36-50 years old.

Table 2.5.17: **Distribution of respondents according to age - Venkatapuam**

Age group (in years)	Number	Percentage
≤ 20	59	19.67
21-35	78	26.00
36-50	110	36.67
51-65	40	13.33
> 65	13	4.33

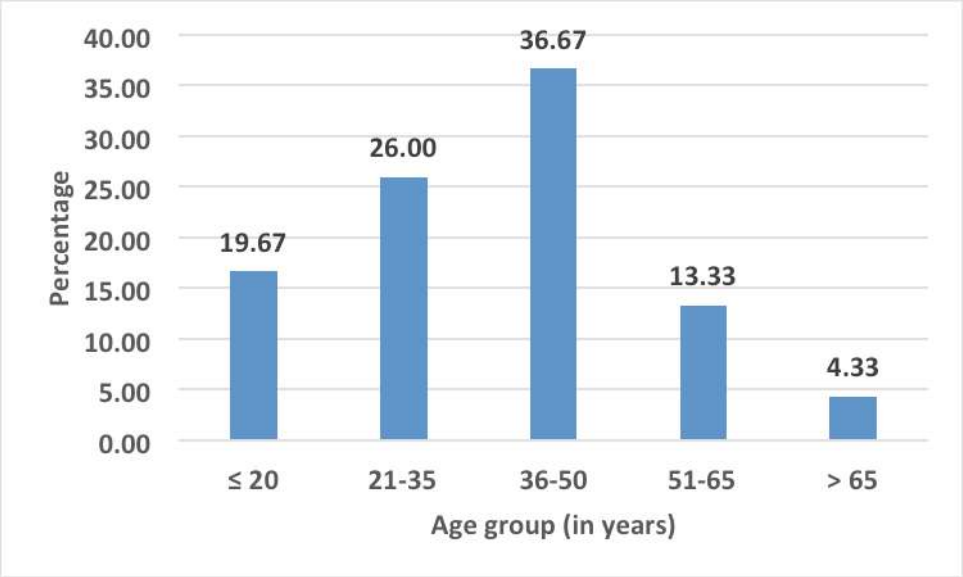


Fig.2.5.17: Distribution of respondents according to age - Venkatapuam

Fig. 2.5.18 & Table 2.5.18 give the distribution of participant according to gender. It can be seen that female fraction was over-represented in the sample.

Table 2.5.18: Distribution of respondents according to gender – Venkatapuam

Gender	Number	Percentage
Male	118	39.33
Female	182	60.67
Total	300	100

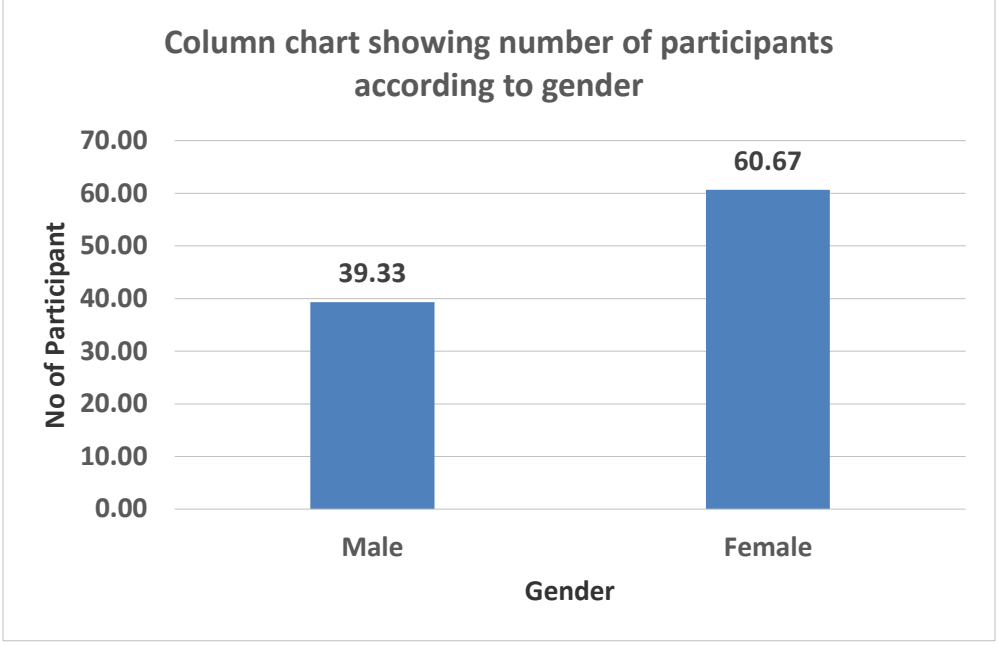


Fig. 2.5.18: Distribution of respondents according to gender– Venkatapuam

Following **Table 2.5.19 & Fig. 2.5.19** show the complaints observed immediately after the gas leakage. Most of people (around 48%) showed headache as the major problem. In all, potential gas leak-induced problems were observed in the population.

Table 2.5.19: Distribution of respondents according to chief complaints - Venkatapuam

Sr.No.	Complaints	Number	Percentage
1	Neurological problems	0	0
2	Headache	145	48.33
3	Skin irritation	118	39.33
4	Breathing Problem	108	36.00
5	Eye irritation	87	29.00
6	Vomiting	65	21.67
7	Body Pain	13	4.33

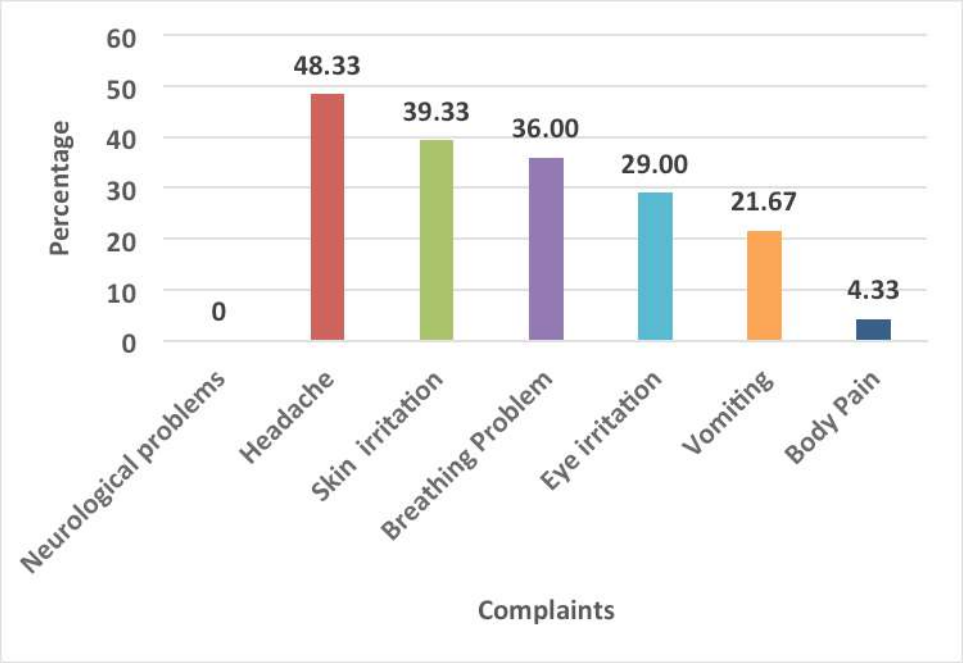


Fig. 2.5.19: Distribution of respondents according to chief complaints – Venkatapuam

From 300 participant, 47.33% participants were hospitalized (**Fig. 2.5.20** and **Table 2.5.20**). Thus, very high number of participants required medical help after the gas leak.

Table 2.5.20: Distribution of respondents according to hospitalization - Venkatapuram

	Number	Percentage
Hospitalized	142	47.33
Not Hospitalized	158	52.67
TOTAL	300	100

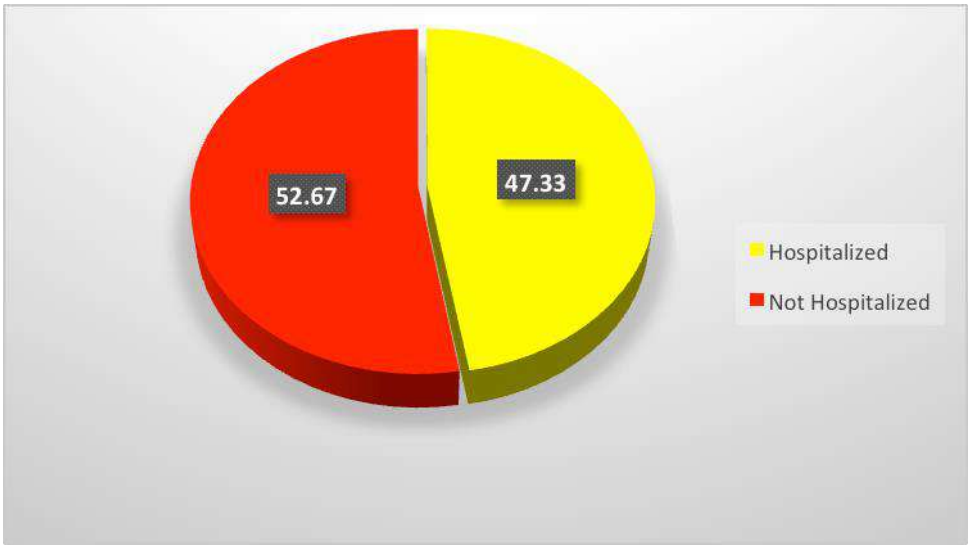


Fig. 2.5.20: Distribution of respondents according to hospitalization –Venkatapuam

2.5.7 Persistence of complaints after the gas leak

In the primary questionnaire, the chief complaints experienced immediately after the gas leak were recorded and results are presented above. These complaints reflected the single dose acute effect. However, the survey was carried out five to six months after the incidence. Hence, the health effects which lingered till the survey date were also recorded. This data will help in quantifying more long term effects of the exposure, if any. The results are presented village-wise below.

Village: Kamarpalam

Table 2.5.21 and **Fig. 2.5.21** show that headache was the most persistent problem (72.63%), and several participants had multiple complaints that persisted till the survey date in Kamparpalam. The percentage of different health problems was only slightly less than that immediately following gas leak. The data indicates that styrene health effects lasted till the survey date.

Table 2.5.21: Distribution of respondents according to persistence of complaints - Kamparpalam

Sr.No.	Complaints	Number	Percentage
1	Neurological	0	0.00
2	Headache	199	72.63
3	Skin irritation	141	51.46
4	Breathing Problem	142	51.82
5	Eye irritation	171	62.41
6	Vomiting	43	15.69
7	Body Pain	30	10.95

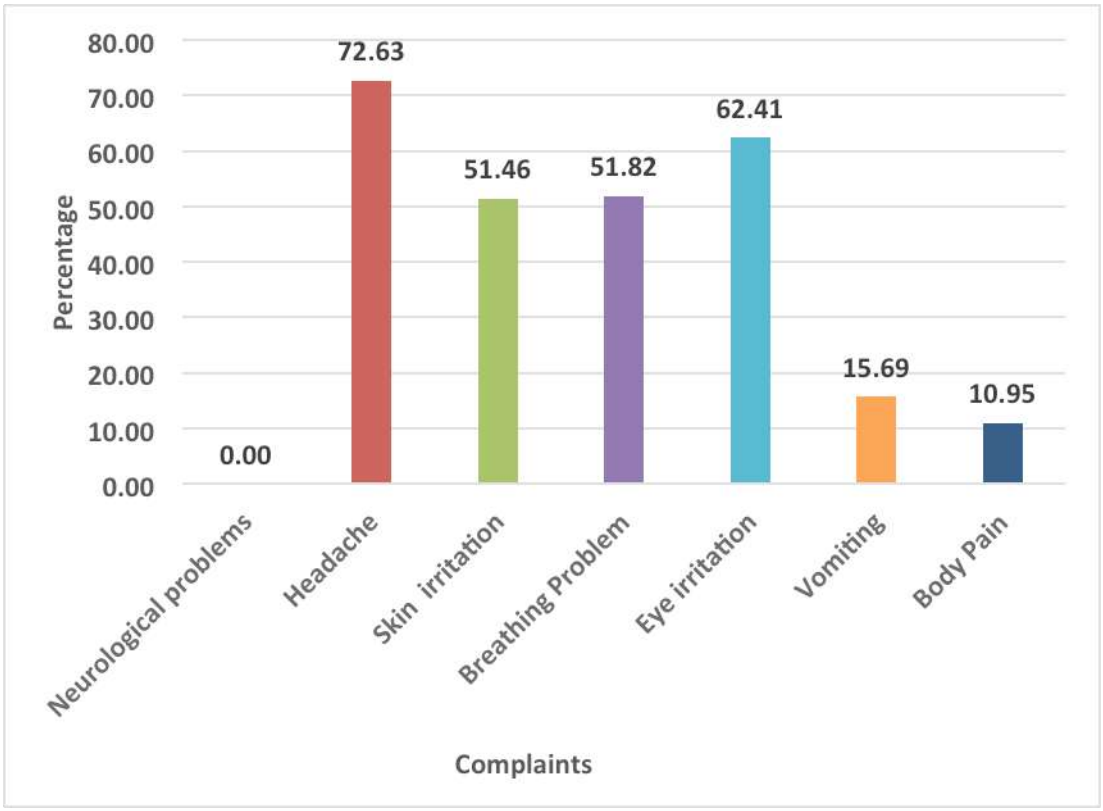


Fig. 2.5.21: Distribution of respondents according to persistence of complaints - Kamparpalam

Village: Nandmuri Nagar

Table 2.5.22 and **Fig. 2.5.22** show that headache was the most persistent problem (31.67%) in Nandmuri Nagar. The percentage of problems significantly decreased as compared to that immediately following the gas leak. However, the lasting health effects could still be recorded in a considerable fraction of population.

Table 2.5.22: Distribution of respondents according to persistence of complaints – Nandmuri Nagar

Sr.No.	Complaints	Number	Percentage
1	Neurological	0	0.00
2	Headache	76	31.67
3	Skin irritation	34	14.17
4	Breathing Problem	45	18.75
5	Eye irritation	47	19.58
6	Vomiting	14	5.83
7	Body Pain	3	1.25

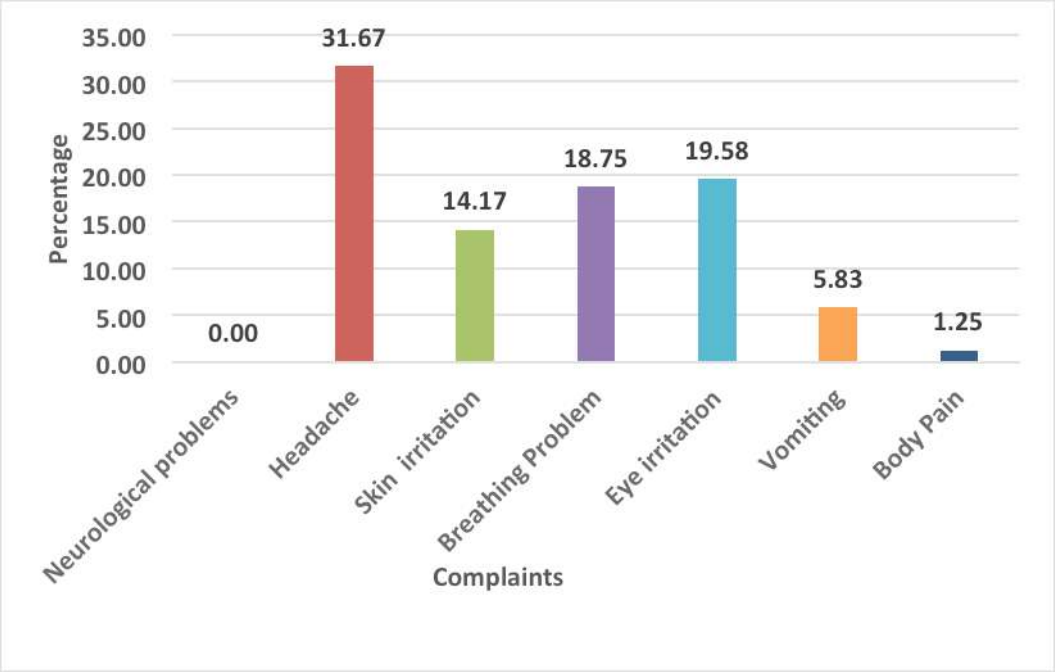


Fig. 2.5.22: Distribution of respondents according to persistence of complaints – Nandmuri Nagar

Village: SCBC Colony

Table 2.5.23 and **Fig. 2.5.23** show that headache was the most persistent problem (14.14%) followed by skin irritation (12.57%) in SC BC Colony. The percentage of problems significantly decreased as compared to that immediately following the gas leak. However, the lasting health effects could still be recorded in a considerable fraction of population.

Table 2.5.23: Distribution of respondents according to persistence of complaints –SC BC Colony

Sr.No.	Complaints	Number	Percentage
1	Neurological	0	0.00
2	Headache	27	14.14
3	Skin irritation	24	12.57
4	Breathing Problem	18	9.42
5	Eye irritation	13	6.81
6	Vomiting	3	1.57
7	Body Pain	0	0.00

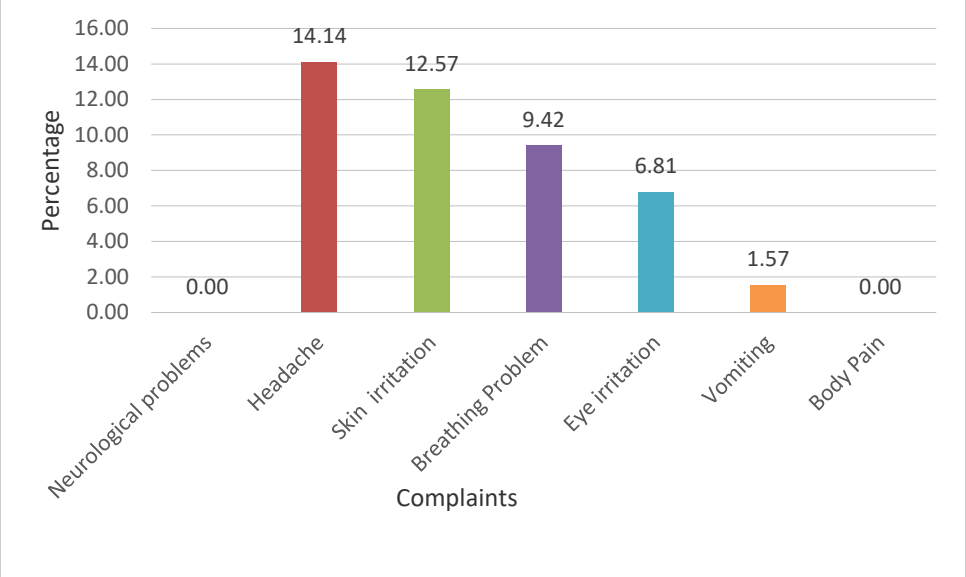


Fig. 2.5.23: Distribution of respondents according to persistence of complaints –SC BC colony

Village: Padmanabh Nagar

Table 2.5.24 and **Fig. 2.5.24** show that headache was the most persistent problem (31.03%) followed by skin irritation (25.29%) and breathing problem (23.56%) in Padmanabh Nagar. The percentage of problems significantly decreased as compared to that immediately following the gas leak. However, the lasting health effects could still be recorded in a considerable fraction of population.

Table 2.5.24: Distribution of respondents according to persistence of complaints – Padmanabh Nagar

Sr.No.	Complaints	Number	Percentage
1	Neurological	0.00	0.00
2	Headache	54.00	31.03
3	Skin irritation	44.00	25.29
4	Breathing Problem	41.00	23.56
5	Eye irritation	33.00	18.97
6	Vomiting	6.00	3.45
7	Body Pain	1.00	0.57

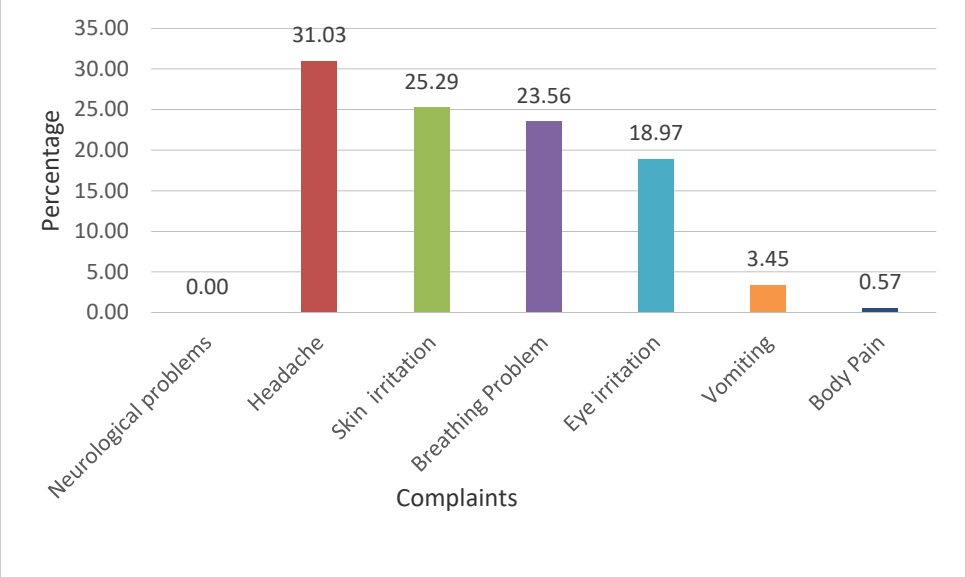


Fig. 2.5.24: Distribution of respondents according to persistence of complaints – Padmanabh Nagar

Village: Venkatapuram

Table 2.5.25 and **Fig. 2.5.25** show that headache was the most persistent problem (36.33%) followed by skin irritation (32%) and breathing problem (28%) in Venkatapuram. The percentage of problems slightly decreased as compared to that immediately following the gas leak. The data showed significantly lasting health effects of gas leak in this area.

Table 2.5.25: Distribution of respondents according to persistence of complaints - Venkatapuram

Sr.No.	Complaints	Number	Percentage
1	Neurological	0.00	0.00
2	Headache	109.00	36.33
3	Skin irritation	96.00	32.00
4	Breathing Problem	84.00	28.00
5	Eye irritation	66.00	22.00
6	Vomiting	18.00	6.00
7	Body Pain	28.00	9.33

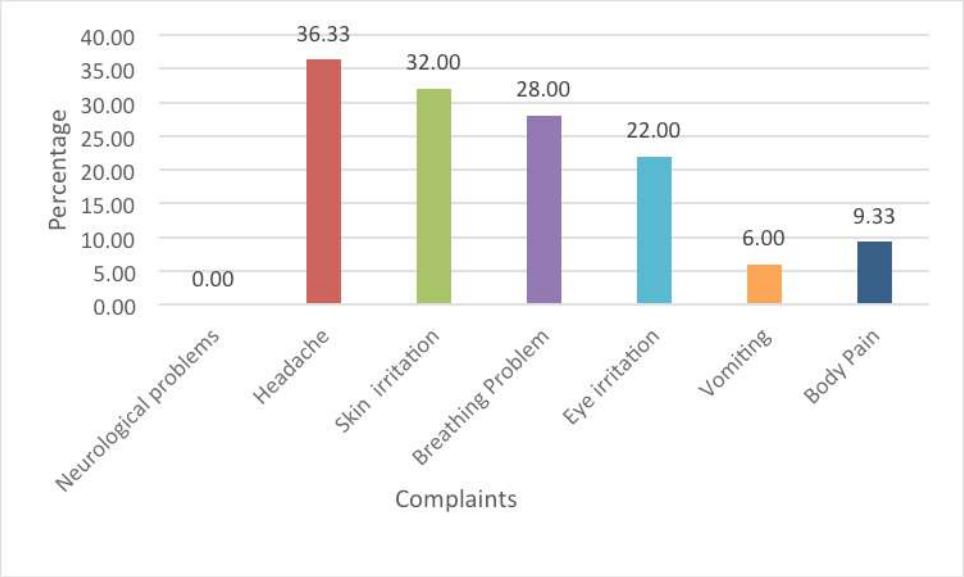


Fig. 2.5.25: Distribution of respondents according to persistence of complaints - Venkatapuram

2.5.8 Secondary health data

Secondary health data was collected from local health centers. The data was collected for potential acute styrene exposure related effects, such as throat/nasal irritation, eye irritation, vomiting/abdominal pain, neurological disorder, skin irritation, diarrhea and death. The data was requested for the period of May to October 2020 i.e. after the gas leak. However, the health agencies were involved in rapid response to the gas leak in May. Hence, they could not maintain proper record of health data of May 2020. Therefore, data for the period of June to October 2020 was obtained and analyzed. The complaint-wise analysis is given below.

Fig. 2.5.26 shows that number of OPDs was highest in Venkatapuram for throat irritation during June-October 2020. Both males and females were highly affected. The number of throat irritation cases was lowest in kamparapalam.

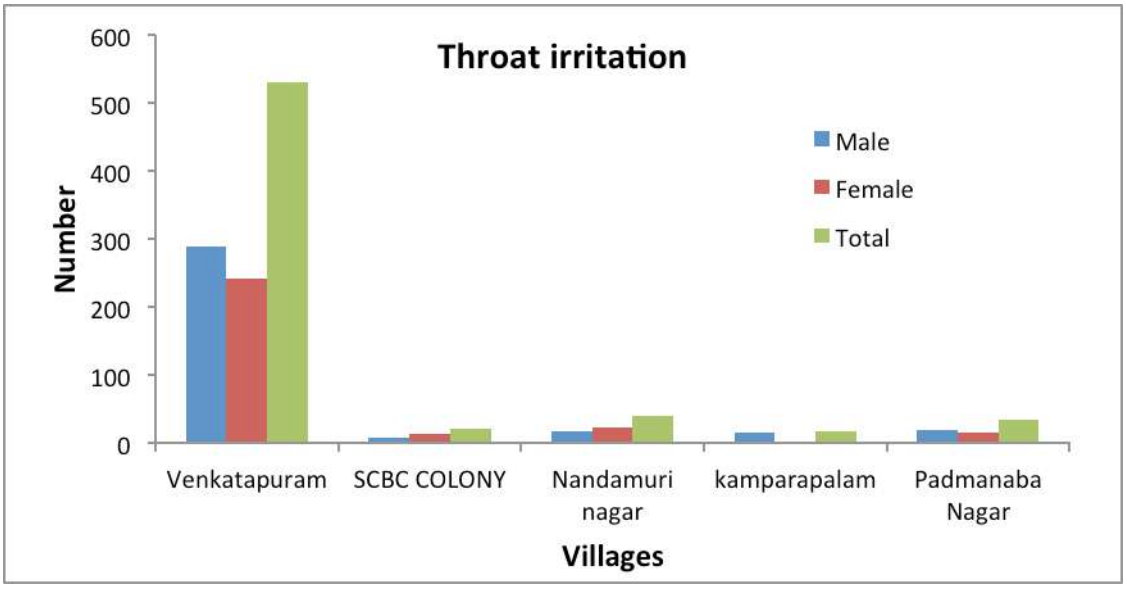


Fig. 2.5.26: Secondary data on throat/nasal irritation (June-October 2020)

Fig. 2.5.27 shows that number of OPDs was highest in Venkatapuram for eye irritation during June-October 2020. Both males and females were highly affected. On the other hand, the number of eye irritation cases was insignificant in other villages i.e. SCBS Colony, Nandamuri Nagar, kamparapalam and Padmanabh Nagar.

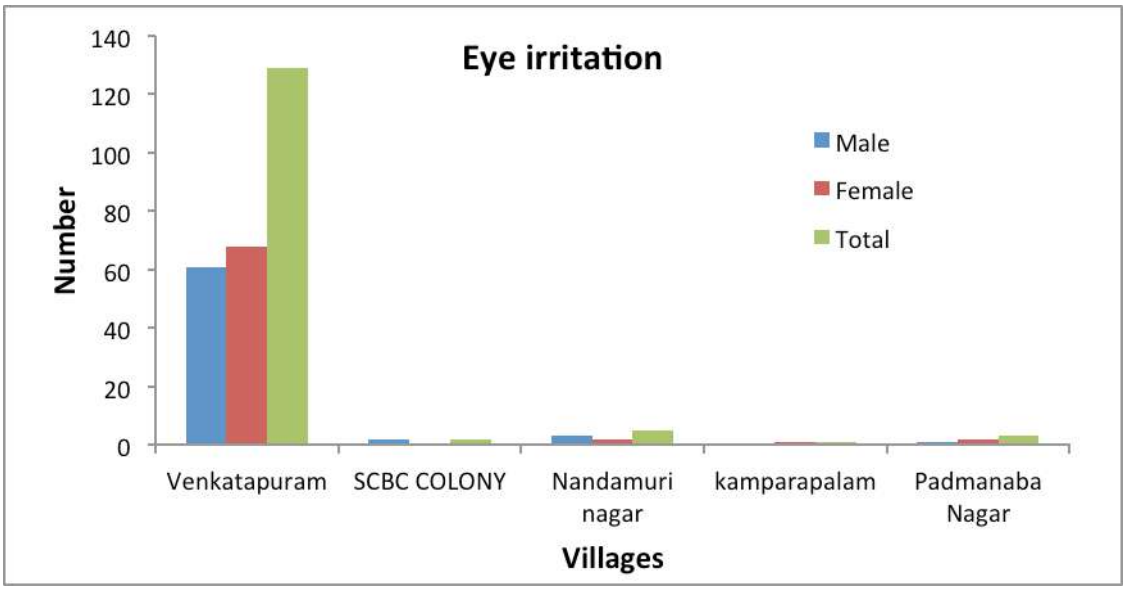


Fig. 2.5.27: Secondary data on eye irritation (June-October 2020)

Fig. 2.5.28 shows that number of OPDs was highest in Venkatapuram for vomiting/abdominal pain during June-October 2020. Both males and females were highly affected. The number of vomiting/abdominal pain cases was lowest in SCBS Colony.

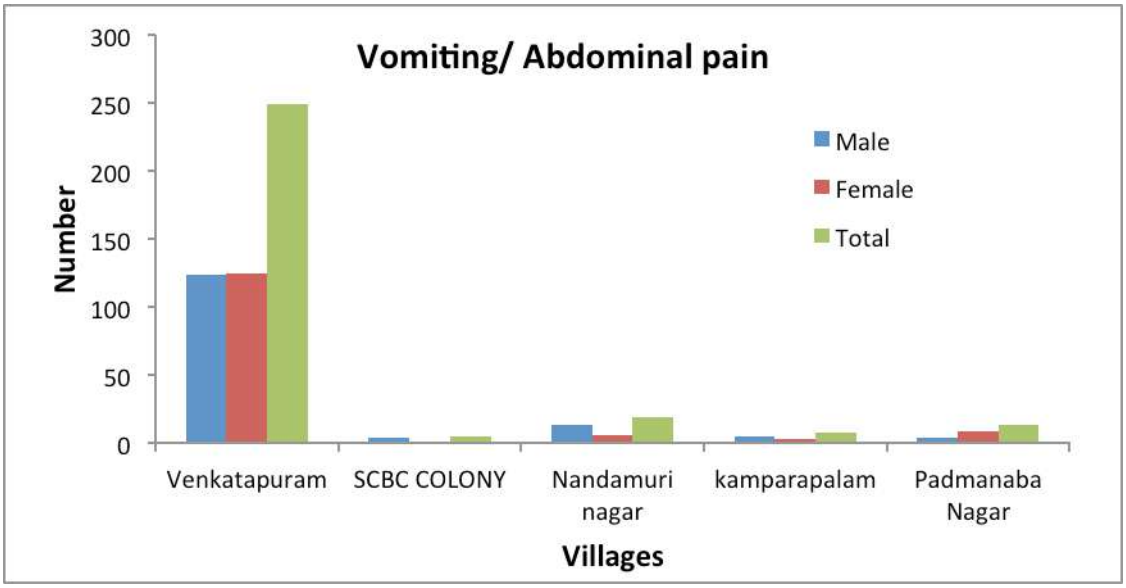


Fig. 2.5.28: Secondary data on vomiting/abdominal pain (June-October 2020)

Fig. 2.5.29 shows that number of OPDs was highest in Venkatapuram for neurological disorders during June-October 2020. Both males and females were highly affected. The number of neurological disorders cases was very low in kamparapalam and SCBC Colony.

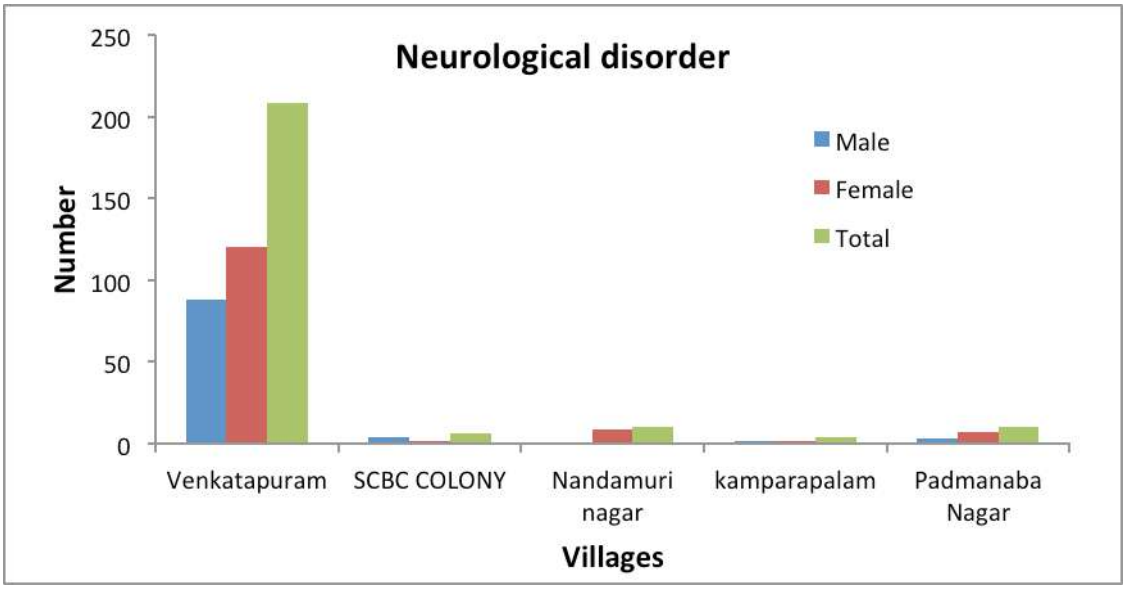


Fig. 2.5.29: Secondary data on neurological disorders (June-October 2020)

Fig. 2.5.30 shows that number of OPDs was highest in Venkatapuram for skin diseases during June-October 2020. Both males and females were highly affected. The number of skin irritation cases was lowest in SCBC Colony.

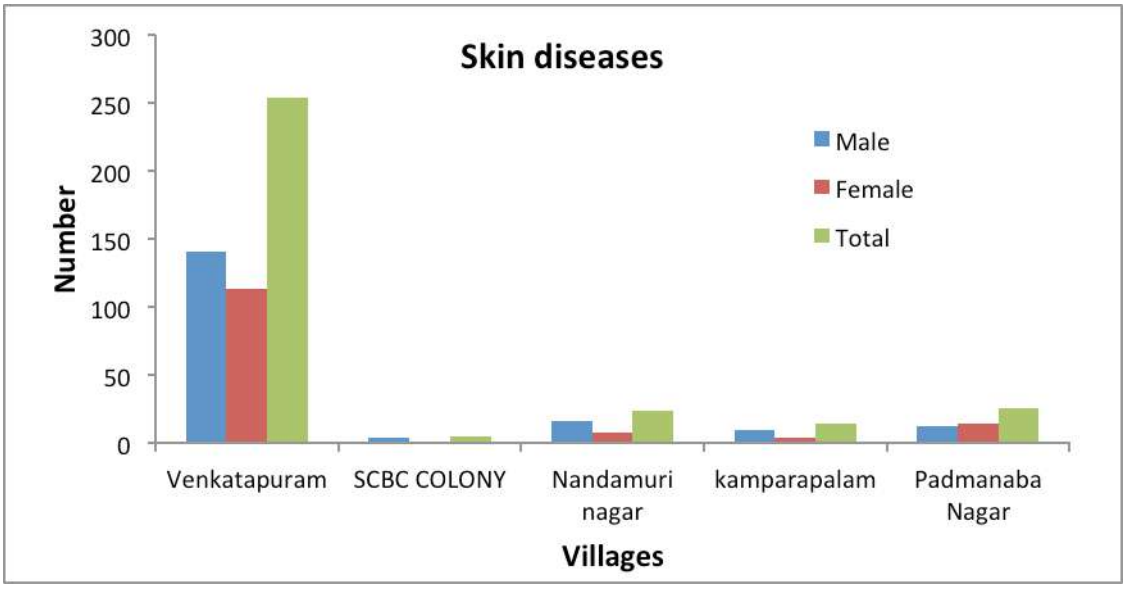


Fig. 2.5.30: Secondary data on skin diseases (June-October 2020)

There were no cases of diarrhea or death during this period in the investigated villages. In all, the data showed high prevalence of potential styrene-induced health effects (throat/nasal irritation, eye irritation, vomiting/abdominal pain, neurological disorder and skin irritation) in Venkatapuram. Thus, this village seems to be the most affected from the gas leak incidence. It is in agreement with primary data, where participants from this village reported the highest complaints of above health effects as compared to other villages. The villagers from Venkatapuram also reported highest persistence of these complaints months after the gas leak, as shown in the primary health data section.

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CHAPTER 3

IMPACT ASSESSMENT

3.0 Impact Assessment

The impacts on ambient air quality, surface and ground water bodies, soil environment and soil microbial diversity in the study area are presented. The details are given in the following sections.

3.1 Impact Assessment on Air Environment

The dispersion analysis of SMV due to the accidental release M6 tank of LGPL was carried out by the Technical Committee as reported in the HPC report are given as secondary data.

3.1.1 Meteorological Setup

The toxic vapours from M6 tank were released around 02.54 A.M on 07/05/2020 and continued till morning of 08/05/2020. The wind direction was observed to have varied from 71.3º to 245º from 02.00 A.M to 10.00 P.M on 07/05/2020. The temperature and relative humidity have varied from 25.97 to 31.1ºC and 83 to 91% during 2 A.M to 10 P.M on 07/05/2020. No wind speed data was available on 07/05/2020 till 8 A.M. The wind speed was observed as 1.67 m/s and 1.7 m/s at 9 P.M and 10 P.M, respectively, on 07/05/2020. However, the wind speed recorded in the morning hours of 08/05/2020 (from 3 A.M to 5 A.M) was 0.5 to 0.6m/s. The observed wind direction was 172º during 3 A.M to 5 A.M. The wind direction was varying from 118º to 278.8º during 6 A.M to 10 P.M on 07/05/2020.

3.1.2 SMV Emission or Loss Calculation

The M6 tank contained SM of about 1800 MT on 06/05/2020. The SM got released at about 02.54 A.M on 07/05/2020 from a height of about 12.5 m, which is the height of vent on M6 tank above the ground.

The technical committee (TC) has analysed the inventory of M6 tank from 02.50 A.M on 07/05/2020 till 09/05/2020, from the SMV level records of SM in the tank. From the SM level record data between 02.50 A.M and 03.47 A.M and between 08.12 P.M and 10.00 P.M on 07/05/2020, the TC has arrived at the loss of styrene from the M6 tank between 03.03 A.M and 03.47 A.M on 07/05/2020 which represents the initial as well as peak period of release of SMV from the M6 tank.

The tank temperature was 109ºC at the measuring point and due to water pumping it increased to 125ºC by 08.45 P.M and to 150ºC by 09.38 P.M due to evaporation.

The observed reduction or loss of SM in M6 tank during 03.05 A.M to 03.20 A.M, 03.20 A.M to 03.35 A.M and 03.35 A.M to 03.47 A.M on 07/05/2020 was found to be 30.91MT, 42.14 MT an 8.43 MT, respectively. The reduction or loss of SM in M6 tank during 09.14 P.M to 10.13 P.M was found to be 16.86 MT.

3.1.3 Dispersion of SM and Threat Zones or Zones of Influence

ALOHA model was used to study the dispersion characteristics of SM released and identification of threat zones or zones of influence with the data on SM loss, M6 tank details and meteorological data.

The validation of ALOHA results was done with loss of SMV of about 16.86 MT during 09.14 P.M to 10.13 P.M on 07/05/2020. The wind speed observed as 0.7 m/s at 9 P.M and 0.6 m/s at 10 P.M. The temperature and relative humidity were 31.4ºC and 31.1ºC and 82% and 83% at 9 P.M and 10 P.M, respectively, on 07/05/2020. The wind direction was between 193º and 248º. Using the above data it was found that the predicted concentration was 422 ppm occurred at 380 m from the source, whereas the observed concentration was 365 ppm at 380 m distance from the source. Based on this, the TC arrived at the loss of SM during initial incident between 03.05 A.M to 03.35 A.M on 07/05/2020.

An amount of 46 MT was taken as loss of SMV at the time of the accident for about 15 minutes release is considered as for estimating the concentrations of SMV and the threat zones / zones of influence using ALOHA along with wind speed of 0.62 m/s for three different wind directions 120º, 145º and 172º, temperature of 25.5ºC and RH 92% (between 3 AM and 5 Am on 07/05/2020).

The predicted threat zone areas, affected in hectares, with different wind directions of 120º, 145º, and 172º is shown in **Fig. 3.1.1**on Google Earth Map and in **Fig. 3.1.2** on GVMC Map, respectively (Adopted from HPC report). The ALOHA model uses 60-minute Acute Exposure Guideline Levels (AEGL) with the following concentrations as AEGL-1:20 ppm (Yellow Zone); AEGl-2:130 ppm (Orange Zone) and AEGL-3: 1100 ppm (Red Zone).

The predicted Red, Orange and Yellow zones for an SM loss/emission of 46 MT from the M6 Tank during 3.20 a.m. to 3.25 a.m. is extended from the source up to 0.421 km, 1.2 km, and 2.9 km, respectively. The maximum concentration is predicted in the red zone. The predicted ambient Styrene concentration at 200 m and 400 m is 5400 ppm and 1220 ppm, respectively.

The predicted red zone extends up to 0.421 km and the Venkatapuram villages are located within this red zone. The occurrence of death cases is also observed to be within this zone of influence which is around 0.42 km.

The orange zone extends up to 1.2 km, the areas might have experienced a concentration more than 130 ppm up to 1100 ppm, and this orange zone encompasses areas like Gopalapatnam, Naidu Thota, etc. as vulnerable areas.

The yellow zone where the Styrene predicted concentration is more than 20 ppm got extended up to 3 km from the SMV emissions source because of which most of the areas beyond NAD Kotta Road, Marripalem, Muralinagar experience pungent chemical odours. The Yellow zones cover most of the area in West, North West direction including part of MeghadriGedda reservoir area. The field verification indicates that the pungent odours were felt even beyond NAD Kotha Road, Marripalem, Marriot Fair filed hotel, Muralinagar area, and Airport area and so on.

The Immediately Dangerous to Life or Health (IDLH) level is 700 ppm. The above modelling estimates indicate that the IDLH limits were significantly crossed up to 200 m from the source and even up to 400 m.

The total or combined area covered under the three wind directions (120^{o}, 145^{o}, and 172^{o}) for emission of 46 MT is calculated as 31.08 ha in Red Zone, 166.29 ha in Orange Zone and 715 ha in Yellow Zone.

3.1.4 Threat Zones in terms of ERPG Levels

The ALOHA model used to predict the SMV concentrations and Threat Zones/ Zones of Influence in terms of Concentrations and distances with a source strength of 46 MT for a release time of 15 minutes by CSIR-NEERI-HZC. The wind direction is 172º, temperature is 25.5ºC, relative humidity is 92% and stability class E and F are considered for different wind speeds 0.62 m/s, 1.2 m/s, 1.5 m/s, 1.8 m/s and 2.0 m/s. The results are given in **Table 3.1.1**.

The ALOHA model uses 60-minute The Emergency Response Planning Guidelines (ERPG) with the following concentrations as ERPG-1: 50 ppm (Yellow Zone); ERPG-2: 250 ppm (Orange Zone) and ERPG-3: 1000 ppm (Red Zone). The predicted threat zones for wind speed of 0.62 m/s and wind direction of 172º are shown in **Fig. 3.1.3**. It is observed that Red zone representing ERPG-3 extended up to 0.44 km, Orange zone representing ERPG-2 extended up to 0.87 km and Yellow zone representing ERPG-1 extended up to 1.9 km respectively, from the source of incident. The villages like Venkatapuram falls under Red zone and the villages like Naidu Thota falls under Orange Zone

The predicted SMV concentrations and Threat Zone distances from the source are in coherence with the HPC Report findings.

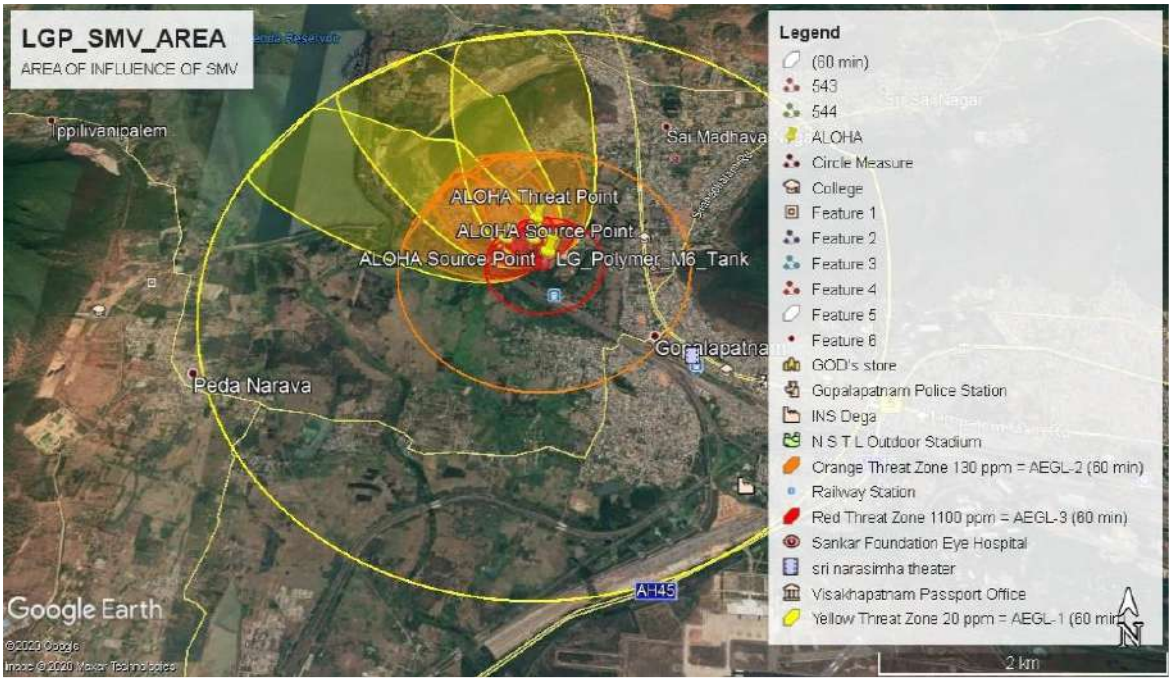


Fig. 3.1.1 Zone of Influence in three different wind directions using 46 MT loss of SMV on 7/5/2020 (Source: HPC Report)

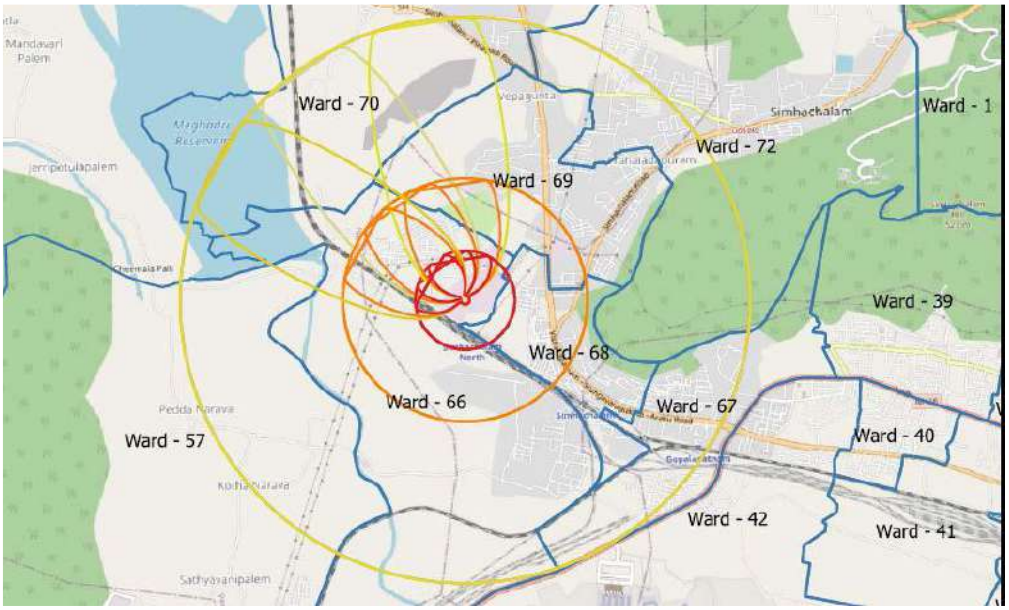


Fig. 3.1.2 Zone of Influence on GVMC Map (Source: HPC Report)

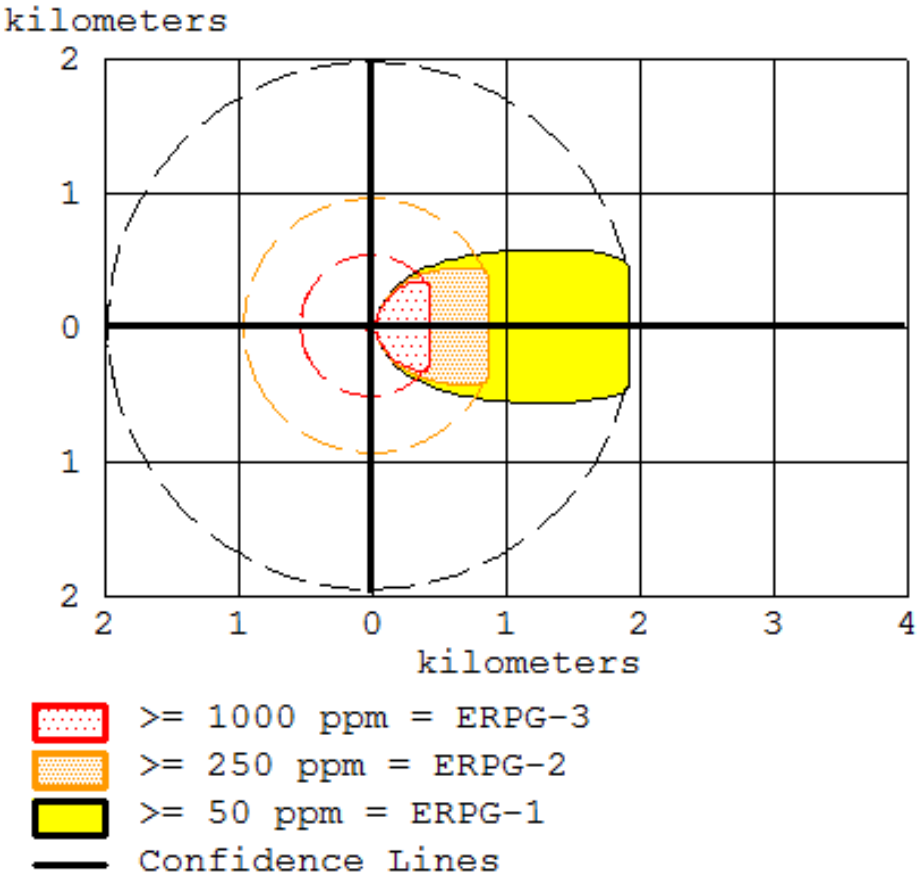


Fig. 3.1.3 Zone of Influence with wind speed 0.62 m/s and wind direction 172º using 46 MT loss of SMV on 7/5/2020

Table 3.1.1 Concentrations of SMV and Threat Zones

WS (m/s)	Threat Area (m)			Styrene Concentration (ppm)			
				200 m from Source		400 m from Source	
	Red (250 - 1000 ppm)	Orange (50 – 250 ppm)	Yellow (up to 50 ppm)	Outdoor	Indoor	Outdoor	Indoor
0.62	440	869	1900	5390	346	1220	70
1.2	386	788	1900	3980	314	930	72.9
1.5	298	625	1700	2020	180	547	48.6
1.8	261	584	1600	1640	163	472	46.9
2.0	230	568	1600	1480	158	445	47.4

References

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3.2 Impact Assessment on Water Environment

Prediction for the future years:

- It has been observed since May 2020 that there was not much change in the water quality.
- All the groundwater quality parameters showed values within the permissible limits of BIS. The surface water quality parameters also showed values within the drinking water quality standards. However, taking a close look at the water quality parameters, the frequent testing of groundwater quality and surface water quality needs to be undertaken frequently.
- The Meghadrigedda reservoir water is being used by the Navy and other parts of areas around LG polymers. The reservoir water needs to be treated with activated charcoal before its sent to the people for treatment.
- Care has to be taken that no effluent discharge takes place in the study area and the dug wells etc needs to be covered so that no dumping takes place.

3.3 Impact of Styrene gas leak on soil

Styrene was analyzed in soil samples immediately after the gas leak (8-14 May 2020) and after about 5 months (28-30 October 2020). While the initial concentrations were very high (ranging from 109 to 5950 mg/kg) during first set of sampling period 8-14 May 2020, however,styrene could be detected in only 2 samples at very low concentrations (0.15-4.7 ppb) during October 2020 sampling. Thus, there was acute exposure to very high level of styrene during the gas leak, which was above the CCME guideline values of 0.1 mg/kg and 50mg/kg for agriculture and industrial activities of the soils respectively. However, it subsequently dissipated due to high volatility, biodegradation or other abiotic factors. Hence, there was no chronic exposure to the population and cattle through soil at the examination site.

The affected soil quanity in the impacted area in the northwestern direction is computed using landuse/land classification (**Fig. 3.3.1**).The LULC map of LG Polymers has been prepared for the 3 km buffer around the LG Polymers incident site. The LULC has been taken from the Bhuvan website for the available latest year 2015-16. The area of classification in the impacted area/wind direction area is given in **Table 3.3.1**.

The affected soil quanitity is calculated considering the area of Agriculture (Fallow, crop land and plantation) and Barren/Uncultivable/wasteland amounting to 3.77 km^2 as given **Table 3.3.1**. The soil quanity of 2.24 Million Kg (if depth is 15 cm) per hectare (Srivastava et

al., 2015) is taken for total affected soil quanity computation. The impactd soil quanity in the affected area is estimated as 1688969 Tons (i.e. 1.689 Millition Tons) for a depth of 30 cm, which is used for calculating the environmental damage cost assessment (EDCA) for soil environment..

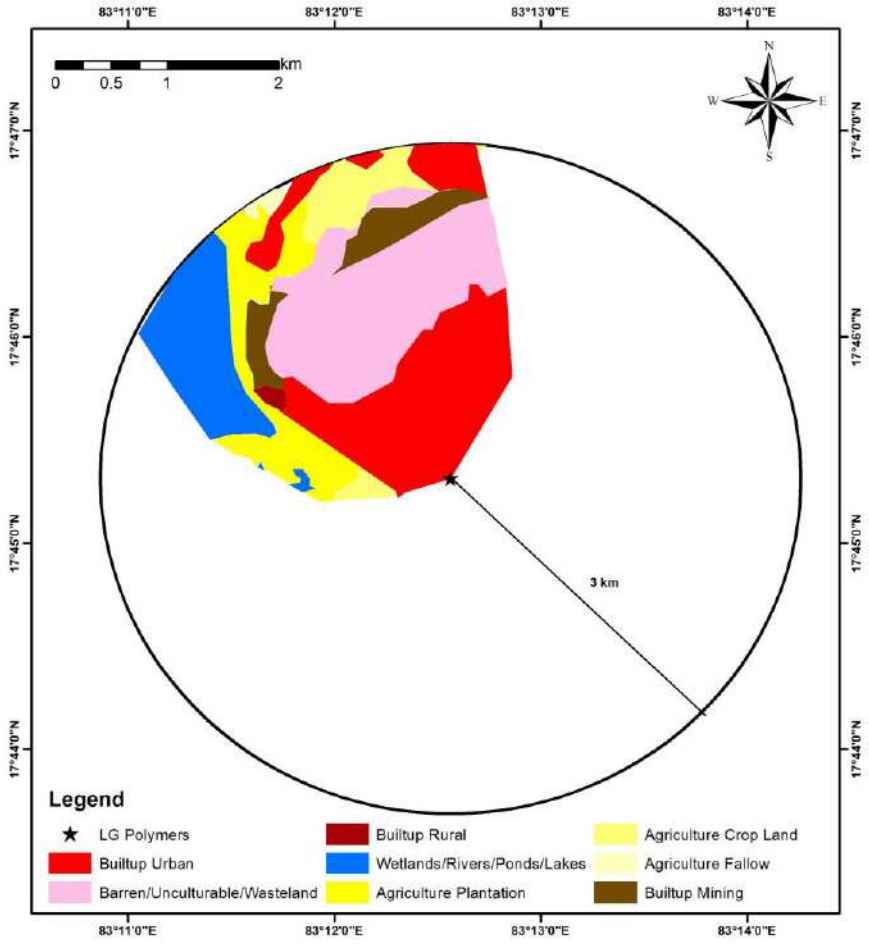


Fig. 3.3.1 LULC Map of Affected Area

Table 3.3.1 LULC Classification and Respective Area

S.No.	Classification	Area (in sq.km)
1.	Builtup – Urban	2.10
2.	Builtup – Rural	0.04
3.	Builtup – Mining	0.49
4.	Wetlands/Water Bodies/Lakes/Rivers/Ponds	1.00
5.	Agriculture – Fallow	0.05
6.	Agriculture – Crop Land	0.55
7.	Agriculture – Plantation	1.00
8.	Barren/Unculturable/Wasteland	2.17
Total		**7.4**

3.4 Assessment of styrene gas leakage incident on soil microbial diversity

The styrene derived products known to affect the diversity of soil microbial flora and alteration of soil microbial diversity could deteriorate the soil quality and function. Thus, this study evaluated the soil microbial diversity around LG polymers Pvt. Ltd. to assess the damage caused by styrene gas leak incident on soil microbes. The main intention of this analysis is to calculate the economic loss due to loss of soil microbial flora and to propose effective restoration plans to improve the soil microbial diversity, if the soil microbial community was affected by styrene gas leakage.

This study included the analyzes of total bacterial and fungal diversity in the soil to assess the styrene gas leakage incident as bacterial and fungal diversity is important for the functioning of soil [1, 4, 5]. In addition, the nitrogen fixing bacteria, Chemoheterotrophs and phosphate solubilizing microbes play important roles in maintaining the soil quality [6, 7, 8, 9]. Thus, the damage caused by styrene gas incident on nitrogen fixing bacteria, Chemoheterotrophs and phosphate solubilizing microbes was also assessed herein. Additionally, the prevalence of common bacterial pathogens in the soil was also studied.

This study grouped the soil samples into three groups based on the zone of the soil sample locations i.e. zone 1 (within 1 KM radius around LG Polymers Pvt. Ltd.), zone 2 (1-3 KM from LG Polymers Pvt. Ltd.) and zone 3 (3-5 KM from LG Polymers Pvt. Ltd.) and the results were analyzed. The reason for analyzing the microbiological results based on zones is that different areas around the LG polymers Pvt. Ltd. might have exposed to different concentration of styrene during the styrene gas leak incident based on their distance from the incident site. For instance, the zone-1 (within 1 KM radius around LG Polymers Pvt. Ltd.) might have exposed to a higher level of styrene chemicals as compared to other two zones whereas the zone-3 (3-5 KM from LG Polymers Pvt. Ltd.) might have experienced a low intensity of styrene gas/ not exposed to styrene gas due to the distance of zone-3 from the styrene gas leakage incident. Therefore, the analyses of microbiological parameters by grouping the samples into different zones could help to properly compare and assess the damage of soil microbial flora due to styrene gas leakage incident.

Based on our knowledge of distance of sampling locations, it is expected to have a distinct microbial diversity profile for zone-1 samples, if the soil microbial flora was affected by styrene gas leakage incident. Nevertheless, the analyses did not show any significant difference in microbial diversity across three zones. The microbial diversity of all three zones was found to be more or less similar which indicates that the soil microbial flora was not affected by the styrene gas leakage incident. Another reason for not observing any difference in microbial diversity across three zones could be due to the fact that soil microorganisms have the capability to decompose styrene and repair the microbial diversity loss eventually. Thus, the diversity of soil microorganisms might have self recovered naturally by the time of sample collection even the microbial diversity was affected by the styrene gas leak incident. In summary, this study suggests that the soil microbial flora was either not affected by styrene gas leak incident or the soil microbial flora was recovered naturally by the time of sample collection.

3.5 Impact of Styrene gas leak on public health

The primary questionnaire survey recorded the incidence of chief health complaints experienced immediately after the gas leak and five to six months after the incidence. It was to trace the incidence and persistence of potential styrene-induced health effects. It was observed that participants from Venkatapuram reported the highest complaints of health effects (throat/nasal irritation, eye irritation, vomiting/abdominal pain, neurological disorder and skin irritation) as compared to other villages. The villagers from Venkatapuram also reported highest persistence of these complaints months after the gas leak. Secondary health data was also collected from local public health centers for the duration June to October 2020.

This data also showed high prevalence of potential styrene-induced health effects (throat/nasal irritation, eye irritation, vomiting/abdominal pain, neurological disorder and skin irritation) in Venkatapuram. Thus, this village seems to be the most affected from the gas leak incidence in agreement and conformation with the primary health data.

A medical examination through a team of doctors may be conducted further to verify and quantify the long-term health effects of styrene exposure.

References

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CHAPTER 4

Environmental Damages Cost Assessment (EDCA) for Styrene Gas Leak

4.1 Introduction

Anthropogenic activities are generally one of the triggering factors that cause adverse effects on environmental goods which finally leads to environmental damages [1].

Natural resources shape the environmental goods which are capable of being unitary such as wild flora and fauna, air, soil, water, or in a combined form such as ecosystem, biodiversity, territory. It also provides ecosystem services that incorporate landscape, subsistence, drainage, purification, tropic production, control of gas and climate, nitrogen cycling, prevention and alleviation of disruptions, so on, and private and public anthropic services to human beings [1].

Anthropogenic activities inflict environmental degradation in many ways which should be discouraged, following the concept of sustainable development [1]. Environmental damage cost assessment (EDCA) is the tool that scrutinizes the potential loss in monetary terms due to anticipated impacts on the environment due to the release of pollutants beyond safety. EDCA is part of economics mainly emphasizing sustainability around the globe. The main purpose of the assessment is not to hinder any type of development in the country, but to retain the ecosystem in its pristine condition to avail the maximum benefits to humans. The major objectives of EDCA include [1]:

- Illustrate the nature of the damage and the connection between the damage and the illegal, defective, or negligent actions that have caused it.
- The determination and quantification of the damage.
- To figure out an appropriate protocol to value the loss monetarily.

The above-mentioned objectives are achieved by executing the EDCA procedure in two stages [1].

Stage 1: Determination of the damages.

This stage includes the determination of the impact caused by the source on the environment by a collection of samples and its analysis. Environmental impact is evaluated by observations, images, analyses, witnesses, and other relevant elements, such as experimental investigations, estimates, models, and comparisons with related circumstances or historical patterns, by recording the impact of the source on the targets.By documenting the damage scenario through the identification and characterization of the source, exposure pathways, and targets, the cause-effect link is verified. The targets are defined in terms of natural resources that are exposed to the source term's effect [1].

Stage 2: Quantification of the damages.

In this stage damage quantification is done by analyzing its extent, severity, and duration in terms of any alteration, deterioration, partial destruction, or destruction made by the source upon the environmental elements or to the services they provide. These damages are compared and quantified with the aid of permissible limits of pollutants [1].

a. Methodological framework:

Concerning the objectives of EDCA explained above, the methodological framework for this project involved the assessment of damages caused by the impact of styrene gas leakage from the LG polymers to the ambient air, water sources, soil, and the nearby ecosystems. A questionnaire survey, which can be used as an efficient tool for the collection of data regarding health issues suffered by the nearby residents, is also used along with this. The questionnaire survey mainly focuses on assorting details about health issues due to the impact, its analysis, and assessment of environmental damages cost is done with the help of Mortality damages cost, Morbidity damages cost, and with the application of the concept "Willingness to accept". Damage costs for livestock and crop damage are also included in the assessment. The designed methodological framework for this purpose is explained under different subsections as provided below.

- Demographic and social survey related to the Styrene gas leakage accident.
- Environmental Damages Cost Assessment of Air, Water, Soil, Livestock & Cropland.
- Assessment of Environmental Damages using Contingent Valuation Method

4.2 Styrene Gas Leak Impacts: Demographic and Social Survey

A questionnaire survey was prepared for the primary data collection and the questions are asked among the residents residing within a 5km radius from the M6 tank of LG polymers. The survey period was from 28th October 2020 to 3rd November 2020. The questions asked include their basic details such as name, age, gender, residing area, occupation, education, and annual income. Preliminary health information is also collected by asking the residents about the major health issues they have before the styrene gas leakage accident, the medications they take, and the cost incurred for their treatment. The questionnaire survey also included questions about the immediate impact confronted by the residents on 7th may 2020, the number of days hospitalized, and the treatment cost. To understand the severity of the disaster details about long-term health issues after the accident, the number of days hospitalized due to these issues, and the treatment cost, etc are collected and it also included questions about their preferences on "willingness to accept" and seek the government's support for the efficient maintenance and improvement of their existing ecosystem.

The total respondents to the questionnaire survey conducted among the residents residing within a 5km radius from the accident epicenter were 409.All the collected data were first tabulated in excel sheets. Pie charts, bar charts, etc. are prepared based on these excel sheets, analyzed, and the results obtained are used in the assessment of environmental damages cost. The different characteristics and the related details of the questionnaire survey are provided in the table below (**Table 4.1**).

Table 4.1: Characteristics of the questionnaire survey.

Characteristics of the questionnaire survey	Details
Population size	About 20000 (In the HPC report, it had been mentioned that 20000 people from the accident zone have been evacuated)
No. of respondents	409
Survey period	From 28.10.2020 to 03.11.2020
Confidence level	95%
Margin of error	4.80%

The data collected and analyzed through the extensive questionnaire survey in the study area and the results derived are explained in detail below:

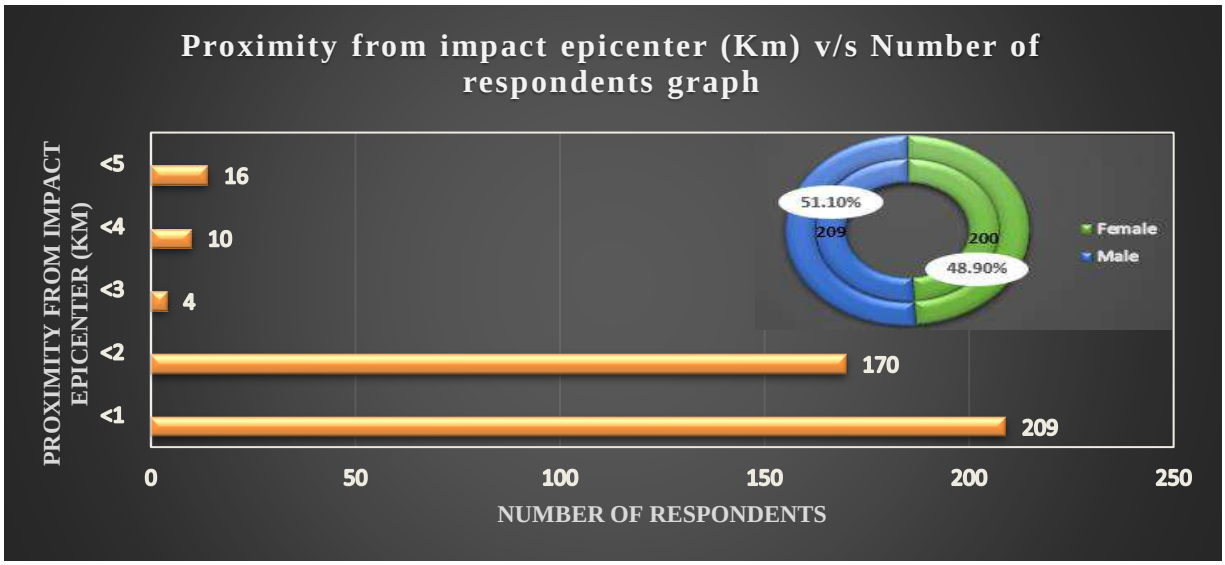


Figure 4.1: Distribution of responses within the study area &Count of gender classification among the survey respondents.

The above bar chart (**Fig. 4.1**) depicts the number of respondents to the questionnaire survey according to the distance from the accident epicenter. The main focus of the questionnaire survey prepared was to collect details about the effects of Styrene gas leakage from the residents mostly residing nearer to the accident epicenter. And the results show that more than 50 % of the total respondents are from a 1km radius of the accident zone. The total number of responses within a 2 km radius amounts to 379 and hence 92.66% of the responses are within a 2km radius which is close to the accident zone and gave more reliable responses. Among the total respondents to the questionnaire survey 200 respondents which corresponds to 48.89% of total peoples surveyed were females and 209 respondents were males which were 51.10% of total respondents. Hence the questionnaire survey had attempted to cover these divisions of gender, almost in equal proportion so that the health effects of styrene in both genders can be studied. However, the survey shows that the people suffered from Headache ache, Breathing issues, Fatigue, Nausea, Changes in color vision, Vomitting, Physical weakness, Eye irritation, skin problems, and skin rashes, Mental illness, Psychological problems, Burns & injuries, and Drowsiness irrespective of the gender due to the impact of styrene gas leakage.



Figure 4.2: Occupational details of the survey respondents.

The above bar chart (**Fig. 4.2**) is made out of details provided by the peoples, corresponding to the questions related to the occupational details of the respondents. It portrays that 32.27% of the respondents are employed peoples while 66.01% comes under the unemployed category.1.71% of respondents have not disclosed their occupation details. The occupational details are important in a questionnaire survey since it aids in understanding the hierarchial social categories such as upper, middle, and lower-class groups and gives a better

understanding of their income status which also helps to understand their preferences towards the concept of “willingness to accept”.

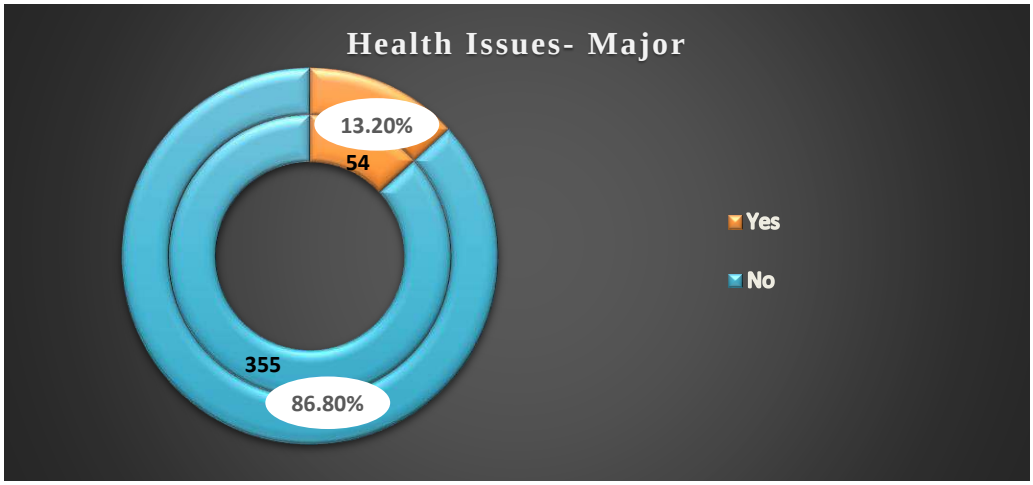


Figure 4.3: Preliminary health information.

The questionnaire survey conducted consists of questions related to the preliminary health issues of the participants before the styrene gas leakage and aided in understanding the number of people with major health issues before the impact. The major health issues among some of the peoples before the impact include Blood pressure, Cardio diseases, Breathing issues, Heart problems, Thyroid, Blood sugar, etc.

The above piechart (**Fig. 4.3**) illustrates the number of people having major health issues before the styrene gas leakage incident. Out of 409 respondents, 54 peoples are facing major health issues and it corresponds to 13.20% of the total respondents.

The data collected from the peoples about the immediate health issues confronted by them due to the styrene gas leakage constitute health issues such as Headache ache, Breathing issues, Fatigue, Nausea, Changes in color vision, Vomitting, Physical weakness, Eye irritation, skin problems, and skin rashes, Mental illness, Psychological problems, Burns & injuries, and Drowsiness, etc.

The following bar chart (**Fig. 4.4**) represents the health issue confronted and the number of people who had effected by this health issue due to the styrene gas leakage according to their proximity from the impact epicenter.

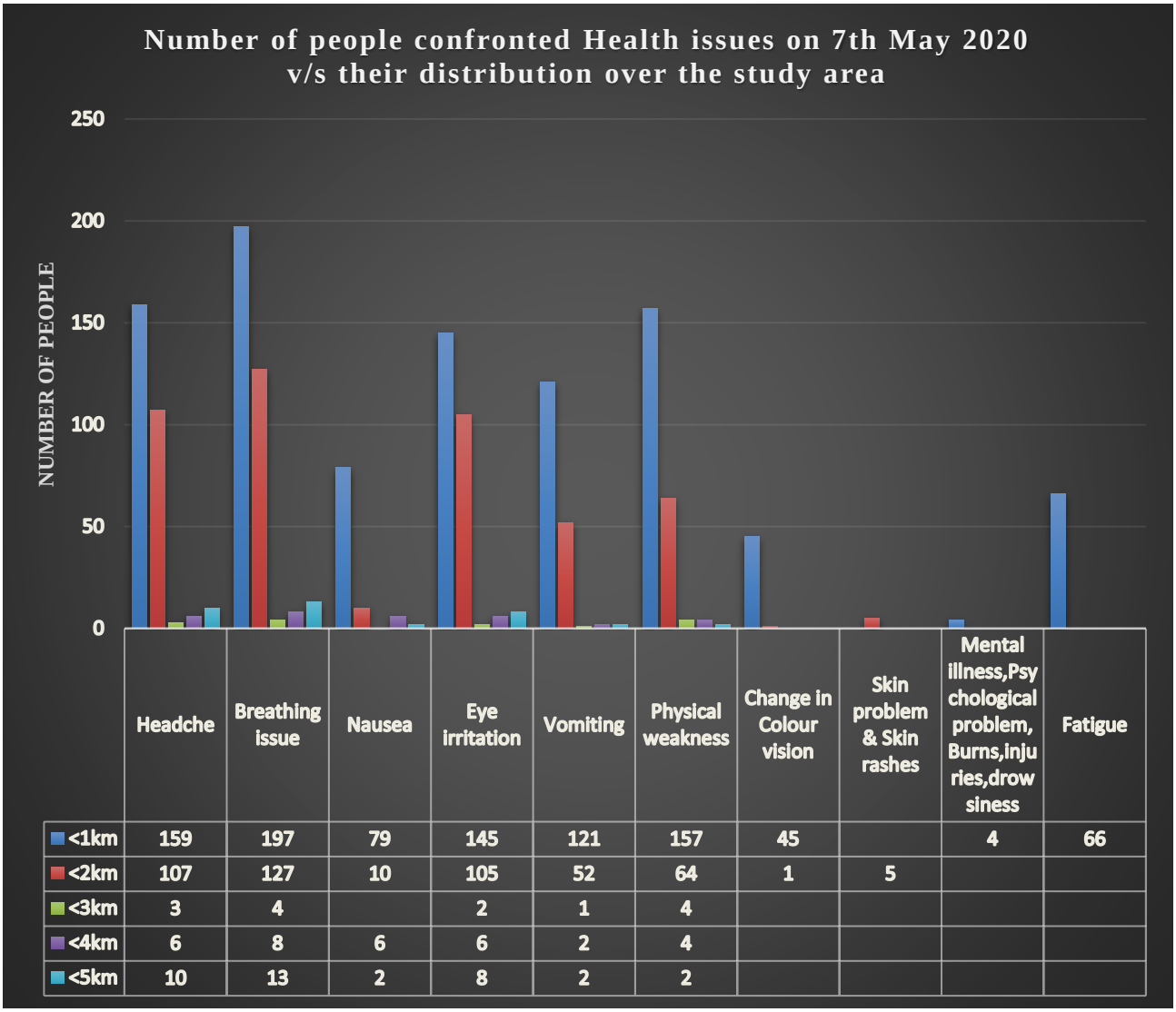


Figure 4.4: Immediate health issues confronted on 7th May 2020.

Dizziness, nausea, vomiting, and breathlessness are caused by sudden exposure to styrene gas. Its effects include blistering and inflammation when it comes into contact with skin and mucosal membranes.The gas also irritates the nose and throat, causes shortness of breath and chemical inflammation of the lung tissues. Exposure to deadly quantities of the gas can cause fluid to accumulate in the lungs, and kill the person.The effects of Styrene gas on the brain include a sense of drunkenness, color vision changes, tiredness, confusion, and problems maintaining balance. The analysis of the above bar chart depicts that almost all the above-mentioned effects of styrene gas were confronted by the residents near LG polymers during the day of the accident on 7th May 2020. The effects were highly amplified within a radius of 2 km. Most of the peoples suffered from Headache, Breathing issues, Fatigue, Nausea, Change in color vision, Vomiting, Physical weakness & Eye irritation. Even though the number of people affected with Skin problems & Skin rashes, Burns, injuries, etc is very low the severity of the issue was very high.

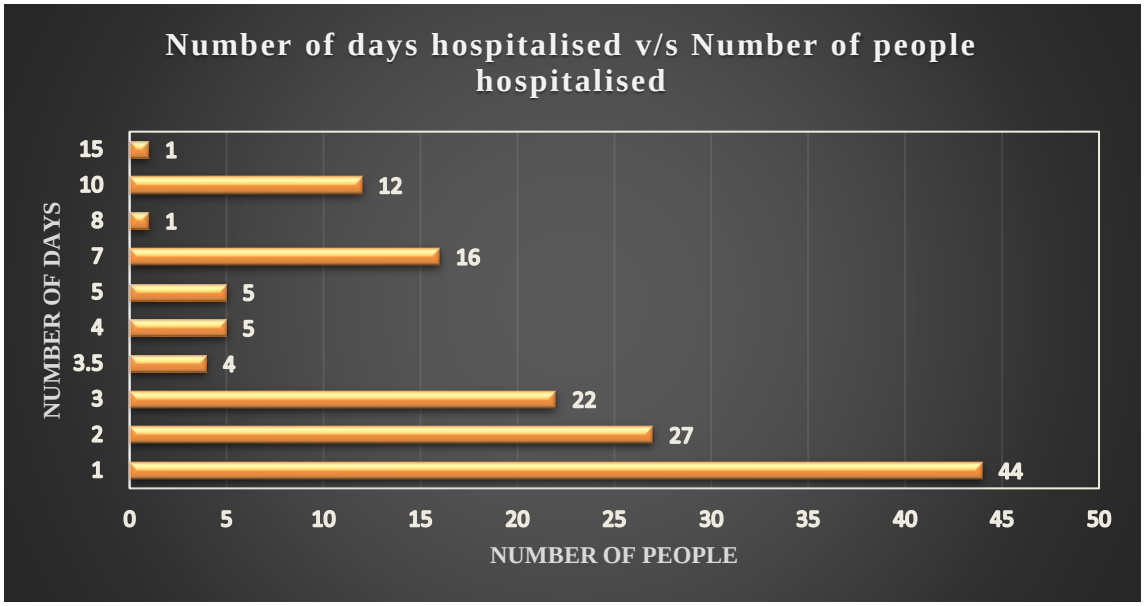


Figure 4.5: Count of days hospitalized by the affected survey respondents.

The above bar-chart (**Fig. 4.5**) exhibits the total number of days spent by the affected person in the hospital and the number of people hospitalized. It shows that 137 persons were hospitalized after the immediate impacts of styrene gas leakage. The extensive approach of the questionnaire survey also figured out that the rest of the people, though diagnosed with multiple issues were not admitted into the hospital due to the perpetual COVID-19 pandemic. Henceforth, the government camp had been set nearby the accident zone where the people visited multiple times for the treatment. Besides, a few of the people also went to the private clinic/hospitals as well as to the King George Hospital, Vizag several times but are not admitted into the hospital due to the less severity of the health issues.

Chronic exposure to styrene in humans results in effects on the CNS, with symptoms such as headache, fatigue, weakness, depression, CNS dysfunction (reaction time, memory, visuomotor speed and accuracy, intellectual function), and hearing loss, peripheral neuropathy, minor effects on some kidney enzyme functions and the blood [2]. Also, several clinical studies show that in humans who are occupationally exposed to styrene for long periods, effects like irritation of conjunctival and respiratory mucosa and pre-narcotic symptoms are reported. Neuro toxicity involving the central as well as the peripheral nervous systems was reported in some cases also [3]. The details collected regarding long-term health issues (**Fig. 4.6**) illustrate, 114 people reported that they are still facing health constraints such as physical weakness, skin problems, fever, headaches, stomach aches, etc. Furthermore, major health problems such as nerve problems, eyesight problems, fits, gastric problems, increase in BP have also been reported for a few of the residents affected. Out of the 114

people, only 48 went to the hospital (Government and Private hospitals) for treatment. The following bar chart provides information about the long-term health issues still faced by the residents near LG polymers and the number of people having the issue.

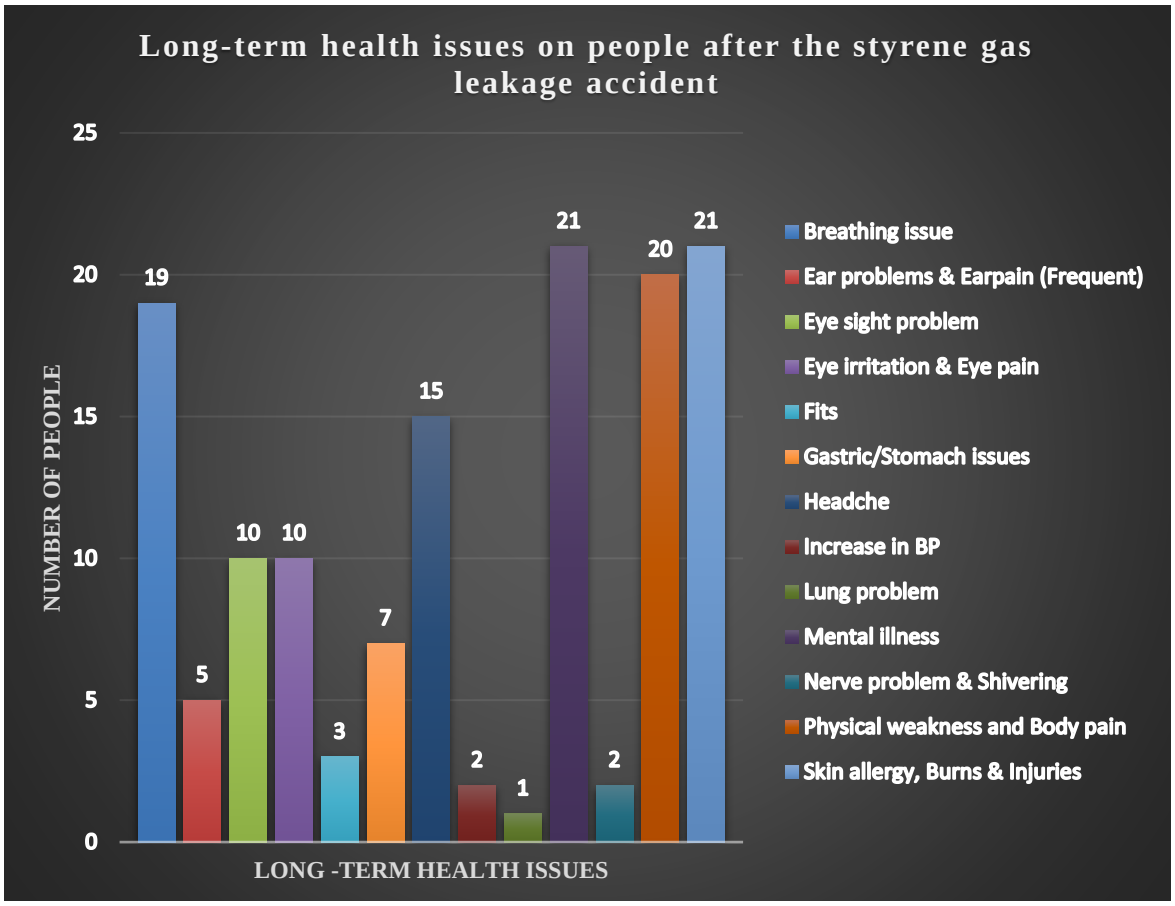


Figure 4.6: Details of Long term health effects caused due to the Styrene gas leakage.

The questionnaire survey included the questions related to the severity of the long-term health issues and are asked among the respondents to know its extent and to realize whether they are aware of the severity or not (**Fig. 4.7**). About 63.20% of the 114 people suffering long-term health issues confessed that they are not aware of the severity of the health issues. The permanent health issue amounts to 12.3% while the temporary issues were 16.70%. A value of 7.90% of people out of 114 have reported both permanent and temporary long-term health issues.

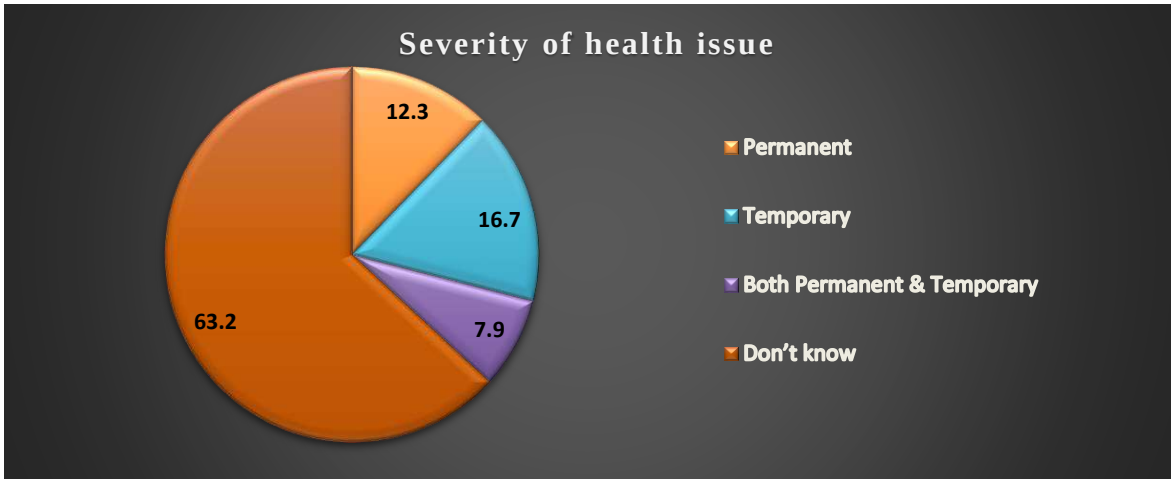


Figure 4.7: Details regarding the severity of long term health issues.

The following piechart(**Fig. 4.8**) depicts the individual preferences towards the efficient maintenance of the existing ecosystem. Out of the 409 participants, 285 peoples which correspond to 69.68% of the total participants responded positively and are seeking the government's support in maintaining and enhancing the existing ecosystem while 124 showed negative responses which are 30.32% of the total surveyed people.

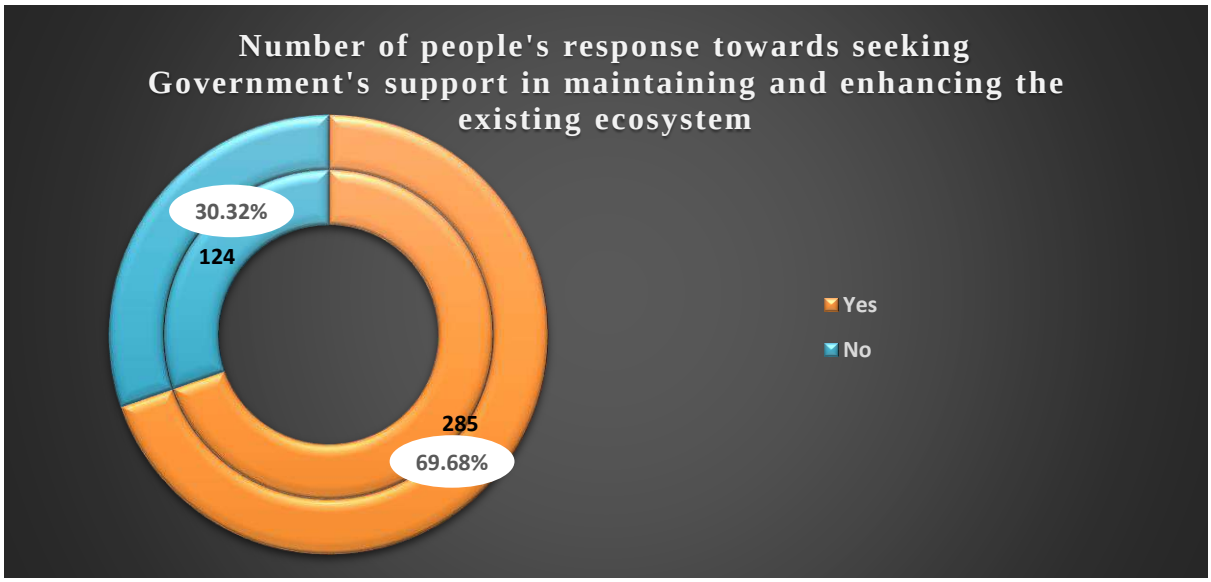


Figure 4.8: People's responses towards seeking Government support in the maintenance of their ecosystem.

4.3 Assessment of Impacts on Livestocks and Croplands

The questionnaire is prepared in such a manner that it included questions relating to other losses confronted by the peoples such as loss of cattle/cropland etc. It also consisted of

questions regarding the sources of water used by the survey respondents for their drinking, domestic, and irrigation purposes.

Details of damages to cattle/Domestic animals

The data collected with help of the questionnaire survey shows that 34 people owned cattle/domestic animals out of the 409 respondents. And many of them lost their cows, calves, buffaloes, buffalo calves, sheep, goats, hens, dogs, birds, and fishes due to the styrene gas leakage accident. A few of them got their cattle/domestic animals treated with the aid of the Animal husbandry department. The details of the number of owners whose cattle/domestic animals were affected by styrene gas leakage accidents are tabulated in **Table 4.2** given below.

Table 4.2: Details of cattle/domestic animals affected by Styrene gas leakage

Cattle/Domestic animals	Owners	No. of cattle/domestic animals owned	Status
Cows	4	11	2 people lost their 7 cows and the other two people's cows got their treatment.
Calves	2	4	1 person lost 3 calves and the other person lost one
Buffalo	3	5	1 person lost her buffaloes and treatment was provided for the other two people's buffaloes
Buffalo calves	1	2	Treatment was provided
Goats	1	2	Loss of goat
Hens	2	Multiple	Both the owners lost their hens
Sheep	1	2	Loss of sheep
Dogs	14	14	9 lost their dogs, 1 person got their pet treated, 4 people's

			dogs were not affected
Birds	2	Multiple (<10)	Loss of hens
Fishes	9	Multiple (<10)	Loss of fishes

Details of damages to cropland

The aggregated data regarding the croplands near the accident zone revealed that 9 people owned cropland nearby the accident zone. 8 of them confessed that the cropland is affected due to the styrene gas leakage accident. The leaves of plants near the accident zone have changed in color and withered away. The details such as the number of persons having cropland, its areal extent, income generated from the cropland before the accident, and the total loss incurred due to accident are provided in the following table (**Table 4.3**).

Table 4.3: Details of cropland affected by Styrene gas leakage

Size of the cropland	**No. of people**	**Income generated from the cropland before the accident**	**Total loss incurred due to the accident**
< 0.1 acre	3 (2 people owned 5 cents and the other owned 6 cents)	● One person-generated INR 400 per months (5 cents) ● One person does not know how much income was generated (5 cents) ● One person-generated INR 600 per month (6 cents)	● Don't know ● Don't know ● INR 600 per month from the accident
0.2 acre	1	No	No
1 acre	3	● Own purpose (Income is not generated) ● INR 10000 per month ● INR 5000 per harvest	● Don't know ● INR 50000 so far ● INR 10000 so far
2 acre	2	Both the persons generated INR 120000 per annum	INR 120000 so far

4.4 Environmental Damages Cost Assessment (EDCA)

The Environmental Damages Cost Assessment (EDCA) is carried out for the environmental elements such as Air, Water, Soil, livestock & cropland near the LG polymers based on the questionnaire survey conducted and with available approaches with suitable assumption if sufficient data is not available*.* EDCA is generally carried out using the below 3 steps.

- **Identification of pollutant**: The concentration of pollutants emitted beyond the standards is analyzed.
- **Identification of the EDCA method**: Based on the pollutant concentration and the damages that occurred suitable methodology is selected.
- **Damage Cost Assessment**: Monetary Loss due to the release of pollutants is quantified.

The observations and results derived from the assessment of damages to ambient air, water sources, soil, Livestock & Cropland are used for the EDCA and are explained as follows.

4.4.1 EDCA for Air environment

Mortality and Morbidity cost estimation is carried out to determine the cost of the environmental damage with the aid of a questionnaire survey conducted and with available information. Mortality refers to the number of deaths in a certain group of people in a certain period while Morbidity has been defined as any departure, subjective or objective, from a state of physiological or psychological well-being. In practice, morbidity encompasses disease, injury, and disability. The health issues confronted by the people due to the Styrene gas leakage accident on 7th May 2020 are analyzed and quantified to determine the environmental damages cost with the application of Mortality damages cost estimation by Value of statistical life (VSL) and Morbidity damages cost estimation by Cost Of Illness (COI) method.

The following **Table 4.4** shows the styrene concentrations measured in ambient air on the 7th and 8thof May 2020 from Venkatapuram Village and LG polymers Main gate.

Table 4.4 Styrene levels in ambient air

Location	Date	Time of Measurement	Styrene Concentration, ppm
Venkatapuram Village	07-05-2020	16.30	75.4
		17.30	151
		18.00	123
		19.00	11.2
		20.00	77
		21.00	54
		22.00	461
	08-05-2020	02.00	374
		03.00	170
		04.00	45
		05.00	11.7
LGPL Main Gate	07-05-2020	15.10	28.4
		20.00	54
		21.00	43
		22.00	365
	08-05-2020	02.00	242
		03.00	142
		04.00	37
		05.00	14.2

The average concentration of styrene in ambient air on 7th May 2020 = 131.18 ppm.

The Low Observed Adverse Effect Level (LOAEL) of styrene is 20-30 ppm [4] and hence excess of styrene concentration in the ambient air on 7th May 2020 is 111.18 ppm, which is used as the basis for EDCA.

Converting Styrene concentration in the air at 25ºC from ppm to µg/m^3 (1ppm of styrene = 4.26 mg/m^3)(C) [2].

Concentration, C = 473635 µg/m^3

Morbidity damages cost assessment

Carcinogenic effects of styrene

By using the following formulae number of persons indicating carcinogenic effects of styrene is calculated. While this is acute exposure, the potential for cancer risk is calculated using the formula given below given the high concentration released and assuming the applicability of formula.

Chronic Daily Intake (CDI) = $\frac{\mathbf{C*IR*ED*EF*L}}{\mathbf{BW*AT*NY}}$ --------- (1)

Lifetime cancer risk = CDI * IURF------- (2)

No. of people affected to cancer=LCR $*$ concentration exposed in the area (sq. km) $*$ population density ---------- (3)

For the calculations, the concentration (C in µg/m^3) for styrene is taken by averaging the monitored styrene levels on 7th May 2020. The inhalation rate (IR in m^3/d) value is taken from US EPA guidelines which are 8.3m^3/d. As per HPC and monitored ambient styrene level data, the exposure duration for styrene amounts to 2 days [5]. Accordingly, the values of Exposure Frequency (EF in Week/Year) and Length of exposure (L in years) are calculated. The average body weight (BW in kg) for males specified by ICMR- National Institute of Nutrition is considered in the calculations [6] with Average lifetime (AT in years) to be 69.73 [7]. NY is taken as the number of days per year. Based on CDI estimated, for calculating the Lifetime Cancer Risk (LCR) we have considered two values, wise IUR Factor for Styrene expressed as (µg/m^3)$^{-1}$ [8] which is 0.00000057 and No observed adverse effect level in humans (NOAEL), 34000 µg/m^3 [2]. The study area considered is within a radius of 5 Km from the impact epicenter and the population density expected in 2020 for the study area is 421 persons/Sq.km.

The Morbidity damages are calculated for the Carcinogenic effects of styrene by utilizing the following formula of the Cost Of Illness (COI) method.

Morbidity cost = $COI_{study\ area}$ * No of people affecting to carcinogenic effect [9] ----------(4)

Where,

$COI_{study\ area} = COI_{Andhra\ Pradesh} * \frac{\text{Per capita Income study area}}{\text{Per capita Income Andhra Pradesh}}$ [10]----------(5)

<u>Calculations</u>

Chronic Daily Intake (CDI) = $\frac{(C * IR * ED * EF * L)}{(BW * AT * NY)}$

CDI = 0.179

1) Lifetime Cancer Risk (LCR) = CDI * IURF

LCR = 0.00000010

No. of people affecting = LCR * Area * Population Density

= 0.0034

2) Lifetime Cancer Risk (LCR) = CDI * (1/NOAEL)

LCR = 0.00000525

No. of people affecting = LCR * Area * Population Density

= 0.1738

Morbidity Damage Cost Calculation by COI Method:

The cost of cancer treatment in AndhraPradesh as per NSS report 2017-2018 is 72174 INR [11]. This value is inflated with the average inflation rates of India to get the cost of cancer treatment in 2020 using the equation (6) given below [12]. The per capita income of the study area estimated out of the questionnaire survey is 221005 INR and the per capita income of Andhra Pradesh as per Socio-Economic Survey,2019 is 169519 INR [13] which is considered for determining the Cost Of Illness of the study area. And morbidity damages are calculated for the two values of the number of people affecting determined by IURF and NOAEL.

$COI_{\text{Target year}} = COI_{\text{Reference year}}[(1+i)^n]$ ---------(6)

i= Average inflation rate

n = Number of years

Hence,

$COI_{\text{Andhra Pradesh}},2020 = 83560$

Therefore, $COI_{\text{Study area}} = COI_{\text{Andhra Pradesh}} * \frac{\text{Per capita Income study area}}{\text{Per capita Income Andhra Pradesh}}$

= 108938

1) Morbidity Damages = $COI_{\text{study Area}}$* No of people affecting to carcinogenic effect

= 108938 * 0.0034

Morbidity Damages = 367 INR (with IURF)

2) Morbidity Damages = $COI_{\text{study Area}}$* No of people affecting to carcinogenic effect

= 108938 * 0.1738

Morbidity Damages = 18,931 INR (with NOAEL)

<u>Non-Carcinogenic effects of styrene</u>

By using the following formulae number of persons affecting Non-Carcinogenic effects of styrene is calculated.

Exposure Concentration (EC) = $\frac{\mathbf{C*ET*ED*EF}}{\mathbf{AT}}$ ---------- (1)

Here the value for concentration C is taken as explained above. The Exposure duration (ED) is expressed in days, Exposure Time (ET) in hrs/day, and Exposure Frequency (EF) in days/year. The same value of Average time (AT) considered for the calculations of carcinogenic effects of styrene is used here and the Exposure Concentration (EC) is calculated accordingly.

Health Quotient is calculated by using reference concentration (Rfc) with is taken as 900 µg/$m3$ [8] and Exposure concentration (EC) as shown below.

HQ=$\frac{\mathbf{EC}}{\mathbf{Rfc}}$---------- (2)

If HQ < 1, there is no damage to the environment and no effect on human health.

If HQ >1, then there are chances of getting different diseases.

Exposed Population = HQ $*$ Area of exposed concentration (Sq.km) $*$ Population density--------- (3)

Due to the lack of data Relative risk (RR) value is taken and is used to calculate the number of people affected. The number of people affected is calculated by using the following formulae

Number of people affected = No. of people exposed $*$ Population attributable fraction (PAF) -------- (4)

If only a fraction p of a population is exposed then the population attributable fraction can be calculated by using the following formula.

PAF = $\frac{\mathbf{p(RR-1)}}{\mathbf{p(RR-1)+1}}$---------- (5)

The RR value estimated based on the questionnaire survey conducted amounts to 1.5 and the p-value is determined by the exposed population and the total population expected in 2020 in the study area.

The Morbidity damages are calculated for the Non-Carcinogenic effects of styrene by utilizing the following formula of the Cost Of Illness (COI) method.

Morbidity cost =COI $_{\text{study area}}$ * No.of people affecting to Non- carcinogenic effect [9]--- (6)

Where,

COI $_{\text{study area}}$ = COI $_{\text{Andhra Pradesh}}$ *$\frac{\text{Per capita Income study area}}{\text{Per capita Income Andhra Pradesh}}$[10]----------(7)

<u>Calculations</u>

Exposure Concentration (EC) =$\frac{\text{C} * \text{ET} * \text{ED} * \text{EF}}{\text{AT}}$

= 1786 µg/$m3$

HQ =$\frac{\text{EC}}{\text{Rfc}}$

$= \frac{1786}{900}$

= 1.985>1, Hence chances of getting different diseases are there.

Exposed Population = HQ $*$ A $*$ Population density

= 1.985 * 78.5 * 421

= 65679

Number of people affected = No. of people exposed $*$ Population attributable fraction (PAF)

PAF = $\frac{p(RR-1)}{p(RR-1)+1}$

RR = 1.5

p= 0.014

PAF = 0.007

Number of people affected = 65679 $*$ 0.007

= 455

Morbidity Damage Cost Calculation by COI Method:

The average cost of treatment for various illnesses in Andhra Pradesh as per NSS report 2014 is 15411 INR [14].This value is inflated by using the above-mentioned equation and the average treatment cost for various illnesses for the year 2020 is determined. The per capita income of the study area estimated out of the questionnaire survey is 221005 INR and the per capita income of Andhra Pradesh as per Socio-Economic Survey,2019 is 169519 INR [13] which is considered for determining the Cost Of Illness of the study area.

$COI_{\text{study area}} = COI_{\text{Andhra Pradesh}} * \frac{\text{Per capita Income study area}}{\text{Per capita Income Andhra Pradesh}}$

Hence $COI_{\text{Andhra Pradesh}}$,

$COI_{2020} = 21084$

Therefore, $COI_{\text{Study area}} = COI_{\text{Andhra Pradesh}} * \frac{\text{Per capita Income study area}}{\text{Per capita Income Andhra Pradesh}}$

= 27488

Morbidity Damages = $COI_{\text{study Area}}$* No.of people affecting to Non- carcinogenic effect

= 27488 * 455

Morbidity Damages =1,25,15,359 INR (As per EDCA Survey)

As per the HPC report, the total number of people injured is 585 [5] and from primary health, data collected the total number of people hospitalized is 572. Hence morbidity damages cost is calculated for this data also and is provided below:

1)Morbidity Damages = $COI_{study\ Area}$* No.of people affecting to Non- carcinogenic effect

= 27488 * 585

Morbidity Damages = 1,60,80,480 INR (As per HPC Report)

2)Morbidity Damages = $COI_{study\ Area}$* No.of people affecting to Non- carcinogenic effect

= 27488 * 572

Morbidity Damages = 1,57,23,136 INR (As per Health Survey)

Mortality damages cost assessment

The total number of mortality cases reported after the styrene gas leakage on 7th May 2020 is 12 and the details of the deceased persons are provided below in the **Table 4.5,** as per the recommendation of the committee to include the age of deceased individuals and post mortem reports.

Table 4.5: Details of deceased persons

Name	DOB/Age At The Time Of Death
Chinni Ganga Raju	48
Meka Krishna Murthy	73
Nagulapalli. Greeshma	10
Annepu Chandra Mauli	19
Yellamanchili Applalanarsamma	45
Ravada Narayanamma	40
Pinapolu Varalaxmi	38
Gandiboyina. Kundana Shriya	6
Nebarthi Nani	30
Sivakoti Govinda Raju	35
Pitta Sankara Rao	45
Pala. Venkayayyamma	80

Mortality damage cost caluculations are carriedout as per Supreme court guidelines. Since sufficient data was not available suitable assumptions are made during the damage cost estimation. The supreme court guide lines for calculation involves several parameters such as

Date of Birth (DOB)/Age at the time of death, Qualification and designation, Salary per month, Future prospectes (in % of income), Taxes payments, Personal expenses, Age multiplier, Expenses for shifting mortal remains and loss of estate & fumeral expenses and worth of Loss of love and affection. The average daily wages determined and the per capita income statistics are considered for the evaluation to get the lower and upper values of mortality damages. Hence accordingly a lower compensation value of **1,85,00,760 INR** and an upper compensation value of **2,28,23,455 INR** is yielded as the mortality damages cost.

4.4.2 EDCA for Water Environment

Groundwater and Surface water samples are collected from the water resources near the LG polymers which are analyzed for their chemical quality and are used for Environment damage cost assessment. The groundwater samples (Dug Wells – 18 nos.) and surface water samples (Reservoir – 4 nos, Lake – 1 no, Collection Tank – 1 no, Fish Pond – 1 no, Drain – 1 no) were collected in the buffer zones of 0.5 km, 1 km, 1.5 km, 2 km, 3 km, 4 km, 5 km radius around LG Polymers Storage Tanks during the period May 12-16, 2020. As per World Health Organization (WHO, 2003) guidelines for drinking water, the permissible value for styrene in drinking water is 0.02 mg/l. The guideline value indicates that the styrene may affect the acceptability of drinking water above 0.02mg/l. Styrene concentrations in water samples was observed to be less than 0.02 mg/l in all the samples except at SGL-9. Styrene concentration of 0.0345 mg/l was recorded at SGL-9 (Dug well), which is at an approximate distance of 1.5 km from LG Polymers. However, It has been observed since May 2020 that there was not much change in the water quality. All the groundwater quality parameters showed values within the permissible limits of BIS. The surface water quality parameters also showed values within the drinking water quality standards and hence EDCA for the water environment is not required.

4.4.3 EDCA for Soil Environment

Soil, which is one among the important environmental elements, has also suffered the adverse impacts of this accident due to contamination by styrene gas. However the cost of damages occurred to the soil due to contamination by styrene, which is a volatile organic compound, is difficult to assess but the cost of treatment to restore the qualities of the soil can be applied to quantify the EDCA for the soil due to the same.

Soils samples were collected from different locations within the LG Polymer industry and around the industry. Sampling was carried out immediately following the gas leak i.e. 8-14 May 2020 to determine the instant levels in soil and consequent exposure level. Styrene concentrations were found to be in the range of 109 mg/kg to 5950 mg/kg in soils. The concentrations are far exceeding the CCME guideline values of 0.1 mg/kg and 50mg/kg for

agriculture and industrial activities of the soils respectively. A second round of soil sampling was carried out during 28-30 October 2020 to estimate the persistence of styrene in soil. All the observed values were much below the CCME value for styrene in soil, indicating no immediate hazard. In comparison with the values observed immediately following the gas leak, there was significant decline and styrene had virtually disappeared from most of the sites. It is in agreement with the limited persistence of styrene in the soil because of its volatility and biodegradation. Various treatments are available to restore and maintain the qualities of soil. These technologies which are used for the remediation of contaminated soil include Excavation and containment (Excavation and disposal to landfill), In-situ physical containment by means of engineering systems (Engineering capping & Encapsulation) and several remediation treatments (Bioremediation, Vitrification, Soil washing, Chemical oxidation, Land farming, Pump and treat method etc) [15]. Along with these Thermal treatment technologies such as Ex-situ and In-situ thermal desorption are also available for treating volatile and semi-volatile hydrocarbon contaminants in soil [16]. The range of cost of these remediation technologies are provided below (**Table 4.6**).

Table 4.6: Cost of Remediation technologies for soil

Remediation Technology	Cost in Euro (2002)	Cost in INR 2020
Excavation and containment	74/m3	2209/m3
In-situ physical containment by means of engineering systems	22-178/m2	657-5313/m2
Remediation treatments	30-319/Tons	895-9522/Tons

Remediation Technology	Cost in $ (2016)	Cost in INR 2020
Thermal treatment – Ex-situ thermal desorption	46-99/Tons	4003-8616/Tons
Thermal treatment – In-situ thermal desorption	70-460/Tons	6092-40034/Tons

However, it is evident that the contamination levels have declined significantly and disappeared from most of the sites during the second sampling observations. Hence it is not required to implement these advanced techniques as a remedial measure and the simplest technologies like “Land treatment” which involves the natural processes such as volatilization,

aeration, biodegradation and photolysis can be adopted and here the cost for “Land treatment” technology is estimated as the EDCA for the soil. It is a treatment process in which the contaminated soil is excavated and spread over an area to improve the naturally occurring processes.

For the EDCA calculations it is assumed that the soil removed/excavated is spread nearer to the excavation zone and only the important factors in the treatment procedure is considered.

Calculations

The following table (**Table 4.7**) illustrates the unit cost required per ton of treated material for the “Land Treatment” remediation technology used for the contaminated soil [17].

Table 4.7: Cost of Land treatment

Remediation Technology - Land Treatment		
Capital Cost ($ per Metric ton of treated material, 1999)	Land	0.55-1.10
Operation & Maintenance Cost ($ per Metric ton of treated material, 1999)	Site operations	1.65-2.20
Total Cost($ per Metric ton of treated material,1999) - Lower value		2.20
Total Cost($ per Metric ton of treated material,1999) - Mean value		2.75
Total Cost($ per Metric ton of treated material,1999) - Higher value		3.30

The reference values of the treatment cost ($) per metric ton of treated material for the year 1999 are inflated with the average inflation rate (0.022) [18] of United States using the equation provided below to get its value for the year 2020.

$\text{Value}_{\text{Target year}} = \text{Value}_{\text{Reference year}}[(1+i)^n]$ ---------(1)

i= Average inflation rate

n = Number of years

The Purchasing Power Parity value of 21.35 [19] for the year 2020 is used to get the values of the treatment cost per metric ton of treated material for the year 2020 in INR. The total quantity of soil to be treated is 16,88,960 Tons and the same is considered to estimate the

EDCA of soil due to styrene gas leakage. The following table (**Table 4.8**) represents the estimated values of EDCA.

Table 4.8: EDCA for Soil Environment

	Lower	Mean	Higher
Total Cost in $ per Metric ton of treated material(1999)	2.20	2.75	3.30
Total Cost in $ per Metric ton of treated material(2020)	3.45	4.32	5.18
Purchasing Power Parity (PPP),2020	21.35	21.35	21.35
Total Cost in INR per Metric ton of treated material(2020)	74	92	111
EDCA for Soil in INR 2020	124548516	155685646	186822775
EDCA for Soil in Crores INR 2020	12.45	15.57	18.68

4.4.4 EDCA for Cropland

According to the questionnaire survey conducted in the study area, the data relating to the damages caused by styrene gas leakage are collected, analyzed and the total loss incurred is calculated (**Table 4.9**) as follows:

Table 4.9 Damages cost for cropland

Size of the Cropland (acre)	No. of people	Total loss incurred due to accident up to Survey period (INR)
0.1	1	2400
	1	3600
1	1	50000
	1	10000
2	2	240000

4.4.5 EDCA for Livestock

The following table (**Table 4.10**) provides the details of the loss of livestock collected with the help of the questionnaire survey conducted and the calculations of EDCA for livestock are done utilizing the data provided in the table.

Table 4.10 Damages to Livestock

Cattle/Domestic animal	Total No. lost due to Styrene gas leakage accident
Cow	7
Calves	4
Buffalo	2
Goat	2
Hen	Multiple
Sheep	2
Dog	9

A study reveals the value of ecosystem benefits by livestock (Farming, various animals), and this is considered for the estimation of EDCA for livestock. The calculations are done as follows:

Ecosystem benefits from Livestock (Farming, various animals),2017 = 103$ / animal / year [20]

The economic benefits from Livestocks are converted to INR using purchasing power parity (PPP) value [19] and are inflated to get its value for the year 2020.

Economic Benefits from Livestocks, 2020 =2463 INR / animal / year

The average lifeperiod for livestock is assumed as 10 years (given the high life of Cattles and comparatively lower life expectancy of dogs and goats and also factoring in their current age, 10 years of economic benefits seems like a valid assumption) and the EDCA for the same is calculated by using the following equation.

EDCA, based on the economic benefits foregone, for livestock = Total No.of livestock lost due to styrene gas leakage accident * Economic benefits * Avg lifeperiod of livestock.----------(1)

1) EDCA for livestock = 26 * 2463 * 10

= **6,40,260 INR (As per EDCA Survey)**

As per the HPC report and according to Animal Husbandry Department a total of 34 animals died due to the effect of styrene from 7th May t0 9th May 2020 [9].

2) EDCA for livestock = 34 * 2463 *10

= **8,37,260 INR (As per HPC report)**

4.5 Statistical correction factor for EDCA

The sample size was selected for EDCA survey and Health Survey within a radius of 5km from the impact epicenter and for primary health survey, which collected details of health issues confronted during the days of accident from the residents of Kamparpalam, Nandamurinagar, SC BC Colony, Padmanabh Nagar &Venkatapuram. EDCA surveyed 409 people and a health survey was carried out for 1179 people respectively. As per the HPC report, nearly 20000 people were evacuated from these locations, which might have been affected [5]. The valuations should be statistically corrected to understand the full potential of damage within the factors considered for valuation. For the statistical correction factor determination, the average number of people affected by the EDCA Survey and the data regarding the total number of hospitalized persons from the primary health survey are considered. The estimated total population affected is ascertained as follows:

- For HPC, the average number of people showing symptoms as per the EDCA survey is considered. The percentage concerning total surveyed in each area is multiplied to 20000 potential affected person to arrive at a value of 6,708 people affected.
- For EDCA, the maximum number of people showing symptoms are considered and the respective percentage is multiplied with a population density of 421 people to arrive at total population affected as 1860 for 5 km surveyed population.
- For the Health survey, hospitalized people are considered as affected and the population of villages is multiplied to get the total affected population as 4849 in the surveyed area. Non hospitalized persons are neglected since they suffered from minor symptoms only.

Based on the above points, the statistical correction factor is estimated accordingly and provided in **Table 4.11** shown below:

Table 4.11: Statistical correction factor

Description	As per HPC	As per primary health Survey	As per EDCA Survey
Affected population (Statistical estimation)	6708	4849	1860
Affected population (Survey estimation/considered for valuation)	585	572	455
Statistical correction factor for valuation	11.47	8.48	4.09

The average correction factor from the above table is about 8. Since the health survey is primary and reflects much more accurate data, 8.48 correction factor is used for valuation of morbidity, livestock, and cropland.

4.6 Value Transfer Method

The Value Transfer Method can be used to translate environmental damages caused due to pollution into monetary terms and it is used in this report for the estimation of EDCA. As per the HPC report, the total weight of styrene emitted in Tonnes is 657.43 [9]. The EDCA is then calculated by using the following equation.

EDCA = Total Styrene emission (Ton/year) * Damage Value in Rupees ----------(1)

The following tables (**Table 4.12 and Table 4.13**) represent the Rs/ton of VOC pollutants for the First Quartile, Second Quartile & Third Quartile by using Value Transfer Method according to European research studies and are considered for the EDCA calculation using WTA method [21].

Table 4.12: Damage Cost for VOC pollutants in Rupee

Environmental damages	European study converted (Rs/ton)
First Quartile (Lower Range)	11,46,805
Second Quartile (Medium Range)	18,55,127
Third Quartile (Upper range)	23,04,854

Table 4.13: EDCA for the three Quartiles

Environmental Damages	First Quartile (Lower Range) Crore INR	Second Quartile (Medium Range) Crore INR	Third Quartile (Upper range) Crore INR
EDCA	75.3	121.9	151.5

4.7 Conclusion for EDCA

The following **Table 4.14** represents the summarized cost of the environmental damage incurred due to the styrene gas leakage in Vishakapatnam on 7th May 2020 based on the questionnaire survey, the health survey, and HPC report findings, under valid assumptions, and with the aid of available information**.**

Table 4.14: EDCA summary by CSIR-NEERI

Based on Impacts on Environment			
	Lower Value	**Median Value**	**Upper Value**
Mortality Damages	18500760	20662107	22823455
Morbidity Damages (a)	12515359	15723136	16080480
Damage to Cropland (b)	306000	306000	306000
Damage to Livestock (c)	640260	738760	837260
Correction Factor for a,b, and c	8.48	8.48	8.48
Damages to soil	124548516	155685646	186822775
Total in ₹	257203805	318539511	355703545
Total in Crore ₹	25.72	31.85	35.57
Based on Value Transfer Method			
	Lower Value	**Median Value**	**Upper Value**
WTA (Based on VTM-International Study) in Cr ₹	75.3	121.9	151.5

It is important to note that the environmental damages, although carried out based on scientific sampling and survey, do not fully capture the magnitude of damage that occurred on that day. This is because the sampling has been carried out three to four months after the accident, and Styrene being highly volatile, may not have left traces in the environmental surroundings. This is the reason soil and water data have reported minimal to no impact. The value transfer method also captures the valuations for a particular region using the transfer functions and the valuation factor for the other region where actual study has been carried out. Hence it may be come sometime inflated given the earning and use potential of services and products in two regions being considered for analysis. Thus a lower estimate of value transfer or upper estimates based on environmental impact may be considered as the final value for

environmental damages, which puts the valuation in the bracket of ₹ 35.57 Crore to ₹ 75.3Crore.

In addition, the sub-committee constituted under the chairmanship of District Magistrate, Vishakapatnam also estimated the restoration and compensation plans for damage to health, crop, property, livestocks etc. The assessment variables for estimation parameters of sub-committee include Compensation for deceased person, Medical treatment to victims, Dead animals and individuals in affected area, Compensation for loss of valuables (Theft occurred), Enumeration of petty shops, Compenation for the contaminated foodgrains/consumables for each family (**for Damage to property**), Estabhlishment of 10 bedded hospital, Cost for Research project to estimate the cytogenetic effects due to accidental exposure of styrene on population, effects of high concentration of styrene on pregnant ladies and its outcome, Mental health assessment and restoration of health in affected villages, Speciality treatment and Unforeseen expenditure in hospitals attached to APMC (**for Damage to health**), Cost for inputs for adoption of best management practices, Charges towards testing parameters including visits of scientists, Compensation for enumerated horticulture crop damage (**for Damage to crops**) and Estimated value of milk discarded during 30 days after incident interim release, Amount required for replacement of animals, Cost estimated for feed and fodder for 180 days, For conducting veterinary health camps (**for Damage to livestocks**) [22].

As per the recommendation in the 3rd meeting of the committee, CSIR-NEERI included the assessment done by the sub committee and removed duplication. Based on the decisions taken in the 4th meeting, the final damage estimates were frozen. Taking the reference of estimated restoration and compensation plans by sub-committee along with the damages estimated by CSIR-NEERI the final assessment procedures were evaluated to avoid any duplication. The goal of the exercise was to classify the "previously calculated damage costs" into mutually compatible sub-heads to help grasp the scope of damage costs estimated and make a final decision. The distribution with respect to higher value estimated by NEERI was done on the basis of individual cost percentages derived for each attribute with respect to lower values. Thus, the Upper bound value of damages estimated by Vatue Transfer Method ie ₹75.30 by CSIR-NEERI is distributed according to the percentage distribution of lower bound values in the above table. After detailed deliberations on assessments made by NEERI and subcommittee and removal of duplications in estimates, the committee constituted for ‘Preparation of Restoration Plan’ in compliance with Hon’ble NGT on the assessment methodology of environmental, health, property, livestock & crop damages, the following

(**Table 4.15**) component-wise damage assessment and restoration cost are finalised and recommended [23].

Table 4.15: Recommended Final Damages Cost

Components	Cost in INR
Damage Assessment in respect of Health	₹38,40,57,085
Damage Assessment in respect of Soil	₹39,54,90,997
Damage Assessment in respect of Crops	₹54,93,183
Damage in respect of Production from Livestock	₹91,75,872
Total	₹79,42,17,134

The Committee unanimously recommended that the total estimated damage cost to environment, health, property, livestock, crops, etc. is ₹79,42,17,137 Crores (say ₹79.42 Crores). However, considering the health restoration component estimated by subcommitte (₹22,77,05,026) the comprehensive damage and restoration cost is assessed as ₹1,02,19,22,163 (say 102.19 Crores). The committee took into the account the fact that the values arrived at by CSIR-NEERI are based on scientific modelling and methodology, whereas the values arrived at by District Sub-Committee are based on the field assessment by the line departments.

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CHAPTER 5

RESTORATION PLAN

5.0 Restoration Plan

As currently, the styrene levels in the ambient air, groundwater and surface watre and soil in the study area are below detectable limits and are not found, the restoration plan may not be required for these environmental componnets. However, continuous monitoring of ambient levels of styrene is required near the storage tank and at the boundaries of the industry and periodical monitoring in the residential areas near the LG polymers to avoid any further accidents.

However, the resoration plan w.r.to Health impacts may be implemented as several villagers, especially those from Venkatapuram, complained about the persistence of potential styrene-induced health effects several months after the gas leak. The persistence of headache, eye irritation, skin irritation, and breathing problems was exceptionally high. A regular medical examination through a team of doctors may be conducted further to verify and quantify the long-term health effects of styrene exposure. Based on the medical findings, appropriate treatment should be given to the affected population.

CHAPTER 6

SUMMARY & CONCLUSIONS

6.0 Summary &Conclusions

An accident occurred in M/s L.G Polymers India Pvt Ltd, Visakhapatnam at 0302hrs on 07.05.2020. The company has stored styrene monomer in vertical MS storage tanks of 2500 KL and 3500 KL capacity provided with internal cooling system through refrigeration. From one storage tank of 2500KL, styrene vapor has leaked and spread to surrounding villages of Venkatapuram, Padmanabhapuram, SC & BC Colony.

The Hon'ble National Green Tribunal had taken suomoto cognizance of the gas leakage incident and constituted an Expert Committee which filed a detailed report on 28.05.2020. The Hon'ble Tribunal after consideration of the responses of various parties and report of Expert Committee, passes an order on 01.06.2020. In pursuance of the orders of Hon'ble NGT dated 01.06.2020, the Ministry of Environment, Forest and Climate Change (MoEF&CC) constituted various committees on July 21, 2020. The 1st meeting of the MoEF&CC Nodal Committee (constituted for the preparation of restoration plan for the incident occurred at LG Polymers) was held on August 17th, 2020, while the first meeting on Environmental Damages and Compensation held on 9th September 2020. In both the meetings, it was proposed to engage CSIR-NEERI for assessment of environmental damages and preparation of the restoration plan for air, water, soil components. In this regard, CPCB approached CSIR-NEERI, Nagpur and Hyderabad Zonal Centre to conduct environmental damages cost assessment and prepare a Plan for Restoration of Environmental Media viz. Air, Water and Soil.

The primary data on ambient air in terms of Styrene, surface water/sediment, groundwater (physico-chemical parameters, DO, COD, BOD and heavy metals, oil & grease, styrene) and soil quality (Styrene and Physico- Chemical Parameters viz. pH, Conductivity, Porosity, available NPK, water holding capacity, soil texture, organic matter and trace elements (As, B, Ba, Cd, Co, Cr, Cu, F, Fe, Hg, Mn, Ni, Pb, Zn) within the study area was collected at identified locations during October 2020. The summary of the existing environmental data monitored since the accident occurred at different times monitored and reported by different agencies, the impact and damage assessment has been given.

6.1 Air Environment

The styrene levels in ambient air are monitored and analysed by several agencies like CSIR-NEERI, CBRN, NDRF and APPCB during the period of Styrene Monomer Vapour (SMV) accident occurred on 07/05/2020 to 10/05/2020. The ambient styrene levels and TVOCs were monitored by CSIR-NEERI-HZC during 12/05/2020 to 15/05/2020 and during 28/10/2020 to 3/10/2020 within the 3 km radial distance from the LG Polymers Storage Tank as centre.

The ambient concentrations of styrene were measured during 07/05/2020 to 08/05/2020 and were found to be varied from 11.2 ppm (at 07.00 P.M) to 461ppm (at 10.00 P.M) on 07/05/2020 at Venkatapuram village near to LGPL and 43 ppm (at 09.00 P.M) to 365 ppm (at 10.00 P.M) near the LGPL Main gate on 07/05/2020. However, styrene levels in ambient air have come down from 374 ppm (at 02.00 A.M) to 11.7 ppm (at 05.00 A.M) on 08/05/2020 at Venkatapuram village. Similarly, the styrene levels have reduced from 242 ppm (at 02.00 A.M) to 14.2 ppm (at 05.00 A.M) near the LGPL Main gate on 08/05/2020.

The ambient levels of styrene monitored by CSIR-NEERI, CERN, NDRF during May 9-10, 2020 and were found to be 4.9 ppm inside the LG polymers plant near office at 11.00 A.M on 09/05/2020 and 2.3 ppm near the Meghadrigadda Reservoir at 02.30 P.M on 09/05/2020. Styrene level in the ambient air was 12.8 ppm at the M6 Tank Top at 10.30 A.M and7.3 ppm at the ground level near M6 Tank at 11.30 A.M on 10/05/2020. The ambient styrene levels were found be 1.2 ppm at Venkatapuram at 11.00 A.M and 2.7 ppm at Narvakota at 03.00 P.M on 10/05/2020.

The ambient styrene levels were monitored by CSIR-NEERI-HZC during 12/05/2020 to 15/05/2020 and were found to be 0.25 ppm near Storage Tank in LG Polymers, 0.01 ppm at Venkatapuram (near Railway Bridge), and were BDL at all other locations. The results indicated that the impact of Styrene is significant near the LG Polymers and around 500 m distance from the LG Polymers Storage Tanks (LGPST) as the styrene concentrations are observed to be high up to 500 m radius area from. But the impact is also spread up to 1.0 Km distance where insitu/spot values of styrene are observed. The ambient values of styrene are observed up to 1.0 Km as styrene is a heavy gas and tends to settle rapidly on the ground and thus may not have reached farther distances after the measures to stop leakage of styrene gas have completed.

Generally, ambient air in urban locations contains styrene at average concentrations of 0.29 to 3.8 μg/m^3, while styrene in rural and suburban air has been measured at 0.28 to 0.34 μg/m^3 (ATSDR, 1992). The styrene concentrations in the ambient air of Visakhapatnam study area during the study period are found to be exceeding the above ambient concentration levels or standard values. Also, the styrene values are higher very close to the LGPST and up to 500 m from LGPST compared to Ontario's ambient air quality criteria of styrene equal to 400 μg/m3 (24 hrlyaverage) for limiting effect on human health.

The ambient styrene levels were monitored by CSIR-NEERI-HZC during 28/10/2020 to 30/10/2020 and were found to be BDL at all locations.

The ambient levels of styrene monitored by APPCB during June 2021 show they are BDL at all lications both inside LGPL and outside LGPL in the study area.

From the above it may be concluded that the styrene levels are found to be high during the first few days of the accident occurred and rapidly reduced to very low levels in the next few days and are below detection limits after 8 to 10 days from the time of incident.

ALOHA model was used to study the dispersion characteristics of SM released and identification of threat zones or zones of influence with the data on SM loss, M6 tank details and meteorological data.

An amount of 46 MT was taken as loss of SMV at the time of the accident for about 15 minutes release is considered as for estimating the concentrations of SMV and the threat zones / zones of influence using ALOHA along with wind speed of 0.62 m/s for three different wind directions 120º, 145º and 172º, temperature of 25.5ºC and RH 92% (between 3 AM and 5 Am on 07/05/2020). The predicted Red (AEGL-3: 1100 ppm), Orange (AEGl-2:130 ppm) and Yellow (AEGL-1:20 ppm) zones for an SM loss/emission of 46 MT from the M6 Tank during 3.20 a.m. to 3.25 a.m. is extended from the source up to 0.421 km, 1.2 km, and 2.9 km, respectively.

The predicted red zone extends up to 0.421 km and the Venkatapuram villages are located within this red zone. The occurrence of death cases is also observed to be within this zone of influence which is around 0.42 km. The orange zone extends up to 1.2 km, the areas might have experienced a concentration more than 130 ppm up to 1100 ppm, and this orange zone encompasses areas like Gopalapatnam, Naidu Thota, etc. as vulnerable areas.

The yellow zone where the Styrene predicted concentration is more than 20 ppm got extended up to 3 km from the SMV emissions source because of which most of the areas beyond NAD Kotta Road, Marripalem, Muralinagar experience pungent chemical odours. The Yellow zones cover most of the area in West, North West direction including part of MeghadriGedda reservoir area. The field verification indicates that the pungent odours were felt even beyond NAD Kotha Road, Marripalem, Marriot Fair filed hotel, Muralinagar area, and Airport area and so on.

The Immediately Dangerous to Life or Health (IDLH) level is 700 ppm. The above modelling estimates indicate that the IDLH limits were significantly crossed up to 200 m from the source and even up to 400 m.

The total or combined area covered under the three wind directions (120o, 145o, and 172o) for emission of 46 MT is calculated as 31.08 ha in Red Zone, 166.29 ha in Orange Zone and 715 ha in Yellow Zone.

The ALOHA model used to predict the SMV concentrations and Threat Zones/ Zones of Influence in terms of Concentrations and distances with a source strength of 46 MT for a release time of 15 minutes by CSIR-NEERI-HZC. The wind direction is 172º, temperature is 25.5ºC, relative humidity is 92% and stability class E and F are considered for different wind speeds 0.62 m/s, 1.2 m/s, 1.5 m/s, 1.8 m/s and 2.0 m/s. The ALOHA model uses 60-minute The Emergency Response Planning Guidelines (ERPG) with the following concentrations as ERPG-1: 50 ppm (Yellow Zone); ERPG-2: 250 ppm (Orange Zone) and ERPG-3: 1000 ppm (Red Zone). It is observed that Red zone representing ERPG-3 extended up to 0.44 km, Orange zone representing ERPG-2 extended up to 0.87 km and Yellow zone representing ERPG-1 extended up to 1.9 km respectively, from the source of incident. The villages like Venkatapuram falls under Red zone and the villages like Naidu Thota falls under Orange Zone. The predicted SMV concentrations and Threat Zone distances from the source are in coherence with the HPC Report findings.

6.2 Water Environment

Based on the collection and analysis of water samples around the LG polymers Industry, the following conclusions have been made:

- The styrene levels in all the samples viz., groundwater and surface water were below detectable limit during October 2020 sampling.
- It was observed during May 2020 sampling that styrene levels were observed in surface water but the same sample in October 2020 showed BDL values of styrene which indicate that the styrene concentration must have degraded from the surface water samples.
- The total dissolved samples in the study area varied from 447mg/l to 1934mg/l. All the samples showed TDS within the limits of BIS of 2000mg/l.
- Chloride was found to be in the range of 69 – 928mg/l in the study area which was within the BIS limits of 1000mg/l.
- Heavy metals such as Arsenic, Boron, Cobalt, Chromium, Copper, Manganese, Nickel, Zinc except Cadmium, Iron, Lead, Mercury were within the permissible limits of BIS

- Cadmium, iron and lead were found to be in the range of BDL to 0.027mg/l, 0.028 to 2.649mg/l and 0.005 to 0.033mg/l, respectively. All these metals occur in the underlying rocks that contribute to the groundwater.
- Mercury was found to be below detection limit of BIS in all the samples.
- The bioassay test was conducted in the four surface water samples around the LG polymers from which it can be concluded that the fishes were found to be stable in all the concentrations of all the samples.
- All the paameters monitored by APPCB were below BIS levels in the study area during June 2021 and also the syrene concnetrations were BDL at all locations in the study area
- Regular monitoring of the groundwater and surface water samples has to be carried out to ensure the good water quality and level for consequent two hydrological cycles. Also any future groundwater withdrawal should be avoided to minimize the depletion of water level in future.

6.3 Soil Environment

Soil samples within and around LG Polymer industry showed very high level of styrene (109 to 5950 mg/kg) immediately after the gas leak (8-14 May 2020). However, after about 5 months (28-30 October 2020), the styrene level dissipated and could be detected at only 2 locations at very low concentrations (0.15-4.7 ppb), which was below the CCME guideline values of 0.1 mg/kg and 50 mg/kg for agriculture and industrial activities of the soils respectively. The styrene levels in soil samples monitored by APPCB during June 2021 were BDL at all location in the study area. Thus, there seems to be no chronic exposure. The soil may be analyzed further for potential transformation products of styrene that can be toxic and remediated using the techniques indicated in the report.

6.4 Soil Microbial Diversity

The effect of styrene gas leakage incident on soil microbial diversity was assessed by analyzing the soil samples collected within 5 Km radius of the incident area. The sampling locations were divided into three zones based on the distance of the sampling locations from the incident site. The analyses found good abundance of soil bacterial and fungal diversity in different zones. Also, the diversity of beneficial microorganisms were also found to be good. Further, the differences in the distribution of organisms in different zones were evaluated. The analyses found no significant difference in the distribution of soil bacterial or fungal diversity. Also, there is no significant difference in the distribution of beneficial microbes across three different zones. Thus, this study suggests that either the soil microbial flora was not affected

by the styrene gas leakage incident or the soil microbial flora was recovered naturally by the time of sample collection.

6.5 Health Assessment

Based on the primary questionnaire survey of nearby population and secondary health data from local health centers, Venkatapuram appeared to be the most affected village with highest complaints of health effects (throat/nasal irritation, eye irritation, vomiting/abdominal pain, neurological disorder and skin irritation). The villagers from Venkatapuram also reported highest persistence of these complaints months after the gas leak. A medical examination through a team of doctors may be conducted further to verify and quantify the long-term health effects of styrene exposure, and any medical intervention, if required.

6.6 Damage Assessment

Environmental Damage Cost Assessment (EDCA) calculations for styrene gas leakage accident includes the morbidity, mortality assessment for the people affected in the area; damages to croplands, livestocks and air, water and soil environment. On ground survey for above parameters was conducted to determine the level of impact. Various econometric methods such as contingent valuation, cost of illness; value of statistical life; market price were used to calculate the EDCA. The data gaps for the application of the above methods were filled using scientific literature. Using the impact parameters, based on survey and with lower values of value transfer method/willingness to accept methods and based on various parameters; data collection, survey results, the damage value was estimated. The total estimated damage cost to environment, health, property, livestock, crops, etc., based on assessments made by CSIR-NEERI and the subcommittee, is ₹79,42,17,137 Crores (say ₹79.42 Crores). However, considering the health restoration component estimated by subcommitte (₹22,77,05,026) the comprehensive damage and restoration cost is assessed as ₹1,02,19,22,163 (say 102.19 Crores).

ANNEXURES

Annexure-I

National Ambient Air Quality Standards - 2009

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1.	Sulphur Dioxide (SO_2), µg/m^3	Annual *	50	20	-Improved west and Gaeke
		24 Hours **	80	80	-Ultraviolet fluorescence
2.	Nitrogen Dioxide (NO_X), µg/m^3	Annual *	40	30	-Modified Jacob &Hochheiser (Na-Arsenite)
		24 Hours **	80	80	-Chemiluminescence
3.	Particulate Matter (Size less than 10 µm) or PM_{10} µg/m^3	Annual *	60	60	-Gravimetric -TEOM -Beta attenuation
		24 Hours **	100	100	
4.	Particulate Matter (Size less than 2.5 µm) or $PM_{2.5}$ µg/m^3	Annual *	40	40	-Gravimetric -TEOM -Beta attenuation
		24 Hours **	60	60	
5.	Ozone (O_3) µg/m^3	8 hours **	100	100	-UV photometric -Chemiluminescence - Chemical method
		1 hour**	180	180	
6.	Lead (Pb) µg/m^3	Annual *	0.50	0.50	-AAS/ICP method after sampling on EPM 2000 or equivalent filter paper -ED-XRF using Teflon filter
		24 Hours **	1.00	1.00	
7.	Carbon Monoxide (CO) mg/m^3	8 hours **	02	02	-Non Dispersive Infrared Spectroscopy
		1 hour *	04	04	
8.	Ammonia (NH_3) µg/m^3	Annual *	100	100	-Chemiluminescence
		24 Hours **	400	400	-Indophenol blue method
9.	Benzene (C_6H_6) µg/m^3	Annual *	05	05	-Gas chromatography based continuous analyzer - Adsorption and Desorption followed by GC analysis
10.	BenzoPyrene (BaP) - particulate phase only ng/m^3	Annual *	01	01	-Solvent extraction followed by HPLC/GC analysis
11.	Arsenic(As) ng/m^3	Annual *	06	06	-AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
12.	Nickel(Ni) ng/m^3	Annual *	20	20	-AAS/ICP method after sampling on EPM 2000 or equivalent filter paper

* Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform intervals

** 24 hourly or 8 hourly or 01 hourly monitored values as applicable shall be compiled with 98% of the time in a year. 2% of the time they may exceed the limits but not on two consecutive days of monitoring

Annexure -II

Specifications for Drinking Water - (IS 10500: 2012)

SNo.	Substance or characteristic	Requirement (Acceptable limit)	Permissible limit in the absence of alternate source	Remarks
Essential Characteristics				
1.	Colour Hazen Units, max	5	15	Extended to 15 only if toxic sub are not suspe cted in absence of alternate so
2.	Odour	Agreeable	Agreeable	a. test cold and when heated b. test after several dilutions
3.	Taste	Agreeable	Agreeable	Test to be conducted only after has been established
4.	Turbidity (NTU) Max	1	5	-
5.	pH value	6.5 to 8.5	No relaxation	-
6.	Total hardness (mg/l, CaC	200	600	-
7.	Iron (mg/l, Fe) Max	0.3	No relaxation	Total concentration of mangan Mn) and iron (as Fe) shall not exceed 0.3
8.	Chlorides (as Cl) mg/l	250	1000	-
9.	Free residual chlorine (mg	0.2	1	To be applicable only when w chlorinated.Tested at consume When protection against viral inf required, it should be minimum
Desirable Characteristics				
10.	Total dissolved solids, mg	500	2000	-
11.	Calcium (mg/l, Ca) M	75	200	-
12.	Magnesium (mg/l, Mg)	30	100	-
13.	Copper (mg/l, Cu) Ma	0.05	1.5	-
14.	Manganese (mg/l, Mn)	0.1	0.3	Total concentration of mangan Mn) and iron (as Fe) shall not 0.3 mg/l
15.	Sulphate (mg/l, SO_4) M	200	400	May be extended upto 400 pr Magnesium (as Mg) does not ex
16.	Nitrate (mg/l, NO_3) M	45	No relaxation	-
17.	Fluoride (mg/l, F) Ma	1.0	1.5	-
18.	Phenolic compounds (mg/l Max.	0.001	0.002	-
19.	Mercury (mg/l, Hg) M	0.001	No Relaxation	-
20.	Cadium (mg/l, Cd) Ma	0.003	No Relaxation	-
21.	Selenium (mg/l, Se) M	0.01	No Relaxation	-
22.	Total Arsenic (mg/l, As)	0.01	0.05	-
23.	Cyanide(mg/l, CN) Ma	0.05	No Relaxation	-
24.	Lead (mg/l, Pb) Max	0.01	No Relaxation	-
25.	Zinc(mg/l, Zn) Max.	5	15	-
26.	Anionic detergents (mg/l, Max	0.2	1.0	-

SNo.	Substance or characteristic	Requirement (Acceptable limit)	Permissible limit in the absence of alternate source	Remarks
27.	Total Chromium (mg/l),	0.05	No relaxation	-
28.	Polynuclear aromatic hydro (mg/l, PAH) Max.	0.0001	No relaxation	-
29.	Mineral oil (mg/l) Ma	0.05	No relaxation	-
30.	Pesticides (mg/l) Ma	-	No relaxation	-
Radioactive materials				
31.	Alpha emitters (Bq/l) M	0.1	No relaxation	-
32.	Beta emitters (pci/l) M	1.0	No relaxation	-
33.	Alkalinity (mg/l) Max	200	600	-
34.	Aluminium (mg/l, Al) M	0.03	0.2	-
35.	Boron (mg/l) Max.	0.5	1.0	-

AnnexureIII

Methods for Preservation and Analysis of Water Samples

S. No.	Parameter	Units of Expression	Preservative and Storage Condition	Reference: APHA 21st Edition Methods
Physical Parameters				
1.	Temperature	^{0}C	Analyze immediately	2550 – B: (Thermometer)
2.	pH	--	Analyze immediately	4500-H^+ - B: (Electrode)
3.	Conductivity	µs/ms	Refrigeration at 4^{O}C	2510 – B: (Conductivity meter)
4.	Total dissolved solids	mg/l	Refrigeration at 4^{O}C	2540 – C: (dried at 180^{0}C & gravimetric)
5.	Total suspended solids	mg/l	Refrigeration at 4^{O}C	2540 – D: (dried at 103^{0}C-105^{0}C & gravimetric)
6.	Turbidity	NTU	Refrigerate and Analyze immediately	2130 – B: (Nephelometric)
Inorganic Parameters				
7.	Total alkalinity	as $CaCO_3$ mg/l	Refrigerate and Analyze immediately	2320 – B: (Titration)
8.	Hardness	as $CaCO_3$ mg/l	Add HNO_3 to pH < 2 and refrigerate	2340 – C: (EDTA Titrimetric)
9.	Chloride	mg/l	Not Required	4500-Cl^- - B: (Argentometric)
10.	Sulphate	mg/l	Refrigeration at 4^{O}C	4500-SO_4^{--} - E: (Turbidimetric)
11.	Fluoride	mg/l	Not Required	4500-F^- - D: (SPADNS)
12.	Sodium and potassium	mg/l	Not Required	3500- K, Na-B: (Flame Photometric)
Nutrient and Demand Parameter				
13.	Nitrate	as NO_3^- - N mg/l	Refrigerate and analyze immediately	4500-NO_3^- B: (UV spectrophotometric)
14.	Total Phosphate	mg/l	Refrigeration at 4^{O}C	4500-P-D: (Stannous Chloride)
15.	Dissolved Oxygen [DO]	mg/l	Analyze immediately	4500-O-C: (Azide modification)
16.	COD	mg/l	Add H_2SO_4 at pH <2 refrigerate & analyze immediately	5220-B: (Open Reflux)
17.	BOD	mg/l	Refrigeration at 4^{O}C & analyze immediately	5210-B: (BOD Test at 27 ^{0}C)
18.	Total Kjeldhal Nitrogen	mg/l	Refrigerate and Add H_2SO_4 to pH<2	4500- N_{ORG}-B: (Macro-kjeldhal)
19.	Oil and grease	mg/l	Add H_2SO_4 at pH <2 refrigerate	5220 –B: (Liquid-Liquid Partition Gravimetric)

S. No.	Parameter	Units of Expression	Preservative and Storage Condition	Reference: APHA 21st Edition Methods
Heavy Metals				
20.	Heavy metals	mg/l	Add HNO_3 to pH <2	3030 –E, 3125 - B: (ICP- MS)

Report of the sub-committee constituted under the chairmanship of the District Magistrate, Visakhapatnam for preparation of '**Restoration and Compensation Plan for damage to health, property, crops, livestock etc**.' (Sub Component-2) as per the Ministry of Environment, Forest and Climate Change(HSM Division), Government of India, office order dt: 21.07.2020 issued in pursuance of the Order dated 01st June 2020 of Hon'ble National Green Tribunal in OA No. 73 of 2020 related to Gas leak incident at M/s.LG Polymers India Pvt. Ltd,, R.R. Venkatapuram Village, Visakhapatnam, Andhra Pradesh.



Submitted to

Ministry of Environment, Forest and Climate Change
(HSM Division), Government of India

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Preface

An accident of uncontrolled release of Styrene vapour occurred at M/s.LG Polymers India Pvt. Ltd, RR Venkatapuram Village, Pendurthi Mandal, Visakhapatnam District, Andhra Pradesh in the early hours of 7th May 2020 from one of the Styrene storage tanks. The hazardous Styrene vapours spread beyond the factory premises, affecting the populace of five villages / habitations leading to death of 12 persons and hospitalization of several citizens.

The Hon'ble National Green Tribunal had taken suo-moto cognizance of the gas leakage incident at M/s.L.G Polymers India Pvt. Ltd in R.R. Venkatapuram Village, Visakhapatnam in Andhra Pradesh on 08.05.2020 as per O.A No.73/2020 and other connected matters. The Hon'ble National Green Tribunal, thereafter constituted an expert committee and tasked it to look into various aspects of the incident including cause of failure, extent of damage, steps for compensation and remedial measures to prevent recurrence, and submit a report to it. The Expert Committee filed an interim report on 17.05.2020 and a detailed report was filed on 28.05.2020. The Hon'ble National Green Tribunal, Principal Bench, New Delhi passed an order on 01.06.2020 in OA No. 73 of 2020.

In pursuance of the directions in the Hon'ble NGT Order dt: 01.06.2020 in O.A No. 73 of 2020, the Ministry of Environment, Forest and Climate Change(HSM Division), Government of India, vide office order dated 21.07.2020, constituted the sub -committee under the chairmanship of District Magistrate, Visakhapatnam comprising of representatives from APPCB / Environment / Factories / Health / Agriculture Department etc for preparation of Restoration and Compensation Plan for damage, to health, property, crops, livestock etc(Sub-component-2).

The MoEF&CC, GOI suggested to work out the Compensation for Damage Assessment in line with the suggestions / recommendations made in report of the Expert Committee and to submit a detailed 'Compensation Plan' to MoEF&CC within stipulated time frame of 2 months.

The District Magistrate constituted the Sub-Committee to work out Restoration and Compensation plan for damage to property, health, crops, livestock, etc. The Sub-Committee has taken up elaborate field study and assessed the damage caused due to release of styrene vapour and prepared long term requirements

for restoration under each component and submitted compensation plan as per terms of reference. The Restoration Plan prepared by the Sub-Committee envisages to bring back the normalcy in all the components taken up for study.

1.0. Introduction:

On 07th May 2020 an incident of uncontrolled styrene vapour release into the atmosphere occurred at M/s.L.G Polymers India Pvt. Ltd, R.R Venkatapuram, Pendurthy Mandal, Visakhapatnam from one of the styrene storage tank(M6 tank). The accident took the life of 12 persons in the immediate subsequent period and 585 people had to undergo treatment in hospitals, besides causing loss of livestock and vegetation.

1.1 Orders of the Hon'ble National Green Tribunal

The Hon'ble National Green Tribunal had taken suo-moto cognizance of the gas leakage incident at M/s.L.G Polymers India Pvt. Ltd on 08.05.2020 as per O.A No.73/2020 and other connected matters. The Hon'ble National Green Tribunal, thereafter constituted an expert committee and tasked it to look into various aspects of the incident including cause of failure, extent of damage, steps for compensation and remedial measures to prevent recurrence, and submit a report to it. The Expert Committee filed an interim report on 17.05.2020 and a detailed report was filed on 28.05.2020. The Hon'ble National Green Tribunal, Principal Bench, New Delhi passed an order on 01.06.2020 in OA No. 73 of 2020. The following directions with regard to preparation of restoration plan and compensation were issued by the Hon'ble Tribunal:

i. The amount of Rs. 50 crores deposited by the Company with the District Magistrate, Vishakhapatnam will stand appropriated towards part liability and interim compensation to be spent for restoration of the environment and compensation for victims in accordance with the restoration plan to be prepared.

ii. Restoration plan may be prepared by a Committee comprising two representatives each of MoEF&CC, CPCB and three representatives of State Government to be named by the Chief Secretary, including the District Magistrate, Vishakhapatnam and such other concerned Departments within two months from today. MoEF&CC will be the nodal agency for the purpose.

iii. Final quantification of compensation may be assessed by a Committee comprising representatives of MoEF&CC, CPCB and NEERI. The said

Committee will be at liberty to associate/co-opt any other expert institution or individual. The Secretary, MoEF&CC may ensure constitution of such Committee within two weeks from today. The Committee may give its report within two months thereafter. MoEF&CC will be the nodal agency for the purpose".

1.2 Directions of the Ministry of Environment, Forest and Climate Change

a. As per the Hon'ble NGT Orders dt: 01.06.2020 in OA No. 73 of 2020, the Ministry of Environment, Forest and Climate Change(HSM Division), Government of India vide office order dt: 21.07.2020 constituted the committee(s) for the 'Preparation of Restoration Plan' and 'Final Quantification of Compensation'. The preparation of restoration plan was divided into the following two sub-components:

   i. Plan for restoration of environmental media viz., air, water and soil quality.
   ii. Restoration and Compensation Plan for damage to property, health, crops, livestock etc.

b. The scope of work specified by MoEF&CC for sub component-2 i.e., plan for restoration and compensation for damage to health, property, crops, livestock etc is as follows:

   i. A sub-committee, under the chairmanship of District Magistrate, Visakhapatnam is constituted comprising of representatives from APPCB / Environment / Factories / Health / Agriculture Department etc.

   ii. The sub-committee shall work out 'Compensation for Damage Assessment' in line with the suggestions / recommendations made in report of the Expert Committee and submit a detailed 'Compensation Plan' to MoEF&CC within the stipulated time frame of 2 months.

   iii. The DM, Visakhapatnam shall be at liberty to constitute a committee or choose experts, if need be, in preparation of a compensation plan.

1.3 Constitution of the Sub-Committee

a. The District Magistrate, Visakhapatnam constituted the following Sub-committee to work out 'Compensation for Damage Assessment':

   i. The Commissioner, GVMC, Visakhapatnam.
   ii. The Joint Collector (Asara & Welfare), Visakhapatnam.
   iii. The Joint Director of Agriculture Department, Visakhapatnam.
   iv. The Joint Director of Animal Husbandry Department, Visakhapatnam.
   v. The Principal, Andhra Medical College, Visakhapatnam.
   vi. Experts from the Regional Agriculture Research Station, Anakapalli, Visakhapatnam.
   vii. The Joint Chief Inspector of Factories, Visakhapatnam.
   viii. The Revenue Divisional officer, Visakhapatnam.
   ix. The Environmental Engineer, A.P.Pollution Control Board, Visakhapatnam.

b. The following expert scientists are nominated by Associate Director of Research, Regional Agricultural Research Station, (RARS), Anakapalle:

   i. Dr. K.V. Ramana Murthy, Principal Scientist (Agronomy), RARS, Anakapalle, Visakhapatnam District.
   ii. Dr. Ch. Sitha Ramalakshmi, Senior Scientist (Soil Science), RARS, Anakapalle, Visakhapatnam District.
   iii. Dr. Ch. Mukunda Rao, Principal Scientist (Crop Physiology), RARS, Anakapalle, Visakhapatnam District.
   iv. Dr. G. Manasa, SMS (Home Science), Krishi Vigyan Kendra, Kondempudi, Visakhapatnam District.

2.0 Scope of work and working methodology of the Sub-Committee

a. The Copies of the report of the Expert Committee constituted by the Hon'ble NGT, High Power Committee constituted by the Govt. of A.P along with the orders of the Hon'ble NGT dt: 01.06.2020 and the MoEF&CC Office Order dated:21.07.2020 were circulated to the members of the Sub-Committee.

b. The Sub-Committee held its meeting on 15.09.2020 under the chairmanship of the District Magistrate, Visakhapatnam to finalize the working plan for 'Compensation for Damage Assessment' in line with the suggestions / recommendations made in report of the Expert Committee constituted by Hon'ble NGT and the High Power Committee constituted by Government of Andhra Pradesh.

2.1 Recommendations of the Expert Committee constituted by the Hon'ble NGT

The following suggestions / recommendations made in report of the Expert Committee are discussed in Sub-Committee meeting:

a) Steps to be taken for compensation of victims under restitution of the damaged property and environment, and the cost involved.

b) Compensation cost to be paid by industry shall be of two components (i) Compensation paid by government and (ii) Environmental Compensation and restitution of the damaged property.

c) For Environmental Compensation and restitution of the damaged property an elaborate scientific study is required to calculate the actual cost for environmental damage and restoration. The services of National Environmental Engineering Research Institute (NEERI) may be utilised since they have conducted the preliminary studies and also have such expertise.

d) Final quantification of compensation may be assessed by a committee comprising representatives of MoEF&CC, CPCB and NEERI.

2.2 Findings and suggestions of the High Power Committee constituted by the Government of A.P

The Government of A.P constituted a High Power Committee(G.O. RT.No.803, dt:08.05.2020) to probe into the causes behind the gas leak and suggest measures to improve the protocol for industrial safety of similar type of plants. The High Power Committee findings and suggestions are discussed in the Sub-Committee meeting:

a) Nearly 20,000 people from 17,000 houses/residences of RRV Puram, Nandamuri Nagar, Kamparapalem, Padmanabha Nagar, SC/ BC Colony, Meghadripeta Colony evacuated, and arrangements were made at 23 rehabilitation centres maintained by GVMC as well as Simhachalam Devasthanam authorities.

b) The GVMC reported disruption in the drinking water supply due to toxic contamination scare because of release of Styrene vapour. Accordingly, GVMC took immediate remedial measures to sanitise the 6318 houses (HH) in the affected areas with mobile water tankers on 11th May 2020, when the evacuated residents returned. On 12th May 2020, Godavari drinking water was made available from 2000 KL GLSR and was released to the public of 5 affected villages, after conducting disinfection and sanitization in all distribution main lines and reservoirs.

c) As reported by the Animal Husbandry Department, a total of 34 animals died due to the effect of Styrene vapour between 7th May 2020 and 9th May 2020.

d) The joint team of NEERI & CBRN, NDRF31 reported that all the trees near the M6 Tank have turned either fully or partially dry. The team observed that wherever the relatively heavy mixture of monomer and polymer Styrene flooded green plants, they got dried. All the trees were dried up to the level of Styrene vapour engulfing the affected area.

e) As reported by the Agriculture Department, there were no crops in the agriculture fields except few vegetables and agro-forestry crops like casuarina and eucalyptus in the neighboring villages adjoining LG Polymers.

f) In addition, the scientists from Rural Agriculture Research Station (RARS), Anakapalli conducted an assessment to study suitability of soil for cultivation after the accident. The team analysed soil quality pH ranges from 6.9 to 8.7 i.e., slightly Alkaline and the electrical conductivity ranges from 0.08 to 0.2 milli mhos, which is normal. It has been advised that Paddy, Vegetables and other crops should be cultivated by reclaiming the soil.

g) The Horticulture Department has analysed the impact of Styrene vapour on the horticulture crop pattern around the company for 5 km radius area. It is reported that 50% of crop damage, i.e., charred and rotting symptoms were observed in vegetable crops, 90% in papaya and no damage in Banana, Drumstick, Sapota, Mango, Cashew, Tamarind and Coconut. The farmers were advised to destroy the crop and not to sell the produce as they were not safe for consumption.

h) The District Collector constituted a group comprising of 10 Doctors under the Chairmanship of Principal, Andhra Medical College for conducting long term study on the health effects on the 585 people who got affected and had received treatment in the hospital and the others living in the vicinity of the factory.

i) Indian Council for Medical Research (ICMR) may be entrusted with the task to study the long-term effects of Styrene monomer vapour on the health of the people. ICMR may also look into the various parameters of affected patients, a spectrum of symptoms reported by the exposed people, the impact of acute inhalation of Styrene during the period of the accident and its impact on the vulnerable group like pregnant women, new-born and children and senior citizens. The ICMR can also study impact on the reproductive system, Styrene-induced genetic disorders and also conduct epidemiological study.

j) A study needs to be conducted by the Animal Husbandry experts to find out the long-term impact on the livestock and animals due to exposure to Styrene vapour.

2.3 Action points for the Sub-Committee

The following component wise action points were decided in the Sub-Committee meeting:

S. No.	Scope of work	Action points	Responsible member of the Sub-Committee
1.	Damage to the property	a. Assessment of physical damage to movable and immovable property. b. Identification of loss of movable property during the time of incident i.e., Theft of valuables and vehicles as per the FIRs registered, spoiled consumables like food grains, etc. c. Compensation plan for above items. d. Ex-gratia paid to the deceased persons and affected population by the Government of A.P to be enumerated and included in the compensation plan.	The Commissioner, GVMC and RDO, Visakhapatnam.
2.	Public Health	a. Identification of duration and no. of health camps required for affected population including pregnant women and assessment of cost involved. b. Establishment of a hospital of required bed strength and assessment of capital and recurring cost. c. Assessment of cost involved for conduct of long term health surveys & restoration of health.	Principal, Andhra Medical College, Visakhapatnam and DM&HO, Visakhapatnam.
3.	Agriculture	a. Assessment of crop damage during the gas leakage incident.	Joint Director,

		b. Long term research study of the impact of styrene gas accumulation on the agriculture and horticulture crops.	Agriculture Department and Regional Agriculture Research Station, (RARS), Anakapalle
4.	Live Stock	a. Assessment of cost involved for conduct of long term veterinary health camps. b. Identification of loss of milk, replacement of live stock, feed and fodder support during the time of incident. c. Long term monitoring and surveillance of the health of animals. d. Compensation plan for above items.	Joint Director, Animal Husbandry.

3.0 Findings of the Sub-Committee

The Sub-Committee members carried out individual field investigations as per the scope of the work and action points identified in the meeting held on 15.09.2020. The restoration and compensation plan for damage to the property was submitted by the Revenue Divisional Officer, Visakhapatnam. The restoration and compensation plan for damage to the health was submitted by the Principal, Andhra Medical College, Visakhapatnam and District Medical and Health Officer, Visakhapatnam. The restoration and compensation plan for damage to the crops was submitted by the Joint Director of Agriculture, Visakhapatnam. The restoration and compensation plan for damage to the livestock was submitted by the Joint Director, Animal Husbandry, Visakhapatnam.

3.1 The restoration and compensation plan for damage to the property

The report submitted by the Revenue Divisional Officer (RDO), Visakhapatnam is annexed (Annexure-I). The RDO and GVMC Officials carried out damage assessment of the property in the affected area. The report of the damage assessment of the property and the compensation for restoration was prepared taking into consideration the compensation paid to the victims under various heads by Government of A.P, theft amounts as per FIRs, food grains spoiled and discarded by households and the damage to the goods stored in the petty shops. The Component wise assessment of damage and compensation for restoration is tabulated below:

S. No.	Component	Cost estimated in Rs.
i.	Compensation paid by the Government of Andhra Pradesh for Deceased Cases, Medical treatment to the Victims, Dead Animals and Individuals in affected Area	37,03,35,000/-
ii.	Theft amount assessed as per the cases filed in the police stations	2,03,500/-
iii.	The enumeration of the petty shop has been taken up and assessed the damage	5,12,585/-
iv.	Compensation for contamination of food grains / consumables losses Rs.2000/- per each family (Total no.of families-6503).	1,30,06,000/-
	Total	**38,40,57,085/-**

3.2 The restoration and compensation plan for damage to the health

The report submitted by the Principal, Andhra Medical College, Visakhapatnam and District Medical and Health Officer, Visakhapatnam is annexed (Annexure-II). The report of the damage assessment of the health and the compensation for restoration was prepared taking into consideration the establishment of 10 bedded hospital for monitoring the health of the affected public for five years, baseline investigations, research studies on accidental exposure, mental health assessment & restoration of health. The Component wise assessment of damage and compensation for restoration is tabulated below:

S. No.	Component	Cost estimated in Rs.
i.	Establishment of 10 bedded hospital	13,79,17,776/-
ii.	Baseline investigations suggested by general medicine, paediatrics, gastroenterology and pathology.	4,78,98,000/-
iii.	Three research projects were proposed to be carried out by the faculty of Andhra Medical College. a. Cytogenetic effects of accidental exposure to styrene monomer vapour – a population based cohort study b. To study the effect of accidental exposure to high concentration styrene gas on pregnancy and its outcomes. c. Mental health assessment and restoration of health in Styrene affected villages	 99,49,250/- 30,24,000/- 89,16,000/-
iv.	Speciality treatment and unforeseen expenditure in hospital attached to Andhra Medical College	2,00,00,000/-
	Total	**22,77,05,026/-**

3.3 The restoration and compensation plan for damage to the Crops

The report submitted by the Joint Director of Agriculture, Visakhapatnam is annexed (Annexure-III). The Joint Director of Agriculture Department, Visakhapatnam and a team of scientists of Regional Agricultural Research Station, (RARS), Anakapalle along with officials from Horticulture

Department & Revenue Department carried out filed inspection in the surrounding area on 17.09.2020. It was felt by the team of scientists that the data on yield at the time of harvest of the Kharif crop (Nov-Dec, 2020) along with the essential soil parameters can be taken for long term study of the impact of "styrene gas" accumulation, if any, on crop performance. Soil and underground water quality needs to be monitored at regular intervals for a period of 1-2 years to monitor the effect of styrene gas on soil and water quality. The report of the damage assessment of the crops and the compensation for restoration was prepared taking into consideration organic inputs and other expenses for restoration of crop in affected villages and analysis of soil and irrigation water. The Component wise assessment of damage and compensation for restoration is tabulated below:

S. No.	Component	Cost estimated in Rs.
i.	Estimated cost for inputs for adoption of Best Management practices(Organic + Inorganic)	5,98,840/-
ii.	Charges towards Testing parameters including visits of Scientists	59,500/-
iii.	Compensation Enumerated horticulture crop damages	1,98,938/-
	Total	**8,57,278/-**

3.4 The restoration and compensation plan for damage to the Livestock

The report submitted by the Joint Director, Animal Husbandry, Visakhapatnam is annexed (Annexure-IV). The report of the damage assessment of the livestock and the compensation for restoration was prepared taking into consideration the livestock profile in the affected villages, value of milk discarded during 30 days, amount for replacement of livestock, feed and fodder support and long term monitoring and surveillance. The Component wise assessment of damage and compensation for restoration is tabulated below:

S.No.	Component	Cost estimated in Rs.
i.	The estimated value of milk discarded during 30 days after incident Interim relief	17,42,400/-
ii.	Amount required for providing replacement of animals	9,00,000/-
iii.	Cost estimated for feed and fodder support for	62,33,472/-

	180 days	
iv.	For conducting veterinary Health camps	3,00,000/-
	Total	**91,75,872/-**

4.0 Conclusions

The damage assessment and the compensation required for restoration of property, health, crops & livestock was taken up by the Sub-Committee consisting of the concerned departments who have taken up elaborate field study and assessed the long term requirements for restoration under each head and submitted compensation plan with the following cost estimate:

The total Compensation for Damage Assessment is Rs. 62,17,95,261/-

S. No.	Component	Cost estimated in Rs.
1.	The restoration and compensation estimate for property	38,40,57,085/-
2.	The restoration and compensation estimate for Health	22,77,05,026/-
3.	The restoration and compensation estimate for crops	8,57,278/-
4.	The restoration and compensation estimate for Livestock	91,75,872/-
	Total	**62,17,95,261/-**

****

Annexure-I

Rc.No.1252/2020/K dt. -09-2020.

Revenue Divisional Office,
Visakhapatnam.

From

K.Penchala Kishore, B.Tech, MBA.,
Revenue Divisional Officer,
Visakhapatnam.

To

The District Collector,
Visakhapatnam.

Sir,

Sub:- Industrial Accident – Visakhapatnam Dist. & Division – Gopalapatnam Mandal – Venkatapuram Village – Styrene Gas leakage incident occurred on early hours at about 3.00 PM on 07-05-2020 – Hon'ble National Green Tribunal order dt.9-6-2020 – Committee for "Final Quantification of Compensation" – Sub Committee Meeting held on 15-09-2020 – Enquiry conducted - Report submitted -Reg.

Ref:-1. Minutes of the meeting & Instructions of the District Collector, Visakhapatnam on submission of report of damages for Preparation of Restoration Plan held on 15-09-2020

***

I invite kind attention to the reference cited.

I submit that on 07.05.2020 at about 3.00 AM, Styrene gas leakage occurred in LG Polymers Ltd., at R.R. Venkatapuram Village, Gopalapatnam mandal; resultantly the surrounding villagers are affected.

I submit that in the above incident 12 persons were died and hundreds of the people suffered with ill-health due to consumption of styrene gas. The Govt. of Andhra Pradesh have paid compensation as detailed below:

Sl.No	Category	No	Amount released	Total Amount
1	Deceased Cases	12	Rs. 1.00 Crore	Rs.12,00,00,000/-
2	Hospitalized cases			
	a) Free Medical Care to all the Victims who are identified in all the Hospital under YSR Aarogyasri Scheme			
	b) Ventilator Treatment	1	Rs.10.00 Lakhs	Rs.10,00,000/-
	c) 2-3 Days Hospitalized	479	1 Lakh	Rs.4,79,00,000/-
	d) People Undergone Primary Treatment	72	Rs.25,000	Rs.18,00,000/-
3	Dead Animals	25 Animals (8 Owners)		Rs.8,75,000/-
4	Individuals in affected Area	19876	Rs,10,000/-	Rs.19,87,60,000/-
Total Amount				**Rs. 37,03,35,000/-**

I submit that the District Collector, Visakhapatnam has convened a meeting on 15-9-2020 and instructed to submit the report on physical damages occurred due to above incident at Venkatapuram Village for reparation of Restoration Plan to arrive at Final Quantification of Compensation. As per the instructions of the District Collector, Visakhapatnam myself along with the Tahsildar, Gopalapatnam, the Zonal Commissioner, Zone-V have visited the habitations to assess the physical damages occurred to the properties in connection with the incident.

During the enquiry it was brought to notice that, on while rescues operations are under progress few miscreants entered in to the houses and taken away few valuable belongings of the victims. Many of the houses kept unlocked as the villagers ran away to save their life's. It is submitted as ascertained that 6 theft cases were filed by the Police Department FIRs also registered and investigation is in progress. Among six cases one case found not genuine and reoffends false. The details of five theft cases are furnished here under:

1. Crime No.216/2020 U/s 457, 380 IPC occurred in between 26-3-2020 at 09 :00 hrs to 09-5-2020 at 21:00 hrs at D No 8-272- 6/1, Flat no 86, VUDA Colony, Gopalapatnam and reported on 10-5-2020 at 13:30 hrs where in the complainant Bokam Nagamani W/o Chinnodu, age 25, Caste by K Velama, R/o D no 8- 272-6/1, Flat no 86, VUDA Colony, Gopalapatnam reported that she was living in above address with her family. On 26-03-2020 morning at 09:00 hrs she went to her mother's house at Kancharapalem. Again she came on 09.05.2020 at 21:00 hrs and noticed that some unknown person broke the lock entered into her house and committed theft of Sony TV, HP Gas Cylinder. Total worth 6000/-. She requested for necessary action. Hence the FIR. **Case is UI for want of clues**

2. Crime No. 217/2020 U/S 457,380 IPC occurred in between 08-05-2020 at 11:00 hrs to 10-5-2020 at 18:00 hrs at D no 2- 173/1, Venkatapuram, RRV Puram Gopalapatnam and reported on 10-5-2020 at 22:00 hrs where in the complainant Piridi Venkata Sathish S/o Someswarrao, age 33, Caste by Rajaka, R/o D no 2-173/1, Venkatapuram, RRV Puram Gopalapatnam reported that he was living in Venkatapuram with his family last 2 months. On 7-5-2020 morning at 04:00 hrs some Gas was leaked from L.G. Polymers Company, due to fear he along with his family members left the house and went to his relatives' house at Karasa. On 08.05.2020 morning at 1100 hrs he came to his house and took his Gold and important items and cash in his room. Again he came on 10-5-2020 at 17:00 to his house and noticed that some unknown persons entered into his house and committed theft of ¼ Tulas Ear studs -2 Pairs, ¼ Tulas Gold Rings-3 and One Tula Gold Ring-1 and cash 13,000/-. Total worth 69,500/- which were kept in his mother's Iron Almarah. Therefore he presented a report for taking necessary action. **Case is UI for want of clues.**

3. Crime No. 218/2020 U/S 454,380 IPC occurred in between 07-05-2020 at 04:30 hrs to 14-5-2020 at 08:00 hrs at D no 1-36, Venkatapuram, Gopalapatnam and reported on 14-5-2020 at 17:30 hrs where in the complainant Seerapu Varaprasad Reddy S/o Apparao, age 27, Caste by Reddy, R/o D no 1-36, Venkatapuram, Gopalapatnam reported that he was living in Venkatapuram with his family. On 7-5-2020 morning at 0430 hrs some Gas was leaked from L.G. Polymers Company, due to fear he along with his family members left the house and went to his friend's house at Adavivaram. Again he came on 14.05.2020 morning at 0800 hrs and noticed that some unknown person entered into his house and committed theft of Two pairs ear studs-2 Tulas, Small Gold Piece -1, Fast Track watch-1, One pair Silver anklets -14 Tulas, One silver spoon, and Silver Harathi stand etc., which were kept in his Iron Almarah. Total worth 60,000 /-. Therefore he presented a report for taking necessary action. During the course of Investigation. Accused A1) Meesala Parameswara Rao @ Paramesh , S/o Late Appalanaidu , A2) Palavalasa Manikanta @ Mani S/o Lakshmanarao , A3) Neduri Sai Kumar @ Siva S/o Eswara Rao , A4) Badiyala Venkatarao @ Mahesh S/o Mangaraju , A5) Badiyala Anith Kumar @ Kumar S/o Mangaraju Was arrested and CICL Nekkinti Vinay S/o late Kishore was apprehended on 18.05.2020 and sent for Remand. **This case u/s 457, 380 IPC(HB by Night) was altered to u/s 454 ,380 IPC(HB by Day). Case was Charged. CC NO.2142/2020.**

4. Crime No. 219/2020 U/S 454,380 IPC occurred in between 07-05-2020 at 04:00 hrs to 15-5-2020 at 11:00 hrs at D no 4-49, Gollaveedhi, venktapuram, Gopalapatnam and reported on 15-5-2020 at 19:30 hrs where in the complainant Sarvasiddhi Lakshmi w/o sunnybabu, age 35, caste by yadava R/o D no 4-49, Gollaveedhi, venkatapuram, Gopalapatnam,Visakhapatnam City reported that she was living in venkatapuram with her family. On 7-5-2020 morning at 04:00 hrs some Gas was leaked from L.G. Polymers Company, due to fear she along with her family members left the house and went to KGH Hospital for medical treatment. After treatment she came to her house on 15.05.2020 morning at 11:00 hrs and noticed that some unknown person entered into his house and committed theft of an amount of Rs.40,000/- which were kept in his Iron Almaraih.

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Therefore she presented a report for taking necessary action. Hence the FIR. During the course of Investigation Accused A1) Meesala Parameswara Rao @ Paramesh , S/o late Appalanaidu , A2) Palavalasa Manikanta @ Mani S/o Lakshmanarao , A3) Neduri Sai Kumar @ Siva S/o Eswara Rao , A4) Badiyala Venkatarao @ Mahesh S/o Mangaraju , A5) Badiyala Anith Kumar @ Kumar S/o Mangaraju Was arrested and CICL Nekkinti Vinay S/o late Kishore was apprehended on 18.05.2020 and sent for Remand. **This case u/s 457,380 IPC(HB by Night) was altered to u/s 454,380 IPC(HB by Day). Case was Charged. CC NO.2142/2020.**

5. Crime No. 220/2020 U/S 454,380 IPC occurred in between 07-05-2020 at 03:30 hrs to 15-5-2020 at 15:00 hrs at D no 3-54/1, Venugopalaswamy temple, venkatapuram, Gopalapatnam and reported on 15-5-2020 at 20:30 hrs where in the complainant Ellapu vasu S/o Kanakaraju, age 27, caste by kapu R/o at D no 3-54/1, Venugopalaswamy temple, venkatapuram, Gopalapatnam reported that he was living in venkatapuram with his family. On 7-5-2020 morning at 03:30 hrs some Gas was leaked from L.G. Polymers Company, due to fear he along with his family members left the house and went to Relatives house at Narava. Again he came to his house on 15.05.2020 morning at 15:00 hrs and noticed that some unknown person entered into his house and committed theft of an amount of Rs. 28,000/- which were kept in his Iron Almarah. Therefore he presented a report for taking necessary action. Hence the FIR. During the course of Investigation Accused A1) Meesala Parameswara Rao @ Paramesh , S/o late Appalanaidu , A2) Palavalasa Manikanta @ Mani S/o Lakshmanarao , A3) Neduri Sai Kumar @ Siva S/o Eswara Rao , A4) Badiyala Venkatarao @ Mahesh S/o Mangaraju , A5) Badiyala Anith Kumar @ Kumar S/o Mangaraju Was arrested and CICL Nekkinti Vinay S/o late Kishore was apprehended on 18.05.2020 and sent for Remand. This case u/s 457, 380 IPC(HB by Night) was altered to u/s 454, 380 IPC(HB by Day). Case was Charged. CC NO.2142/2020.

In all these above 5 cases the worth of damage is as follows:

Sl.No	Crime No. and details	Value of damage in Rs
1	216/2020	6000/-
2.	217/2020	69500/-
3.	218/2020	60000/-
4	219/2020	40000/-
5.	220/2020	28000/-
		2,03,500/-

(Rupees two lakhs three thousand five hundred only)

I further submit that due to the heavy ness of the styrene Gas vapors' settled down in the village especially in Venkatapuram habitations. Due to this the food grains and other food items were got effected. The villagers have thrown away these grains and food items into dust bins. In this way it can be assessed that at least 2,000/- of worth of food grains and other consumable were got damaged. So each family can be given Rs.2,000/- of compensation towards food grains / consumable losses. 6503 families exist in the effected zone.

I also submit that the petty vendors/Kirana shops are also affected due to this Styrene Gas leakage. The stocks which they have purchased and stored in their shops were also got damaged. These shop keepers have thrown away their damaged stocks into dust bins as they become hazardous. The enumeration of the petty shop has been taken up and assessed the damage. The details are furnished here under:

Sl. No.	Name of the Kirana Shop	Estimated Damage Amount in Rs.
	Venkatapuram-1	
1	Sri laxmi durga shop	16,163/-
2	Nooka raju kirana shop	30,000/-
3	Venkata padma kirana and general stores	12,630/-
	TOTAL	58,793/-

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	Venkatapuram -2	
4	Gandam siva general stores	38,885/-
5	pavan venkat teja kirana shop	3,600/-
6	venkat satya sai kirana and general stores	49,422/-
7	Sri rajesawri kirana and general stores	52,366/-
8	mahadhanalaxmi kirana	19,290/-
9	Sri satyakima and general stores	24,075/-
10	ellapu appalanarsamma (small shop)	4,005/-
11	S.L.V bengalore bakery	1,10,300/-
12	Godla srinivasurao Sai pan shop	20,845/-
13	vimalakirana general stores	19,204/-
14	palavaralaxmi (tiffin shop)	3,910/-
15	satyanaryana chicken center	8,900/-
16	sridurga chips company	6,600/-
17	kotiyadaJyothi food centre	10,005/-
18	vamsi hot food centre	10,640/-
19	balajisatyavatikiran store	15,640/-
20	srilaxmiganapati manufacturing noodles	5,550/-
21	sivakotivaralaxmi (small shop)	2,760/-
22	pydimaba hot chat	4,750/-
24	chinntalabaddi	445/-
25	togalachinnitalli small shop	1,440/-
26	srivijayadurgabavani daily parlour	9,300/-
27	venkatarama and general stores	27,330/-
	TOTAL	**4,53,792/-**
	Grand Total (Rupees five lakhs twelve thousand five hundred and eighty five only)	**Rs. 5,12,585/-**

The copies of FIRs and record of enquiry is submitted for kind perusal.

Yours faithfully

Revenue Divisional Officer,
Visakhapatnam

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Annexure-II

ANDHRA MEDICAL COLLEGE

Affiliated to Dr.NTR University of Health Sciences, Vijayawada, Andhra Pradesh
Recognised by Medical Council of India, New Delhi
Maharanipeta, Visakhapatnam, Andhra Pradesh, INDIA 530002

Dr.P.V.Sudhakar,
M.S., M.Ch, DNB,FAIS,FICS.
Principal

Date:- 18.9.2020

To
The Collector & District Magistrate
Visakhapatnam

Sir,

Sub: Styrene gas leak at LG Polymers RR, Venkatapuram, Visakhapatnam – Plan for restoration and compensation for damage to health – submitted

Ref: Committee meeting on restoration and compensation for damage to health, Property, Crops, Livestock etc., dated: 15.9.2020.

As per the instructions received during the above meeting and as per the MoEF & CC office order subcomponent – 2, I am here with submitting the plan for restoration and compensation for damage to health. The plan for restoration of health as submitted by the DM&HO is incorporated in this report. The budget requirements for research activities under Andhra Medical College, Visakhapatnam for the long term benefits of the population in the affected villages is submitted for your kind perusal and necessary action.

Thanking You Sir,

Yours faithfully

18.9.2020

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Andhra Medical College
Visakhapatnam

ANDHRA MEDICAL COLLEGE

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Styrene Gas leak at LG polymers Chemical plant in RR Venkatapuram, Visakhapatnam

Plan for restoration and compensation for damage to health

In the wee hours of 7th May, 2020 uncontrolled Styrene gas release took place from LG Polymers, RR Venkatapuram Village, Visakhapatnam.

This is the first incident of Styrene gas leakage from India. Victims were admitted to King George Hospital, Visakhapatnam, CHC, Pendurthi, CHC, Gopalapatnam & CHC Aganampudi and various private hospitals. There were 12 deaths before reaching the hospitals and 585 patients were admitted as shown below. All the patients admitted to the hospitals survived and discharged after treatment.

Details of Admissions and Discharges

Sl. No.	Type of Hospital	Admissions			Discharged
		On Ventilator	General	Total	
1	Government Hospital	0	418	418	418
2	Private Hospital	1	166	167	167
Total		**1**	**584**	**585**	**585**

People in RR Venkatapuram and neighboring villages were evacuated to safer places. Once the patients were discharged they have returned home.

Medical camps were conducted daily in all the 6 villages by qualified doctors and Paramedics from 11.05.2020 to 06.07.2020. Approximately 5000 patients were examined and treated.

To have continuous monitoring of the health status of people in RR venkatapuram and neighboring villages an expert committee was formed under the Chairmanship of Principal, Andhra Medical College as follows.

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Visakhapatnam

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Sno.	Committee Member	Designation	Role
01	Dr. P.V. Sudhakar	Principal, AMC	Chairman
02	Dr. K.V.V. Vijaya Kumar	Prof & HoD, Pulmonology	Member
03	Dr. P. Venu Gopal	Prof & HoD, Pediatrics	Members
04	*Dr. VVL Narasimha Rao	Suptd of REH	Member
05	Dr. G. Butchi Raju	Prof & HoD, Neurology	Member
06	Dr. L.R.S. Girinath	I/c Prof Gastroentrology	Member
07	Dr. B. Devi Madhavi	Prof & HoD, SPM	Member
08	**Dr. B. Purushotam Rao	Prof of Gen Med	Member
09	Dr. A. Bhagya Lakshmi	Prof & HoD Pathology	Member
10	Dr. K.V. Leela	Assoc Prof of Biochemistry	Member

*Dr.V.Rajeswara Rao, Superintendent REH, is included in place of Dr. VVL Narasimha Rao who retired from service.

**Dr.D.Radha Krishna, Professor of General Medicine is included in place of Dr.B.Purushotam Rao who expired due to COVID-19

The following recommendations were given by the expert committee.

1. Baseline study of the population and establishment of registry with different cohorts.
2. Data analysis of all the patients admitted in KGH and other hospitals.
3. Establishment of hospital at RR Venkatapuram.
4. Baseline investigations suggested by departments of General Medicine, Pediatrics, Gastroenterology and Pathology:
   A. Haemogram
   B. LFT
   C. RFT
   D. X- Ray

   Specific advanced tests as and when required.

   a. Neurology:
      i. To Study post trauma stress disorder (Psychological Analysis)
      ii. Cognitive dysfunction – Psychometric Test for children
      iii. CNS – EEG, MRI Brain if required
      iv. PNS – NCV if required

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b. **Pulmonology** :

i. Baseline respiratory status (COPD)

ii. Symptomatic patients will be followed with X Ray and CT Thorax if required

c. **Ophthalmology** :

i. Symptomatic patients to undergo slit lamp examination.

ii. Neurological examination for visual defects.

5. Monitoring of pregnant women with outcome of pregnancy and 1 year follow up of newborns

Dr.Y.S.R. Clinic : A dedicated facility with 10 beds was established on 07.07.2020 and patients being monitored with adhoc staff.

Health cards were distributed for 10,000 population of all the affected villages for continuous monitoring of health of affected people. (Annexure I)

The District Medical & Health Officer was requested for carryout the baseline investigations of all the card holders.

Way Forward :

1. Individual departments of Andhra Medical College will monitor the change in health status of individuals in affected villages and will compare with health status of public in unaffected villages. Weekly camps by two departments will be conducted at Dr YSR health Clinic located at RR Venkatapuram village.
2. Patients requiring specialized treatment will be treated in various teaching hospitals attached to Andhra Medical College.
3. Three research projects were proposed to be carried out by the faculty of Andhra Medical College. The details are given in Annexure II

A. CYTOGENETIC EFFECTS OF ACCIDENTAL EXPOSURE TO STYRENE MONOMER VAPOUR – A POPULATION BASED COHORT STUDY.

B. To Study the Effect of Accidental Exposure to High Concentration Styrene Gas on Pregnancy and Its Outcomes.

C. Mental health assessment and restoration of health in Styrene affected villages of Visakhapatnam District, Andhra Pradesh.

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BUDGET REQUIREMENTS

YSR CLINIC – STYRENE GAS LEAK - VENKATAPURAM

PROPOSED EXPENDITURE FOR THE 10 BEDDED HOSPITAL FOR 5 YEARS

S No	POST	Number of Persons	Salary for Each Person	Total Salaries for one month	Total Salaries for 1st year	Total Salaries for 2nd year	Total Salaries for 3rd year	Total Salaries for 4th year	Total Salaries for 5th year	TOTAL
1	Doctors	03	54,000	1,62,000	19,44,000	40,82,400	62,40,240	84,00,024	1,05,60,002	3,12,26,666
2	Staff Nurse	03	34,500	1,03,500	12,42,000	26,08,200	39,86,820	53,66,682	67,46,668	1,99,50,370
3	Pharmacists	02	28,000	56,000	6,72,000	14,11,200	21,57,120	29,03,712	36,50,371	1,07,94,403
4	Lab Tech.	02	28,000	56,000	6,72,000	14,11,200	21,57,120	29,03,712	36,50,371	1,07,94,403
5	Attenders	04	15,000	60,000	7,20,000	15,12,000	23,11,200	31,11,120	39,11,112	1,15,65,432
6	Night Watchman	02	10,000	20,000	2,40,000	5,04,000	7,70,400	10,37,040	13,03,704	38,55,144
7	Sweepers	02	10,000	20,000	2,40,000	5,04,000	7,70,400	10,37,040	13,03,704	38,55,144
8	Thotty	02	10,000	20,000	2,40,000	5,04,000	7,70,400	10,37,040	13,03,704	38,55,144
9	DEO	01	15,000	15,000	1,80,000	3,78,000	5,77,800	7,77,780	9,77,778	28,91,358

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10	Clerk	01	18,000	18,000	2,16,000	4,53,600	6,93,360	9,33,336	11,73,334	34,69,630
11	Drugs & Disposables			50,000	6,00,000	12,60,000	19,26,000	25,92,600	32,59,260	96,37,860
12	Lab Consumables			15,000	1,80,000	3,78,000	5,77,800	7,77,780	9,77,778	28,91,358
	Total				**71,46,000**	**1,50,06,600**	**2,29,38,660**	**3,08,77,866**	**3,88,17,785**	**11,47,86,912**

(Contd)

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YSR CLINIC – STYRENE GAS LEAK - VENKATAPURAM

PROPOSED EXPENDITURE FOR THE 10 BEDDED HOSPITAL

S. No	POST	No. of Persons	Salary for Each Person	Total Salaries for one month	Total Salaries for 1st year	Total Salaries for 2nd year	Total Salaries for 3rd year	Total Salaries for 4th year	Total Salaries for 5th year	TOTAL
	BF				71,46,000	1,50,06,600	2,29,38,660	3,08,77,866	3,88,17,786	11,47,86,912
13	Maintanance i.e. power ,Internet and Telephone			15,000	1,80 ,000	3,78,000	5,77,800	7,77,780	9,77,778	28,91,358
14	**Ambulance Maintanance**									
	Drivers	02	20,000	40,000	4,80,000	10,08,000	15,40,800	20,74,080	26,07,408	77,10,288
	Helpers	02	15,000	30,000	3,60,000	7,56,000	11,55,600	15,55,560	19,55,556	57,82,716
15	Fuel			30,000	3,60,000	7,56,000	11,55,600	15,55,560	19,55,556	57,82,716
16	Vehicle Maintenance			5,000	60,000	1,26,000	1,92,600	2,59,260	3,25,926	9,63,786
	Grand Total				**85,86,000**	**1,80,30,600**	**2,75,61,060**	**3,71,00,106**	**4,66,40,010**	**13,79,17,776**

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PROPOSED EXPENDITURE FOR INVESTIGATIONS

S.No.	Test	No. of People to be covered	Rate (INR)	No. of times	Total
1	Routine tests	10,000	720	6	4,32,00,000
2	CT scan	1,000 (10% of population)	1200	1	12,00,000
3	USG abdomen	2,000 (20% of population)	699	1	13,98,000
4	MRI Brain	500 (5% of population)	1700	1	8,50,000
5	EEG	500 (5% of population)	1500	1	7,50,000
6	NCS	500 (5% of population)	1000	1	5,00,000
				Grand Total	4,78,98,000

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PROPOSED EXPENDITURE FOR RESEARCH ACTIVITY

(A)CYTOGENETIC EFFECTS OF ACCIDENTAL EXPOSURE TO STYRENE MONOMER VAPOUR – A

(B) POPULATION BASED COHORT STUDY

Budget Head	1st year	2nd year	3rd Year	Total
a. Staff	2 Lab technicians @ 25,000/-per month (6,00,000/ P.A)			18,00,000/-
b. Contingency	1,00,000/- (P.A)			3,00,000/-
c. Chemicals & Consumables **Cytogenetic Investigations** **MN & SCE(700 samples)** **Chromosomal Aberrations (350 samples)**	700*1285/- = 8,99,500/-	350*1285/- = 4,49,750/-		13,49,250/-
Molecular Investigations (700 samples)			2000*700 =14,00,000	14,00,000/-
Hematological & Biochemical Investigations	(700 samples * 4 times testing= 2800 samples) 2800*1500 = 42,00,000/-			42,00,000/-
d. LOGISTICS	Vehicle for carrying samples			9,00,000/-
TOTAL				**99,49,250/-**

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B. To Study the effect of accidental exposure to high concentration Styrene Gas on Pregnancy and its Outcomes

Budget Head	Split	1st year	2nd year	3rd year	Total
Staff salaries	4 health works	4 * 20000 = 80000	4 * 20000 =80000	4 * 20000 =80000	**240000**
Contingency	2 supervisors	2 * 30000 =60000	2 * 30000 =60000	2 * 30000 =60000	**180000**
Stationery		50000	50000	50000	**150000**
		25000	25000	25000	**75000**
Logistics					
Transport for health care staff	500 per visit	500 * 10 = 5000	500 * 10 = 5000	500 * 10 = 5000	**15000**
Transport for mothers for TIFFA scan and other Investigations	500 per person	500 * 120 = 60000	-		**60000**
TIFFA scan	3000 per person	3000 * 120 =360000	-	-	**360000**
Chemicals for Cytogenetics RPMI Medium With L-Glutamine, FBS, PHA-M, Penicillin, Streptomycin and Sodium bicarbonate 1X Liquid Karyotyping Medium Colchicine Solution KCL Methanol and Glacial acetic acid(fixative) Giemsa Stain and Trypsin 5-Bromo-2'-deoxyuridine (BrDu) Cytochalasin B DPS mount	1000 per sample MN and SCE for both cases and controls Chromosomal aberrations analysis will be done only for	120 * 1000 = 120000	-		**120000**

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	cases				
Chemicals for Biochemical & Molecular Investigations DNA isolation Kits Primers Ladders Agarose Gel	3214 per sample	120 * 3214 = 385680	-	-	**385680**
Chemicals for Hematological Investigations	857 per sample	857 * 360 * 2 = 617040	857 * 360 * 2 = 617040	857*120*2 =204240	**1438320**
Total					**30,24,000/- INR**

(C) Mental health assessment and restoration of health in Styrene affected villages of Visakhapatnam District, Andhra Pradesh

BUDGET:				
Sl No.	**Particulars**	**1st Year (In Rs.)**	**2nd Year (In Rs.)**	**3rd Year (In Rs.)**
A	**Non-Recurring**			
1	Office establishment	5,00,000	-	-
2	Equipment's	5,00,000	-	-
3	Furniture	5,00,000	-	-
B.	**Recurring**			
1.	**Manpower**			
a	Project Manager No. 1 @ Rs. 34,000 p.m	2,48,000	2,48,000	2,48,000
b	Field Investigators (6 months) No. 5 @ Rs. 20,000 p.m.	6,00,000	-	-
c	Medico social Worker			

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	No. 1 @ Rs. 20,000 p.m.	2,40,000	2,40,000	2,40,000
d.	Counsellor No. 1 @ Rs. 20,000 p.m.	2,40,000	2,40,000	2,40,000
e.	Multitasking worker No. 1 @ Rs. 12,000 p.m	1,44,000	1,44,000	1,44,000
f.	Data Entry Operator No. 1 @ Rs. 20,000 p.m	2,40,000	2,40,000	2,40,000
2.	**Miscellaneous Expenses**			
	Hiring of Building	1,80,000	1,80,000	1,80,000
	Power and Internet	1,80,000	1,80,000	1,80,000
3.	Consumables	1,00,000	1,00,000	1,00,000
4.	Contingencies	2,00,000	2,00,000	2,00,000
5.	Transport	3,00,000	3,00,000	3,00,000
6.	Report Writing	2,00,000	2,00,000	2,00,000
	Total	**43,72,000**	**22,72,000**	**22,72,000**
	Grant Total (1st Year + 2nd Year + 3rd Year)	**89,16,000**		

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PROPOSED BUDGET FOR SPECIALIST TREATMENT AND UNFORESEEN EXPENDITURE IN HOSPITALS ATTACHED TO ANDHRA MEDICAL COLLEGE : 2CR

Abstract of budget requirements

S.No.	HEAD	INR
1	Expenditure for 10 bedded hospital for 5 years	13,79,17,776
2	Investigations	4,78,98,000
3	Research project 1	99,49,250
4	Research project 2	30,24,000
5	Research project 3	89,16,000
6	To Andhra Medical College	2,00,00,000
	Total	22,77,05,026

(RUPEES TWENTY TWO CRORES SEVENTY SEVEN LAKHS FIVE THOUSAND AND TWENTY SIX ONLY)

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ANNEXURE I



Dr YSR HEALTH CLINIC

HEALTH CARD FOR STYRENE GAS AFFECTED POPULATION

NAME :

AGE/ SEX :

ADDRESS :

ADHAR NUMBER :

CONTACT NUMBER :

IP NO OF DISCHARGE :

ANTENATAL STATUS : YES/NO

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NEW BORN : YES/NO

COMORBID CONDITIONS: DIABETES/HYPERTENSION/ CAD/
THYROID – HYPO/HYPER/ COPD/
BRONCHIAL ASTHMA

PRESENTING COMPLAINTS:

PHYSICAL EXAMINATION:

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FIRST VISIT: 1ST WEEK

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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FIRST VISIT: 2ND WEEK

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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SECOND VISIT: IST MONTH

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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THIRD VISIT: 3RD MONTH

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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FOURTH VISIT: 6TH MONTH

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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FIFTH VISIT: 9TH MONTH

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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SIXTH VISIT: ONE YEAR

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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UNSCHEDULED VISIT

HEMOGRAM	
HB	
WBC COUNT	
PLATELET COUNT	
PERIPHERAL SMEAR	
PCV	
MCV	
LFT	
TB	
DB	
SGOT	
SGPT	
ALP	
RFT	
CREATININE	
BUN	
Na	
K	

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COMPLAINTS	
EXAMINATION	BP: PALLOR: ICTERUS: SKIN: EYE: CVS: RS: CNS: P/A:
CXR	
CT THORAX	
USG ABDOMEN	
SLIT LAMP EXAMINATION	
VISUAL FEILDS	
NEURO	
MRI BRAIN	
EEG	
NCS	

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ANNEXURE II : Research Projects

(A)

Title : CYTOGENETIC EFFECTS OF ACCIDENTAL EXPOSURE TO STYRENE MONOMER VAPOUR – A POPULATION BASED COHORT STUDY.

1. Investigator — **Dr P.V. Sudhakar, M.S, M.Ch., DNB,FAIS,FICS,**
Principal, AMC.

2. CO-I's — **Dr A. Bhagyalakshmi, MD**
Professor & HoD,
Department of Pathology, AMC
Dr B. Devi Madhavi
Professor & HOD,
Dept of Community Medicine,AMC
Dr K .V. Leela
Associate Professor,
Department of Biochemistry, AMC
Dr K. Satya Sri
Associate Professor,
Department of Pathology, AMC
Dr A. Anuradha
Research Scientist,
Multidiscplinary Research Unit (MRU),AMC

INTRODUCTION: Exposure to styrene mainly occur via inhalation during the industrial accident. About 90% of inhaled styrene is absorbed by the lung and undergoes biotransformation to Styrene-7,8-Oxide (SO) via cytochrome P-450s. The product is then hydrolysed by microsomal epoxide hydrolase, followed by metabolism to the main final metabolites, mandelic acid (MA) and phenylglyoxylic acid (PGA). Styrene-7,8-Oxide (SO) can also be conjugated with glutathione giving rise to mercapturic acids. Styrene has been shown to induce single-strand breaks (SSBs) in human white blood cells as well as cytogenetic damage including chromosome breaks, aneuploidy, sister chromatid exchanges (SCEs) and micronuclei (MN) in several cell systems in

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vitro and in lymphocytes of exposed workers. International Agency for Research on Cancer classified styrene as possibly carcinogenic to humans and Styrene-7,8-Oxide (SO) as probably carcinogenic to humans. However, there is a little literature regarding the association between styrene and cancer.

These genotoxic biomarkers (MN and SCEs) provide information about normal and pathological states of population and also used for monitoring different aspects of a disease such as: prevention,diagnosis, treatment and progression of the disease.These also helps to assess the environmental and epidemiological risk measurement.

Since the induction of SCEs and MN represent sensitive cytogenetic endpoints for the detection of genotoxic activity of environmental mutagens and carcinogens (WHO, 2014), these two assays will be employed in the present study to monitor a group of subjects accidentally exposed to styrene at LG Polymers,Visakhapatnam.

Primary Objectives:

1.To compare the DNA damage assessed in the form of MicroNuclear(MN) assay and Sister Chromatid Exchanges (SCEs) in people exposed to styrene with that of unexposed people.

2. To compare the frequency of MN and Sister Chromatid Exchanges (SCEs) chromosomes in subjects and unexposed people with respect to their habits(smoking and alcohol).

3. To analyze correlation between age and MN.

Secondary Objectives:

1.To observe the chromosomal aberrations among the individuals with high scores of MN & SCE's.

2.To assess whether genetically determined individual variations in xenobiotic metabolizing capacity might modify individual susceptibility to potential genotoxic effects following styrene exposure. Individuals will be genotyped for several genes involved in the metabolic fate of styrene including GSTM1 and GSTT1 (gene deletions), GSTP1 (Ile105Val), EPHX1 (Tyr113His and His139Arg), and CYP2E1 (DraI polymorphism in intron 6 that identifies a Thr7668Ala substitution).

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3. To evaluate correlation between genetic polymorphisms and biomarkers of effect(MN and SCE).

MATERIAL & METHODS

Hypothesis: It is assumed that the people exposed to styrene monomer vapour leak have genotoxic effects.

Null hypothesis: The people exposed to styrene monomer vapour leak will not have genotoxic effects.

Altenative hypothesis: The people exposed to styrene monomer vapour leak will have genotoxic effects.

Study Design: The study is a Cohort study.

Study period : The study will be carried out for a period of **3years**.

Study population : Exposed group & Unexposed group

The **Exposed group** are the villagers who are residents of place where the LG Polymers company is located and have been admitted to KGH on the day of industrial accident.

Unexposed group will be the residents residing in same geographic conditions with similar levels of air pollutants will be recruited for cytogenetic study.

Sampling frame:-

Sample size: The sample size consists of 350 individuals in exposed group or 350 individuals in unexposed group and the recruited random sample will be tested for Hematological parameters ,MN and SCEs in the first year.

Sample technique: Stratified sampling in which the population is divided into stratums/groups i.e.,

Group 1(5-18yrs)

Group 2(19-64yrs)

Study tools: The demographic data will be collected in the form of structured questionnaires.

Place Of Work : Andhra Medical College, King George Hospital, Visakhapatnam.

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Exposed Group:

Inclusion criteria :

1. Individuals of nearby villagers who are exposed to the industrial accident at LG Polymers on 7th May 2020 will be recruited.

2. Aged between 5 to 60 years.

Exclusion criteria :

1. Patients without informed consent and assent.

2.People under cancer ,prolonged usage of immune suppressors and Chronic Kidney failure treatment are excluded.

Unexposed Group:

Inclusion criteria :

1.Age and sex matched Individuals residing in similar geographic conditions with similar levels of air pollutants will be recruited.

2. Aged between 5 to 60 years.

Exclusion criteria :

1.Patients without informed consent and assent.

2.People under cancer, prolonged usage of immune suppressors and Chronic Kidney failure treatment are excluded.

Methodology:

At enrollment, investigator collects information on demographic characteristics, current illness, and medical history.

After taking the written informed consent; clinical and medical history will be noted on a predesigned proforma along with three generation pedigree to assess any history of disease and consanguinity.

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MicroNuclear(MN) assay

Aliquots of 2.5ml of heparinized whole blood are cultured in 4.5ml Hams F10 medium supplemented with 24% foetal calf serum (Sigma), penicillin (100IU/ml) (Sigma), streptomycin (100g/ml) (Sigma), 1% l-glutamine (Sigma) and 1% heparin (50IU/ml) (B. Braun). Lymphocytes are stimulated using 80µl of phytohaemaglutinin (Gibco BRL) and incubated at 37◦C. **Cytochalasin B** (Sigma) is added after 44h at a final concentration of 6g/ml (Fenech and Morley, 1985). After a total of 72-h culture, cells are harvested by centrifugation, treated twice with 5ml of a mixture (pH 7.2) of RPMI, supplemented with 2% foetal calf serum, for 7min.

The cells are again centrifuged and submitted to a mild hypotonic treatment in a mixture (pH 7.2) of RPMI 1640:deionized water 1:4, supplemented with 2% foetal calf serum, for 5min. The centrifuged cells will be placed on dry slides and smears are performed. After air-drying, the slides are fixed with freshly prepared and cold methanol:acetic acid (3:1 v/v) for 20min. One day later the slides are stained with 4% Giemsa in phosphate buffer, pH 6.8 for 7min. For each subject, 1000 binucleated (BN) lymphocytes with well-preserved cytoplasm are scored blindly by the same reader. MN are identified according to the criteria of Caria et al. (1995) using a 500× magnification for detection and a 1250× magnification for confirmation.

Sister Chromatid Exchanges (SCEs) assay

Aliquots of 2.5ml of heparinized whole blood are cultured as described above and 4.5l of **5-bromo-deoxyuridine** (BrDu) solution at a final concentration of 10g/ml was added at 24hr. Lymphocytes were incubated at 37◦C for 72h in the dark and colcemide (0.11g/ml) is added for the last hour; cells are prepared by standard procedures with hypotonic treatment followed by fixation with methanol:acetic acid (3:1 v/v). Slides are stained for SCE detection by the fluorescence-plus-Giemsa procedure (Perry and Wolff, 1974) for differential chromatid staining. A minimum of 25-s division metaphases will be scored for SCE per subject on coded slides by a single observer.

Hematological Parameters: 3 ml venous blood sample was collected in EDTA (Ethylenediaminetetraacetic acid) vacutainer tubes.The sample will be thoroughly, but gently mixed with the anticoagulant immediately after filling the tube. Blood samples will be tested within 4 hours on an automated 5 part differential cell counter for hemoglobin, WBC and platelet counts.

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Genotyping :

DNA will be isolated from lymphocytes using a commercially available kit according to the manufacturer's instructions (QIAamp DNA extraction kit; Qiagen, Hilden, Germany). CYP2E1, GSTT1, GSTP1, GSTM1, and EPHX1 polymorphisms will be determined as described by Teixeira et al. (2004).

Biochemical Analysis:
Urinary metabolites of styrene, namely, MA and PGA, will be measured in all subjects by using kits.
And lastly genetic counseling will be done to all families .
The study will be approved by ethical committee of the Andhra Medical College.

Results & Data analysis:
Project-specific case report forms will be used for data collection.
Prior to the study, a questionnaire will be supplied concerning health status, smoking habits, alcohol consumption, medication, and occupational history. The control group will be matched for gender, age, smoking, and lifestyle habits. The normality of variables will be evaluated by the Kolmogorov–Smirnov test. When no significant departure from normality found, Student's t-test will be applied for comparison between group means. Nonparametric tests will be applied when data distribution significantly deviated from normality, and are referred to when results are presented. When no test is specified, Student's t-test and parametric analysis will be applied. Spearman correlation analysis will be used for the estimation of correlations between parameters. A value of $p < .05$ will be used as the criterion of significance. Multifactorial analysis was performed to evaluate the contribution of potential confounding factors (sex, age, smoking) to the response variables considered.
Microsoft Excel and SPSS will be used for validation and cleaning, for all analyses.

Microsoft Excel will be used for validation and cleaning, for all analyses.

LIMITATIONS : As the study is scheduled for a limited period of time, the results may vary when we change the no. of subjects and study period.

ETHICAL CONSIDERATIONS:

Prior permission will be taken from Institutional Ethics Committee, Andhra Medical College, Visakhapatnam.

Prior informed consent will be taken from each individual of the study.

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Proposed Budget:

Budget Head	1st year	2nd year	3rd Year	Total
b. Staff	2 Lab technicians @ 25,000/-per month (6,00,000/ P.A)			18,00,000/-
b. Contingency	1,00,000/- (P.A)			3,00,000/-
e. Chemicals & Consumables **Cytogenetic Investigations** **MN & SCE(700 samples)** **Chromosomal Aberrations (350 samples)**	700*1285/- = 8,99,500/-	350*1285/- = 4,49,750/-		13,49,250/-
Molecular Investigations (700 samples)			2000*700 =14,00,000	14,00,000/-
Hematological & Biochemical Investigations	(700 samples * 4 times testing= 2800 samples) 2800*1500 = 42,00,000/-			42,00,000/-
d. LOGISTICS	Vehicle for carrying samples			9,00,000/-
TOTAL				**99,49,250/-**

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(B)

PROJECT TITLE:

To Study the Effect of Accidental Exposure to High Concentration Styrene Gas on Pregnancy and Its Outcomes

Investigator **Dr P.V. Sudhakar, M.S, M.Ch., DNB,FAIS,FICS,**
Principal, AMC.

CO-I's **Dr B. Devi Madhavi**
Professor & HOD,
Dept of Community Medicine,AMC
Dr A. Bhagyalakshmi, MD
Professor & HoD,
Department of Pathology, AMC
Dr.T.Nagamani
Prof. & HOD,
OBG, AMC
Dr.G.Ganga Bhavani
Associate Professor,
Department of Community Medicine, AMC
Dr.L.Siva Kumar
Assistant Professor,
Department of Community Medicine, AMC
Dr.G.Raja Lakshmi
Assistant Professor,
OBG ,AMC

AIM:

To study the genotoxic effects among antenatal women who are accidentally exposed tohigh concentrations styrene gas and its impact on pregnancy outcomeat the LG polymers styrene gas leak accident in Visakhapatnam in May 2020.

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OBJECTIVE:

1. To assess the impact of styrene gas exposure on pregnancy outcome in the form of miscarriage, still births, low birth rate, congenital anomalies in the new born both morphologic and genetic.
2. To assess the susceptibility to genotoxicity in antenatal mothers who were accidentally exposed to styrene.
3. To compare the pregnancy outcomes among the exposed antenatal women with and without exposure to styrene gas.
4. To follow the children born to mothers exposed to styrene up to a period of two years for growth and developmental assessment.

DELIVERABLES:

1.Early detection of genetic damage is crucial to implement the necessary measures to reduce or suppress the exposure to deleterious agent (styrene) when the damage is still reversible, thus reduce the risk to suffer diseases. Therefore, genotoxicity tests should be considered as essential tools for a complete medical surveillance of people potentially exposed to styrene and, in order to prevent the occurrence of diseases to styrene exposure. On the other hand, the application of these tests is useful to detect possible long-term effects of substances that are encountered by an industrial accident without knowing their capacity to affect human and environmental health.

2. This work provides new data about the ante natal exposure to styrene and helps to create a baseline data which can assist the physicians by increasing their awareness to determine the health risks that they may present as it is a unique incident.

3. Helps further in the search of information about ante-natal health for future interventions and genetic counselling.

METHODOLOGY

Study design - Cohort study

Study setting - within 3 km radius from LG polymers plant, the people who got accidentally exposed to styrene

Study population - All the pregnant mothers who got exposed to styrene gas within 3km radius from the LG polymers plant.

Study duration - August 2020 toAugust 2023. Which is 36 months.

Sample size- 60 pregnant women who were exposed to styrene gas on May 10 2020.

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Data collection method: Exposed pregnant women are recruited within three Kilometre radius of LG polymers where styrene gas leak has occurred. Pregnant women who are registered by the local ASHA /ANM by house to house survey are line listed and taken into the study after informed consent. Controls are taken from nearby PHC who are not exposed and willing to participate in the study in the ratio of 1:2. These are matched on the basis of age, trimester and nutrition.

Necessary investigations (lymphocyte micro nuclei frequency, CBMN ASSAY, Sister Chromatid)

One time new born investigations for assessing congenital anomalies(TIFFA Scan)

Growth follow up using Trivandrum development scale, length, weight up to 2 years.

congenital anomalies

Miscarriage, IUD, still birth

Preterm delivery

Testing for genotoxicity in both pregnant and new-born

BUDGET:

Budget Head	Split	1st year	2nd year	3rd year	Total
Staff salaries	4 health works	4 * 20000 = 80000	4 * 20000 =80000	4 * 20000 =80000	**240000**
Contingency	2 supervisors	2 * 30000 =60000	2 * 30000 =60000	2 * 30000 =60000	**180000**
Stationery		50000	50000	50000	**150000**
		25000	25000	25000	**75000**
Logistics					
Transport for health care staff	500 per visit	500 * 10 = 5000	500 * 10 = 5000	500 * 10 = 5000	**15000**
Transport for mothers for TIFFA scan and other investigations	500 per person	500 * 120 = 60000	-		**60000**
TIFFA scan	3000 per person	3000 * 120 =360000	-	-	**360000**

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Chemicals for Cytogenetics RPMI Medium With L-Glutamine, FBS, PHA-M, Penicillin, Streptomycin and Sodium bicarbonate 1X Liquid Karyotyping Medium Colchicine Solution KCL Methanol and Glacial acetic acid(fixative) Giemsa Stain and Trypsin 5-Bromo-2'-deoxyuridine (BrDu) Cytochalasin B DPS mount	1000 per sample MN and SCE for both cases and controls Chromosomal aberrations analysis will be done only for cases	120 * 1000 = 120000	-		**120000**
Chemicals for Biochemical & Molecular Investigations DNA isolation Kits Primers Ladders Agarose Gel	3214 per sample	120 * 3214 = 385680	-	-	**385680**
Chemicals for Hematological Investigations	857 per sample	857 * 360 * 2 = 617040	857 * 360 * 2 = 617040	857*120*2 =204240	**1438320**
Total					**30,24,000/- INR**

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(C)

Mental health assessment and restoration of health in Styrene affected villages of Visakhapatnam District, Andhra Pradesh.

Investigator — Dr P.V. Sudhakar, M.S, M.Ch., DNB,FAIS,FICS,
Principal, AMC.

CO-I's — Dr B. Devi Madhavi
Professor & HOD,
Dept of Community Medicine,AMC

Dr.S.Radha Rani
Professor of Psychiatry,
Department of Psychiatry, AMC

Dr.T.S.N.Raju
Assistant Professor of Psychiatry,
Department of Psychiatry, AMC

Dr.Kiran Kumar
Assistant Professor,
Department of Community Medicine, AMC

Dr.L.Siva Kumar
Assistant Professor,
Department of Community Medicine, AMC

Introduction:

Studies conducted in the aftermath of environmental disasters such as Chernobyl and Bhopal, as well as studies of less well-known contamination cases, have documented a variety of important psychosocial impacts (1-10). These psychosocial impacts range from increased levels of distress to severe social disruption and conflict. In addition, some studies have suggested that the psychosocial impacts of environmental accidents can be quite long lived (1).There is a growing body of literature and research focused on understanding these psychosocial impacts, much of it dealing with clinical issues and implications. Up to this point, however, far less attention has been focused on program and policy issues connected with efforts to plan and deliver psychosocial assistance to victims of chemical and nuclear accidents. Because environmental accidents are expected to be a continuing problem incoming decades (11), and because psychosocial services are certain to be a crucial part of the public health and human service response, there is a pressing need for these program and policy issues to be more fully considered.

PRINCIPAL
Andhra Medical College
Visakhapatnam

In view of above studies under taken after accidents, this current study is propose to assess the psychosocial wellbeing through a base line survey & to provide services for psychosocial wellbeing, also to access the prevalence of Post trauma stress disorder due to styrene gas release in the Visakhapatnam area.

Objectives:

1. To assess the psychosocial wellbeing through a base line survey.
2. To assess the prevalence of Post trauma stress disorder.
3. To provide services for psychosocial wellbeing
4. To establish a centre for counseling for assessment of psychological wellbeing will be done using a standardized questionnaire.

Methodology:

A base line survey will be taken over for 6 months by the field investigators for a population of 20,000 people. A centre will be established for the next 2 ½ years for counseling the population to access the prevalence of Post trauma stress disorder due to styrene gas release & provide necessary psychological wellbeing services to the population.

Expected Deliverables:

1. Prevalence of PTSD (Post trauma stress disorder) among the affected community.
2. Improvement in mental health



BUDGET:				
Sl No.	**Particulars**	**1st Year (In Rs.)**	**2nd Year (In Rs.)**	**3rd Year (In Rs.)**
A	**Non-Recurring**			
1	Office establishment	5,00,000	-	-
2	Equipment's	5,00,000	-	-
3	Furniture	5,00,000	-	-
B.	**Recurring**			
1.	**Manpower**			
a	Project Manager No. 1 @ Rs. 54,000 p.m	2,48,000	2,48,000	2,48,000
b	Field Investigators (6 months) No. 5 @ Rs. 20,000 p.m.	6,00,000	-	-
c	Medico social Worker No. 1 @ Rs. 20,000 p.m.	2,40,000	2,40,000	2,40,000
d.	Counsellor No. 1 @ Rs. 20,000 p.m.	2,40,000	2,40,000	2,40,000
e.	Multitasking worker No. 1 @ Rs. 12,000 p.m	1,44,000	1,44,000	1,44,000
f.	Data Entry Operator No. 1 @ Rs. 20,000 p.m	2,40,000	2,40,000	2,40,000
2.	**Miscellaneous Expenses**			
	Hiring of Building	1,80,000	1,80,000	1,80,000
	Power and Internet	1,80,000	1,80,000	1,80,000
3.	Consumables	1,00,000	1,00,000	1,00,000
4.	Contingencies	2,00,000	2,00,000	2,00,000
5.	Transport	3,00,000	3,00,000	3,00,000
6.	Report Writing	2,00,000	2,00,000	2,00,000
	Total	**43,72,000**	**22,72,000**	**22,72,000**
	Grand Total (1st Year + 2nd Year + 3rd Year)	**89,16,000**		

PRINCIPAL
Andhra Medical College
Visakhapatnam

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From
Dr.K.Vijaya Lakshmi
District Medical and Health officer,
Visakhapatnam.

Date: 18.9.2020.

To
The Principal
Andhra Medical College
Visakhapatnam.

Sir,

Sub:- Styrene Gas leak –LG Polymers, RR Venkatapuram - Estimation of budget for running health centre- submitted

Ref:- Committee meeting on restoration and compensation plan for damage to health, property, crops live stock etc. dt.15.9.2020.

*****

With reference to above subject, I wish to submit the estimated budget requirement for running Health Center (Dr.YSR Health Clinic) established in RR Venkatapuram on 07.7.2020.

I request you to incorporate the estimate under Sub component – 2 as per the MoEF & CC orders.

Thanking you Sir,

Yours faithfully,

18/9/2020

(Dr.K.Vijaya Lakshmi)
District Medical & Health Officer
Visakhapatnam

BUDGET REQUIREMENTS

YSR CLINIC – STYRENE GAS LEAK - VENKATAPURAM

PROPOSED EXPENDITURE FOR THE 10 BEDDED HOSPITAL FOR 5 YEARS

S. No	POST	Number of Persons	Salary for Each Person	Total Salaries for one month	Total Salaries for 1st year	Total Salaries for 2nd year	Total Salaries for 3rd year	Total Salaries for 4th year	Total Salaries for 5th year	TOTAL
1	Doctors	03	54,000	1,62,000	19,44,000	40,82,400	62,40,240	84,00,024	1,05,60,002	3,12,26,666
2	Staff Nurse	03	34,500	1,03,500	12,42,000	26,08,200	39,86,820	53,66,682	67,46,668	1,99,50,370
3	Pharmacists	02	28,000	56,000	6,72,000	14,11,200	21,57,120	29,03,712	36,50,371	1,07,94,403
4	Lab Tech.,	02	28,000	56,000	6,72,000	14,11,200	21,57,120	29,03,712	36,50,371	1,07,94,403
5	Attenders	04	15,000	60,000	7,20,000	15,12,000	23,11,200	31,11,120	39,11,112	1,15,65,432
6	Night Watchman	02	10,000	20,000	2,40,000	5,04,000	7,70,400	10,37,040	13,03,704	38,55,144
7	Sweepers	02	10,000	20,000	2,40,000	5,04,000	7,70,400	10,37,040	13,03,704	38,55,144
8	Thoty	02	10,000	20,000	2,40,000	5,04,000	7,70,400	10,37,040	13,03,704	38,55,144
9	DEO	01	15,000	15,000	1,80,000	3,78,000	5,77,800	7,77,780	9,77,778	28,91,358
10	Clerk	01	18,000	18,000	2,16,000	4,53,600	6,93,360	9,33,336	11,73,334	34,69,630
11	Drugs & Disposables			50,000	6,00,000	12,60,000	19,26,000	25,92,600	32,59,260	96,37,860
12	Lab Consumables			15,000	1,80,000	3,78,000	5,77,800	7,77,780	9,77,778	28,91,358
	Total				**71,46,000**	**1,50,06,600**	**2,29,38,660**	**3,08,77,866**	**3,88,17,786**	**11,47,86,912**

District Medical & Health Officer
Visakhapatnam

YSR CLINIC – STYRENE GAS LEAK - VENKATAPURAM

PROPOSED EXPENDITURE FOR THE 10 BEDDED HOSPITAL

S. No	POST	Number of Persons	Salary for Each Person	Total Salaries for one month	Total Salaries for 1st year	Total Salaries for 2nd year	Total Salaries for 3rd year	Total Salaries for 4th year	Total Salaries for 5th year	TOTAL
	BF				**71,46,000**	**1,50,06,600**	**2,29,38,660**	**3,08,77,866**	**3,88,17,786**	**11,47,86,912**
13	Maintanance i.e. power,Internet and Telephone			15,000	1,80,000	3,78,000	5,77,800	7,77,780	9,77,778	28,91,358
14	**Ambulance Maintanance**									
	1) Drivers	02	20,000	40,000	4,80,000	10,08,000	15,40,800	20,74,080	26,07,408	77,10,288
	2) Helpers	02	15,000	30,000	3,60,000	7,56,000	11,55,600	15,55,560	19,55,556	57,82,716
15	Fuel			30,000	3,60,000	7,56,000	11,55,600	15,55,560	19,55,556	57,82,716
16	Vehicle Maintanance			5,000	60,000	1,26,000	1,92,600	2,59,260	3,25,926	9,63,786
	Grand Total				**85,86,000**	**1,80,30,600**	**2,75,61,060**	**3,71,00,106**	**4,66,40,010**	**13,79,17,776**

15/9/2020
District Medical & Health Officer
Visakhapatnam

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From
Dr.K.Vijaya Lakshmi
District Medical and Health officer,
Visakhapatnam.

Date: 18.9.2020.

To
The Principal
Andhra Medical College
Visakhapatnam.

Sir,

Sub:- Styrene Gas leak –LG Polymers, RR Venkatapuram - Budget requirement for Lab tests- submitted.

Ref:- Committee meeting on restoration and compensation plan for damage to health, property, crops live stock etc. dt.15.9.2020.

*****

With reference to above subject, Laboratory tests are contemplated for needy 10000 populations in the affected villages. A detailed exercise of required tests was done and quotations were called from laboratories and finalized the rates.

In this connection, I am herewith submitting the detailed budget proposals for carrying out the tests.

Hence I request you to incorporate the proposal in the Sub component – 2 as per the MoEF & CC office order.

Thanking you Sir,

Yours faithfully,

18/9/2020

(Dr.K.Vijaya Lakshmi)

District Medical & Health Officer
Visakhapatnam

PROPOSED EXPENDITURE FOR INVESTIGATIONS

S.No.	Test	No. of People to be covered	Rate (INR)	No. of times	Total
1	Routine tests	10,000	720	6	4,32,00,000
2	CT scan	1,000 (10% of population)	1200	1	12,00,000
3	USG abdomen	2,000 (20% of population)	699	1	13,98,000
4	MRI Brain	500 (5% of population)	1700	1	8,50,000
5	EEG	500 (5% of population)	1500	1	7,50,000
6	NCS	500 (5% of population)	1000	1	5,00,000
				Grand Total	**4,78,98,000**

18/9/2020

District Medical & Health Officer
Visakhapatnam

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Annexure-III

DEPARTMENT OF AGRICULTURE

From
Smt. G.S.N.S.Leelavathi, M.Sc(Ag),
Joint Director of Agriculture,
Visakhapatnam.

To
The Joint Chief Environmental Engineer
A.P. Pollution control board
Visakhapatnam

Sir,

File No.AGRI-CAL/ /2020-JA(T1)-AGRLVSKP, Dated 23.09.2020

Sub:- Disaster Management – Gas leakage tragic incident- Visakhapatnam district- styrene vapours released from m6 storage tank of LG Polymers India Pvt. Ltd.- submission of input assessment report – Regarding.

Ref:- 1. AGRI-CAL/ 2020-SA(T1)-AGRLVSKP, Dated 19.09.2020, of this office
2. Roc.No.A/2037/2020, Dt.21.09.2020, ADR, RARS, Anakapalli
3. Rc. No. H(1) 16/2020, Dt. 23-09-2020, ADH, Visakhapatnam

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It is submitted that, in continuation to the restoration plan for damage to the crops village level a report submitted (as per ref. 1st cited), The Associate Director of Research has furnished the information on input requirement for adoption of best management practices in paddy crop and other expenses towards visit of the scientist has been submitted (ref.2nd cited), The Assistant Director of Horticulture has submitted the enumerated crop damages at the time of incident (ref 3rd cited) is herewith enclosed.

In this connection I submit the abstract of report towards supply of Inputs for adoption of Best Management practices both Organic and Inorganic, expenses towards visit of scientists and also compensation enumerated horticulture crop damages.

Estimated cost for inputs for adoption of Best Management practices (Organic + Inorganic) (Rupees)	**598840**
Charges towards Testing parameters including visits of Scientists	**59500**
Compensation Enumerated horticulture crop damages	**198938**
Grand total	**857278**

Hence submitted for necessary information.

Yours faithfully

23/9/2020
Joint Director of Agriculture
Visakhapatnam

Copy submitted to the District collector, Visakhapatnam for favour of kind information
Copy submitted to the Commissioner of Agriculture, A.P., Guntur for favour of kind information
Copy submitted to ADR, RARS, Anakapalli
Copy submitted to ADH, Visakhapatnam

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Details of Inputs and other expenses for restoration of crop in L.G.Polymers affected villages
Agriculture Department

	Particulars	Qty per Ha	unit rate (Rs.)	Amount per Ha.
	Organic Inputs			
1	FYM	10 MTs	650	6500
2	Biofertilizers (3types per lit)	1.25 Lit	300	1125
3	Neem cake	500Kg	10	5000
4	Greenmanure	37.5 kg	50	2000
5	Trichocards (4releases)	10 cards	50	500
	Inorganic inputs			
1	Urea	263Kg	296/- (per 50kg bag)	1555
2	SSP	375 kg	500/- (per bag)	3750
3	MOP	100 kg	950/- (per bag)	1900
	Plant protection chemicals (Need based)			
1	Monocrotophos	1000ml	272/500ml	540
2	Tricyclazole	300gm	255/120gm	637.5
3	Hexaconazole	1000ml	245/400ml	612.5
4	Carbendizm	750gm	200/300gm	500
5	Cartaphydrochloride	20kg	650/5kg	2600
		Total cost per ha		27220
	The villages affected in the L.G.Polymers incident are mostly living habitations, the only village with cropping area is R.Venkatapuram. As per the report given by MAO, there is an extent of 22Ha paddy in kharif grown in the endowment lands of the village, hence the estimated cost for inputs (Rupees)	1)		598840

	Additional Testing parameters	Rs. Per sample	As per recommendation samples	
1	soil sample	600	6000	
2	plant sample	1000	11000	
3	grain sample	1000	10000	
4	irrigation water	250	2500	
5	earthworm count	1000	10000	
6	Microbial Count			
7	soil sample collection charges per visit (5 visits)	1000	5000	
8	POL Charges (for scientist visits) per visit (5 visits)	3000	15000	
		2)	59500	
	Total estimation (Inputs + testing parameters)		(1+2)	658340

Total estimated enumerated Horticulture crop damages	3)	198938
GRAND TOTAL	(1+2+3)	857278

23/8/2010
Joint Director of Agriculture
Visakhapatnam

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DEPARTMENT OF AGRICULTURE

From
Smt. G.S.N.S.Leelavathi, M.Sc(Ag),
Joint Director of Agriculture,
Visakhapatnam.

To
The Joint Chief Environmental Engineer
A.P. Pollution control board
Visakhapatnam

Sir,

File No.AGRI-CAL/ /2020-JA(T1)-AGRLVSKP, Dated 22.09.2020

Sub:- Disaster Management – Gas leakage tragic incident- Visakhapatnam district-styrene vapours released from m6 storage tank of LG Polymers India Pvt. Ltd.-submission of input assessment report – Regarding.

Ref:- 1. AGRI-CAL/ 2020-SA(T1)-AGRLVSKP, Dated 19.09.2020, of this office
2. Roc.No.A/2037/2020, Dt.21.09.2020, ADR, RARS, Anakapalli

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It is submitted that, in continuation to the restoration plan for damage to the crops village level a report submitted (as per ref. 5th cited), The Associate Director of Research has furnished the information on input requirement for adoption of best management practices in paddy crop and other expenses towards visit of the scientist has been submitted (ref.6th cited) is herewith enclosed.

Hence submitted for necessary information.

Yours faithfully

22/9/2020

Joint Director of Agriculture
Visakhapatnam

22/9/2020

Copy submitted to the District collector, Visakhapatnam for favour of kind information
Copy submitted to the Commissioner of Agriculture, A.P., Guntur

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Details of Inputs and other expenses for restoration of crop in L.G.Polymers affected villages- Agriculture Department

S.No.	Particulars	Qty per Ha	unit rate (Rs.)	Amount per Ha.
	Organic Inputs			
1	FYM	10 MTs	650	6500
2	Boifertilizers (3types per lit)	1.25 Lit	300	1125
3	Neem cake	500Kg	10	5000
4	Greenmanure	37.5 kg	50	2000
5	Trichocards (4releases)	10 cards	50	500
	Inorganic inputs			
1	Urea	263Kg	296/- (per 50kg bag)	1555
2	SSP	375 kg	500/- (per bag)	3750
3	MOP	100 kg	950/- (per bag)	1900
	Plant protection chemicals (Need based)			
1	Monocrotophos	1000ml	272/500ml	540
2	Tricyclazole	300gm	255/120gm	637.5
3	Hexaconazole	1000ml	245/400ml	612.5
4	Carbendizm	750gm	200/300gm	500
5	Cartaphydrochloride	20kg	650/5kg	2600
		Total cost per ha		27220
The villages affected in the L.G.Polymers incident are mostly living habitations, the only village with cropping area is R.Venkatapuram. As per the report given by MAO, there is an extent of 22Ha paddy in kharif grown in the endowment lands of the village, hence the estimated cost for inputs (Rupees)				598840

	Additional Testing parameters	Rs. Per sample	As per recommendation samples	
1	soil sample	600	6000	
2	plant sample	1000	11000	
3	grain sample	1000	10000	
4	irrigation water	250	2500	
5	earthworm count	1000	10000	
6	Microbial Count			
7	soil sample collection charges per visit (5 visits)	1000	5000	
8	POL Charges (for scientist visits) per visit (5 visits)	3000	15000	
			59500	
Total estimation (Inputs + testing parameters)				658340

Joint Director of Agriculture
Visakhapatnam

GOVERNMENT OF ANDHRA PRADESH
DEPARTMENT OF HORTICULTURE

From
Smt.K.Sailaja
Asst. Director of Horticulture
Visakhapatnam

To
The Joint Director of Agriculture
Visakhapatnam

Rc. No. H(1) 16/2020, Dt. 23-09-2020

Madam,

Sub:- M/s LG Polymers - Styrene Gas Leakage – Damage to Horticulture crops - - Compensation to farmers from M/s LG Polymers – Request-Regarding.

Ref:- 1. Rc.No. 360/2020/B/dt 4-6-2020O/o Tahsildar, Gopalapatnam
2. Rc.No. 190/2020/C/dt 6-6-2020O/o Tahsildar, Pendurthi
3. Study report of Dr. YSR. Horticulture University Scientists, Venkataramannagudem, West Godavari, district

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With references to 1st and 2nd cited above, it is submitted that Mandal level teams of Gopalapatnam and Pendurthi have enumerated Horticulture crop damages in R.Venkatapauram village of Gopalapatnam Mandal and Vepagunta village of Pendurthi Mandal due to Styrene gas leakage from M/s LG Polymers.

Further, submitted that, both the Tahsildars have certified that the lands belong to Sri SVLN Devastanam and are unsettled villages. As the compensation cannot be released to farmers in unsettled inam villages by the Government, the compensation detailed below may be recommended from M/s LG Polymers.

The recommended compensation to affected farmers is as detailed below.

Sl.No	Crop	Extent damaged in Acres/No. Of trees	Estimated loss per acre/ fruit crops in (Rs)	Recommended compensation per acre @ 75 % (Rs)	Estimated Total amount (Rs)
1	Vegetables	4.25 ac	40000	30000	127500
2	Banana	0.30 ac	49000	36750	11025
3	Papaya	0.15 ac	200000	150000	22500
4	Mango	400 trees	22500	-	16875
5	Cashew	100 trees	9000	-	6750
6	Sapota	40 trees	18000	-	13500
7	Coconut	30 trees	1050	-	788
	Grand Total				**198938**

Vide ref 3rd cited, team of Horticulture Scientists from Dr.YSR Horticulture University, Venkataramannagudem, West Godavari, district have concluded that there is no adverse effect on soil, hence horticulture crops can be cultivated during succeeding seasons.

In this, connection, it is requested to recommend compensation of crop loss to affected farmers in Inam lands from M/s LG Polymers.

Submitted for favour of information.

Yours faithfully

Asst. Director of Horticulture,
Visakhapatnam

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ACHARYA N.G.RANGA AGRICULTURAL UNIVERSITY

ANGRAU

Dr. M. Bharathalakshmi,
M.Sc.(Ag.) Ph.D.
Associate Director of Research

Regional Agricultural Research Station,
Anakapalle – 531 001,
Visakhapatnam Dist
Ph : 08924-223370 (O), 9989625211
e-mail : adrnczone1983@gmail.com

Roc. No. A/ 2037 /2020, Dated.21-09-2020

To
The Joint Director of Agriculture
PM Palem
Visakhapatnam

Respected Madam,

Sub : Regional Agricultural Research Station, Anakapalle-Information on input cost for best management of paddy crop per unit area and other expenses in R. Venkatapuram village, M/s LG polymers Gas leakage affected area – Submission – Reg.

Ref : Telephonic discussion with the Joint Director of Agriculture, Visakhapatnam on 20.09.2020

***

In the light of above mentioned subject and as per the telephonic discussions held with the Joint Director of Agriculture, Visakhapatnam on 20.09.2020, I am herewith furnishing information on Input requirement for adoption of best management practices in paddy crop and other expenses towards visit of Scientist and chemicals pertaining to soil, plant and irrigation water sample analysis in R. Venkatapuram village, M/s LG polymers Gas leakage affected area for favour of information.

Details of input cost per unit area and other expenses:

S.No.	Particulars	Qty. per ha	Unit rate (Rs.)	Amount per ha (Rs.)	Remarks
	Organic Inputs				
01	Farm Yard Manure	10 T	650	6500	Any one of the organic source can be utilized
02	Vermi compostper Tonne	2 T	3000	6000	
03	Biofertilizers per Lt (3 types of biofer.)	1.25 Lt	300	1125	
04	Neem cake	500 kg	10	500	
05	Green manure (Diancha/Sunhemp seed)	37.5 kg	50	2000	
06	Trichocards (4 releases)	10 cards	50	500	
	Inorganic inputs				
07	Urea	263 kg	296/bag	1555	Recommended dose of
08	Single Super Phosphate	375 kg	500/bag	3750	

09	Muriate of Potash	100 kg	950/bag	1900	fertilizers
10	Monocrotophos	1000 ml	272/500 ml	540	Need based plant protection chemicals
11	Tricyclozole	300 g	255/120 g	637.5	
12	Hexaconazol	1000 ml	245/400 ml	612.5	
13	Carbendazim	750 g	200/300 g	500	
14	Cartop Hydrochloride granules	20 kg	650 /5 kg	2600	
15	Seedling cost for Agroforestry (Seedlings from Department of Forestry)				
	Testing charges (per sample)	Rs. Per sample			
15	Soil sample analysis (per sample)	600		Analysis for soil and Irrigation water will be taken up before and after the crop season and plant sample will be taken up at maturity stage (For every 5 acres of land one sample is the optimum sample size). The heavy metal analysis has to be taken by the Pollution Control Board.	
16	Plant sample analysis (per sample)	1000			
17	Grain sample analysis (per sample)	1000			
18	Irrigation water analysis (per sample)	250			
19	Earthworm count	1000			
20	Microbial count (will be done at ARS, Amaravathi)				
	Other Miscellaneous charges				
21	Sample collection charges per visit	1000			
22	POL charges (Conveyance to scientist visits) per visit	3000			

This is submitted for favour of kind information and further necessary action.

Yours faithfully

21/4/2020

Associate Director of Research

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DEPARTMENT OF AGRICULTURE

From
Smt. G.S.N.S.Leelavathi, M.Sc(Ag),
Joint Director of Agriculture (FAC),
Visakhapatnam.

To
The Joint Chief Environmental Engineer
A.P. Pollution control board
Visakhapatnam

Sir,

File No.AGRI-CAL/2020-SA(T1)-AGRLVSKP, Dated 19.09.2020

Sub:- Disaster Management – Gas leakage tragic incident- Visakhapatnam district-styrene vapours of LG Polymers India Pvt. Ltd.- preparation of the restroration plan and compensation for damage to the crops – Regarding.

Ref:- 1. High Power Committee on Investigation Of Styrene Vapour Leak From LG Polymers India Pvt. Ltd., Visakhapatnam report Dt.15.06.2020
2. NGT (Sesha Sainareddy) report Dt.,28.05.2020
3. Lr.no.Gen/PCB/RO-VSP/NGT/2020- Dt.31.08.2020, APPCB, Visakhapatnam
4.F.No.11/20/2020, Dt21.07.2020, MoEF &CC office order
5. File No.AGRI-CAL/2020-JA(T1)-AGRLVSKP, Dated 01.06.2020 of this office.
6. Analysis reports from VIMTA labs Dt.07.06.2020
7. Analysis reports of microbial population dynamics, ARS, Amaravathi, Dt.22.06.2020
8. Roc. No.A/1587/2020, Dt.16.07.2020, RARS, Anakapalli
9. File No.AGRI-CAL/2020-JA(T1)-AGRLVSKP, Dated 01.08.2020 of this office
10. Lr.No.2937/Dr.YSRHU/Res.I/2020, Dt.14.09.2020, Dr.YSR Horticulture University, Venakatarammannagudem.
11.Lr. from RARS, Anakapalli, Dt18.09.2020

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It is submitted that vide ref. 9th cited a report has been submitted stating that, At the time of gas leakage incident there were no field crops existing in the affected area except few vegetable crops and agroforestry. But to study the affect of styrene on the soil, 63 soil samples were collected on 13.05.2020 and analysed for various parameters like pH, E.C, O.C, N,P, K, Zn, Fe, Mn, Cu, S, B at the Soil testing laboratory, Department of Agriculture. According to the soil health reports, the pH ranges from 6.9 to 8.7 i.e., slightly Alkaline and the E.C ranges from 0.08 to 0.2 mms which are normal.

The Biological properties of soil i.e,Total bacterial population, total fungal population, Beneficial microorganisms were analysed at ARS, Amaravathi (ref. 7th cited) and also analysed for heavy metals at VIMTA, Labs Visakhapatnam (ref.6th cited). Based on these reports received from Research Scientist, ARS, Amaravathi and VIMTA- Laboratories, crop suitability assessment for cultivation has been given by Associate Director of Research, RARS Anakapalli, that it is satisfactory and the soil is suitable for cultivation of crops. (Ref. 8th cited).

It is further submitted that a team of Scientists from Dr.YSR Horticulture University, Venakatarammannagudem, has also submitted a report (Ref.10th cited) on soil quality, micro fauna, Water quality stating that there was no affect of styrene vapour on soil physiochemical and biological properties after 40days of the said incident and hence suggested that all crops can be grown by adopting good agricultural practices.

It is further submitted that, as per the instructions received in ref. 3rd and 4th cited for preparation of the restroration plan and compensation for damage to the crops a team constituting of Scientists from RARS, Anakapalli (Principal Scientist-Crop physiology, Principal Scientist-Agronomy, Senior Soil Scientist), Officers from Department of Agriculture ie., Joint Director of Agriculture, ADA® Visakhapatnam along with MAO,

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Chinagadili, Assistant Director of Horticulture, and MRO, Gopalapatnam has visited the village on 17.09.2020.

The team visited the Agricultural fields of R. Venkatapuram village and made the following observations (ref.11th cited)

1. The paddy crop is being irrigated with seepage water of Meghadrigedda reservoir mixed with municipal drainage water which was of poor quality for crop cultivation, dumped with plastic and other wastages, it may be a threat to the soil health in near future.
2. Paddy variety of BPT 5204 (Sambamahsuri) was planted with over aged seedlings of 50-60 days nursery and the crop is at active tillering stage (25-30 days after transplanting)
3. The cultivators, in general, have not adopted the timely management practices. The crop was planted with aged nursery, basal dose of fertilizers were not applied. The crop has symptoms of leaf blast and leaf folder incidence for which the plant protection chemicals were not sprayed.
4. On visual observation, Paddy crop looked healthy and symptoms of any adverse effect on growth due to styrene gas leak were not visible as the plant height and tillering were normal with 25-40 tillers per hill and 40-45 cm plant height coupled with chlorophyll content of leaf at 37.4 SPAD/SCMR value, which is a good sign of crop geometry at tillering stage for reaping good yields.
5. It was informed by the cultivators, that they are taking two crops in a year with the crop sequence of Paddy-Paddy and Paddy-Vegetables with available municipal drainage water.
6. The surrounding vegetation viz.,*Casuarina*, Banana, Eucalyptus and other miscellaneous tree vegetation were also observed to be normal.
7. It is observed that, at present there is No abnormalities in crop condition situated in R.Venkatapuram village and further inference can be realized after receipt of the harvesting data of paddy (Nov/Dec, 2020).

Based on the above visual observations and the soil data obtained from the Department of Agriculture/Horticulture, the team is of the opinion that reclamation of soils can be done to ward off the any possible ill effects due to styrene gas leakage on the performance of crops and for avoiding the ill effects of drainage water which is being utilized for cultivation of crops.

a. It is suggested that green manure crops like Diancha, sunhemp etc., should be invariably grown as preceding kharif crop to sustain the soil and crop productivity.
b. Application of organic manures like Farm Yard Manure, Pressmud cake, vermicompost, neem cake and other edible cakes can also be advocated for enrichment of soil organic matter content and soil health management.
c. Use of different types of biofertilizers (Azatobactor, Azospirillum, Phosphate solubilizers and Potash solubilizers) can also be suggested for improvement of crop yields through enrichment of soil beneficial microflora.
d. Irrigation with municipal drainage water for cultivation of crops can also be discouraged to curtail the soil health hazards in future.
e. Incorporation of crop residues after every cropping cycle may be made mandatory for improvement of soil health.
f. Supply of orchard/forest seedlings keeping in view of maintaining green vegetation for healthy livelihood as many people are residing in the vicinity of M/s LG Polymers.

Use of biocontrol tools like trichocards can also be promoted for pest control in crops to discourage chemical plant protection keeping in view of environmental safety and protection.

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It was felt by the team of scientists that data on yield at the time of harvest of the kharif crop (Nov-Dec, 2020) along with the essential soil parameters can be taken for long term study of the impact of "styrene gas" accumulation, if any, on crop performance. Similar observations at periodical intervals for at least two years may help in drawing valid conclusions on the impact of Styrene gas leakage on crop performance in the subsequent years.

This is submitted for favour of information.

Yours faithfully

19/9/2020

Joint Director of Agriculture
Visakhapatnam

19/9/2020

Copy submitted to the District collector, Visakhapatnam for favour of kind information

Copy submitted to the Commissioner of Agriculture, A.P., Guntur

Copy submitted to the Associate Director of Research, RARS, Anakapalli

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DEPARTMENT OF AGRICULTURE

From
Smt. G.S.N.S.Leelavathi, M.Sc(Ag),
Joint Director of Agriculture,
Visakhapatnam.

To
The Commissioner of Agriculture
A.P., Guntur.

Sir,

File No.AGRI-CAL/ /2020-JA(T1)-AGRI.VSKP, Dated 01.06.2020

Sub:- Disaster Management – Gas leakage tragic incident- report on News article "Ryots hit as gas leak damages, halts cultivation – Regarding.

Ref:- 1. News article – Ryots hit as gas leak damages, halts cultivation"- Indian express.
2. R.C.No.679/2020/D3, Dt.10.05.2020, District Collector Visakhapatnam
3. Lr. No.7063/PCB/ZO-VSP/Tech./2020- A.P Pollution Control board-zonal office -Visakhapatnam
4. AGRI. CAL JA(T1)- AGRIL.VSKPdt14.05.2020 & 23.05.2020 of this office
5. RC. No. H(1)16/2020, Dt01.06.2020 Department of Horticulture, Visakhapatnam
6. Reports received from the Mandal Agricultural Officers of Chinagadili and Pendurthi
7. Mail sent to RARs Anakapalli, dt 01.06.2020 from this office.
8. Report from APPCB, Zonal lab Visakhapatnam dt:01.06.2020

@@@

It is submitted that, in response to the News article "Ryots hit as gas leak damages, halts cultivation" the facts analysed are here with reported

a) As per the orders from the District Collector received in the reference 2nd cited above to Collect the vegetables, fruits and grass etc., in the farms and handed over safely to GVMC for safe disposal in biomedical waste method for avoiding consumption and feeding of cattle around.
b) In view of the letter vide ref. 3rd cited from A.P Pollution Control board-zonal office - Visakhapatnam, the crop damage report and contamination assessment report has been submitted through ref. 4th cited. Soil samples were collected in random manner and assessed for nutrient status parameters (PH, E.C, O.C, N,P, K, Zn, Fe, Mn, Cu, S, B).
c) In response to the ref. 1st cited, Department of horticulture has submitted the assessment report stating the cropping around the affected villages, concluding that crops exposed, charred and rotten due to styrene gas affect are being destroyed through disposal in biomedical waste method. And soil samples were collected from around the 5km radius immediately after the incident,63 soil samples have been collected from Agri and Horticulture fields and analysed by Mobile testing Laboratory Visakhapatnam.
d) According to soil health reports the PH ranges from 6.9 to 8.7 i.e., slightly Alkaline and the E.C ranges from 0.08 to 0.2 mms which is normal. It is advised Paddy, Vegetables and other Plantation crops can be taken by reclamating the soil with Cypsum @ 200 kgs per acre where the PH is beyond 8.5. The report received from APPCB, Zonal lab Visakhapatnam in ref. 8th cited, has also indicated the similar results, stating that Styrene concentrations couldn't be analysed as the Styrene standard is not readily available with them and the same will be procured and the samples will be analysed in due course.

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e) As per the reference 6th cited, report submitted by Mandal Agricultural Officers China Gadili and Pendurthi, stated that Venkatapuram and Kothapalem villages comes under Venkatapuram Revenue village having 55 Acres of wet land and approximately 92 farmers are cultivating the crops which are unsettled endowment lands. The main crops are Paddy during Kharif, and Vegetables during Rabi seasons. These fields are being benefitted by the seepage water of Megadhri Gedda reservoir. At the time of incident there were no field crops existing.

f) In the Kamparapalem village 100 acres of wet land is there, with 175 farmers usually take up Paddy in Kharif, it is totally rainfed area and there is no other crop for the rest of the season. Laxmipuram village is having 30 acres of wet land with Paddy in Kharif followed by Vegetables in Rabi in an extent of 5-7 acres being cultivated by 75 farmers. There were no Agricultural crops existing in the field except Vegetables and Agro forestry crops like Casuarina and Eucalyptus at the time of incidence.

g) Meanwhile the scientists from RARS, Anakapalli have been contacted for the Parameters to be analyzed for assessment of the styrene gas affect along with the suitability of soil for cultivation and have been suggested for analyzing soil quality parameters -Chemical and physical properties like pH, E.C, Available nutrients (macro and micro nutrients), Heavy metals, Bulk Density, Hydraulic Conductivity, Infiltration rate etc. and also suggested for assessment of Biological properties of soil Total bacterial population, total fungal population, Beneficial microorganisms (Nitrogen fixers and phosphate solubilizers), Enzyme activity (Dehydrogenase, urease, acid and alkaline phosphotase). For guidance on analysis of biological properties, a letter has been addressed to Directorate of Research, microbiology, Amaravathi.

h) As the real time effect of Styrene has not reflected in the above parameters analysis and also APPCB, Visakhapatnam has informed that Styrene concentrations couldn't be analysed, A.U. Environmental Engineering Department, College of Engineering, Andhra university, Visakhapatnam are also consulted for further clarification on suitability of soil for cultivation in these areas along with analysis of soil for other parameters if any required, but due to the non-availability of required facilities with them the VIMTA, Laboratories have been contacted for analysis of heavy metals on payment basis and each sample analysis costing Rs.3500/- approximately. We have collected composite samples of 4 numbers from the affected villages which are being submitted for analysis. As informed by the laboratory the analysis report on heavy metals will be received in 5days, soon after the receipt of the same will be submitted for further necessary action.

Yours Faithfully

Joint Director of Agriculture
Visakhapatnam

Copy submitted to the District Collector for favour of information.

01/06/2020

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ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY

From:
Dr. D.V.Ramana Reddy,
Principal Scientist (SS&AC) & Head,
Agril. Research Station,
AMARAVATHI – 522 020.
Guntur (Dist.), A.P.,

To
The Joint Director of Agriculture,
Visakhapatnam-

Lr. No. ARS, AMT/Microbial analysis of soil samples/2020, dt.21.06.2020.

Sir,

Sub: Agril. Research Station, Amaravathi – Microbial analysis of soil samples-Report-Submitted-Reg.
Ref: 1. File No. AGRI-CAL/2020-JA(T1)-AGRL VSKP, Dt.01.06.2020
Joint Director of Agriculture, Visakhapatnam

####

As per the reference cited above, the report of microbial analysis of the soil samples is herewith enclosed / attached.

Yours faithfully,

22/6/2020

Principal Scientist & Head
Agril. Research Station
AMARAVATHI - 522 020
Guntur (Dist.) A.P.

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Your Ref : **File No, AGRI-CAL/2020-JA(T1)-AGRL VSKP, *Dt.01.06.2020***

Joint Director of Agriculture, *Visakhapatnam*

***

Microbial population dynamics in soil samples of the villages of *Vishakhapatnam*

Sample Name	Total Bacteria	Total fungi	Beneficial Population					
			KRB	PSB	*Rhizobium*	Actinomycetes	*Azospirillum*	*Azotobacter*
Kothapalem	30×10^{7}	10×10^{4}	40.6×10^{5}	30.0×10^{5}	10.0×10^{5}	93.0×10^{6}	5×10^{5}	33×10^{6}
Laxmipuram	10×10^{7}	90×10^{3}	38.0×10^{5}	38.0×10^{5}	40.0×10^{4}	108.0×10^{6}	12×10^{5}	62×10^{6}
Venkatapuram	30×10^{7}	20×10^{4}	47.0×10^{5}	10.2×10^{5}	12.0×10^{5}	74.0×10^{5}	28×10^{5}	36×10^{5}
Kampara palem	10×10^{7}	10×10^{4}	15.0×10^{5}	12.0×10^{4}	25.0×10^{4}	57.5×10^{5}	36×10^{4}	96×10^{6}

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Test Report

ISSUED TO :-	REPORT NUMBER :VLL/VSKP/20/00426/001
Customer Name : Joint Director of Agriculture	ISSUE DATE : 2020-06-07
Customer Address: Joint Director of Agriculture, P M Palem, Vizag ,AP,India	CUSTOMER REFERENCE : TRF
	CUSTOMER REFERENCE DATE : 2020-06-02

Customer Provided Details :			
Sample Name :	Soil (Kancharapalem village)		
Brand Name :	NA	Batch/Lot Number :	NA
Mfg. Date :	NA	Exp .Date	NA
Test Required :	Heavy metals		
Others Details if Any	NA		
Lab provided Details :			
Sample Received Date :	2020-06-02	Sample Registration Date :	2020-06-02
Analysis Starting Date :	2020-06-05	Analysis Completion Date :	2020-06-05
Qunatity Received :	500gms X 1No		
Sampling Details :	NA		

TEST RESULTS

Sl. No.	Test Parameters	Method of Testing	UOM	Results
1	Heavy Metals			
1.a	Arsenic as As	In house	ppm (mg/kg)	0.22
1.b	Cadmium as Cd	In house	ppm (mg/kg)	<0.1
1.c	Mercury as Hg	In house	ppm (mg/kg)	<0.1
1.d	Lead as Pb	In house	ppm (mg/kg)	7.68

Results relate only to the sample tested.
Remark: Nil

END OF THE TEST REPORT

For Vimta Labs Limited

Yesudasu.Ch
Sr.Analyst

Sample tested at and report issued by: VIMTA LABS LTD, # 9-13-43/2-9-3, 3rd Floor Above Tanishq, 'N' Circle, VIP Road, Visakhapatnam-530003, Andhra Pradesh, India
Tel No: 040 67404040 Ext: 6071, 6074

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Test Report

ISSUED TO :-	REPORT NUMBER :VLL/VSKP/20/00126/002
Customer Name : Joint Director of Agriculture	ISSUE DATE : 2020-06-07
Customer Address: Joint Director of Agriculture, P M Palem, Vizag ,AP,India	CUSTOMER REFFRENCE : TRF
	CUSTOMER REFERENCE DATE : 2020-06-02

Customer Provided Details :			
Sample Name :	Soil (Laxmipuram village)		
Brand Name :	NA	Batch/Lot Number :	NA
Mfg. Date :	NA	Exp .Date	NA
Test Required :	Heavy metals		
Others Details if Any	NA		
Lab provided Details :			
Sample Received Date :	2020-06-02	Sample Registration Date :	2020-06-02
Analysis Starting Date :	2020-06-05	Analysis Completion Date :	2020-06-05
Quantity Received :	500gms X 1No		
Sampling Details :	NA		

TEST RESULTS

Sl. No.	Test Parameters	Method of Testing	UOM	Results
1	Heavy Metals			
1.a	Arsenic as As	In house	ppm (mg/kg)	0.25
1.b	Cadmium as Cd	In house	ppm (mg/kg)	<0.1
1.c	Mercury as Hg	In house	ppm (mg/kg)	<0.1
1.d	Lead as Pb	In house	ppm (mg/kg)	0.26

Results relate only to the sample tested.
Remarks: Nil

END OF THE TEST REPORT

For Vimta Labs Limited

Yesudasu.Ch
Sr.Analyst

Sample tested & and report issued by: VIMTA LABS LTD. # 9-13-45/2-9-3, 3rd floor Above Tanishq, "N" Circle, VIP Road, Visakhapatnam-530003, Andhra Pradesh, India.
Tel No: 040 67404040 Ext: 6071, 6024

Scanned with CamScanner

Vimta

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Test Report

ISSUED TO :-	REPORT NUMBER :VLL/VSKP/20/00426/003
Customer Name : Joint Director of Agriculture	ISSUE DATE : 2020-06-07
Customer Address: Joint Director of Agriculture, P M Palem, Vizag ,AP,India	CUSTOMER REFERENCE : TRF
	CUSTOMER REFERENCE DATE : 2020-06-02

Customer Provided Details :			
Sample Name :	Soil (Kothapalem village)		
Brand Name :	NA	Batch/Lot Number :	NA
Mfg. Date :	NA	Exp .Date	NA
Test Required :	Heavy metals		
Others Details if Any	NA		
Lab provided Details :			
Sample Received Date :	2020-06-02	Sample Registration Date :	2020-06-02
Analysis Starting Date :	2020-06-05	Analysis Completion Date :	2020-06-05
Qunatity Received :	500gms X 1No		
Sampling Details :	NA		

TEST RESULTS

Sl. No.	Test Parameters	Method of Testing	UOM	Results
1	Heavy Metals			
1.a	Arsenic as As	In house	ppm (mg/kg)	0.28
1.b	Cadmium as Cd	In house	ppm (mg/kg)	<0.1
1.c	Mercury as Hg	In house	ppm (mg/kg)	<0.1
1.d	Lead as Pb	In house	ppm (mg/kg)	8.87

Results relate only to the sample tested.

Remark: Nil

END OF THE TEST REPORT

For Vimta Labs Limited

Yesudasu.Ch

Sr.Analyst

Sample tested at and report issued by: VIMTA LABS LTD, # 9-13-45/2-9-3, 3rd floor Above Tanishq, 'N' Circle, VIP Road, Visakhapatnam-530003, Andhra Pradesh. Ind
Tel No: 040 67404040 Ext: 6071, 6074

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ACHARYA N.G.RANGA AGRICULTURAL UNIVERSITY

Dr. M. Bharathalakshmi
M.Sc (Ag.), Ph.D
Associate Director of Research &
Principal Scientist (Sugarcane) i/c

Regional Agricultural Research Station,
Anakapalle - 531 001, Visakhapatnam Dist.
Ph: 08924-223570 (O), 224164 (R)
Fax:08924-224021
e-mail: adres.ors1983@gmail.com

Roc.No.A/1587/ 2020,Dt:16.07.2020

To
The Joint Director of Agriculture,
Visakhapatnam District

Sir,

Sub: RARS, Anakapalle - Department of Soil Science & Agricultural Chemistry - Soil analytical report from Gas leakage affected villages of Visakhapatnam District – Crop suitability for cultivation on affected villages - Remarks - Submitted – Reg.

Ref: 1. File No. AGRI-CAL/2020-JA (TD) - AGRI VSKP, Date. 02.07.2020 of Joint Director of Agriculture, Visakhapatnam District.
2. Note from the Principal Scientist (Soil Science & Agril. Chemistry). Date. 13.07.2020

***

With reference to the above, I am to inform that, as per the testing reports regarding the quality of soils suitability to different crops it is found that the heavy metals (Pb, Cd, AS, Hg) are in safer limits and soil beneficial microbial counts, total bacteria and total fungi are also found at satisfactory levels.

Therefore the crops which were grown hither to can be suggested for cultivation in the specified gas leakage affected village soils.

Yours faithfully,

16/7/2020

Associate Director of Research

16/7/2020 16/7/2020 16/7/2020

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Dr.Y.S.R. HORTICULTURAL UNIVERSITY
Administrative Office, Venkataramannagudem – 534 101,
West Godavari District, Andhra Pradesh

Ph. No. 08818 216373
Fax No. 08818 284353

From
Dr.R.V.S.K.Reddy,
Director of Research.

To
The Commissioner of Horticulture,
Department of Horticulture,
TTPC Building, 1st Floor,
Old Market Yard,
Near Rythu Bazar,
Chuttuguntla, Guntur – 522007.

Lr.No.2937/Dr.YSRHU/Res.1/2020, Dated:14.09.2020

Sir,

Sub: Dr.YSRHU – Research – Horticulture Department – Leakage of styrene gas vapours from M/s.L.G.Polymers India Pvt, Ltd., Visakhapatnam on 07.05.2020 – Compliance report – Enclosed - Regarding.

Ref: 1. N.F.No.P&M(1) 44/2015, dtd:02.06.2020 of the Commissioner of Horticulture, A.P., Guntur.
2. Lr.No.2937/Res./2020, dtd:12.06.2020 of this office.
3. Lr.No.HRS-ABJ/147/LG Poly/Styrene/20, dt:31.08.2020 of the Pri.Sci.(Hort.) & Head, HRS, Ambajipeta.
4. Note orders of the Hon'ble Vice-Chancellor, Dr.YSRHU, dtd:11.09.2020.

*****

In accordance with the reference 1st cited, I am herewith enclosing the compliance report of "Adverse affects of styrene vapour on the soil, horticulture crops/other adverse impact exising with in 5 km vicinity of the M/s LG Polymers India Pvt, Ltd., Visakhapatnam",

This is for favour of kind information & necessary action.

Yours faithfully,

14/9/2020

DIRECTOR OF RESEARCH

Encl: Compliance Report

Cc: to PS to Hon'ble Vice-Chancellor, Dr.YSRHU, V.R.Gudem.
Copy to SF/SC.

REPORT ON ADVERSE AFFECTS OF STYRENE VAPOUR ON THE SOIL PROPERTIES, HORTICULTURE CROPS/OTHER ADVERSE IMPACT EXISTING WITHIN 5 KM VICINITY OF THE M/S LG POLYMERS INDIA PVT. LTD., VISAKHAPATNAM

Dr.Y.S.R. HORTICULTURAL UNIVERSITY
VENKATARAMANNAGUDEM
WEST GODAVARI DISTRICT
ANDHRA PRADESH

Report on adverse affects of styrene vapour on the soil, horticulture crops/other adverse impact existing within 5 km vicinity of the M/s LG Polymers India Pvt. Ltd., Visakhapatnam.

Background:

M/s LG Polymers India Pvt. Ltd. was established in 1961 as "Hindusthan Polymers" for manufacturing polystyrene and its co-polymers at Visakhapatnam, India. The industry is located at R.R.Venkatapuram, Visakhapatnam district, Andhra Pradesh. The company has stored styrene monomer in vertical MS storage of 2500 KL and 3500 KL capacity provided with internal cooling system through refrigeration to maintain below 20°C. An accident occurred at 03:02 am on 7th May 2020 where the stored styrene monomer in vertical MS storage tank of 2500 KL capacity has spread in the form of gas to the surrounding villages of Venkatapuram, Padhmanabhapuram, SC & BC Colony. The concentration of styrene was high at the time of leakage in Venkatapuram village among other surrounding villages.

With regard to the above issue, a group of scientists from Dr. YSRHU, V.R.Gudem were deputed by the Director of Research, Dr. YSR Horticultural University, Venkataramanagudem vide Lr. No. 2937/Res./2020, Dated: 12.06.2020 as per the instructions given by Hon'ble Vice-Chancellor and Commissioner of Horticulture, Dr.YSRHU, A.P with an objective to study the adverse effects of styrene vapour on different existing horticultural crops and soil properties within 5 km vicinity of LG Polymers India Pvt. Ltd., Visakhapatnam.

The following team members visited Venkatapuram village on 18.06.2020 which bore the burnt of styrene gas release,

1. Dr.B.V.K.Bhagavan, Principal Scientist (Hort.) and Head & Zonal Research Head (CZ-I), HRS, Ambajipeta
2. Dr.N.B.V.Chalapathi Rao, Principal Scientist (Ento.), HRS, Ambajipeta
3. Dr.K.Ravindra Kumar, Scientist (Hort.), HRS, Kovvuru
4. Sri. P. Raja Sekhar, Scientist (SS&AC), KVK, Pandirimamidi

During the visit, the team has observed existing crop condition of vegetables crops like Brinjal, Chilli, Okra and gourds, fruits crops like Sapota, banana and mango. Scientists have also collected the soil samples at different depths in styrene affected gardens as per standard methods for analysis of soil physio-chemical properties and also to examine the population of soil micro fauna under laboratory conditions.

Styrene Gas Leak Accident:

- An accident occurred at 03:02 am on 07.05.2020 from 2500 KL tank. The company has stored styrene monomer in vertical MS storage tanks of 2500 KL and 3500 KL capacity provided with internal cooling system through refrigeration to maintain 200 ^{0}C. Due to accident the styrene gas has spread to the surrounding villages of Venkatapuram, Padmanabhapuram, SC&BC colony.
- The concentration of styrene was high at the time of accident in the villages. The concentrations could not be measured at that time as there were lethal and villages were inaccessible.
- Subsequently the concentrations of styrene were measured in the ambient air by Andhra Pradesh Pollution Control Board (APPCB) on 07.05.2020. As per the monitoring values the styrene gas is present at low concentrations in the range of 1 to 2.5 ppm in the affected area as on 07.05.2020 at 09.30 AM.

About styrene:

Styrene is a colourless, clear liquid. It has a sweet smell and can be found in nature as well as manufactured. It can also be found in common foods and beverages, such as strawberries, coffee, cinnamon, peanuts and tobacco. Manufactured styrene has wide range of uses and is a component of many goods including polystyrene, fibreglass, packaging materials, electrical insulation, home insulation, drinking cups, food packaging, rubber and carpet backing.

Styrene is a volatile and highly in flammable compound. Styrene vapour is heavier than air and 3.25 times higher than oxygen molecular weight (32 g/mol). At concentrations normally encountered in the workplace, the air and styrene mixer is not significantly heavier than clean air. Styrene evaporates more rapidly at high temperatures (eg. the evaporation rate at 30^{0}C is twice to that at 20^{0}C).

Physical and Chemical Properties of Styrene (C_8H_8):

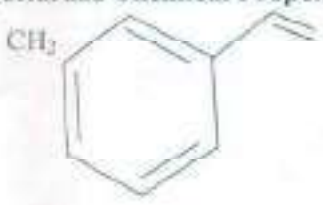


Fig. Structural formula of styrene

Parameter	Unit	Value	Remark
Molecular weight	[g.mol^{-1}]	104.15	-
Water solubility	[g.L^{-1}]	0.3	20°C
Vapour pressure	[pa]	667	20°C
Melting point	[°C]	-30.6	-
Boiling point	[°C]	145-146	-
Hydrolysis half-life	DT50 [d]	-	Styrene contains no hydrolysable groups
Photolysis half-life	DT50 [h]	< 16 hrs	Hydroxyl radicles and trophosheric ozone rapidly degraded styrene
Degradability	-	-	Readily bio-degradable

(Source: Letter report 601782017on Environmental risk limits for styrene from National Institute for Public Health and the Environment, 2009)

Sampling and Analysis:

During the visit to study site a total 22 no. of soil samples were collected randomly from 6 locations at two depths i.e. 0-15 cm and 15-30 cm in both conventionally tilled land and zero tilled land at about 0.25 km, 0.5 km, 1 km, 1.5 km, 2 km and >5 km distance towards north-east direction where the actual flow and spread of styrene gas leak was recorded. Also 3 no. of water samples were collected at 40 days after gas leak incident within the vicinity of 5 km from the LG Polymers at Venkatapuram village. The details of sampling locations where soil and water samples have been collected are given in Table 1 & 2 and the methods employed for soil and water analysis were mentioned in Table 3. Analysis of soil and water samples was carried out at Central Tobacco Research Institute, Rajahmundry and Horticultural Research Station, Ambajipeta, Dr.YSR Horticultural University.

Table 1: Details of soil sampling at Venkatapuram village under study.

S.No	Location/ Distance	Crop/ Particulars	ZT/CT*	Depth of soil sampling	Sampling Code	GPS
1	0.25 km	Casuarina plantation	ZT	0-15 cm	1-A	N 17°45.819'
				15-30 cm	1-B	E 083°12.318'
		Fallow	CT	0-15 cm	1-C	N 17°45.327'
				15-30 cm	1-D	E 083°12.304'
2	0.5 km	Brinjal	ZT	0-15 cm	2-A	N 17°45.487'
				15-30 cm	2-B	E 083°12.296'
		Brinjal	CT	0-15 cm	2-C	N 17°45.485'
				15-30 cm	2-D	E 083°12.293'
3	1 km	Bhendi	ZT	0-15 cm	3-A	N 17°45.670'
				15-30 cm	3-B	E 083°12.584'
		Fallow	CT	0-15 cm	3-C	N 17°45.512'
				15-30 cm	3-D	E 083°12.442'
4	1.5 km	Chilli	ZT	0-15 cm	4-A	N 17°45.478'
				15-30 cm	4-B	E 083°12.298'
		Fallow	CT	0-15 cm	4-C	N 17°45.462'
				15-30 cm	4-D	E 083°12.302'
5	2 km	Fallow	ZT	0-15 cm	5-A	N 17°45.074'
				15-30 cm	5-B	E 083°12.066'
		Fallow	CT	0-15 cm	5-C	N 17°45.098'
				15-30 cm	5-D	E 083°12.023'
6	>5 km	Fallow	ZT	0-15 cm	6-A	N 17°44.211'
				15-30 cm	6-B	E 083°17.371'

(Note: * ZT- Zero tilled soil after styrene gas leak. CT- Conventionally tilled soil after gas leak)

Table 2: Details of water sampling at Venkatapuram village under study.

S.No	Location/Distance	Source of irrigation water	Sampling Code	GPS
1	1.5 km	Dug well	W1	N 17°45.478' E 083°12.298'
2	2 km	Bore well	W2	N 17°45.074' E 083°12.066'
3	>5 km	Bore well	W3	N 17°44.211' E 083°17.371'

Table 3. Methods employed for the analysis of soil and water samples.

a) Soil sampling and analysis

S.No	Parameter	Method	Reference
Physico-Chemical Properties			
1	Texture	Feel method	USDA
2	pH (1:2)	Glass electrode pH meter	Jackson (1967)
3	Electrical Conductivity (dSm^{-1})	Conductometric method	Jackson (1967)
4	Organic Carbon ($g\ kg^{-1}$)	Walkey and Black's wet oxidation method	Piper (1966)
5	Total Nitrogen ($kg\ ha^{-1}$)	Kjeldhal's method	Jackson (1967)
6	Available P_2O_5 ($kg\ ha^{-1}$)	Olsen's method	Watanabe and Olsen (1965)
7	Available K_2O ($kg\ ha^{-1}$)	Flame photometric method	Jackson (1967)
8	Sulphur (ppm)	Turbidity method	Piper (1966)
Soil Biological Properties			
9	Bacteria ($x10^6$)	Serial dilution plate count method	Waksman (1922)
10	Fungi ($x10^4$)		
11	Actinomycetes ($x10^5$)		

b) Water analysis

S.No	Parameter	Method	Reference
1	pH (at 25°C)	Glass electrode pH meter	Jackson (1967)
2	Electrical Conductivity (dSm^{-1})	Conductometric method	Jackson (1967)
3	Chlorides (meq/l)	Mhor's method	Piper (1966)

Observations of the committee:

The observations of the above investigation are presented under the following heads.

A) Soil quality

B) Soil micro fauna

C) Water quality

A) Soil quality:

As per the summarised results given in table 4 & 5 pertaining to soil physico-chemical properties, the surface and sub-surface soils of study area are characterised with sandy loam (SL) and sandy clay loam (SCL) in texture respectively within 0.25 km, 2 km and > 5 km distance and sandy clay loam (SCL) and clay loam (CL) in texture respectively at about 0.5 km, 1 km and 1.5 km distance where the cultivated lands are being located. The analysis indicated that, soils are neutral (pH 6.79) to moderately alkaline (pH 8.66) in reaction having mean electrical conductivity of 0.38 dSm^{-1} and medium in organic carbon content (0.56 %).

With regard to soil fertility status, the soils are very low in available nitrogen (138.95 kg ha^{-1}) in surface and sub-surface soils and increased with increase in depth of soil. It may be due to more leaching of soluble nitrogen from sandy loam surface to sandy clay loam sub-surface soil and further to deeper layers resulted in retention of low nitrogen in surface soils.

Available phosphorus was recorded with low to high in content (varied from 13 to 170 kg ha^{-1}). But, maximum available phosphorus was observed in surface soils than sub-surface soils in both zero tilled (ZT) and conventionally tilled (CT) soils. This wide range of fertility status may be due to site-specific inheritance of soil and differential practices of soil fertilization and manuring in different crops being cultivated in these fields.

However, medium in available potassium (156 to 259 kg ha^{-1}) was recorded within the vicinity of 0.25 km from LG Polymers, Pvt. Ltd, Venkatapuram. But, high to very high in available potassium (ranges from 356 to 2388 kg ha^{-1}) was recorded after 0.5 km distance onwards where most of field crops and vegetables grown in the styrene affected area. Very

high potassium content was observed at about 0.5 km under zero tilled (ZT) soil, 1 km under zero tilled (ZT) & conventionally tilled (CT) soil and 1.5 km under conventionally tilled (CT) soil where the actual surface and sub-surface soils are characterised with sandy clay loam (SCL) and clay loam (CL_s) texture respectively than the surface and sub-surface soils of other locations with sandy loam (SL) and sandy clay loam (SCL) texture respectively. This may be due to high clay content of soils that holds the potassium effectively in interlayer spaces of clay and due to site-specific deposits of potash minerals i.e feldspars and micas in clay loam textural soils and also due to addition of potassic fertilizers in different crops grown in these fields.

It can be concluded that more potassium content was observed in affected area than unaffected area which was 5 km away from the styrene gas tank but cannot be comparable with the content of soil potassium in unaffected area as it may vary in native soil fertility status. But, the release of styrene or deposit of styrene in soil has no scientific evidence in changing any of the physicochemical properties of soil. So, this may be concluded that no effect of styrene on soil fertility status but, it is of purely inherent capacity of parent soil material that determines the distribution and availability of various macro and micro nutrients at variable concentrations in the soil profile.

Table 4. Physico -chemical properties of soil of study area.

S.No	Location/ Distance	ZT/CT*	Texture		pH (1:2)		EC (dSm^{-1})		OC (%)	
			0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30
1	0.25 km	ZT	SL	SCL	8.16	8.03	0.170	0.297	0.32	0.18
		CT	SL	SCL	6.79	7.52	0.270	0.166	0.26	0.01
2	0.5 km	ZT	SCL	CL	7.95	8.44	0.209	0.665	0.41	0.47
		CT	SL	SCL	7.89	8.05	0.236	0.213	0.44	0.41
3	1 km	ZT	SCL	CL	8.47	8.54	0.626	0.659	0.92	0.99
		CT	SCL	CL	8.46	8.66	0.758	0.573	0.82	0.37
4	1.5 km	ZT	SL	SCL	8.06	8.17	0.355	0.266	0.85	0.38
		CT	SCL	CL	7.67	8.54	0.543	0.718	1.41	0.91
5	2 km	ZT	SL	SCL	7.83	7.95	0.299	0.288	0.53	0.40
		CT	SL	SCL	8.16	7.99	0.282	0.285	0.63	0.73
6	>5 km	ZT	SL	SCL	7.36	7.83	0.146	0.260	0.45	0.41
Mean					**7.89**	**8.16**	**0.35**	**0.40**	**0.64**	**0.48**

(Note: * ZT- Zero tilled soil after styrene gas leak, CT- Conventionally tilled soil after styrene gas leak)

Table 5. Chemical properties of soil in study area.

S.No	Location/ Distance	ZT/CT*	Available N (kg/ha)		Available P (kg/ha)		Available K (kg/ha)	
			0-15	15-30	0-15	15-30	0-15	15-30
1	0.25 km	ZT	113	115	43	27	156	189
		CT	141	156	168	38	281	259
2	0.5 km	ZT	133	138	74	18	450	1721
		CT	116	166	67	69	356	356
3	1 km	ZT	167	173	45	43	2066	2197
		CT	116	141	31	27	2161	1540
4	1.5 km	ZT	121	131	67	13	1111	234
		CT	166	163	168	49	1294	2388
5	2 km	ZT	133	138	16	56	385	310
		CT	138	123	43	52	702	785
6	>5 km	ZT	133	136	170	152	657	666
Mean			**134.27**	**143.64**	**81.09**	**49.45**	**874.45**	**967.73**

(Note: * ZT- Zero tilled soil after styrene gas leak, CT- Conventionally tilled soil after gas leak)

B) Soil micro fauna:

In the study site, composite surface and sub-surface soil samples at two depths i.e. 0-15 cm and 15-30 cm were collected randomly in both conventionally tilled land and zero tilled lands at about 0.25 km, 0.5 km, 1 km, 1.5 km, 2 km and >5 km distance towards North-East direction where the actual flow and spread of styrene gas leak was recorded and brought these soil samples in sterilized new polythene packets along with sampling code to the soil biology laboratory by maintaining its field moist condition and further stored in the refrigerator at 10°C in later cases after 48 hours of sampling in order to estimate the total population of bacteria, fungi and actinomycetes. The collected soil samples have been analysed for enumeration of microbial population by following serial dilution plate count technique. The results obtained are given in table 6.

Table 6. Soil biological properties of study area.

S.No	Location/ Distance	ZT/CT*	Bacteria ($\times 10^6$) (cfu)		Fungi ($\times 10^4$) (cfu)		Actinomycetes ($\times 10^3$) (cfu)	
			0-15	15-30	0-15	15-30	0-15	15-30
1	0.25 km	ZT	4	35	12	17	**320**	**115**
		CT	**12**	**5**	**6**	**5**	120	321
2	0.5 km	ZT	14	17	4	12	**238**	**120**
		CT	**45**	**10**	**8**	**2**	124	206
3	1 km	ZT	12	18	7	8	**192**	**107**
		CT	5	6	**21**	**5**	**118**	**54**
4	1.5 km	ZT	**27**	**13**	**29**	**8**	**235**	**216**
		CT	**21**	**6**	14	16	157	184
5	2 km	ZT	**12**	**8**	**12**	**4**	120	149
		CT	9	18	**3**	**2**	98	154
6	>5 km	ZT	**27**	**18**	**5**	**1**	21	26
Mean			**17.09**	**14.00**	**11.00**	**7.27**	**158.45**	**150.18**

As per the results obtained, minimum bacterial population (4×10^6 cfu) was recorded at a depth of 0-15 cm in zero tilled (ZT) land within the vicinity of 0.25 km from the place where gas leakage occurred and increased population (35×10^6 cfu) was recorded comparatively at a depth of 15-30 cm in the same zero tilled land (fig.2). However, the trend of less bacterial population at depths of 0-15 cm was observed as compared to the population at depths of 15-30 cm among all zero tilled (ZT) soils at about 0.25 km, 0.5 km and 1 km distances from the LG Polymers Pvt. Ltd., Venkatapuram. It was also noticed that bacterial population at depths of 0-15 cm was more than that of 15-30 cm depth among conventionally tilled soils at about 0.25 km, 0.5 km and 1.5 km distances from the styrene tank.



Fig.2. Bacterial population ($x10^6$) (cfu)

With regard to fungal population in the styrene affected area, the same trend was observed as that of bacterial population i.e., less population at depths of 0-15 cm as compared to the population at depths of 15-30 cm in all zero tilled (ZT) soils (fig.3). But, it was more at depths of 0-15 cm than that of soil at depths of 15-30 cm in conventionally tilled (CT) soils at about 0.25 km, 0.5 km and 1 km distance from the LG Polymers Pvt. Ltd., Venkatapuram. It indicates that fungal population was decreased with increase of soil depth among conventionally tilled (CT) soils in three sites and also vice-versa among zero tilled (ZT) soils. These observations of maximum and minimum fungal populations may be associated or influenced based on the availability of soil moisture and organic carbon content prevailed in the study site.

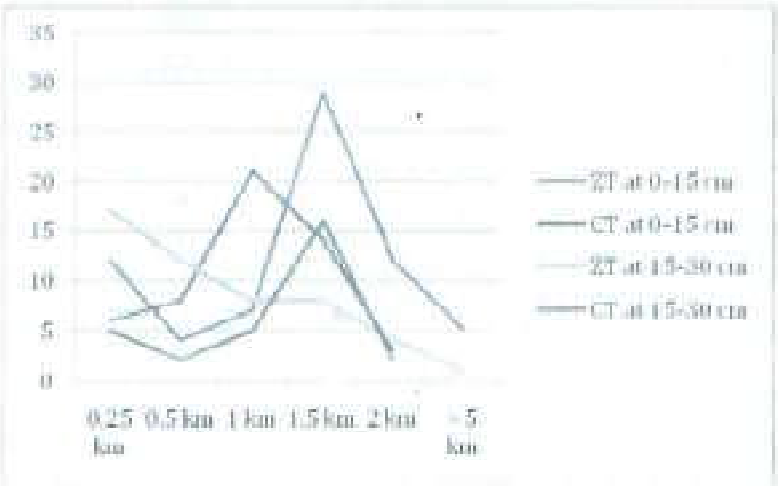


Fig.3. Fungal population ($x10^4$) (cfu)

The trend of Actinomycetes population was summarised in table 6 and shown in fig.4. Maximum population of actinomycetes (320 x 10^3 cfu) was recorded followed by (238 x 10^3 cfu) and (235 x 10^3 cfu) at depths of 0-15 cm in zero tilled (ZT) soils at a distance of 0.25 km, 0.5 km and 1 km respectively than with the minimum population (98 x 10^3 cfu) at depth of 0-15 cm in conventionally tilled (CT). Among conventionally tilled soils, it was observed that more population at depths of 15-30 cm than the population at 0-15 cm depth. However, Maximum population of actinomycetes was recorded in zero tilled (ZT) soils than that of conventionally tilled (CT) soil.

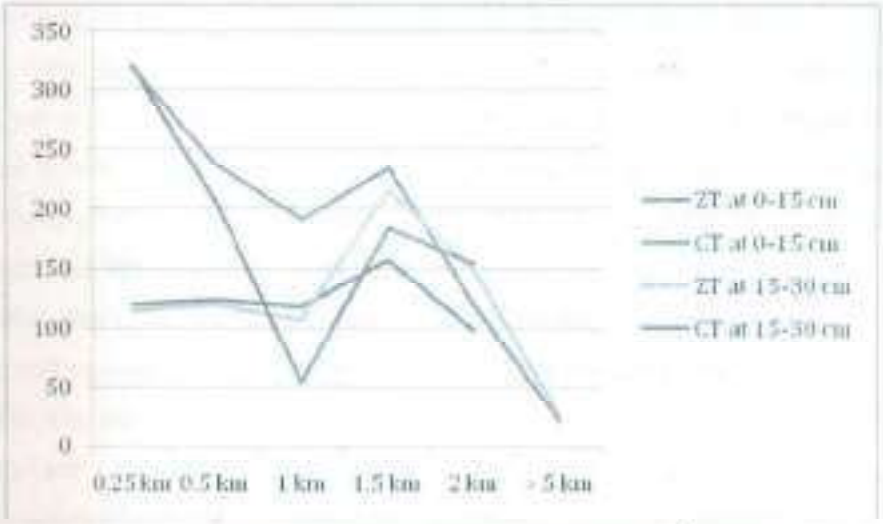


Fig.4. Actinomycetes population (x10^3) (cfu)

On the basis of mean values of microbial population it can be concluded that microbial count was more on the soil surface and decreased with increase of soil depth as usually and might not be stimulated by the effect of styrene gas spread in affected area. Fluctuation in microbial populations recorded due to site-specific soil reaction (pH), soil moisture and organic carbon content as energy source prevailed in the study site. It was also observed that more population of actinomycetes enumerated nearer to the LG Polymers within the vicinity of 0.25 km to 2 km and decreased with gradual increase of distance from LG Polymers Pvt. Ltd., Venkatapuram. These results and observations straightly indicates that there is no effect of released styrene gas on microbial population as it is readily bio-degradable by a wide variety of micro-organisms and may lead to extensive or complete destruction of the compound in soil.

C) **Water quality:**

In study site, open dug well and bore wells are the main irrigation sources to the crops being cultivated in styrene affected fields. As part of the study, total 3 no. of water samples have been collected from two irrigation sources i.e open dug well and bore well at about a distance of 1.5 km, 2 km under styrene affected area and 5 km under unaffected location from the LG Polymers Pvt. Ltd., Venkatapuram. The water samples were collected into sterilized new bottles and brought to the laboratory within 36 hours to analyse quality parameters as mentioned in table 2. The results were summarised in table 7.

Pertaining to the results obtained, the pH of water samples was neutral in reaction and on par with each of them. It indicates that irrigation water is normal in reaction and safe for plant growth as it does is not contains other elements at hazard levels. Mean electrical conductivity of water in affected area was 1.428 dS/m having 914 mg/l of average content of total dissolved salts in irrigation water and is on par with the water sample collected from unaffected area i.e > 5 km distance. It is indicative that the irrigation water has moderate salinity and requires leaching at higher range after its irrigation to sensitive crops like peas, beans etc. The chloride content of dug well and bore well water samples of affected area was 5.7 meq/l and 2.8 meq/l respectively and low in residual sodium carbonate (RSC) also. The results indicate that water from these two irrigation sources is generally safe for all plants with respect to chloride and RSC content as it is categorised as low. However, Keeping the the quality of water in view, it has moderate salinity and requires 12 to 17.5 % of leaching after its irrigation to sensitive crops.

Table 7: Details of water sampling at Venkatapuram village under study.

S.No	Location/ Distance	Source of irrigation water	Sample Code	pH (at 25°C)	EC (dSm^{-1})	Chlorides (meq/l)	RSC
1	1.5 km	Dug well	W1	7.49	1.780	5.7	Low
2	2 km	Bore well	W2	7.33	1.076	2.8	Low
3	>5 km	Bore well	W3	7.54	1.258	4.5	Low
Mean				**7.45**	**1.37**	**4.33**	~~7.45~~

Some of the salient features and observations were recorded during the visit to study site:

1. It was observed that, sufficient number of earth worm **population was present** in all the surveyed lands and was satisfactory.
2. High percent of in situ seed germination (from the fallen Okra seeds) was also observed in the affected soils.
3. Active flying and substantial population of butterflies and dragon flies were also observed.
4. In few coconut palms (nearly 10 palms) drying of lower leaves was recorded. Fronds and other younger leaves were green and healthy. Flowering, fruit setting and new spadix emergence was normal and **no abnormalities were observed.**
5. No damage symptoms were observed in fruit crops cultivated like mango, sapota, banana and also vegetables *viz.* brinjal, okra and gourds as well as fodder grass.
6. In one casuarina field drying of younger plants was observed which might be due to the effect of styrene gas but new sprouting was observed from axillary buds in dried plants.
7. No toxicity effects were recorded /observed with those persons who have eaten the vegetables and fruits from the affected area.
8. At present the residents are using the open well water and bore well water for drinking.
9. The ridge gourd fruits were collected from the field left over without harvesting and extracted the seed at HRS, Kovvur and observed more than 85% seed germination which was normal and found no effect of toxic gas.
10. It is also assumed that, due to the recent rains, the soil should have reached 100% saturation and the soil bound styrene may escape from the soil pore space.
11. Full bearing and profuse flowering was recorded in sapota orchard which is adjacent to the L.G. Polymers plant.
12. Native Earth worm activity was noticed while taking soil sample at a depth of 0-15 cm under zero tilled casuarina plantations and at depth of 15-30 cm under conventional tillage practice after gas leak at the distance of 0.5 km from LG

Polymers and also recorded 7-12 no. of adult earth worms per square foot area under zero tilled grass land at a distance of 2 km from LG Polymers site.

13. Burning effect of casuarina trees up to a height of 5-8 feet and coconut trees up to height of 10-12 feet was observed in the immediate vicinity of LG polymers where the actual flow and spread of styrene gas leak in the north-east direction.
14. Luxurious growth of weeds like *cynodon* sps (star grass), *cyperus rotundus*, *Parthenium* etc. were noticed in styrene affected fields.

Conclusion:

Further, it is to submit that based on laboratory results and other scientific findings, there is no effect of styrene vapour on soil physicochemical and biological properties during the observation at 40 days after gas leak. It can also be concluded that there is no antagonistic impact on soil micro-flora as it may readily bio-degraded by aerobic microorganisms leading to complete destruction of the compound into other degradable sub-compounds i.e CO_2 etc.

As per the quality of irrigation water, it has moderate salinity that limits the yield of various crops. But, it can be managed with the practice of leaching and good drainage after its irrigation to the crops. Based on the observations made during the visit on 18.06.2020 and results of soil biological properties, it can be concluded that there is no adverse impact on the crops to be grown in upcoming *kharif/rabi* seasons.

As per the overall observations recorded on different crops, soil physical and biological properties, the team did not find any adverse effect of styrene gas. Hence, the farmers can grow the vegetables and other horticultural crops by adopting the regular good agricultural practices.

Dr. B.V.K. Bhagavan	**Principal Scientist (Hort.) and Head & Zonal Research Head (CZ-I), HRS, Ambajipeta**	
Dr. N.B.V. Chalapathi Rao	**Principal Scientist (Ento.), HRS, Ambajipeta**	
Dr.K.Ravindra Kumar	**Scientist (Hort.), HRS, Kovvuru**	
Sri. P. Raja Sekhar	**Scientist (SS&AC), KVK, Pandirimamidi**	

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Division of Crop Chemistry & Soil Science
ICAR-CTRI, Rajahmundry

SOIL ANALYSIS REPORT

Date: 06-07-2020

Name: Dr. B.K.V.Bhagavan
Principal Scientist (Hort.) & Head
Horticultural Research Station
Ambajipeta-533214
East Godavari District

S.No	Sample details	Texture (Feel method)	pH (Soil Reaction) (1:2)	E.C (dS/m)	OC (%)	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)	Available Sulphur (ppm)
1	1	SL	8.16	0.170	0.32	113	43	156	9.7
2	2	SCL	8.03	0.297	0.18	150	27	189	45.4
3	3	SL	6.79	0.270	0.26	141	168	281	5.0
4	4	SCL	7.52	0.166	0.01	156	38	259	10.5
5	5	SCL	7.95	0.209	0.41	133	74	450	7.1
6	6	CL	8.44	0.665	0.47	138	18	1721	64.9
7	7	SL	7.89	0.236	0.44	116	67	356	6.7
8	8	SCL	8.05	0.213	0.41	166	69	356	6.7
9	9	SCL	8.47	0.626	0.92	161	45	2066	64
10	10	CL	8.54	0.659	0.99	173	43	2197	66
11	11	SCL	8.46	0.758	0.82	116	31	2161	72
12	12	CL	8.66	0.573	0.37	141	27	1540	50
13	13	LS-SL	8.06	0.355	0.85	121	67	1111	12
14	14	SCL	8.17	0.266	0.38	131	13	234	5.3
15	15	SCL	7.67	0.543	1.41	166	168	1294	33
16	16	CL	8.54	0.718	0.91	163	49	2388	70
17	17	SL	7.83	0.299	0.53	133	16	385	10.4
18	18	SCL	7.95	0.288	0.40	138	56	310	13
19	19	SL	8.16	0.282	0.63	138	43	702	11
20	20	SCL	7.99	0.285	0.73	123	52	785	7.4
21	C_1	SL	7.36	0.146	0.45	133	170	657	6.25
22	C_2	SCL	7.83	0.260	0.41	136	152	666	10.2

*SL-Sandy loam *SCL-Sandy clay loam *CL-Clay loam *LS- Loamy sand

(C.CHANDRA SEKHARA RAO)
Head
Div. of Crop Chemistry & Soil Science

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Microflora enumerated in the soil samples (in CFU)

Bacteria (Nutrient agar)
Fungi (Potato dextrose agar)
Actinomycetes (Kenknights and Munaier's medium)

Soil Sample No.	Bacteria (x 10^5)	Fungi (x 10^4)	Actinomycetes (x 10^3)
1.	4	12	320
2.	35	17	115
3.	12	6	120
4.	5	5	321
5.	14	4	238
6.	17	12	120
7.	45	8	124
8.	10	2	206
9.	12	7	192
10.	18	8	107
11.	5	21	118
12.	6	5	54
13.	27	29	235
14.	13	8	216
15.	21	14	157
16.	6	16	184
17.	12	12	120
18.	8	4	149
19.	9	3	98
20.	18	2	154
C1	27	5	21
C2	18	1	26

9/7/2020

09/07/2020

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Division of Crop Chemistry & Soil Science
ICAR-CTRI, Rajahmundry

WATER ANALYSIS REPORT

Date: 06-07-2020

Name : Dr. B.K.V.Bhagavan
Principal Scientist (Hort.) & Head
Horticultural Research Station
Ambajipeta-533214
East Godavari District

S.No	Sample Details	Source of water (well,borewell,pond,stream)	pH (at 25°C)	E.C (dS/m)	Chlorides (meq/l)	RSC
1	C_1	Bore water	7.49	1.780	5.7	Low
2	1	Well water	7.33	1.076	2.8	Low
3	2	Bore water	7.54	1.258	4.5	Low

(C.CHANDRA SEKHARA RAO)
Head
Div. of Crop Chemistry & Soil Science

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Annexure-IV

GOVERNMENT OF ANDHRA PRADESH
ANIMAL HUSBANDRY DEPARTMENT

From
Dr.D.Ramakrishna, B.V.Sc & A.H.,
FAC. Joint Director (A.H),
Visakhapatnam.

To
The Chairman,
Collector & District Magistrate,
Visakhapatnam District.

Lr. Rc. No.1/RRT/2020 Dated 18.09.2020

Sir,

Sub: APPCB RO VSP – Hon'ble NGT Matter 73/2020 & connected matters related to gas leak incident at M/S. LG Polymers Ltd., Visakhapatnam (Andhra Pradesh) – Committee for final Quantification of compensation in compliance with Hon' ble NGT order dt.01.06.2020 – ***"Plan of Restoration and compensation for damage to livestock"*** – Submission – Regarding.

Ref: 1.This Office Proc.Roc.No.1/RRT/2020 Dt.29.05.2020 to the Joint Chief Environmental Engineer, APPCB, Visakhapatnam
2. Lr. No. Gen/PCB/RO-VSP/NGT/2020 Dated 31.08.2020 of the Environmental Engineer, APPCB, RO, Visakhapatnam.
3. Report of the High Power Committee
4. Minutes of the meeting & instructions of the Chairman (District Collector, Visakhapatnam) on submission of restoration and compensation plan for damage to livestock Dt.15.09.2020

******

In obedience to the instructions issued by the Chairman and District Collector, Visakhapatnam regarding submission of ***Plan of Restoration and compensation for damage to livestock*** vide reference 4th cited, I herewith submit the detailed plan of action pertaining to livestock sector for perusal and kind consideration:

Thanking You sir

Encl: Proposal for Restoration and compensation for damage to livestock.

Yours faithfully,

Joint Director (AH),
Visakhapatnam.

15/9/20

ab/18/9

REPORT ON LG POLYMERS STYRENE GAS LEAK

Sub Component -2: Plan for Restoration and compensation for damage to Livestock

1. IMMEDIATE REFIEF MEASURES UNDERTAKEN:

A. Deployment of Rapid Response Teams

The Animal Husbandry Department has constituted **12 Rapid Response Teams (RRTs)** each team comprising of one Veterinarian, 1 Paravet and 2 Office Subordinates/ Gopalamitras in response to the Styrene gas leak disaster on 07.05.2020. The Assistant Director (A.H), Area Veterinary Hospital, Gopalapatnam was designated as Team leader and was entrusted the responsibility of coordinating the relief operations at field level by assigning the duties to the RRTs. A control room was also set up in the Office of the Joint Director (A.H), Visakhapatnam to receive the information from the field and report the information to the District Collector, Visakhapatnam and the Director of Animal Husbandry, A.P., Vijayawada. A Whatsapp group was also created for this purpose with the members of RRTs, Joint Director (A.H), Deputy Director (A.H), Addl. Director (A.H), Director of A.H., A.P, to monitor the relief operations effectively.

B. Handling of dead and affected animals:

A total of 27 livestock died on exposure to the styrene gas (25 livestock between 07-05-2020 and 09-05-2020 and 2 animals subsequently). The teams deployed ensured hygienic disposal of the carcasses in coordination with the GVMC and local revenue authorities duly taking all the necessary precautions to prevent spread of diseases. ***242 animals were treated*** in the affected villages by organizing Veterinary health camps. The ailing animals were provided with supportive therapy by distributing mineral mixture and supplements.

C. Laboratory Investigation

The Animal Disease Diagnostic Laboratory, Visakhapatnam has collected the blood, urine and milk samples from the ailing animals and also fodder samples and sent to "Pharmacovigilance Laboratory for Animal Feed and Food Safety" Tamil Nadu Veterinary and Animal Sciences University, Chennai for analysing the residues of Styrene gas. The test reports of the laboratory has indicated that the milk and urine samples had levels below detection limit (<0.2ppm) and the vital organs had no traces of the styrene metabolite.

D. Advisory for the Livestock owners

The livestock owners are advised not to feed the feed and fodder stocks available with them that are exposed to the gas. They are also advised not to feed the green fodder available in the fodder plots in the gas affected villages until further instructions. The farmers are advised to milk the animals but to discard the same till further instructions.

E. Monitoring and Surveillance

A total of 5 teams constituting of One Veterinarian, One Para Veterinarian and one Office Subordinate/ Animal Husbandry Assistant were deputed to the 5 gas affected villages from 12.05.2020 as per the instructions of the District Administration to create awareness on the use of feed and fodder and also regarding use of milk for human consumption in these villages.

F. Feed and Fodder support

The livestock owners were distributed with concentrate feed (20 MTs) and silage fodder (10 MTs) as an immediate relief measure to feed their animals for an amount of Rs.3,75,914/- only from the funds of Animal Husbandry Department. Besides, mineral mixture and nutritive supplements were also provided for faster recovery.

G. Compensation for deceased livestock:

As per the immediate instructions of the Hon'ble Chief Minister, the District Administration has released an amount of R.8.75 lakhs towards the ex-gratia for the 25 reported livestock deaths between 07-05-2020 to 09-05-2020. Subsequently two more livestock succumbed post exposure for which ex-gratia proposals were submitted to the District Administration.

2. RESTORATION AND COMPENSATION FOR DAMAGE TO LIVESTOCK

A. Livestock profile in the affected villages

The livestock owners in the affected villages which are in the peri-urban area mainly sustain on direct milk sales to the consumers in the city. As such the farmers maintain mostly productive animals (milk yielding animals) and very few dry animals are in their possession.

As per the survey on the livestock and their productivity, it was noted that the average daily milk yield was 6 litres for buffalo and 8 litres for cows. The selling price of buffalo milk ranges from Rs.40-50 per litre and Rs.30-40 per litre in case of cow milk.

Table 1: Livestock census in the 5 affected villages

S. No.	Village	Livestock population			
		Cattle	Buffalo	Young	Total
1	Venkatapuram	29	80	38	**147**
2	Venkatadrinagar	13	3	8	**24**
3	Nandamurinagar	6	43	32	**81**
4	Pydimamba Colony	30	31	29	**90**
5	BC Colony	8	37	16	**61**
TOTAL		**86**	**194**	**123**	**403**

B. Compensation for loss of milk

On the recommendations of NEERI and upon the instructions of the District Administration, the livestock farmers were advised to discard the milk of cows and buffaloes in the affected villages. Based on the findings of the test report of **"Pharmacovigilance Laboratory for Animal Feed and Food Safety, TANUVAS, Chennai"** received on 15-07-2020 which indicated that the milk samples had no residues of Styrene metabolite i.e, ***DL - Mandelic acid***, instructions were passed for safe use of milk of the affected animals for human consumption.

It is therefore proposed to compensate the loss incurred by the livestock farmers by enumerating the volume of milk discarded and its saleable value for a period of 30 days. The financial outlay for the proposed compensation is as detailed in Table 2.

Table 2: Estimated value of milk discarded during 30 days.

S. No	Village	Lactating		Total Daily Milk yield* (Ltrs)		Value of milk discarded for 30 days # (Lakh Rs.)		Total Amount (Lakh Rs.)
		Cow	Buff	Cow	Buff	Cow	Buff	
1	Venkata puram	23	71	184	426	1.656	5.112	**6.768**
2	Venkatadri nagar	10	2	80	12	0.720	0.144	**0.864**
3	Nandamuri nagar	5	38	40	228	0.360	2.736	**3.096**
4	Pydimamba Colony	29	25	232	150	2.088	1.800	**3.888**
5	BC Colony	7	32	56	192	0.504	2.304	**2.808**
TOTAL		**74**	**168**	**592**	**1008**	**5.328**	**12.096**	**17.424**

* Avg. Milk yield of cow per day – 8 litres; buffalo – 6 litres

Saleable price of cow milk per litre @ Rs.30/- & buffalo milk @ Rs.40/-

C. Providing replacement livestock

As an immediate relief to the livestock farmers whose animals have died due to the impact of the styrene gas, 8 farmers have been provided with an ex-gratia amount of Rs.8.75 Lakhs to help him sustain due to lack of livelihood. It is therefore proposed to provide replacement livestock to the farmers who have lost their animals by grounding from the adjoining District. A total of 4 cows, 10 buffaloes and 1 cross bred Jersey heifer belonging to 8 farmers have died and the financial implication for providing animals are submitted in Table 3.

Table 3: Amount required for providing replacement animals

S. No	Name of the farmer	Village	Livestock lost	Qty	Market value + Transport # (Rs.)	Total amount (Rs.)
1	Baliji Pydi Raju	Venkata puram	Cow	3	55000	165000
2	Noonela Nooka Raju	Venkata puram	She Buffalo	3	65000	195000
3	B. Sanyasamma	Venkata puram	She Buffalo	1	65000	65000
4	Yellapu Tatarao	Venkata puram	Cow	1	55000	120000
			She Buffalo	1	65000	
5	Noonela Sagar	Venkata puram	She Buffalo	2	65000	130000
6	Ch. Nookaratnam	Venkata puram	She Buffalo	2	65000	130000
7	Pala Amaravathi	Venkata puram	She Buffalo	1	65000	65000
8	G. Atchibabu	BC colony	CB Heifer	1	30000	30000
TOTAL				**15**		**9,00,000**

 # the proposed market value of the animal including transport for cow is Rs. 55,000/- and for buffalo is Rs. 65,000/-

D. Feed and fodder support

The survey conducted by the Animal Husbandry Department to analyse the impact of the styrene vapours on the productivity of livestock has indicated that there is a drop in the milk production by 30% in cows and 60% in buffaloes 10 days post exposure.

It is therefore proposed to provide feed and fodder support to all the animals in the affected villages for a period of 6 months to help them re-coop and regain the production. It is also proposed to provide mineral and vitamin supplementation to the needy animals for improved fertility. The provision of these feeding inputs will help the animals in better reproduction and also sustained milk production in the next lactation. It is submitted that an amount of **Rs. 62, 33,472/-** is required for providing the proposed feed and fodder support.

Animal	Allowance of Concentrate feed per day	Allowance of TMR per day
Adult	4 Kg @ Rs.15.17 per kg	5 Kg @ Rs.12.60 per kg
Young	2 Kg @ Rs.15.17 per Kg	3 Kg @ Rs.12.60 per kg

Table 4: Cost estimation for feed and fodder support for 180 days

S. No	Village	Livestock population		Feeding inputs for 180 days in MTs		Cost (Rs.)		Amount Rs.
		Adult	Young	TMR	Conc.	TMR	Conc.	
1	Venkata puram	109	38	98.10	78.48	1236060	1190542	2426602
2	Venkatad ri nagar	16	8	14.40	11.52	181440	174758	356198
3	Nandamu ri nagar	49	32	44.10	35.28	555660	535198	1090858
4	Pydiman ba Colony	61	29	54.90	43.92	691740	666266	1358006
5	BC Colony	45	16	40.50	32.40	510300	491508	1001808
TOTAL		280	123	252.00	201.60	3175200	3058272	6233472

E. Long term monitoring and surveillance

The Animal Husbandry Department has deployed special teams to monitor the health of the animals in the affected villages till 30.06.2020. Thereafter, the Area Veterinary Hospital, Gopalapatnam has been providing the required Animal Husbandry services by keeping a close watch on these affected villages.

It is now proposed to organize at least one health camp per month in each of these 5 gas affected villages for a period of one year to monitor the health of the animals and also to collect the data on production and reproductive parameters to assess the long term impact on the livestock due to styrene vapours.

It is submitted that a total amount of **Rs. 3,00,000/-** is required to conduct 60 camps in one year with an estimated budget of Rs. 5000/- per camp towards drugs/medicines and logistics.

ABSTRACT OF FUNDS REQUIRED FOR PROPOSED RESTORATION AND COMPENSATION

S. No.	PROPOSAL	ESTIMATED EXPENDITURE (Rs.)
1	Compensation for milk discarded for 60 days	**17,42,400**
2	Provision of replacement animals	**9,00,000**
3	Feed and fodder support	**62,33,472**
4	Veterinary Health camps	**3,00,000**
	TOTAL	**91,75,872**

Submitted for kind perusal.

Joint Director (A.H.)
Visakhapatnam.

Attendance for Sub-Committee meeting on Restoration and Compensation plan for damage to Health, Property, Crops, Livestock etc, on 15.09.2020 at 12:00 Noon 545

S.No.	Name of the official	Name of the Department	Email & Phone No.	Signature
1.	V. Vinaychandra	Dist Collector		
2.	Dr. P.V. SUDHAKAR	PRINCIPAL ARC SUPERINTENDING, KAU	Kglsuperintendent@gmail.com 9849982060	
3.	DY.C. VIJAYA LAKSHMI	DM HO	9849902299	
4.	T. Jagannadha Reddy	JCLE APPCB	7772014520	
5.	R.J. Vidyullatha	Town planning, GVMC	ccpgvmc@gmail.com 9848288827	
6.	D. Ramakrishna	Town planning GVMC	8978798435	
7.	K.V. Bhaskar	Town Planning GVMC	9849893236	
8	G.S.N.S. Seetaramaraju	J.D. Agri	8331056663	
9	Dr. D. Ramakrishna	J.D (A.H)	9989982828	
10	Dr. K.V. Ramana Murthy	Principal Scientist RARS, Anakapalle	9849636324	
11.	Dr. Ch. S. Ramalakshmi (SSCSE)	Regional Stg. Research Station, Anakapalle.	9441210908	
12.	Sudhakar. K	Inspector of factories Visakhapatnam	9618769799	
13	K. Ravindra Kishore	RDO, Vizag	9849903835	
14	A. PRASAD	DRO, Vizag	9849038820	
15.	R. Govinda Rao	JC (ALW)	9849903829	
16.	G. Sujana	Commissioner GVMC.	9121233377	

'Records of Discussion' of the 1st meeting of the MoEFCC Nodal Committee constituted for Preparation of Restoration Plan in reference to the order passed by Hon'ble NGT in the matter of OA 73/2020 & connected matters related to Gas Leak incident at M/s LG Polymers Limited, Visakhapatnam (Andhra Pradesh)

A meeting of the MoEFCC Nodal Committee constituted for Preparation of Restoration Plan was convened under the chairmanship of Dr. Satish C Garkoti, Sceintist 'G', MoEFCC on 17.08.2020 at 3 P.M. through video-conferencing. All the members of the Committee attended the meeting in person, except Shri V Vinay Chand, District Magistrate, Vishakhapatnam, who was represented by the Joint Collector, Vishakhapatnam. The followings were present:

- Shri A. K. Pateshwary, Director, IA (Industry-II), MoEFCC
- Shri R Govinda Rao, Joint Collector (represented District Magistrate, Vishakhapatnam)
- Dr. Prashant Gargava, Member Secretary, CPCB
- Shri Dinbandhu Gouda, Divisional Head (IPC-I) & Additional Director, CPCB
- Shri Bharat Sharma, Addl. Director and In-charge, CPCB Regional Directorate, Pune
- Shri A Ramchand, Chief Environmental Engineer, APPCB
- Shri D. Chandra Sekhara Varma, Director of Factories, Govt. of Andhra Pradesh
- Dr. Dharmendra K. Gupta, Director, HSM Division – Member Convenor

2. At the outset, Chairman welcomed all the participants and meeting began with brief round of introduction. The Chairman also informed that this meeting is convened to get status update from the sub-committees constituted under the order dated 21.07.2020, wherein Central Pollution Control Board (CPCB) and State Government (District Magistrate, Vishakhapatnam) were directed to submit detailed plan to MoEFCC w.r.t. restoration of environmental media viz. air, water and soil and restoration and compensation plan with regard to the damages done to health, property, crops, livestock etc.

3. The Committee took note of the fact that after the incident of gas release many agencies like National Disaster Response Force (NDRF), National Environmental Engineering Research Institute (CSIR-NEERI), Andhra Pradesh Pollution Control Board (APPCB), Department of Industrial Safety and Health (DISH) etc. have undertaken separate studies with regard to the incident. In addition, the Govt. of Andhra Pradesh had constituted a High Power Committee (HPC), who had prepared/ submitted a comprehensive report to the State Govt. along with Annexures. The floor was thereafter opened for discussion.

4. The APPCB representative informed that extensive field monitoring/ sample analysis was done by APPCB since the accident took place. A detailed report *(running into more than 300 pages)* was submitted to the court as well as HPC, which could form the basis of preparing an environmental restoration plan. The Member Secretary, CPCB informed that apart from APPCB, the CSIR-NEERI had also undertaken sampling and analysis work

during the incident. It was informed that the APPCB Zonal Office, Vishakhapatnam and CSIR-NEERI Office, Hyderabad had played a pivotal role during the initial sampling and monitoring phase and are well versed with the situation emerged after the incidence. It was, therefore, suggested to involve NEERI in the preparation of the plan for restoration of environmental media.

5. With regard to impact zone due to incidence, Dr Bharat Sharma, CPCB *(who also happened to be a nominated member of HPC on behalf of MoEFCC/ CPCB)* informed that the Experts from Andhra University had assessed the styrene gas impact zone through modelling. The modelling data indicated the impact zone as approximately 3 kms, wherein majority of impact was found in the windward side. It was further informed that the impact of styrene leakage in air has now been degraded; however, the monitoring done during the accident phase would be helpful in indicating the extent of its concentration in the ambient environment during that period. Similarly, samples of ground water, surface water and soil were collected by APPCB and CSIR-NEERI also. The Joint Collector represented the office of DC, Vishakhapatnam during the meeting informed that they are in the process of undertaking the assigned task.

6. Dr. Dharmendra K. Gupta, Director and Member Convenor emphasized that Hon'ble NGT had given the task of preparation of restoration plan to a group of agencies considering the need/ requirement of expertise and adequate coordination among them. The Ministry, after careful examination of the task to be performed, had decided to assign roles to various agencies based on their core-expertise. However, to further support the identified agencies, provisions have been made to rope-in other experts, if needed, for preparation of restoration plan. The Committee noted that while the plan was to be prepared within two months; it is apparent that activities are yet to be started by agencies. With specific submission of CPCB regarding the need to on-board CSIR-NEERI (an expert agency) for the task, the Chair informed that CPCB can suitably look in to it, as provisions have already been made in the order dated 21.07.2020, issued by the Ministry with the approval of Secretary (EF&CC).

The meeting ended with vote of thanks to and from the Chair.

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'Records of Discussion' of the Committee meeting held on 07.06.2021 constituted for 'Preparation of Restoration Plan' in compliance with Hon'ble NGT's order dated 01.06.2020 in the matter of OA 73/2020 & connected matters (Styrene Gas Leak incident at M/s LG Polymers Limited, Visakhapatnam, Andhra Pradesh)

The second meeting of the MoEFCC Nodal Committee constituted for 'Finalisation of Restoration Plan' was convened under the Chairmanship of Dr. Satish C. Garkoti, Scientist 'G', MoEFCC on June 7, 2021 at 10:30 A.M. through video-conferencing. The representatives of CPCB, CSIR-NEERI, APPCB and MoEFCC attended the meeting. A list of participants is annexed.

2. At the outset, the Chairman welcomed all the participants and informed that pursuant to the 1st meeting of the Committee held on 17.08.2020, this Ministry has received reports from the District Committee and CSIR-NEERI. Due to second wave of Corona, the instant meeting got delayed. The purpose of this meeting is to have a broad uniformity in the assessment methodology of both the institutions.Thereafter, CSIR-NEERI was requested to make a presentation.

3. The CSIR-NEERI Team, led by Dr. Shaik Basha, Principal Scientist & Head, Hyderabad Zonal Centre made a presentation on 'Assessment of Environmental Damages and Preparation of Restoration Plan for Air, Water and Soil Environment due to Styrene Gas Leakage Incident at Visakhapatnam', which was covered into three parts:

- Styrene concentration monitoring in environmental media *(ambient air, water, and soil)* and its analysis for preparation of a 'Restoration Plan';
- Collection, analysis and assessment of health care data; and
- Environment Damage Cost Assessment due to incident

4. The summary of the CSIR-NEERI presentation is as under:

- The monitoring data from October 28-30, 2020 indicated the ambient levels of styrene and Total Volatile Organic Compounds (TVOC) as BDL within the study area of up to 1 km radius. However, spot concentration of styrene and TVOC was observed as 0.007 ppm and 0.018 ppm respectively at the Storage Tank of LG Polymers. Similarly, the spot concentrations of TVOC was observed as 0.018 ppm at Styrene Unloading Area.
- The concentration of styrene in groundwater and surface water were BDL during October 2020 whereas styrene levels were observed in surface water in May-2020, which indicate that styrene may have degraded from the surface water samples. Further, the water sample parameters were observed to be

meeting the permissible water quality limits of BIS, including for heavy metals. The bioassay test conducted for four surface water samples *(around the LG Polymers)* also indicated fish's stability in all samples for 96 hours.

- It is mentioned that regular monitoring of the groundwater and surface water samples be carried out for consequent two hydrological cycles to ensure the good water quality and level.
- The styrene concentration in soil was detected at 2 locations at low concentrations (0.15 ppb and 4.7 ppb), which is below the CCME guideline values of 0.1 mg/kg (100 ppb) and 50 mg/kg (50000 ppb) for agriculture and industrial activities respectively. It was noted that soil samples recorded high level of styrene (109 to 5950 mg/kg) immediately after the gas leak i.e. between 8^{th}-14^{th} May 2020).
- It is mentioned that the soil microbial flora was either not affected by the gas leak incident or recovered naturally by the time of sample collection. It is sated that increasing the biodiversity of the affected environment can reduce or remediate the pollution level and accordingly, gardening/ plantation activities can be undertaken in the affected area. Such activities may support the growth of soil microbial level as well as higher-level organisms in the rhizosphere environment.
- A thorough medical examination needs to be conducted to verify, quantify and record the long-term health effects of styrene exposure at Venkatapuram village, since similar studies/ data do not exist either domestically or globally.
- The provisional EDCA was assessed using 'Contingent Valuation method'. It was also mentioned that the Hon'ble Supreme Court has also provided detailed guidelines to work-out compensation and environmental damages in similar cases and the same were also taken into consideration while calculating the EDCA. Based on the detailed exercise undertaken, it was informed that an average value of the lower estimate of contingent valuation or upper estimates based on environmental impact has put EDCA in the bracket of ₹56.75 Crore to ₹75.30 Crore ***i.e. ₹ 66.03 ± 9.27 Crore.***
- The restoration plan for the environment in the vicinity of LG Polymeirs due to the styrene gas accident has been prepared. Multiple steps have been proposed for restoration in the current context, given the intensity of the accident. However, it is essential that detailing of each aspect is carried out separately in consultation with various stakeholders and a corresponding action plan may be formulated.

5. Thereafter, the District Committee was invited for presentation; however,

District Committee was not prepared to make presentation. Moreover, there was no representation from the Office of District Magistrate as well as Director of factories, Govt. of AP. ; therefore, the 'Restoration Plan and Compensation' related aspects w.r.t. damage to health, property, crops, livestock etc. were not presented.

6. The committee, thereafter deliberated on the following points:

- The availability of baseline styrene monitoring data i.e. prior to chemical accident were sought for comparison; however, APPCB informed that there is no baseline data availability w.r.t styrene in environment media such as air, water and soil. However, after the incident, the APPCB is reportedly monitoring the concentration of styrene on periodic basis. The Committee requested APPCB to provided the data *(of last one year)* and asked CSIR-NEERI to correlate the data to come to a specific conclusion on presence of styrene in environment. The 'Restoration Plan' submitted by CSIR-NEERI need to be supported by a definitive conclusion on prevalence of styrene in environment.
- It was also suggested to carryout additional round of monitoring near the storage tank of M/s LG Polymers where styrene values are observed above BDL during October, 2020 monitoring to get an idea about its source.
- Dr. Bharat Sharma, CPCB Regional Director, Pune also supported the significance of having background data *(i.e. styrene concentration in environment media)* 'prior to' and 'after' the incident. It was emphasized that the study should be able to conclusively say *(based on available monitoring data)* about the impact as well as presence of styrene in environmental media since more than a year has been passed. The Committee noted that monitoring conducted by CSIR-NEERI in the region and the APPCB can be used as available data sets. To undertake fresh monitoring, as per the deliberations, APPCB was requested to coordinate with District Authority *(who is also a Committee member)* and obtain required permission for entering the premises for the purpose of collection of data.
- To keep a uniformity among various damage assessment studies undertaken, the Committee suggested that the EDCA may be calculated based on the Hon'ble Supreme Court's Guidelines for being a standardized and uniform method. Accordingly, CSIR-NEERI was requested to re-calculate the damages and submit to the Committee.
- The Committee noted that the report is required to be recommended and forwarded to the MoEFCC Nodal Committee for 'Finalization of Compensation'. Thereafter, the consolidated recommendations on restoration plan, damages and compensation are required to be submitted to Hon'ble

Tribunal. *Hence, the third meeting is proposed be convened on June 21, 2021 to finalize the report on 'Restoration Plan'*. During the third meeting, the District Committee and CPCB/ CSIR-NEERI shall present the studies undertaken/ modifications incorporated in the report, in line with the deliberations.

7. The next meeting of the Committee will be held on 21.06.2021; therefore. all the members and participants were requested to go through the reports and provide their inputs, if any, to the Ministry for consideration.

8. The meeting ended with a vote of thanks to the Chair.

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List of participants

Members of the Committee:

1. Dr. S. C. Garkoti, Adviser, MoEFCC - Chairman
2. Shri A. K. Pateshwary, Director, IA (Industry-II), MoEFCC
3. Shri Dinbandhu Gouda, Divisional Head (IPC-I) & Additional Director, CPCB
4. Shri Bharat Sharma, Addl. Director and Incharge, CPCB Regional Directorate, Pune
5. Shri B Mahusudhana Rao, Chief Environmental Engineer, APPCB

MoEFCC/ CPCB/ APPCB/ CSIR-NEERI Officials:

6. Dr. Shaik Basha, Sr. Principal Scientist, CSIR-NEERI, Hyderabad Zonal Centre
7. Shri Krishna Murthi Kannan, Chief Scientist, CSIR-NEERI
8. Dr. B. Madhusudhana Rao, CEE, APPCB
9. Shri. Dinesh Runiwal, Scientist 'E', HSM Division
10. Ms. H D Varalakmi, Scientist 'E', CPCB Regional Office, Chennai
11. Ms. Mahima T, Scientist 'D',CPCB Regional Office, Chennai
12. Shri Hemant Bherwani, Scientist, CSIR-NEERI
13. Shri Ramya Sanam, Scientist, CSIR-NEERI
14. Shri T. Rajendra Reddy, Joint CEE, APPCB
15. Ms. Shivani Mudgal, Consultant, MoEFCC
16. Ms. Shruti Mishra, Legal Assistant, MoEFCC
17. Ms. Uma Pandey
18. Shri Mukesh
19. Shri P. V. Chalapathi Rao

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'Record of Discussions' of the meeting held on 21.06.2021 of the committee constituted for 'Preparation of Restoration Plan' in compliance with Hon'ble NGT's order dated 01.06.2020 in the matter of OA 73/2020 & connected matters (Styrene Gas Leak incident at M/s LG Polymers Limited, Visakhapatnam, Andhra Pradesh)

The third meeting of the MoEFCC Nodal Committee constituted for 'Preparation of Restoration Plan' was convened under the Chairmanship of Dr. Satish C. Garkoti, Scientist 'G', MoEF&CC on June 21, 2021 at 11:00 A.M. through video-conferencing. The representatives of CPCB, CSIR-NEERI, APPCB and MoEF&CC attended the meeting. A list of participants is annexed.

2. At the outset, the Chairman welcomed all the participants and highlighted that the CSIR-NEERI team had made a presentation before the Committee earlier on 07.06.2021, when CSIR-NEERI was requested to incorporate the updated monitoring data and re-calculate the cost of damages as per the Hon'ble Supreme Court guidelines. Accordingly, NEERI was requested to make a brief presentation.

3. The CSIR-NEERI's team started a presentation and apprised the committee members that styrene concentration (inside and outside the premises) in environmental media viz. air, ground and surface water and soil was found Below Detection Level (BDL) in the month of June, 2021. Further, Shri Hemant Bherwani, Scientist, CSIR-NEERI informed that morbidity/ mortality related component of Environment Damage Cost Assessment (EDCA) has now been re-calculated as per the Hon'ble Supreme Court guidelines. **Accordingly, the final value for environmental damages w.r.t. sub-component 1 is arrived in the bracket of ₹35.57 Crores to ₹75.30 Crores i.e. ₹ 55.44 Crores (as average) with deviation of (±)19.87 Crores.**

4. Thereafter, the District Committee was invited for presentation for sub component (ii) i.e. Preparation of Restoration Plan and Compensation for damage to health, property, crops, livestock etc. Shri D C S Varma, Director of Factories, Andhra Pradesh gave an overview and explained the background, root cause of the accident happened at M/s LG Polymers. The situation 'prior-to' and 'during' accident, lacunae at the end of unit etc. were also informed. It was mentioned that the accident had resulted in loss of 12 lives, besides hospitalization of 585 people and loss of livestock and vegetation. The task undertaken by the High Power Committee (HPC) w.r.t. in-depth examination of root-causes and general/ accident-specific

recommendations provided to avoid recurrence of similar incidents.

5. Shri T. Rajendra Reddy, Joint CEE, APPCB, presented on the work undertaken by the sub-committee under the chairmanship of the District Magistrate, Visakhapatnam. It was informed that to gather information and work out compensation for damage to health, property, crops, livestock etc., a committee comprising of the Commissioner, Vishkhapatnam and representative of various departments such as Agriculture, Animal Husbandry, Factories, Revenue, Andhra Medical College, APPCB and experts from the Regional Agriculture Research station was constituted. The Committee calculated the compensation amount w.r.t. the actual damage happened in the affected areas as well as made financial estimates w.r.t. the restoration activities required to be carried out. Accordingly, the sub-component two was broadly divided into three categories as below:

- Restoration and Compensation plan for damage to the property - It comprised of the compensation paid to the victims under various heads by the Government of A.P, theft amounts as per FIRs, food grains spoiled and discarded by households and the damage to the goods stored in the petty shops. The estimated Compensation for Damage Assessment to the property is **₹38,40,57,085**/-. *The Committee noted that out of the total amount, ₹37,17,80,000/- was alreay paid to the affected people.* A State Govt. GO was issued to affectuate such payment to the deceased, injured, hospitalised persons then. The copy of the GO was also shared with MoEFCC.

- Restoration and compensation plan for damage to the health - It comprised of the actual expenditures as well as proposed expenditures for health investigations, long-tem studies on accidental exposure, mental health assessment & restoration of health, monitoring of the affected population and establishment of 10 bedded hospital. The estimate towards 'Restoration & Compensation w.r.t. Health' is **₹22,77,05,026/-.**
- Restoration and compensation plan for damage to the crops - It comprised of the actual as well as proposed expenditure towards organic inputs and other expenses for restoration of crop in affected villages and analysis of soil and irrigation water. The estimated Compensation for Damage Assessment to the crop is **₹8,57,278/-.**
- Restoration and compensation plan for damage to the livestock - It comprised of actual as well as proposed expenditure towards restoration of livestock profile in the affected villages, value of milk discarded during 30 days, amount for replacement of livestock, feed and fodder support and long-term monitoring and surveillance. The estimated Compensation for Damage Assessment to the Livestock is **₹91, 75,872/-.**

The Committee noted that the total compensation estimated for damage assessment w.r.t. sub-component 2 is ₹62,17,95,261/-

6. The Committee, thereafter, undertook detailed deliberations as follows:

- The baseline data on presence of styrene in environment media is not available with APPCB. It was, however, informed that data w.r.t. Total Volatile Organic Compounds (TVOCs) *(of which styrene can be considered as major component)* was monitored by M/s LG polymers. Therefore, it was suggested that APPCB may obtain monitoring data of TVOCs from the unit, so that correlation between presence of TVOCs/ Styrene prior to accident can be linked to TVOC/ Styrene measurements 'during the accident', 'immediately after (1-8 days) the accident', 'October-2020' and 'June-2021' data. Based on such analysis, the Committee may get an idea of the prevalence of styrene concentration in environmental media.
- The Committee noted that there are certain components for which the damage assessment has been done by CSIR-NEERI as well as District Committee. Accordingly, CSIR-NEERI was requested to go through the District Committee report and identify such components. CSIR-NEERI was also requested to suggest a scientific method of removing such duplicity and rational for considering the final value *(for identified components)*.
- The CPCB representatives suggested that the expenses occurred for preparation of Restoration Plan *(after the styrene incident)* should be borne by M/s LG Polymers as it is incidental to the accident happened in their factory. This matter may be examined by the MoEFCC.

- The Committee unanimously noted that the instant report is required to be recommended and forwarded to the MoEFCC Nodal Committee for 'Finalization of Compensation'. Thereafter, the consolidated recommendations on restoration plan, damages and compensation are required to be submitted to the Hon'ble Tribunal. *Hence, the fourth/ final meeting is proposed to be convened on July 2, 2021 to finalize the recommendations of MoEFCC Nodal Committee on 'Preparation of Restoration Plan'.*

7. All the members and participants were requested to go through the reports and provide their inputs, if any, to the Ministry for consideration.

8. The meeting ended with vote of thanks to the Chair.

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List of participants

Members of the Committee:

1. Dr. S. C. Garkoti, Adviser, MoEF&CC - Chairman
2. Shri Dinbandhu Gouda, Divisional Head (IPC-I) & Additional Director, CPCB
3. Shri Bharat Sharma, Addl. Director and Incharge, CPCB Regional Directorate, Pune
4. Shri B Mahusudhana Rao, Chief Environmental Engineer, APPCB
5. Shri D. Chandra Sekhara Varma, Director of Factories, Govt. of Andhra Pradesh

MoEF&CC/ CPCB/ APPCB/ CSIR-NEERI Officials:

6. Dr. Shaik Basha, Sr. Principal Scientist, CSIR-NEERI, Hyderabad Zonal Centre
7. Shri Krishna Murthi Kannan, Chief Scientist, CSIR-NEERI
8. Shri T. Rajendra Reddy, Joint CEE, APPCB
9. Shri. Dinesh Runiwal, Scientist 'E', HSM Division
10. Ms. H D Varalakmi, Scientist 'E', CPCB Regional Office, Chennai
11. Ms. Mahima T, Scientist 'D',CPCB Regional Office, Chennai
12. Shri Hemant Bherwani, Scientist, CSIR-NEERI
13. Ms. ShivaniMudgal, Consultant, MoEF&CC
14. Ms. Shruti Mishra, Legal Assistant, MoEFCC
15. Ms. Uma Pandey

'Record of Discussion' of the meeting held on 02.07.2021 of the committee constituted for 'Preparation of Restoration Plan' in compliance with Hon'ble NGT's order dated 01.06.2020 in the matter of OA 73/2020 & connected matters (Styrene Gas Leak incident at M/s LG Polymers Limited, Visakhapatnam, Andhra Pradesh)

The fourth (4th) meeting of the MoEFCC Nodal Committee constituted for 'Finalisation of Restoration Plan' was convened under the Chairmanship of Dr. Satish C. Garkoti, Adviser, MoEFCC on July 2, 2021 at 11:00 A.M. through video-conferencing. The representatives of CPCB, CSIR-NEERI, APPCB and MoEF&CC attended the meeting. A list of participants is annexed.

2. Carrying forward the discussion from previous meetings, the Chairman initially welcomed all the participants and thereafter, asked CSIR-NEERI to apprise the committee on the aspects identified for further action *viz.* the monitoring data of total Volatile Organic Compounds (TVOCs) in environment media and identification of duplicate components of damage assessment.

3. The CSIR-NEERI team apprised the committee about the Total VOCs concentration data *(primarily reflecting Styrene concentration)* in ambient air prior to incident (i.e. from January 2020 to May 2020). The data was provided by APPCB, and sourced from an automatic VOC measurement instrument installed by M/s LG Polymers. The installed instrument was reported to be an automatic data logger measuring TVOC concentrations every minute and was installed to monitor the TVOCs near the M6 storage tank inside the premises. The Committee noted that the average values of styrene concentration measured by the instrument was 4.05ppm to 5.3ppm from January to April, 2020 whereas the similar readings for May-2020 were 14.48 ppm. The Committee inferred that the average values of May-2020 were 3-4 times of the previous months indicating styrene release. **Summing up the environmental monitoring component, the Committee inferred from the results of the field analysis done by CSIR-NEERI and APPCB that styrene, being highly volatile, might have progressively degraded in environmental media and the latest monitoring results indicate that styrene traces are not present in air, water and soil.**

4. Thereafter, the CSIR-NEERI team informed the Committee Members that it has done a comparative examination of the District Sub-committee report vis-a-vis the CSIR-NEERI report and attempted for segregation of the damage cost components for all the categories *viz.* environmental media *(air, water & soil)*, health, property, crops, livestock etc. The exercise was aimed at grouping the 'already calculated damage costs' under mutually exclusive sub-heads to assist the Committee in understanding scope of damage costs calculated and arriving at a final decision.

5. The Committee undertook detailed deliberations on the assessment methodology of environmental, health, property, livestock & crop damages and considered the submissions of the sub-committees. The Committee took into the account the fact that the values arrived at by CSIR-NEERI are based on scientific modelling and methodology, whereas the values arrived at by District Sub-Committee are based on the field assessment by the line departments. The Committee recommended the following as component-wise damage assessment and restoration

cost:

i. Damage Assessment in respect of Health - ₹38,40,57,085 *(includes Compensation for deceased person, Medical treatment to victims, dead animals and individuals in affected area, Compensation for loss of valuables (theft cases), enumeration of petty shops, Compensation towards contaminated food grains/ consumables for each family)*
ii. Damage Assessment in respect of Soil - ₹39,54,90,997 *(includes cost estimate for the contaminated quantity of soil based basic remediation technique)*
iii. Damage Assessment in respect of Crops - ₹54,93,183 *(includes income loss from cropland occurred to the affected people due to the accident, up to EDCA survey period)*
iv. Damage in respect of Production from Livestock - ₹91,75,872 *(includes the estimated value of milk discarded during 30 days after incident interim release, amount required for replacement of animals, cost estimated for feed and fodder for 180 days and for conducting veterinary health camps)*
v. Restoration Cost in respect of Health - ₹22,77,05,026 *(includes the cost proposed towards undertaking health related research studies, specialty treatment expenditure, suggestive baseline investigations and establishment of 10-bedded hospital)*

6. Based on the above, the Committee unanimously recommended that the total estimated damage cost to environment, health, property, livestock, crops, etc. is ₹79,42,17,137 Crores (say ₹79.42 Crores). However, considering the health restoration component the comprehensive damage and restoration cost is assessed as ₹1,02,19,22,163 (say 102.19 Crores).

7. The follow-up action in the matter was identified as below:

- CPCB to submit an updated final report on 'Preparation of Restoration Plan' to the Ministry
- The instant Committee's recommendations may be placed before the MoEFCC Nodal Committee for 'Finalization of Compensation'.
- On the aspect of considering the expenses incurred by CPCB on engagement of CSIR-NEERI for the study and monitoring, CPCB may separately take up the matter with Ministry

8. The Chair thanked all the members of the committee and other participants for their valuable inputs in preparing the report.

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List of participants

Members of the Committee:

1. Dr. S. C. Garkoti, Adviser, MoEF&CC - Chairman

2. Shri Dinbandhu Gouda, Divisional Head (IPC-I) & Additional Director, CPCB
3. Shri Bharat Sharma, Addl. Director and Incharge, CPCB Regional Directorate, Pune
4. Shri B Mahusudhana Rao, Chief Environmental Engineer, APPCB
5. Shri D. Chandra Sekhara Varma, Director of Factories, Govt. of Andhra Pradesh

MoEF&CC/ CPCB/ APPCB/ CSIR-NEERI Officials:

6. Dr. Shaik Basha, Sr. Principal Scientist, CSIR-NEERI, Hyderabad Zonal Centre
7. Shri Krishna Murthi Kannan, Chief Scientist, CSIR-NEERI
8. Shri N V Bhaskar Rao, Joint CEE, APPCB
9. Shri. Dinesh Runiwal, Scientist 'E', HSM Division
10. Ms. H D Varalakmi, Scientist 'E', CPCB Regional Office, Chennai
11. Ms. Mahima T, Scientist 'D',CPCB Regional Office, Chennai
12. Shri Hemant Bherwani, Scientist, CSIR-NEERI
13. Ms. Shivani Mudgal, Consultant, MoEF&CC
14. Ms. Shruti Mishra, Legal Assistant, MoEFCC
15. Ms. Uma Pandey

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'Records of Discussion' of the 1st meeting of the MoEFCC Nodal Committee constituted for Finalisation of Compensation in reference to the order passed by Hon'ble NGT in the matter of OA 73/2020 & connected matters related to Gas Leak incident at M/s LG Polymers Limited, Visakhapatnam (Andhra Pradesh)

A meeting of the MoEFCC Nodal Committee constituted for Finalisation of Compensation was convened under the chairmanship of Dr. Prashant Gargava, Member Secretary, CPCB on 10.09.2020 at 11 A.M. through video-conferencing. All the designated members of the Committee attended the meeting in person. The following members were present:

- Dr. Prashant Gargava, Member Secretary, CPCB – in Chair
- Dr. Dharmendra K. Gupta, Director, HSM Division – Member Convenor
- Shri Amardeep Raju, Addl. Director/ Scientist-E (Violation Projects), MoEFCC
- Shri Hemant Bherwani, Scientist, CSIR-NEERI

Special Invitees

- Shri Raghu Kumar Kodali, Director/ Scientist-F, MoEFCC
- Shri Dinbandhu Gouda, Divisional Head (IPC-I) & Additional Director, CPCB
- Shri Bharat Sharma, Addl. Director and In-charge, CPCB Regional Directorate, Pune

2. At the outset, Chairman welcomed all the participants and meeting began with brief round of introduction. The Member Convenor informed the Committee about the background and purpose for which it has been constituted and highlighted that the task assigned to it i.e. finalisation of compensation is a follow-up activity which needs to be undertaken once the report of 'Finalisation of Restoration Plan' is ready. The Chair supplemented that for undertaking the compensation assessment, a detailed restoration plan need to be in place covering both 'environmental restoration measures and cost' and 'assessment of damages and associated cost'. The Committee members agreed to the above.

3. The Chair mentioned that in line with the deliberations of the 1st meeting of 'Finalisation of Restoration Plan', the CPCB has further lined up with CSIR-NEERI for undertaking the work related to 'Preparation of Restoration Plan w.r.t. Environmental Media'. The scope of engagement is under discussion and would be finalised soon. It was further informed that the CSIR-NEERI report, upon finalisation, is expected to cover the damage cost as well as environmental restoration cost which would form the basis of finalisation of compensation w.r.t. environmental aspects. Similarly, an assessment with regard to damages to property, health, livestock, agriculture etc. by another sub-Committee constituted under DM, Vizag. A report from the sub-Committee constituted under the chairmanship of DM, Vizag is expected to cover the damage cost as well as restoration cost w.r.t. damage to property, agriculture, health, livestock etc. which would form the basis of finalisation of compensation. The MoEFCC nodal committee for 'Finalisation of Restoration Plan' shall examine and consider the reports from both the sub-committees and thereafter, finalise the restoration plan.

4. During the deliberations, the Committee noted that since finalisation of compensation is a skilled activity that requires experience/ expertise, services of a couple of experts can be

utilised for the same. Accordingly, the Chair requested all members, especially CSIR-NEERI expert *(having experience in handling similar issues)* to explore and suggest some experts that can guide the committee in undertaking the task assigned to it. The Director (HSMD) informed that to enable the on-boarding of experts in the committee, approval would be required from the Competent Authority and IFD, in the Ministry. Hence, members are requested to share the CVs of expert(s) and thereafter, the on-boarding shall be finalised in consultation with Chairman.

5. Environmental Restoration Plan shall be prepared based on assessment of extent of damage. Hence, project proposal shall be divide into two phases i.e. Phase-I: Damage assessment, and Phase-II: Restoration plan. During damage assessment, preliminary investigation of soil and groundwater/ surface water/sediment may be done, so that the outcome of preliminary study may be ascertained whether detailed investigation of contaminated soil, groundwater/ surface water/sediment including Risk assessment study is needed or not. Phase I report should be delivered in two month and phase II report in next three months.

6. MoEF&CC may pray Hon'ble NGT for extension of time for implementation and mentioning above technical reasons.

7. The Director (HSMD) further suggested that, if considered appropriate by members, the meetings of both the Committees can be convened jointly to have better understanding and coherence among them. The Chair, and members welcomed the suggestion and consented for a joint meeting in future.

The meeting ended with vote of thanks to the Chair.

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'Record of Discussion' of the meeting held on 12.08.2021 of the committee constituted for 'Finalization of Compensation' in compliance with Hon'ble NGT's order dated 01.06.2020 in the matter of OA 73/2020 & connected matters (Styrene Gas Leak incident at M/s LG Polymers Limited, Visakhapatnam, Andhra Pradesh)

The second meeting of the MoEF&CC Nodal Committee constituted for 'Finalization of Compensation' was convened under the Chairmanship of Dr. Prashant Gargava, Member Secretary, CPCB on August 12, 2021 at 3:30 P.M. through video-conferencing. The representatives of MoECC, CPCB, CSIR-NEERI and APPCB attended the meeting. A list of participants is annexed.

2. At the outset, the Chairman welcomed all the participants and noted that the Hon'ble National Green Tribunal took *suo moto* cognizance of styrene gas leakage incident happened at M/s LG Polymers. In pursuance of Hon'ble NGT order, MoEFCC had constituted two Expert Committees in July, 2020 for 'Finalization of Restoration Plan' and 'Finalization of Compensation'. Both the Committees in their 1st meeting had agreed upon to request Sub-Committees comprising of District Administration, and representatives of CPCB and CSIR-NEERI to submit Restoration Plan(s). The CSIR-NEERI was engaged for assessment of environmental damages and preparation of the restoration plan for air, water, soil components. The following sub-components were identified agency-wise:

- **Sub-component 1** i.e. Plan for Restoration of Environmental Media viz. air, water and soil - By CPCB/CSIR-NEERI
- **Sub-component 2** i.e. Plan for Restoration and Compensation for damage to health, property, crops, livestock etc.- By District Administration

3. It was also noted that the MoEF&CC Nodal Committee on 'Preparation of Restoration Plan' constituted under the Chairpersonship of Dr. Garkoti, Adviser, MoEFCC had series of deliberations in June and July, 2021 on the report submitted by CPCB/ CSIR-NEERI and District Committee. The said Committee, having considered the 'Restoration and Compensation framework' proposed in the sub-Committee reports, forwarded its recommendations to instant Committee i.e. MoEFCC Nodal Committee for 'Finalization of Compensation'. Thereafter, the Chairman requested CSIR-NEERI to present the findings of the study.

4. The CSIR-NEERI team presented the reports in two parts viz. (i) Monitoring of Styrene concentration in environment such as ambient air, water, and soil and its

analysis for preparation of 'Restoration Plan'; and (ii) Environment Damage Cost Assessment (EDCA). The major findings of the report are as follows:

- During the periods of May 7-10, 2020 and May 12-15, 2020, ambient levels of styrene were observed Below Detectable Limit (BDL) near M6 Storage tank and Main Gate of LG Polymers, Venakatapuram village, Venkatapuram Railway Bridge, Meghadrigadda reservoir. The styrene levels close to the industry i.e. within the study area for 1 km radius were also BDL during June 2021 and October 28-30, 2020.
- Degradation of styrene concentration in surface water from May 2020 to October 2020 has been observed.
- Styrene levels in all the samples viz., groundwater and surface water were below detectable limit during October 2020 and June 2021.
- Styrene concentrations in all environmental components i.e. ambient air, groundwater, surface water and soil are below detectable level.
- Medical examination through a team of doctors may be conducted further to verify, record and quantify the long-term health effects of Styrene exposure at Venkatapuram village, since no reference could be found on this kind of study data.
- The total estimated damage cost to environment, health, property, livestock, crops, etc. is ₹79,42,17,137 (say ₹79.42 Crores). However, considering the health restoration component estimated by sub-committee (₹22,77,05,026) the comprehensive damage and restoration cost is assessed as ₹1,02,19,22,163 (say 102.19 Crores).

5. After the detailed deliberations, the Chairman noted that certain aspects of the report need to have proper scientific justifications/ rationale. The typical aspects considered for such justifications and responses are as below:

S.No	Issues	Justification
1	Assumptions for EDCA calculation like 10 years of economic benefits, statistical correction factor for valuation, cost land abatement value taken from developed world, etc. need to be scientifically justified	The CSIR-NEERI team explained that the assumptions are based on standard scientific methodology used in similar assessments and have been appropriately described in the report.

S.No	Issues	Justification
2	Correlation of the reported variation in instantaneous recordings of TVOCs concentration (inside the premises) with that of Styrene concentration, from January, 2020 to May, 2020 considering that the values for the month of April-2020 reflect the lockdown period.	CSIR-NEERI team explained that the high TVOC levels during March and April 2020 could be due to high ambient temperatures during the summer season as Visakhapatnam is located in the tropical region. Further, since the sensors of the gas detector alarm was set to 2200 ppm, these levels could not be detected (as mentioned in the High-Power Committee Report, 2020 also).
3	The reference to OSHA permissible exposure limit of styrene can be mentioned in the report.	The CSIR-NEERI team reported that as per the National Institute for Operational Safety and Health (NIOSH), the IDLH value (i.e. immediately dangerous for life and health) for styrene monomer is 700 ppm, TWA is 50 ppm (time-weighted average for 10 hours) and STEL is 100 ppm (short term exposure limit of 15 minutes). Further, the acute exposure guideline levels (AEGL) for styrene for 30 min exposure period are AEGL-1 20 ppm, AEGL-2 160 ppm and AEGL-3 1900 ppm. The Lower Explosive Limit (LEL) for styrene is 9000 ppm. The protective active criteria (PAC) limits for styrene are PAC-1 of 20 ppm, PAC-2 of 130 ppm and PAC-3 of 1100 ppm which are severity based chemical release scenarios of styrene and required to handled accordingly. The Emergency Response Planning Guidelines (ERPGs) values where adverse effects styrene release can be observed are fixed as ERPG-1 of 50 ppm, ERPG-2 of 250 ppm and ERPG-3 of 1000 ppm. Hence, general styrene odour should have been detectable

S.No	Issues	Justification
		near ERPG-1 (as mentioned in HPC Report, 2020 also). Similarly, the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) for styrene - 100 ppm (TWA), 200 ppm (Ceiling), 600 ppm (Max. Conc.: 5-minute max. peak in any 3 hours) which is mentioned in the report)
4	Reason for assessing environmental damages in media viz. air, water and soil for up to 5 kms as against the fact that the styrene release had impact up to 3kms only.	The CSIR-NEERI team mentioned that a total of 409 respondents were surveyed within a 5 km radius from the accident epicenter. **A radius of 5 km was chosen, beyond 3 km of health survey, to remove the bias generated during surveys, if any. The survey indicated that majority of the population which were affected, were concentrated in the radius of 2 to 3 km only as covered by health survey as well**. The aspect has been mentioned in Section 4.2 of the Report.
5	Overlap between the study components of CPCB and District Authority and scientific rational of calculating certain components which might have overlapped	It was noted that the sub-committee constituted under the Chairmanship of District Magistrate, Vishakapatnam estimated the restoration and compensation plans for damage to health, crop, property, livestock's etc. The work assigned to CPCB was environmental damages cost assessment and prepare a Plan for Restoration of Environmental Media viz. Air, Water and Soil
6	The reasoning for calculating lower, medium and higher values may be documented in report and scientific rational for	It is important to note that the environmental damages, although carried out based on scientific sampling and survey, do not fully capture the magnitude of

S.No	Issues	Justification
	adopting one of them for environmental damages.	damage that occurred on that day. This is because the sampling has been carried out three to four months after the accident, and Styrene being highly volatile, may not have left traces in the surrounding environment. This is the reason soil and water data have reported minimal to no impact. The value transfer method also captures the valuations for a particular region using the transfer functions and the valuation factor for the other region where actual study has been carried out. Hence it may become sometime inflated given the earning and use potential of services and products in two regions being considered for analysis. Thus a lower estimate of value transfer or upper estimates based on environmental impact may be considered as the final value for environmental damages, which puts the valuation in the bracket of ₹35.57 Crore to ₹ 75.3Crore. **The reason for choosing higher value is based on the premise that the exposure concentrations of styrene at the time of incident were falling in the most severe bracket of NIOSH/ OSHA regulations (standards) and as such, the human/ animal population exposed to such scenarios might be at the risk of developing health issues in future also. Further, the higher values of compensation to affected population can also work as a deterrent for erring industries for not handling safety issues seriously. In all probabilities, the Committee is of the opinion that that risk**

S.No	Issues	Justification
		inflicted through the leakage of styrene not only caused instantaneous damage but may also result in long-term health effects.
7	The EDCA calculations for duplicate items may be recorded and justification for removing the duplicity and thereafter, rational for considering the final values (for identified components).	In light of the foregoing amid as per the recommendation in the 3rd meeting of the MoEFCC Committee on 'Finalization of Restoration Plan', CSIR-NEERI included the assessment done by the sub-committee and removed duplication. Based on the decisions taken in the 4th meeting, the final damage estimates were frozen. Taking the reference of estimated restoration and compensation plans by sub-committee along with the damages estimated by CSIR-NEERI the final assessment procedures were evaluated to avoid any duplication. **The goal of the exercise was to classify the "previously calculated damage costs" into mutually compatible sub-heads to help grasp the scope of damage costs estimated and make a final decision.**
8	Build a justification for taking higher value ₹102 crore for environmental damage assessment.	The distribution with respect to higher value estimated by NEERI was done on the basis of individual cost percentages derived for each attribute with respect to lower values. Thus, the Upper bound value of damages estimated by Value Transfer Method i.e. ₹75.30 crore by CSIR-NEERI is distributed according to the percentage distribution of lower bound values in the above table. After detailed deliberations on assessments made by NEERI and subcommittee and removal of duplications in estimates, the committee constituted for 'Preparation of Restoration Plan' in compliance with Hon'ble NGT on

S.No	Issues	Justification
		the assessment methodology of environmental, health, property, livestock & crop damages (Table 4.16) component-wise damage assessment and restoration cost are finalized and recommended. The MoEFCC Committee unanimously recommended that the total estimated damage cost to environment, health, property, livestock, crops, etc. is ₹79,42,17,137 (say ₹79.42 Crores). However, considering the health restoration component estimated by sub-committee (₹22,77,05,026) the comprehensive damage and restoration cost is assessed as ₹1,02,19,22,163 (say 102.19 Crores). The committee took into the account the fact that the values arrived at by CSIR-NEERI are based on scientific modelling and methodology, whereas the values arrived at by District Sub-Committee are based on the field assessment by the line departments.

6. In light of the above clarifications/ justifications, it was noted that the aspect of 'Finalisation of Restoration Plan' as well as 'Finalization of Compensation' has been thoroughly considered by the members of both the Committees and a scientific rational has been built to arrive at the compensation. Accordingly, it was unanimously agreed that the total estimated damage cost to environment, health, property, livestock, crops, etc. is ₹79,42,17,137 (say ₹79.42 Crores). Accordingly, MoEFCC may like to consider the deliberations of the MoEFCC Nodal Committee(s) and Reports of CSIR-NEERI and District Authority for making recommendations to the Hon'ble NGT.

The meeting ended with thanks to the Chair.

List of participants

Members of the Committee:

1. Dr. Prashant Gargava, Member Secretary, CPCB-Chairman
2. Shri Ved Prakash Mishra, Director, HSM Division – Member Convener
3. Dr. Mahendra Phulwariya, Scientist 'C', MoEF&CC
4. Dr. Shaik Basha, Sr. Principal Scientist, CSIR-NEERI, Hyderabad Zonal Centre

MoEF&CC/ CPCB/ APPCB/ CSIR-NEERI Officials:

5. Shri Dinesh Runiwal, Scientist 'E', HSM Division
6. Shri Dinbandhu Gouda, Divisional Head (IPC-I) & Additional Director, CPCB
7. Shri Krishna Murthi Kannan, Chief Scientist, CSIR-NEERI
8. Shri Hemant Bherwani, Scientist, CSIR-NEERI
9. Shri B.Siva Prasad, CEE, APPCB
10. Ms. Shivani Mudgal, Consultant, MoEF&CC
11. Ms. Uma Pandey

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Minutes of the Central Crisis Group (CCG) meeting held under the chair of Secretary (EF&CC) on 16.02.2021 at 1:00 PM

Introduction

A meeting of the Central Crisis Group was held under the chairpersonship of Secretary (EF&CC) on 16.02.2021 at 1:00 PM through video conferencing. The meeting was attended by the Joint Secretary (HSMD) & officials of MoEFCC, members of Central Crisis Group, members of the High Power Committee (HPC) *(constituted by Govt. of Andhra Pradesh in the matter of M/s LG Polymers Ltd. Vishakhapatnam)* and Chief Inspector of Factories (CIF) of States/ representatives. A list of participants of the meeting is enclosed as Annexure -I.

2. At the outset, the Joint Secretary (HSMD) briefed the chair about the last CCG meeting held on 08.05.2020, after the incident of styrene gas/vapour leak at M/s LG Polymers Ltd. It was informed that the Government of Andhra Pradesh had constituted a HPC to look into the root causes of the incident, response of the authorities and suggest measures to avert such accidents. Accordingly, the HPC, besides finding the root causes of the incident and analysing the response of authorities during the incident, made technical recommendations regarding the operation of industries dealing with hazardous chemicals, in general and using styrene as raw material, in particular. JS (HSMD) further highlighted that the CCG is constituted under the provisions of the Chemical Accident (Emergency Preparedness, Planning and response) Rules, 1996 and in line with its mandate, the meeting shall discuss the preparedness level of the States in dealing with chemical accidents and remedial measures taken to avert chemical accident emergencies. Five states, accounting for maximum no. of Major Accident Hazard (MAH) units and occurrence of chemical accidents during the last five years *viz.* Andhra Pradesh, Gujarat, Maharashtra, Uttar Pradesh and Tamil Nadu were asked to make a presentation also. The Meeting agenda included the placement of 'Red Book' – Crisis Alert System before the CCG for adoption and any other issue, with due permission of chair. Thereafter, the chair was invited for brief opening remarks to initiate the deliberations.

3. The Secretary (EF&CC) welcomed all the participants in the meeting and highlighted that Shri Neerabh Prasad, then Spl. Chief Secretary (EF&ST), Govt. of AP (at the time of M/s LG Polymers incident) has also joined for the meeting in the capacity of Chairman, HPC, which was tasked to examine the referred accident and make suitable recommendations. It was also pointed out that the HPC did a praiseworthy job in strict timeframe and submitted its report along with technical and administrative recommendations. The chair emphasised the need for developing an institutional mechanism for preventing chemical accidents comprising of suitable regulatory measures to monitor and enforce

stipulated provisions aimed at accident prevention. The participants were requested to make a brief presentation on the issues.

Deliberation on Agenda Items

Part A – CCG Deliberations w.r.t accident prevention, preparedness and remedial measures taken by the States Govts. and Adoption of Red Book

- Presentation by Gujarat State

4. The representative of CIF Gujarat informed that there are 563 identified MAH units in the state. The total number of chemical factories registered under the Factories Act, 1984 is 7942. The following chemical accidents had happened in the state in 2020, after opening up of lockdown:

Date	**Name of the industry**	**Cause**	**Number of fatalities**
3/6/2020	Yashasvi Rasayan Private Limited, Bharuch	Chemical Explosion	11
11/6/2020	Hemani Industries Ltd., Ankleshwar, Bharuch	Fire and Explosion	3
31/8/2020	Jay Chemical Industries Limited, Anand	Fire	1
09/12/2020	Matangi Industries, Ahmedabad	Fire	0

5. It was informed that there are 33 District Crisis Group(s) and 41 Local Crisis Group(s) established in state of Gujarat. In compliance of the CAEPPR Rules, 1996, periodical meetings and mock exercises are carried out in coordination with District Administration. A State Level Mega mock exercise was organized on 11.10.2019 to ascertain the preparedness of units as well as State Authorities, with involvement of National Disaster Management Authority (NDMA) and Gujarat State Disaster Management Authority wherein 8 off-site emergency mock drills and 216 on-site emergency mock drills were conducted. The State also celebrated Safety Month (in August-September 2020), which was steered at the level of Addl. Chief Secretary, Labor and Employment Department, during which 1054 training programs and 520 mock exercises were conducted.

6. The chair asked about reasons for chemical accidents at M/s Yashasvi Rasayan Private Limited and M/s Hemani Industries Ltd wherein there were multiple fatalities. The reasons for accident were attributed to

'mixing of two incompatible chemicals viz. diethyl sulphate and nitric acid' and 'rising of temperature and pressure beyond control' in M/s Yashasvi Rasayan Private Limited and M/s Hemani Industries Ltd. respectively. It was informed that units have now been directed to unload the chemicals in the presence of a 'Trained Chemist' only. Similarly, chemical factories have been directed to incorporate 'male-female coupling system' based fire extinguishing arrangement in the premises. It was also mentioned that a prosecution has been filed in the court against the units and production will remain suspended, until all safety norms are fulfilled. The chair noted that the reasons cited for chemical accidents are basic aspects of any 'Standard Operating Procedure (SOP)'. However, the State representative was requested to submit information w.r.t. to steps taken for preventing the accidents.

- Presentation by the state of Uttar Pradesh

7. The representative of CIF Uttar Pradesh informed that there are 464 MAH units and 14,347 non-MAH units operating in the state. Out of 45 districts (having MAH units), the Offsite Emergency Plan for 38 districts has reportedly been prepared. The four major chemical accidents occurred in the state on 19.06.2020, 05.07.2020, 22.10.2020 and 22.11.2020 at M/s Nitin Candle, M/s Swaroop Chemicals Pvt. Ltd., M/s India Pesticide Limited and M/s IFFCO, respectively were explained. The chair suggested that CIF UP may ensure that all the SOPs are being followed by the chemicals industries in order to prevent chemical accidents.

- Presentation by the state of Maharashtra

9. The CIF MPCB mentioned that Maharashtra has 391 MAH units and 3798 chemical factories. It was informed that On-site emergency plans of all MAH units are prepared and updated, as per extant provisions. Similarly, all districts with MAH units have an Off-site emergency plan prepared. A 3-day training program for operators and supervisors working in the chemical factories in Maharashtra was reported to have conducted recently. The CCG was further apprised that around 897 safety officers are appointed at MAH units/ chemical factories operating in the state. On preparedness front, it was mentioned that 2856 and 2604 mock drills were conducted in 2019 and 2020, respectively.

- Presentation by the state of Andhra Pradesh

10. The Chairman, APPCB highlighted that 8 webinars on training and awareness for workforce/ staff of the factories were jointly conducted with Director of Factories and Administrative Staff of College in India, Hyderabad. Additional, 4 webinars will also be conducted in due course of time. It was further informed that 86 MAH units have been selected for implementing the HPC Technical recommendations. The chair requested

that the details of measures identified to be implemented in the 86 MAH units may be shared with Ministry also.

- Chief Inspector of Factories, Tamil Nadu or representative did not attend the meeting.

11. Upon hearing the State representatives, the chair noted that the submissions made before the CCG clearly point out towards obvious lapses in operational safety. All the reasons stated for chemical accidents are related to non-adherence to routine maintenance/ standard SOP procedures, which resulted in a chemical emergency. The provisions of enforcement and monitoring of operational safety aspects is well regulated and defined under Factories Act, 1948 as well as MSIHC Rules, 1989; however, in spite of having required provisions there is lack of enforcement/ monitoring by concerned authorities and laxity in following SOPs/ Guidance manuals and procedural lapses on the part of occupiers/ industrial units. The chair also mentioned that placement of technically qualified and skilled person at crucial processes/ operations is required to have better awareness about handling of hazard.

12. To overcome such a situation and keep a close vigil, the chair suggested that special emphasis may be lied on the monitoring of MAH units and a special drive be undertaken by all State Govts. to crosscheck the adherence to SOPs in order to prevent chemical accidents. Dr Anjan Ray, Director, Indian Institute of Petro-chemicals (an Expert member of HPC) supplemented the observations of chairperson, CCG and advised that handling new products/ chemicals in the factories may be dis-allowed until SOPs are made for them. Further, such units must be audited on 'priority' once the production commences. The preparation of SOP and subsequent audit by concerned authorities can acts as a monitoring tool for preventing accident.

- Adoption of Red Book

13. The JS (HSMD) apprised the chair that 'Red Book' is already shared with CCG members as well as State Representatives for any suggestions/ modifications. The Chairman, CCG requested all the participants to go-through the relevant listings in the 'Red Book' and provide updates to the Ministry, if any, within 7 days, so that the same may be updated and hosted on the Ministry's Website.

Part – B Deliberations on the Technical Recommendations and other aspects of High Power Committee (HPC)

14. During the course of deliberations, the Chairman, CCG invited the HPC Chairman to briefly explain the work done by HPC and provide an

insight to the technical recommendations w.r.t operation of factories using hazardous chemicals, in general and Styrene, in particular. The HPC also considered the aspect of industrial operations close to residential areas. The HPC Chairman appreciated the Ministry's involvement in examination of report and highlighted the following:

- Onsite Emergency Plans of industries must be comprehensive to include all cases of spills/ leakages etc. and not limited to fire and explosion only.
- Monitoring of operational parameters like pressure, temperature etc. is vital in chemical industries, as it provides an early warning about the imminent chemical disasters. Like in case of M/s LG Polymers, the increase in polymer content, decrease in inhibitor levels were required to be monitored to have an early indication about storage tank.
- Installation of alarm system/ public warning system and use of siren should be mandatory in all emergencies/ mock-drills/ awareness exercises.
- The availability of Personal Protective Equipment's (PPEs) in industrial premises is vital during an emergency, enabling the staff to undertake meaningful actions to control the situation. PPEs help in avoiding undesirable exposure to hazardous chemicals.
- All such chemicals, that may play a vital role in neutralising an accidental leakage/ discharge situation (like tertiary inhibitors in case of M/s LG Polymers) must be thought of and used to mitigate adverse impacts of the disaster.

15. The Chairman, CCG took note of the above observations and stated that the industries, being the primary responders, may prepare their chemical disaster action plans/ onsite emergency plans considering all possible hazards and actively coordinate with the District Administration to get their hazard potential reflected in the District Disaster Management Plan. It was also pointed out that until such synergies emerge between the On-site and Off-site Emergency Plans, the stakeholder authorities will continue to struggle during emergencies. The installation of 'advanced process monitoring' and 'automatic alarm system' is required for early warning as well as mobilisation/ sensitisation during actual emergency. PESO was also requested to examine/ consider HPC observations as well as recommendations to control chemical accidents.

16. The JS (HSMD) mentioned that the very purpose of a mock drill is to check the preparedness of chemical industries in meeting emergencies. However, the way accidents are happening, it is clear that either mock-drills are not being conducted or the learnings/ lacunas observed during drills are not addressed. The Chairman, CCG agreed to the submission and asked the State Govt. representatives to review the Safety Audit Reports and Mock-drill observations. The aspect of making workers aware about the hazardous nature of various chemicals such as benzene, phenol etc. is also

considered to be important in educating/ disseminating information for participation in mock drills. JS (Mitigation), NDMA suggested that District Disaster Management Authority may be involved to develop more robust mechanism for awareness for people inside as well as outside the premises.

17. On the aspect of creation of Factory Safety Boards in draft omnibus chemical regulations, the DCPC representative informed that the matter was examined and discussed with stakeholders on 29.01.2021. Based on the deliberations, it emerged that the proposed National Chemical Authority (NCA) would help in effective implementation of the draft Chemical (Management and Safety) Rules. Since NCA is expected to provide technical guidance for management of chemical safety, the requirement of Factory Safety Board at the state level is not envisaged. Further, NCA may provide technical assistance to Disaster Management Authorities and Disaster Response Forces, at Central/ State/ District level. With regard to digitisation of information, it was informed that, under OCR, all chemical units will be required to notify all the substances and the data would be shared with the respective state authorities for better implementation of chemical safety rules. For mitigation of adverse effects of chemicals, DCPC is also working out to incorporate HAZOP study as a part of safety audit under omnibus chemical regulations. The HPC Chairman, however, suggested that investigation of major chemical accidents may be mandated by specialised agency under the omnibus regulations. With regard to Factory Safety Boards, the HPC Chairman mentioned that since Factory Safety is more closely related to Ministry of Labour, the same can be referred to them for suitable inclusion in existing institutional mechanism, as deemed appropriate.

14. The Chairman, CCG while summing up the discussion, asked the State Representatives and CCG Members to shares their comments, if any, on 'Technical Recommendations prepared by HPC' and 'Red Book' within 7 days of the sharing of these Minutes. The Chairman, CCG expressed concern regarding inadequate monitoring mechanism, mock-drills and non-adherence to SOPs leading to issues of operational safety and of chemical industries. The following actionable points were identified:

- MoEF&CC may compile the comments *(received within 7 days)* on 'Technical recommendations' and thereafter, circulate it to States and other stakeholder agencies.
- MoEFCC may update the 'Red Book', in line with the responses received *(within 7 days)* and host the same on its website
- In line with the existing regulatory structure, the Ministry of Labour and Employment (with support from DGFASLI & CIFs of State Governments) and CPCB/ SPCB may continue to coordinate and investigate the cases of chemicals accidents under the provisions of The Factories Act, 1948 and the MSIHC Rules, 1989/ CAEPPR Rules, 1996 respectively.

- The State Authorities (DISH/ CIFs/ Factories Deptt.)/ SPCBs and PESO may ensure that data related to chemical accidents, mock-drills, safety audit, On-site Emergency Plan etc. is regularly fed into the monitoring system and the CPCB may coordinate for access of such data for examination and subsequently, submission to MoEFCC.
- CPCB may establish a group of Experts comprising of State representatives (CIFs/ DISH), SPCBs, and PESO, subject experts etc., as may be considered appropriate, to scrutinize the SOPs for handling and storage of chemicals considering their threshold levels.
- Local authorities may set up a system, through Local Crisis Groups, to maintain data of every mock drill conducted (like date, time, place, list participants, name of the participants, scenario created etc.) and respective State Authorities may randomly cross-verify the actual details. The Authorities may also check as to whether the occupiers have built the required operational safety parameters in their process control centre.

The meeting ended with vote of thanks to the chair.

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Annexure

List of Participants

MoEF&CC officials:

1. Shri R. P. Gupta, Secretary, MoEF&CC cum Chairman Central Crisis Group
2. Shri Naresh Pal Gangwar, Joint Secretary (HSMD), MoEF&CC
3. Dr. Dharmendra Kumar Gupta, Director (HSMD), MoEF&CC
4. Shri Shrawan Kumar, Research Investigator, MoEF&CC

Members of CCG

5. Shri Dharam Pal Singh Negi, Principal Labour and Employment Advisor (PLEA), Ministry of Labour & Employment
6. Shri Ramesh Kumar G, Joint Secretary (Mitigation), NDMA
7. Shri D. K. Shami, Fire Adviser, Directorate General of Civil Defence, Ministry of Home Affairs
8. Dr. Aparna Pandey, Advisor, NCDC
9. Shri K K Srivastava, Director (Chem-1), DCPC
10. Shri Dinabandu Gouda, Addl. Director, CPCB
11. Dr. Vishal Choudhary, Dr. Industrial Advisor, DCPC
12. Dr. Ravindran, Representative of Ministry of Health and Family Welfare
13. Shri Ashbir Singh, Scientist D, CPCB
14. Shri Prasad Bhukya, Scientist C, CSIR-Central Institute of Mining and Fuel Research, Dhandbad
15. Representative of the Chief Controller of Explosives, Petroleum and Explosives Safety Organisation (PESO)

Members of HPC

16. Shri Neerabh Kumar Prasad, Special Chief Secretary, EFS&T Department, Govt. of AP cum Chairman,
17. Shri Vivek Yadav, IAS, Member Secretary, APPCB
18. Dr. R K Elangovan, DG, DGFASLI
19. Dr. Bharat K Sharma, Regional Director, CPCB Pune
20. Dr. Anjan Ray, Director, NDMA, Indian Institute of Petroleum & Member, High Power Committee
21. Shri PSG Krishnan, Principal Director and Head, CIPET

Chief Inspector of Factories and Others

22. Shri A K Parida, Chairman, APPCB
23. Shri D. Chandra Sekhara Varma, Director of Factories, Andhra Pradesh
24. Dr. B Madhusudhana Rao, JCEE, APPCB
25. Er. Suryapal Majumdar, Inspector of Factories, Tripura
26. Shri B. Rajagopala Rao, Director of Factories, Telangana

27. Shri Raj Shekhar Singh, Director Industrial Health & Safety, Govt. of M. P.
28. Shri. Mahendra Kalyankar (IAS), Director (Addl. Charge), Directorate of Industrial Safety & Health (DISH), Maharashtra
29. Shri O. P. Bharti, Director of Factories, UP
30. Shri K. Srinivas, Director of Factories and Boilers, Karnataka
31. Shri P.M. Shah, Director, DISH, Gujarat
32. Shri S. Pandya Ranjan, Chief Inspector of Factories, Labour Department, Govt. of NCT of Delhi
33. The Chief Inspector of Factories, Assam
34. Dr. Mohit Kumar Patralekh, CMO, Dte.GHS
35. Shri Jayant Raushan, Consultant (Chemical), NDMA
36. Shri Kunal Sharma, Consultant, NDMA
37. Shri Anil Nanda
38. Shri Jayakumar Gopinath
39. Shri Jitendra Vyas
40. Shri Lal
41. Shri Ranjeet Kumar
42. Shri Sanjeev Kohli
43. Shri Surya Prakash Singh Sengar

Tabulation of the technical and administrative/ regulatory recommendations made by High Power committee constituted by Govt. of Andhra Pradesh

S. No.	Item Description	Observations/ Recommendations
1.	Recommendation w.r.t. M/s LG Polymers	1. To shift the Hazardous Chemical industry of M/s LG Polymers from the present location and it may be relocated away from the human habitations preferably in the established notified industrial estates. Government/APIIC may allot suitable land in any industrial estates as per rules, for smooth shifting of the factory. 2. The present M/s LG Polymers industrial land may be used for either green or white category industry, subject to the outcome of Environment Clearance. In case this is not feasible, then conversion of the land for residential purpose/ commercial purpose may be examined. 3. The concerned Revenue Department may examine the aspect of Ceiling surplus land, which has been raised in representations. 4. The M/s LG Polymers may be asked to continue the staff employed in the White or Green category industry at the same location or may be asked to provide employment to the staff in the new factory location.
2.	Technical suggestions regarding Styrene industries	1. The tank must have a floating valve circulation or any other technology which provides circulation for Styrene. The change in design was a critical aspect in the case of LG Polymers. 2. There must be provision for mixing in case of failure of the circulation system. 3. The material of construction of the tank should be carbon steel with coating inside. 4. Tank life should be clearly defined; tank cleaning and coating should be carried out once in two years. 5. The roof of the tank should be supported with outside structures.

S. No.	Item Description	Observations/ Recommendations
		6. The number of nozzles in the tank should be kept to the minimum required. 7. All Styrene monomer tanks should have flare system or cryogenic system so that there is no Styrene vapour release even under normal circumstances. These systems will also prevent pollution of air. 8. There must be multiple continuous temperature measurement probes at different levels of the tank linked to the control room. 9. Temperature monitors and Refrigeration system should be interlinked in such a way to maintain temperature of the entire tank below 20°C at any point of time. 10. The standards for the refrigeration system in terms of pumping capacity and cooling capacity should be clearly defined for the various mass of Styrene by the industry, duly taking into account the ambient condition of the city where the factory is located. 11. In case of failure of the operating refrigeration system, standby refrigeration system shall be started automatically. 12. Automatic monitoring of inhibitor content (in ppm) and measurement at different levels of the tank with data recording and alert facility in the control room is essential. Further, the industry standards need to define clearly the quantity of inhibitor to be added depending upon the ppm level of the inhibitor content at various levels. Similarly, the industry standards should define the action to be taken in case the inhibitor content increases above the threshold level. 13. Dissolved Oxygen measurement system must be available at different levels of the tank and linked to the control room. Further, the industry needs to define clearly the action to be taken in case the Dissolved Oxygen reduces below/increases above the threshold range. 14. Polymer content measurement (in ppm) must be available at different levels of the tank and linked to the control room. The acceptable range of polymer content in ppm also needs to be clearly defined by the industry standards. Further, the

S. No.	Item Description	Observations/ Recommendations
		industry standards need to define clearly the action to be taken in case the polymer content increases above the threshold level. This was the critical gap in the case of LG Polymers. 15. Use of Siren even during minor emergencies should be made mandatory practice. 16. Safety protocol for units/factories storing/ processing Styrene Monomer must include vapour release, apart from the possibility of fire and explosion in the Emergency Plans. Besides, the possibility of leakage/spillage of liquid Styrene monomer must also be a part of the safety protocol and Emergency Plans. 17. Units/Factories storing/processing Styrene monomer must undertake an annual safety audit. 18. The PESO which has classified Styrene monomer as B category petroleum should look into this issue again and classify it as A category as it needs to be stored below 20°C, although the flashpoint is 31°C. 19. SCBAs and other equipment needed for dealing with chemical disasters should be made compulsory for the units storing/ processing Styrene monomer. 20. Vapour Detectors shall be provided at the boundary of the factory also, to indicate in DCS the Styrene vapour escape outside the factory premises. 21. The industry shall provide the Styrene detectors at unloading point, near all the vents, downwind, upwind directions and factory boundary, and the same shall be connected to the Control room with alert facility. In the case of exceedance, SMS alert shall be sent to the Plant Safety Officer, Plant Head, local Police Station and Fire Station, District Collector Control Room, Factories Department, APPCB etc. 22. Plant Control rooms shall be located at the strategically safe location and shall be made easily accessible and shall be made gas-tight and accident proof to the extent feasible. 23. Process safety management is a systematic, comprehensive approach towards various aspects of chemical safety with 19 elements; this shall be made

S. No.	Item Description	Observations/ Recommendations
		mandatory for all factories which are covered by MSIHC Rules,1989. This is a regulation in Occupational Safety and Health Administration (OSHA) brought in the year 1992 in USA with similar criteria for application as in MSIHC Rules. 24. The industry may examine the possibility that the sprinkler system is interlocked with tank internal temperature measuring devices. The sprinkler system shall start automatically whenever there are an unacceptable thermal profile (both internal tank temp as well as external ambient temperatures). 25. The industry may examine the possibility to provide detachable insulation to the Styrene storage tank, in such a way that, it can be easily removed during any emergency. 26. The industry shall ensure that there will not be any reverse pumping from the reactor / pre-mixing tank to the main storage tank. 27. There are a number of Styrene storage/processing/trading/importing units across India. It is essential that all these units should all have their safety features audited. Further, the PESO/ Government of India may also consider regulations that no unit shall sell/ trade in Styrene Monomer with any unit which does not have the required safety features for storage and handling of Styrene Monomer.
3.	Technical suggestions regarding Hazardous Chemical Industries	1. Hazard and Operability Study (HAZOP) and its compliance shall be made compulsory for all Hazardous process factory/unit wherever there is processing/storage of hazardous chemicals. 2. The industry should arrange for Annual Safety Audit and Annual Environmental Audit. The recommendations of the audit shall be meticulously complied within a reasonable timeframe. 3. Industries handling hazardous chemicals shall compulsorily appoint a senior level safety officer with prescribed technical qualifications and experience. There should be a safety officer available in each shift viz., a safety officer should be available in the factory in 24 hours in the factory. The safety officer shall

S. No.	Item Description	Observations/ Recommendations
		mandatorily undergo 1-year Diploma course on safety by recognized Institutes. 4. All officers working in regulatory departments dealing with factories shall undergo Safety course once in every 3 years. This is especially important for Fire Department and Police Department personnel posted in the areas having jurisdiction over the hazardous chemical units/factories. 5. All employees and people in the vicinity of the industry shall be made aware of the MSDS of hazardous chemicals. 6. The MSDS of the chemicals which has potential to create Offsite emergency should be displayed at the factory gate, on the website of the company and should also be informed during the Offsite emergency mock drill. 7. The hazardous industry should prepare a uniform standard format for the emergency plans with full details including the equipment and chemicals required in the event of an emergency. 8. Each State should develop a database of all industries/units handling, storing and processing hazardous chemicals as defined in MSIHC Rules,1989 including isolated storages and the respective Material Safety Data Sheets (MSDS) which should be available with the APSDMA, SDRF, Factories Department, Boilers Department, APPCB, Fire Department, Department of Industries, PESO, Transport Department etc. 9. The CPCB/MOEF, GoI shall stipulate standards for the fugitive emissions from the Tank farms and isolated storages as they are equally potential areas for release of toxic/hazardous gases/pollutants to the environment. 10. The industry shall identify Process Safety Competency-based training needs and shall develop training modules and the training to be imparted till the competency levels are improved. 11. The hazardous industry must undertake competency mapping for all the operating and maintenance staff. The gaps incompetency should not be tolerated

S. No.	Item Description	Observations/ Recommendations
		in respect of hazardous chemicals industries at all.
4.	Strengthening of Administrative/ regulatory Framework w.r.t. Factory Safety	• The major legislations dealing with industrial safety in factories are the Factories Act, 1948, Indian Boilers Act-1923, Indian Electricity Act- 1910, Petroleum Act, 1934, Explosives Act-1884, A.P. Fires services, MSIHC Rules Act, 1989; Building and Other Construction Workers Act, 1996. and different set of rules framed under these rules. • There are Factory Safety Regulatory Gaps due to the following: ▪ Multiple Agencies ▪ Multiple Strong Laws. ▪ Weak Structure of the Concerned Organization/ Department. ▪ Absence of Compliance / Third Party Verification Systems. ▪ More driven as License Permit System rather than facilitating industries. • The HPC suggested to constitute a State Factory Safety Board in each state and a Central Factory Safety Boards with a single point regulatory agency for regulating all factory safety laws, rules and regulations. a) The role of the Central Factory Safety Board would primarily be in setting up of safety norms, setting up of standards, capacity building of the state boards and dealing with certain large size hazardous factories. b) One of the special functions of the Central Factory Safety Board would be investigating each and every major factory accident, mandatorily by law. c) It is suggested to constitute the Factory Safety Board with sufficient manpower and Infrastructure, to deliver the solutions for all the existing safety aspects as a unified regulatory body.
5.	Strengthening of Administrative/ regulatory Framework w.r.t.	• To address the environmental regulatory gaps, the Committee has deliberated on the issue and suggest the following: a) All SPCBs can be constituted as authorities under Section 3(3) of the E (P) Act; with the condition that all A Category projects will be sent with the

S. No.	Item Description	Observations/ Recommendations
	Factory Safety	recommendation of the SPCB to the MoEF&CC and for B category projects, SPCB shall be the final authority. In other words, i. The SEIAA will not be separately constituted but will be part and parcel of the SPCBs. ii. However, to assist the SPCBs, there can be SEAC constituted under Section 3(3) of the E(P) Act. iii. Requirement / Grant of EC under E(P) Act and CFE / CTE under Air Act and Water Act will be simultaneously examined by the SPCB, for both categories A and B projects. For category B projects, EC and CFE shall be issued simultaneously by the SPCB. For category A projects, the SPCB shall send the recommendation for EC to the MoEFCC. It shall issue CFE for category A projects, after issue of EC by MoEFCC. iv. It will save facilitate the project proponents to get their clearances in one place. • To effectively monitor and implement the provisions of the E(P) Act and rules and notifications issued thereunder, it is essential that all the officers of SPCBs are appointed as monitoring and competent officers under Section 4 of E (P) Act for all categories of industries including category A. • Section 5 of the E(P) Act provides for action for violation. This has been presently delegated to the State Governments. It is essential to delegate this function to the SPCBs, so that they can exercise the monitoring function effectively • Environment is a matter of concern for both State and Central Governments. "Environment" subject should be included in the Concurrent list of the Constitution.

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