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Item No. 01 Court No. 1

BEFORE THE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI

(By Video Conferencing)

Execution Application No. 05/2018 (THC)
IN
Original Application No. 40/2014

(With report dated 18.03.2020)

AND

Objections by way of I.A. Nos. 197/2020,
201/2020, 174/2020 or otherwise

Charudatt Koli Applicant(s)

Versus

M/s Sea Lord Containers Ltd. Respondent(s)

Date of hearing: 30.06.2020
Date of uploading of order: 13.08.2020

CORAM: HON'BLE MR. JUSTICE ADARSH KUMAR GOEL, CHAIRPERSON
HON'BLE MR. JUSTICE S. P. WANGDI, JUDICIAL MEMBER
HON'BLE DR. SATYAWAN SINGH GARBYAL, EXPERT MEMBER

ORDER

S. No	CONTENT	Para No.
I	The Issue: Execution of order dated 18.12.2015 passed by the Tribunal for control air pollution in the *Mahul, Ambapada* and *Chembur* areas in Mumbai particularly by M/s Sea Lord Containers Limited (SLCL), Aegis Logistics Limited (ALL), Bharat Petroleum Corporation Limited (BPCL) and Hindustan Petroleum Corporation Limited (HPCL)(Respondents 1,2,9 and 10)	1-2
II	Earlier orders in execution proceedings: 05.02.2019, 07.03.2019 and 15.07.2019	3-7
III	Report of CPCB dated 18.03.2020 assessing the quantum of VOC pollutants by SLCL, ALL, BPCL and HPCL and their respective liability to pay compensation for period of five years on polluter pays principle	8-10
IV	Objections by SLCL, ALL, BPCL and HPCL to the CPCB report and consideration in hearing on 30.06.2020 and directions	11-17
V	Further report of CPCB dated 10.7.2020 as per order dated 30.6.2020 and objections/applications filed by ALL, BPCL and HPCL thereto	18-24
VI	Final consideration of the reports of CPCB and objections of ALL,	25-33

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I. The Issue: Execution of order dated 18.12.2015 passed by the Tribunal for control air pollution in the Mahul, Ambapada and Chembur areas in Mumbai particularly by respondents no. 1, M/s Sea Lord Containers Limited (SLCL), respondent no. 2, Aegis Logistics Limited (ALL), respondent no. 9, Bharat Petroleum Corporation Limited (BPCL) and respondent no. 10, Hindustan Petroleum Corporation Limited (HPCL):

1. Present proceedings are for execution of order of this Tribunal dated 18.12.2015. The Tribunal considered the issue of remedial steps to be taken for control of air pollution in the *Mahul, Ambapada and Chembur areas* in Mumbai. Major contributors to the air pollution were said to be the **logistic services, storing oil, gas and chemical items, as well as oil companies releasing emissions of VOCs** during loading, storage and unloading or handling of hazardous chemicals at various stages. The Tribunal found that there was deterioration of ambient air quality causing threat to health of the residents. Accordingly, the Tribunal directed the Maharashtra Pollution Control Board to prepare a comprehensive action plan for control of air pollution. Health Impact Assessment study was directed to be carried out, apart from VOC assessment study. The Tribunal issued other incidental directions for prevention and remedial action by the operators of various projects as well as regulatory authorities.

2. The substance of order was summed up in a later order[1] as follows:

> *"2. The matter was considered by this Tribunal in judgment dated 18.12.2015 in the light of the reports of the several Committees, including a report of KEM hospital.* ***It was found that there was***

[1] Dated 5.2.2019

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deterioration of ambient air quality below the prescribed standards (issue no. 1), there was threat to health of the residents due to the deteriorated air quality (issue no. 2), probable sources are activities of respondents no. 1, M/s Sea Lord Containers Limited, respondent no. 2, Aegis Logistics Limited, respondent no. 9, Bharat Petroleum Corporation Limited and respondent no. 10, Hindustan Petroleum Corporation Limited as well as other unidentified sources *(issue no. 3), the polluting activities of the concerned respondents had adverse health impact and steps are required to be taken to ameliorate the potential threat.*

3. Following issues were framed for consideration:

"1. Whether the ambient air quality at the residential areas of the Applicants is deteriorated below the prescribed standard and norms?

2. ***Whether there is any threat or anticipated threat to the health of residents of Mahul and Ambapada due to prevailing air quality in the area?***

3. What are the important probable sources of air pollution in the disputed area in question regarding presence of Volatile Organic Chemicals?

4. ***Whether the industrial operations of Respondent Nos.1 and 2 are causing air pollution and associated health impacts or such inference can be drawn on basis of their proximity and use of precautionary principle under Section 20 of the National Green Tribunal Act, 2010****?*

5. Whether any specific steps are required to improve the air quality in the disputed area to ameliorate any potential threats to the health of the local residents?

6. Whether any specific directions are required to be given by the Tribunal for the purpose?"

4. Under issue No. 1, it was found:

"19. Still, however, we find one important aspect that the ***concentrations of Nickel and Benzopyrene are regularly exceeding the standards in all the samples. In fact, highest Benzopyrene concentration is 32.88 micrograms/Nm^3 against the standards of 1 micrograms/Nm^3, whereas highest Nickel concentration is 151 against the standards of 20 micrograms/Nm^3.***

20. Considering the above data, it is obvious that there is a significant presence of the Volatile Organics, Benzene, Toluene, Xylene, Ethyl Benzene, though there are no specific ambient air quality standards for then except Benzene."

5. Under issue No. 2, it was found that there is significant respiratory morbidity on account of air pollution. The observations in this regard are as follows:

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"The KEM hospital has conducted respiratory morbidity survey in Mahul and Ambapada villages and reported on 16.7.2013 that in Mahul area, 67.1 per cent population had complains of breathlessness more than three times in a month, 76.3 per cent reported the complaints in all season, 86.6 per cent complained of eye-irritation and 84.5 per cent have history of persisting chocking sensation in chest. On pulmonary function testing 7.3 % had mild restriction and 5% had mild obstruction from Chereshwar CHS ltd. Similar observations were recorded for Ambapada village, 66.5 % reported cough as a complaint, 61.3% reported eye irritation, 51.4% reported chocking sensation in chest, 53.3% had complaints of frequent colds and running nose and 81% reported strong smell in the area. The Applicants, therefore rely on this interim report of KEM wherein environmental pollution containment measures were recommended to be taken up on priority.

23. *The interim report of KEM has concluded that the results and analysis of* ***health assessment of five (5) areas of Chambur which includes Anikgaon, Ambapada, Mahul, Gavanpada in Vishnu Nagar shows significant respiratory morbidity***. *The report has dealt with the co-relation aspects of the ambient air quality and increased prevalence of Asthma which reveals statistically significant relationship between air pollution and respiratory/cardio-vasculature outcomes."*

6. *The following steps are required:*

"1. ***Establishment of Environment and Lung Health Institute for city of Mumbai by 2015.***

2. *Environment aspect should include study regarding effect of traffic management solutions, building architectural aspects of newer constructions and HVAC systems maintenance criteria to be laid down for better health of citizens.*

3. *Environment containment measures to be undertaken during construction, demolition work, solid and e-waste management.*

4. *Lung Health Institute to further research and offer practical solutions for treatment of chronic respiratory disorders, impart education to people at large e.g. workplace (occupational) safety, precautions during use of pesticides, mound (fungus) prevention at workplace/homes.*

5. ***Establish a Global Information system for mapping, trend identification and analysis of environment and health in Mumbai city and provision of environmental alerts for sensitive population which include children, women, elderly and people with respiratory and cardiac disorders****."*

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7. *It was further observed that:*

> *"Considering such observations and also, the demonstrated link between the prevalent ambient air quality at Mahul and Ambapada villages with the health impacts in those areas, it can be observed that there is a perceptible threat to health of the residents of village Mahul and Ambapada due to prevailing air quality in the area."*

8. *Under issue no. 3, it was found that:*

> *"**In view of these peculiar circumstances and the data available on record, it is evident that the Respondent Nos.1, besides Respondent Nos. 9 and 10 are the important industrial sources. Obviously, therefore, as far as the industrial sources are concerned, Respondent Nos. 1, 9 and 10 are major contributory industrial sources in ambient air pollution of the area.** The issue No. 3 is accordingly answered."*

9. *Under issue no. 4, it was observed that:*

> *"We find it difficult to understand how said important activity, though may be conducted at the other location, but which is intrinsically connected to the Respondent No.1 terminal, in terms of continuous pipelines and also, effect of such operation on the emissions at Respondent No1 unit, can just be avoided without seeking permission of the Tribunal. **It is pertinent to note that the pigging operation is claimed to be an important source of VOC emissions and should have been covered in the study. Another aspect of nature and composition of VOC emissions is also not answered in said report and it is stated that composition of VOC emissions on various activities and unit processes at HCL is behind the scope of this study**."*

10. *Under issues no. 5 and 6, it was held as follows:*

> *"43. Some conclusions of the foregoing discussions can be summarised by recording our findings in the present matter as under:*
>
> *a. There is a persisting problem of air pollution in Mahul, Ambapada and Chembur areas.*
> *b. There is strong evidence that this air pollution is linked and can be scientifically correlated to the adverse health effects on the surrounding population as observed through KEM (Govt. Hospital) studies.*
> *c. **There is an urgent need to control this air pollution by devising the suitable action plan as per section 17 of the Air (Prevention and Control of Pollution), 1981, may be on the lines***

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of CEPI action plan prepared by MPCB for some other areas.

d. ***The contribution of individual source of air pollution in the air quality in the area is not available on record (source apportionment). However, considering the complexity involved in measurements, prediction and modelling of VOCs, it is prudent to evolve such an action plan for all the identified sources of VOCs. However, considering the principle of proximity and findings of ICT/KEM, it would be necessary to deal with emission from Respondent-1 on priority, in the first phase of such action plan.***

55. *The information available on record, particularly, the KEM Report, shows significant occurrence of incidents of air pollution related health effects in the local population. Though, the linkage of air pollution and health is well known, this Report of KEM is unique in view of the fact that the report has identified a particular air pollutant related to the adverse health impacts observed in the local population. It is high time now that the subject of air pollution control and air quality management be identified and treated as "Public Health Issue" and be given due priority and importance it deserves. It is necessary to acknowledge the multi-disciplinary nature of the subject.* ***In our considered opinion, the first priority in this direction would be to establish credible and quantifiable air quality-health linkages, which we hope, will trigger cascading actions towards air pollution control. Another priority would be to promote advance multi-disciplinary research in the field of non-criteria pollutants, more particularly, hazardous air pollutants, (HAP's) including VOC which have significant health impacts, even at very small concentration and short exposure duration. The science of atmosphere chemistry of such HAPs is a complex subject due to its reactive behaviour and formation of secondary air pollutants which would need a much complex multi-disciplinary approach****. Traditionally, the monitoring, research and even action plans for air pollution control are focused on criteria pollutants, that too, mainly the particulates either PM_{10} or PM 2.5. But now with the improved understanding of several non-criteria pollutants mainly HAPs, it is essence of time that such pollutants are also considered as an integral part of the air quality management."*

11. *Finally, the Tribunal directed as follows:*

"a. ***MPCB shall prepare a comprehensive action plan for control of air pollution in Mahul, Ambapada and Chembur areas, with a focus on control of VOCs within 2 months, and submit it to CPCB for its concurrence/approval which shall be confirmed in***

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next 2 months. Such action plan shall be implemented by CPCB and MPCB within next 12 months through the MPCB.

b. *MPCB shall immediately issue necessary directions for implementation of the recommendations of its expert committee as per report of August 2014, and ensure that these directions are complied with in 12 months.*

c. *The health impact assessment studies as proposed by KEM shall be conducted for the minimum period of 3 years. KEM shall give necessary proposal including the associated air quality monitoring which can be conducted through reputed institute like NEERI, Mumbai to MPCB within 2 months and such studies shall be co-ordinated by MPCB. The cost of such studies shall be equally borne by Respondent-1, 9,10,11 and 14.*

d. ***MPCB shall carry out the VOC assessment studies in line with CEPI studies as per CPCB protocol for the areas of Mahul, Ambapada and Chembur on yearly basis for next 3 years to assess the trends of such problem.***

e. *Respondent-6, Commissioner, MCGM shall provide necessary medical facilities and treatment for the residents of Mahul, Ambapada and Chembur, in view of the adverse health effects observed. Respondent-1,9,10, 11 and 14 shall provide all necessary assistance and financial support for such measure to Respondent-6.*

f. *SEIAA and MPCB shall assess the environmental compliance of activities of Respondent-1 as far performance of air pollution control measures, by monitoring of VOCs and also, change in capacity of chemical handling which is changed from 75000 KL/month to 75000 KL, within a period of 3 (three) months. In case of non-compliance of this direction, the Respondent-1 shall operate the plant maximum at the present chemical handing rate (maximum of last six months on monthly basis), till such assessment by SEIAA and MPCB is done, on the basis of precautionary principle. MPCB to serve the copy of this order to Member Secretary SEIAA for further necessary action.*

g. *The observed air quality in Chembur area and associated health impacts necessitates considerations of VOC in ambient air quality and also, source emissions standards for chemical storage terminals. MPCB shall evolve such standards under the powers available under section 17 of Air Act, in consultations with CPCB, within next 4 months.*

h. *Respondent-3 is hereby directed to form a committee of experts to suggest the location criteria for industries and activities involved in hazardous chemicals handling and more specifically the environmentally safe distance from residential areas, which shall be formulated in next 4 months, as per provisions of the Air act and Environmental (Protection) Act, 1986.*

i. *Respondent Nos.1, 9 and 10 shall pay amount of Rs.5,00,000/- (Rs. five lakhs) to each Applicant as litigation costs."*

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II. Earlier orders in execution proceedings: 05.02.2019, 07.03.2019 and 15.07.2019:

Order dated 5.2.2019:

3. An execution application being EA 5/2018 was filed before this Tribunal alleging non-compliance of the direction dated 18.12.2015 which was taken up for consideration on 05.02.2019, in light of earlier proceedings. The Tribunal considered the report of the Joint Committee dated 01.01.2019, submitted on directions of the Tribunal, **finding damage to the air quality by VOC emissions and suggesting steps for control of VOCs**. The Tribunal directed remedial action and **assessment of compensation on polluter pays principle**. An action plan was required to be submitted by the respondents to the Central Pollution Control Board ("CPCB") so that CPCB could give its comments in the matter. The directions are:

> *"12. Complaining of non-compliance of the directions of this Tribunal, execution application was filed and on 17.07.2018, the Tribunal found that situation had not improved as order of the Tribunal had not been complied with in the letter and spirit. It was also observed:*
>
> > *"We understand that following operations are causing the odor problem and expect monitoring protocol to be designed accordingly:*
> >
> > 1. *Unloading from the sea-vessel-tanker to off-shore storage tanks*
> > 2. *Pigging operation when the unloading pipeline is cleaned, to prepare for unloading of new chemical*
> > 3. *Tankers are dispatched by unloading from the storage tankers*
> >
> > *Depending on the chemicals unloaded from the sea-vesseltanker, odour characteristics would change. All the chemicals imported, handled, unloaded may not be giving rise to criteria pollutants as per NAAQS or may be VOC or PAH. Those can be as per the demand-supply or arrival of cargo as such.*
> >
> > *The monitoring or sampling is usually done over the longer period, whereas the emissions are only for the short period coterminous with the operations that are causing the odour / emissions / obnoxious smell. The*

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peak effect of the short-term pollution caused is gets averaged out over longer period of time, giving much lower results, as against the peak pollution levels actually generated, though for the shorter period of time, which actually give rise to strong obnoxious foul smell.

We, therefore, order that sampling should be planned in such a manner to capture the true and correct picture of the peak levels of pollution reached. The sampling should be done in close proximity of the operations where the complainants are residing and/or just towards the boundary wall of the industry near Storage Tanks, i.e. Amba pada, Chereshwar Society and Mahul Village. The sampling period has to be coterminous with the actual operation time only as indicated in para supra.

There is also alleged contribution from the refineries in the area. These refineries also have their storage tanks of the finished products. There can be instances of leakages and escape of gases from their manufacturing processes. To sample them, it is necessary that the sampling be done in the vicinity of these refineries. If the suspected operations are intermittent, then the sampling interval should be coterminous with that. Alternately, the samples should be collected as per standard methods for measurement in ambient air as per IS Code (BS), US EPA, APHA, OSHA, in the sequence of availability and appropriate applicability for the situation, as may be decided by the members of expert team with reasons to be recorded for selection of the specific method.

We feel that in order to understand the contribution of these refineries or logistic companies better, simultaneous sampling will have to be done in the downwind and upwind directions. Continuous automatic weather stations will have to be installed to measure the wind velocity, direction and also the rainfall, relative humidity and temperature. The automatic Wind Rose has to be presented on the layout map of the area.

To add authenticity to the sampling and analysis, the laboratory should submit the complete details of instruments used, gas separation column, flow of inert IOLAR grade gases used, carrier phase material used, its calibration record against Certified Reference Material (CRM), logs and data of the running of the sample, prints, calculation, comparison of peak, its identification against the library records of CRM, also should be submitted."

13. The Tribunal constituted a team comprising of representatives from the Central Pollution Control Board (CPCB), National Environmental Engineering Research Institute (NEERI), Nagpur and the Maharashtra Pollution Control Board (MPCB).

14. Thereafter, on 25.10.2018, the situation was again considered and found to be not satisfactory.

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15. We have heard the learned Counsel for the parties at some length today and also perused the report of the Joint Committee filed on 01.01.2019 concluding, inter-alia, as follows:

> ***"Presence of VOCs is found in the area with concentration values more than odour threshold concentrations. Therefore, focus on control measures on dominant 'sources of emissions of VOCs is required in this case. Benzene, Styrene Toluene, Xylenes, Diethylbenzene, Trimethylbenzene and Dichlorobenzenes emerged as dominant VOCs present in significant concentrations at one or the other place in the area among total 21 VOCs detected in the area. The odour threshold values given in "Odour Threshold for Chemicals with Established Health Standard, 2nd Edition [American Industrial Hygiene Association] are referred.***
>
> *Concentration of Benzene has been found below the odour threshold value of 0.47 ppm in work zone as well as in ambient air but* ***concentration values are found to be higher than the annual standard prescribed for ambient air i.e. 5 pg/m³. Maximum value of Benzene in ambient air found to be 88.67 pg/m³[0.0277 ppm] and maximum value in work zone found to be 540 pg/m³[0.16 ppm]. It is worth to mention that Benzene is predominantly handled by BPCL refinery in the area****.*
>
> *Concentration of Styrene has been found above the odour threshold value of 0.0028 ppm in work zone as well as in ambient air. Maximum value of Styrene in ambient air found to be 775 pg/m³[0.182 ppm] and maximum value in work zone found to be 225 pg/m³ [0.0528 ppm].* ***The Styrene monomer is only handled by Logistics companies namely M/s Sealord Ltd and M/s Aegis Logistics Pvt. Ltd.***
>
> *Concentration of Toluene has been found much above the odour threshold value of 0.021 ppm in work zone as well as in ambient air. Maximum value of Toluene in ambient air found to be 639.50 pg/m³[0.169 ppm] and maximum value in work zone found to be 5000 pg/m³ [1.32 ppm].* ***The Toluene handled by both the refineries namely HPCL, BPCL and logistics company M/s Aegis Logistics Pvt. Ltd. as well.***
>
> *Concentration of Xylenes has been found above the odour threshold value of 0.012 ppm in work zone as well as in ambient air. Maximum value of Xylenes in ambient air found to be 365.4 ug/m³[0.0842 ppm] and maximum value in work zone found to be 1000 pg/m³[0.23 ppm].* ***The Xylene is handled by both the refineries namely HPCL, BPCL and logistics company M/s Aegis Logistics Pvt. Ltd. as well****."*

16. The suggestions given for control of VOCs are as follows:

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"✓ *Storage of high volatiles is required to be done in tanks with floating roof only so that potential of emissions due to displacement/breathing can be prevented. This aspect is required to be streamlined as same compound is reportedly stored in fixed as well as floating roof tanks also.*

✓ *Major tanks/storage cleaning operations should be taken-up with due care to reduce the escape of VOCs and residues removed should be handled and disposed in scientific manner without causing exposure to the atmosphere in case of high volatiles.*

✓ *All venting locations should be identified, inventorized and provided with trap receiver and condensers.*

✓ *Control of emissions from open-ended lines like pipes or hoses open to the atmosphere or surrounding environment. Leaks from open-ended lines occur at the point of the line open to the atmosphere and are required to be identified and controlled by using caps, plugs, and flanges. Sampling connections are used to obtain samples from storage tanks. Leaks from sampling connections usually occur at the outlet of the sampling valve when the sampling line is purged to obtain the sample. Reduction in tapping line and suitable control measures should be taken to minimize fugitive losses.*

✓ *All tanker filling operations should have manhole cover with provision of suction line for fumes routed to recovery system, gasket collar with pipes & dip-gauge to prevent escape of fumes while filling and measuring levels.*

✓ *Tanker filling operations are required to be switched from top filling to bottom filling in a phased-wise manner in future to reduce displacement losses.*

✓ *BPCL, Aegies and Sea Lord may also explore the possibilities to decentralize tanker filling operations with increase in pipeline based transfers.*

✓ *Refineries and Logistic companies are required to arrange awareness of tankers drivers on their own as well as through their clients regarding importance of safety, risk and importance of keeping even empty tankers closed while kept in parking.*

✓ *Required training/awareness should be imparted to all workers, operators, drivers about the risk/hazard associated with spills and leaks of various chemicals. These will in-turn promotes careful handling and prevent accidental leaks/spills/fugitive emissions.*

✓ *The LDAR programme should be integral part of operation and focus and frequency should be more intensified at the places where chemicals with high volatility and toxicity is stored and handled.*

✓ *Hydrocarbon audit outcome should be shared by refineries with MPCB also on regular basis. Past trend data should also be made available since beginning of hydrocarbon audit by refineries.*

✓ *Sources with low potential emission rate should be equipped with adsorption and/or absorption system. It is*

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equally important that spent media of adsorption/absorption should be replaced, stored and disposed/regenerated scientifically so that VOCs adsorbed/absorbed do not escape in environment while handling spent.

- ✓ *Sources with significantly high emissions should be identified and equipped with suction/collection, adequate condensation recovery system and adsorption before venting to atmosphere at height prescribed in the consent. Considering the habitation in the vicinity, increased height may be suggested.*
- ✓ *Plant premises generating effluent streams should be characterised with respect to content of VOCs in it and stripping, collection of fumes from strippers and recovery through condensers should be arranged inside battery limit so that emissions from ETP are minimized to great extent.*
- ✓ *All the residues, spent and off gases generated collected should be disposed scientifically either through incineration/thermal destruction or any other suitable means.*
- ✓ *Generation and maintenance of records with respect to emissions, LDAR, hydrocarbon audits, effluent & waste handling should be ensured in support of various measures taken and their effectiveness.*
- ✓ *Considering the findings of this study, all measures should be taken on top most priority at places where ever Benzene, Toluene, Xylenes and Styrene are handled / found. Based on the mathematical correlation matrix, it may be inferred that priority measures on these compounds will also result in control/minimization of other secondary compounds namely Propylbenzene, 1, 4 Dichlorobenzene, Naphthalene, Tetrachloroethane, m & p Xylene and o-xylene."*

17. Only contention so far put forward by contesting respondents is that apart from respondent nos. 1, 9 and 10, who have been held to be sources of air pollution, there are other sources and, thus, role of respondent nos. 1, 9 and 10 has not been fully established.

18. ***We are of the view that once there is damage to the air quality adversely affecting the health of the inhabitants, no polluter can escape liability for the polluting activities. Even a suspect polluter can be held accountable precautionary principle as well as prohibitory remedial action can be required to be taken. Action may be closure of unit, requiring steps to check pollution and also requiring payment of compensation for damage to the environment. The principle of precaution, which is established norm for sustainable development, involves the anticipation of harm and taking measures to avoid it or to choose the least environmentally harmful activity***.[2] *Lack of full scientific certainty shall not be used as a reason for post-poning cost-effective measures to prevent*

[2] (1999) 2 SCC 718

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environmental degradation.[3] *Action may be closure of unit, requiring steps to check pollution and also requiring payment of compensation for damage to the environment.*

19. In the present case, liability of respondent nos. 1, 9 and 10 has been fully established. The authorities have failed to perform their duties. The remedial action, apart from invoking the principles of "Polluter Pays", has to be in the form of an integrated action plan."

Order dated 7.3.2019

4. Thereafter the matter was further considered on 07.03.2019. Action plans filed by the Respondent Nos. 1, 2, 9 and 10 were considered and were directed to be executed alongwith observations/ directions of CPCB. The Tribunal directed payment of interim compensation to the victims and for restoration of the environment as follows:

"17. ***As regards the claim for compensation to victims namely Mr. Charudatt Koli, Mr. Dayaram H. Mahulkar, Mr. Mohan L. Mhatre and Mr. Dattaram L. Koli, Mr. Charudatt Koli and Mr. Dattaram L. Koli be paid interim compensation of 2.5 lakhs each. Mr. Dayaram H. Mahulkar and Mr. Mohan L. Mhatre be paid compensation of Rs. 5 lakhs each. We are informed that two of the applicants Mr. Charudatt Koli and Mr. Dattaram L. Koli are employees of BPCL and are paid medical expenses. On that account, a sum of Rs. 24 lakhs has already been spent for medical treatment. The compensation amount will be over and above any other payment earlier made****. The compensation amount of Rs. 15 lakhs may be deposited with the MPCB for disbursement within one month. Disbursement be made by MPCB within one month thereafter and a report be filed before this Tribunal by e-mail at ngt.filing@gmail.com.*

18. ***We also fix an interim amount of Rs. 10 crores to be deposited with CPCB for restoration of the environment. The amount will be equally borne by Respondents Nos. 1, 2, 9 and 10. This deposit be made within one month****. The CPCB will spend the amount for improvement of the air quality in the area by preparing an appropriate action plan."*

Orders of Hon'ble Supreme Court dated 22.4.2019 and 8.5.2019

[3] (2005) 13 SCC 186

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5. BPCL filed *Civil Appeal No. 3813 of 2019* before the Hon'ble Supreme Court against the order of this Tribunal dated 07.03.2019. It was submitted that the BPCL had already spent about Rs. 20 crores for environmental compliance and therefore further interim compensation of Rs. 10 crores for restoration of the environment (out of which Rs. 2.5 crore is to be paid by BPCL) was not justified. Vide order dated 22.04.2019, the Hon'ble Supreme Court directed:

> *"In view of the fair attitude which has been shown by the appellant before this Court, we are of the view that, at the present stage,* ***it would be appropriate to dispense with the requirement of an amount of Rs 2.5 crores with the CPCB. However, we leave it open to the CPCB to quantify the deposit, if any required from the appellant so as to enable the CPCB to monitor compliance, meet its expenditure and to undertake necessary precautionary measures in accordance with law. The appellant shall effect deposit within two weeks of being called upon to do so by the CPCB.***
>
> *Subject to reserving liberty in the above terms, we dispense with the deposit of Rs 2.5 crores by the appellant with the CPCB at this stage. We also leave it open to the NGT to pass appropriate orders in the pending proceedings."*

6. HPCL also filed Appeal against orders dated 05.02.2019 and 07.03.2019 being *Civil Appeal No(s). 4463-4464 of 2019* which was disposed of vide order dated 08.05.2019 as follows:

> *"On 22 April 2019, this Court passed a direction dispensing with the deposit of Rs 2.5 crores by BPCL pending further consideration by the CPCB.* ***We are inclined to follow the same course of action in the case of the appellant. We accordingly direct that at present, the requirement of the deposit of Rs 2.5 crores shall be dispensed with in the case of HPCL. We leave it open to the appellant, while furnishing its action plan in terms of the commitment which was made before the NGT, to establish the contention of the appellant which is noted above. We have not expressed any finding or opinion thereon. CPCB shall take into account the explanation of the appellant before it arrives at its conclusion. The appellant shall duly implement the action plan in compliance with the directions which have been issued by the NGT.***
>
> ***It has been stated on behalf of the appellant by Mr. Rohatgi that the appellant is a wholly owned government undertaking and remains committed to its duty and***

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obligation to conserve the environment in the area in the best possible way as mandated by the regulatory authorities."

CPCB report dated 27.6.2019 and further order of Tribunal dated 15.7.2019

7. Further order was passed on 15.07.2019 referring to the comprehensive action plan prepared by the CPCB on 27.06.2019. The Tribunal directed the CPCB to inter alia **assess the value of the damage to the environment and public health and the proportion in which the amount is required to be recovered from the identified contributors.** Parties could give their viewpoint and CPCB could take help of experts. Further order dated 6.11.2019 was also passed.

III. Report of CPCB dated 18.03.2020 assessing the quantum of VOC pollutants by SLCL, ALL, BPCL and HPCL and liability to pay compensation for period of five years:

8. Accordingly, report dated 18.03.2020 has been filed by the CPCB. The report determines the quantum of Volatile Organic Compounds ("VOCs") emitted by the contesting respondents viz., respondent No. 1, M/s Sea Lord Containers Limited, respondent no. 2 (SLCL), Aegis Logistics Limited ("ALL"), respondent no. 9, Bharat Petroleum Corporation Limited ("BPCL") and respondent no. 10, Hindustan Petroleum Corporation Limited ("HPCL"), in the course of their operations in the outskirts of Mumbai, at and around villages Ambapada and Mahul. On that basis, loss to the environment in monetary terms has been worked out as follows:

"Table 4.2: Environmental Damage Cost for Individual Industries

S. No	***Name of the company***	***Total VOC Emissions (Kg/day), based on***	***Total VOC Emissions (t/year), based on the present level***	***Environmental Damage Cost (Rs. Crores/ton)***	***Damage Cost/ year, (Rs. In Crores)***	***Damage Cost/year for 5 years, (Rs. In***	***Deterrent factor***	***Total damage cost payable (Rs. in***

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		the present level of emissions	***of emissions***			***crores)***		***Crores***
1.	*HPCL*	*120*	*43.8*	*0.21*	*9.19*	*45.95*	*2*	***91.90***
2.	*BPCL*	*176.55*	*64.441*	*0.21*	*13.53*	*67.65*	*2*	***135.30***
3.	*AEGIS*	*376*	*137.24*	*0.21*	*28.82*	*144.1*	*2*	***288.2***
4.	*SEALORD*	*1.993*	*0.727*	*0.21*	*0.15*	*0.76*	*2*	***1.52***

"

9. The basis of the above conclusion is the data relating to emissions using USEPA AP-42. The data was taken from the industrial units in question based on which estimation was done. In the process, AERMOD model was applied to calculate the concentration of each pollutant. Number of affected persons was assessed based on the density. The damage was based on the treatment cost as far as public health is concerned and value of the environmental damage. Deterrent factor of 2 was applied. Relevant discussion in the report is as follows:

> ***"2. VOC Emissions Estimation:***
>
> *In this study, emission estimation of VOCs was carried out by using USEPA AP-42 method, for which specific data for making calculations was to examined and analysed. Accordingly, a comprehensive excel sheet* ***(Annexure-II)*** *was developed having all the parameters for calculation and was shared with all the industries. The data provided by four major industries viz. HPCL, BPCL, ALL and SCL was used to calculate the estimated emissions, from storage tanks, process vents, loading gantries, wastewater water treatment plant etc. Wherever information was lacking, necessary assumptions as listed in the respective sections, were also made to facilitate calculations.*
>
> *The various formulae used for estimation of emissions and the values estimated by CPCB with the assistance of Experts from CSIR-NEERI are summarized in* ***Table 1.1*** *and* ***Table 1.2*** *respectively.*
>
> ***Table 1.1: Calculation for emissions from different types of tanks, process units, flares, ETP, loading gantries and leakages***

EMISSION ESTIMATION FROM FIXED ROOF TANK		
Losses from FRT	*Formula*	*Variables*

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Standing Storage Loss	*LS = 365 VV*WV*KE*KS*	*LS = standing storage loss, lb/yr* *VV = vapor space volume, ft3* *WV = vapor density. lb/ft3* *KE = vapor space expansion factor, dimensionless* *KS = vented vapor saturation factor, dimensionless* *365 = constant. d/yr*
Working Loss	*LW=0.0010*MV*PVA*Q*KN*KP*	*MV = vapor molecular weight, lb/lb-mole:* *PVA = vapor pressure at daily average liquid surface*
		temperature. psia *Q = annual net throughput (tank capacity [bbl] times annual turnover rate). bbl/yr* *KN = turnover factor, dimensionless;* *N = number of turnovers per year, dimensionless* *N = 5.6 14Q / VLX* *VLX = tank maximum liquid volume, ft3* *D = diameter, ft* *HLX = maximum liquid height. ft* *0.75 For crude oils; for all other organic liquids,* *KP= I* *KP = working loss product factor. dimensionless,*
EMISSION ESTIMATION OF FLOATING ROOF TANK		
Losses of ***Floating*** *Roof Tank*	***Formula***	***Variables***
Withdrawal Loss	$Lwd = \frac{(0.943)\ QC_S W_L}{D} \frac{[1+N_c F_c]}{D}$	*LWD = withdrawal loss,* *Q = annual throughput* *CS = shell clingage factor* *WL = average organic liquid density* *D = tank diameter* *NC = number of fixed roof support columns* *FC = effective column* ***Diameter***

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Rim Seal loss	*LR= (KRa+KRb*vn) DP* MV KC*	*LR = rim seal loss. lb/yr KRa = zero wind speed rim seal loss factor. lh-mole/ft-yr; KRb = wind speed dependent rim seal loss factor, lb-mole/(mph)n-ft-yr, v = average ambient wind speed at tank site, mph; D = tank diameter, ft MV = average vapor molecular weight, lb/lb-*
		mole: KC = product factor: [0.4 for crude oils: 1 for all other organic liquids] n = seal-related Wind speed exponent. dimensionless: P = vapor pressure function. dimensionless*
Deck fitting loss	*LF = FF* P*MV*KC*	*FF = total deck fitting loss factor, lb-mole/yr FF = [(NFI KFI) + (NF2 KF2) + ... + (NFnf KFnf)]*

CRU	*VOCs emissions = Density of VOCs*Emission from industry (Data given by industry)*	
CCU	*VOCs emissions = Emissions Factor of compound*Capacity of*	
SRU	*VOCs emissions = VOCs emission factor*Emission from industry*365 days*	
Flares	*VOCs emissions = Emissions Factor of compound*Capacity of*	
Leakages	*Measured values of leak V0C's from different units provided by industries. (No calculations done for this, as its value*	
Loading Gantries	*LL=12.46*SPM/T*	***Where, S=saturation factor P= True vapor pressure of liquid loaded M=molecular weight T= temperature***
Wastewater from different processes (HPCL, BPCL, ALL, SCL)	*Closed ETP, (Considered as a Tank and calculation was done as a fixed roof Tank)*	

Tabel.2: Emission Estimation of Tanks, ETP, Flares, Gantry, LDAR, CRU, CCU, and SRU after control measures

S. No.	***Sources of VOC***	***HPCL (kg/day)***	***BPCL (kg/day)***	***Sea lord (kg/day)***	***Aegis (kg/day)***
1.	*Tanks*	*110*	*113.83*	*0.103*	*369*
2.	*ETP*	*8*	*27*	*0.16*	*2.61*
3.	*Flare*	*1.9*	*0.47*		
4.	*Product Gantry*	*NA*	*10.35*	*1.73*	*4.39*

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5.	*LDAR*	*0.16*	*15.83*	*-*	
6.	*CCU*		*9.07*		
	Total in Kg/day	*120*	*176.55*	*1.993*	*376*

2.0 Estimation of environmental damage cost

The Estimation of environmental damage cost was worked out based on environmental and health impacts due to VOC emissions.

Environmental damage cost assessment (EDCA) is carried out by following the 3 steps as under:

i) Identification of pollutant and its load: The concentration of pollutant types emitted beyond the standards is analyzed.
ii) Selection of the EDCA method: Based on the likely occurring damages from the type of pollutants released, suitable method is selected out of various methods scrutinized.
iii) Assessment of damage costs in monetary terms, due to the release of pollutants is quantified.

Various studies were also referred by CPCB, to arrive at the damage costs. Studies referred were mainly based on Estimates of Willingness to pay (WTP)/ Willingness to Accept (WTA). It attempts to translate people's preferences for environmental goods, living environment and willingness to avoid environmental health effects and is considered as the complete valuation approach. The following table 2.1 and 2.2 summarize the list of carcinogenic and non-carcinogenic VOC pollutants that are released from such industries.

Table 2.1: List of Carcinogenic VOC Pollutants [Ref: USEPA]

S. No.	***Carcinogen Pollutants***	***Cancer risk (1-[1]9/m4[1]***	***Limit (Ng/ m3) and chances of*** *getting* ***Cancer***	
			Limit (Ng/ m3)	***Chances of getting Cancer***
1.	*Benzene (EPA)*	*2.2 x 10^{-6} — 7.8 x 10^{-6}*	*0.13 — 0.45*	*$1/10^{6}$*
			1.3 — 4.5	*$1/10^{5}$*
			13-45	**$1/10^{4}$**
2.	Formaldehyde (EPA)	1.3 x 10^{-5}	0.08	$1/10^{6}$
			0.8	$1/10^{5}$
			8	$1/10^{4}$
3.	1,3 Butadiene (EPA)	3 x 10^{-5}	-	-
4.	Acetaldehyde (EPA)	2.2 x 10^{-6}	0.5	$1/10^{6}$
			5	$1/10^{5}$
			50	$1/10^{4}$

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5.	Methyl chloride(EPA)	4.7×10^{-7}	2.0	$1/10^6$
			20	$1/10^5$
			200	$1/10^4$

Table 2.2: List of Non- Carcinogenic VOC Pollutants [USEPA]

Sr.No	***Non-Carcinogen Pollutants***	***Reference Concentration(n/ mi***
1	***Ethylbenzene***	***1000***
2	*Hexane*	*200*
3	*Methyl bromide*	*5*
4	*Phenol*	*6*
5	*Xylenes*	*300*

3. Modelling for Estimating Emissions:

AERMOD model was applied to calculate the concentration of each pollutant by considering the following assumptions.

Following assumptions were made for running AERMOD Model:

i. *10 km reduces around the area source for calculating the VOC concentration.*
ii. *The base elevation is taken as an average of that area base elevation. For each company, 441 receptors are taken and each receptor area is lknn*1km concentrations of each company that is calculated from the AERMOD.*
iii. *Emission releasing height is assumed as maximum 20m and min as 12m for all industries.*
iv. *Terrain option is taken as flat and WebGis taken as SRTM (Globally 30m) version 3.*

To calculate the number of persons effecting for cancer due to the industries, the population density per sq.km of that area is required. The density of Mumbai is 32000 Persons/Sq.km, which was considered for calculating the number of people affected by carcinogenic pollutants.

In Maharashtra, the minimum treatment cost for Cancer is 1 lakh INR. The number of people affecting cancer is multiplied by minimum treatment cost for cancer of Maharashtra. By these formulae damage, the cost assessment of each pollutant is calculated.

Due to non-carcinogenic pollutants, people exposed to the concentration will be affected by different diseases like irritative & sensory effects, damage to the liver, kidneys and central nervous system, respiratory effects. Damage cost due to non-carcinogenic was calculated by the value of statistical life (VSL). The average expenditure for hospitalized and non-hospitalized is about Rs. 31028 and Rs 809 for Maharashtra state from the NSSO report.

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As per NSSO report, 47 people were hospitalized and 953 were non-hospitalized per thousand number of affected people, per year in Maharashtra state.

In the WTP/WTA study, population size taken is 32000 and sample size taken is 312. The confidence level is 95% with the confidence interval of 5%. The statistical description of the Survey is summarized below in ***Table 3.1.***

Table 3.1 : Statistical Description of Sample Survey	
Parameter	*Value*
Mean	*306.4231*
Standard Error	*30.73766*
Median	*175*
Mode	*100*
First Quartile	*100*
Second Quartile	*175*
Third Quartile	*500*
Minimum	*10*
Maximum	*2000*
Count	*130*
Largest (1)	*2000*
Smallest (1)	*10*
Confidence Level (95 %)	*60.81522*

4. Environmental Damage Cost:

The methodology developed by CPCB, was first applied to test its applicability followed by discussion with the Experts of CSIR-NEERI. Thereafter, the damage cost was calculated based on the actual data collected and analysed during the study. In case of emissions, where WTP/WTA method could not be made applicable, the damage cost was calculated based on Environmental Price of that particular emission. The following ***Table 4.1*** *summarizes the overall value of environmental damage cost/ton of pollutant as calculated by the in-house committee of CPCB with the assistance of CSIR-NEERI.*

Table 4.1: Damage Cost for VOC pollutants in Rupees

Environmental Damages	***Rs./Ton of pollutant***	***European study converted (Rs./ton)***
First Quartile (Lower	*12,00,000*	*11,46,805*
Second Quartile (Medium	*21,00,000*	*18,55,127*
Third Quartile (Upper	*60,00,000*	*23,04,854*

Note: Environmental damage cost is calculated by taking WTP value Second quartile (Median range) i.e 21 lakh.

5. Conclusion:

The damage cost calculated in the present study, was reviewed by in-house committee of CPCB on March 09, 2020, in a meeting with the experts of CSIR-NEERI. The suggestions made by the Experts were incorporated and the Environmental Damage Cost w.r.t.

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*individual industries (**Table 4.2 quoted above**), for the last five years, was finalized on 11/03/2020."*

Claim of individual applicant for higher amount of personal compensation

10. While the applicant and CPCB have supported the report, the respondent industries have opposed the same. The applicant has filed I.A. No. 168/2020. The said application is being disposed of by a separate order.

IV. Objections by SLCL, ALL, BPCL and HPCL and consideration in hearing on 30.06.2020 and directions:

11. We now take up objections to the report put forward by way of I.A. No. 197/2020, I.A. No. 201/2020 and I.A. No. 174/2020 respectively by BPCL, HPCL and ALL which have been adopted also by learned Counsel appearing for SLCL. The main grievance is that the Expert Committee has erred in estimating the quantum of VOC emissions by as much as 50 times. Shri Atmaram N.S. Nadkarni, learned Senior Counsel appearing for BPCL relied upon the averments in I.A. No. 197/2020 and submitted that the BPCL was not handling any other substance except Benzene & Hexane but the report has not limited liability of the BPCL to these substances. In the meeting of the Expert Committee held on 09.03.2020, the possible damage was mentioned to be Rs. 27 crores, while in the final assessment share of BPCL has gone up to Rs. 130 crores.

12. Shri Maninder Singh, learned Senior Counsel appearing for ALL relied upon the averments in I.A. No. 174/2020 and additional affidavit filed on 27.06.2020. He submitted that his client was dealing only with Xylene and no other substance. The ALL was not engaged in manufacturing but only storing and transporting of the said substance.

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There is no adverse finding against it post judgment as all control measures have been taken. It got a report from another expert body i.e. ICT according to which the estimated emissions are 2.84 kg as per one method and 7.44 kg as per another method as against 369 kg taken in the report. Shri Krishnan Venugopal, learned Senior Counsel appearing for HPCL submitted that HPCL was neither manufacturing nor storing the substances. It is dealing in petrol which has small quantity of Benzene below the risk level.

13. As against the above, learned Counsel appearing for the CPCB supported the report with the plea that liability of the said respondents stands established in the final judgement and in execution the issue cannot be reopened. The basis of calculation of quantum of emissions is the data furnished by the units in question themselves to which well-known scientific principles have been applied to arrive at the quantum of VOCs and the amount of compensation. Use of one or other substance does not rule out the estimated emissions of VOCs.

14. We have considered the rival submissions. From the final judgement dated 18.12.2015, it is clear that the Tribunal found deterioration of air quality inter alia on account of activities of respondents 1,2,9 and 10. Damage to public health was found from the report of the KEM hospital. The said hospital conducted respiratory morbidity survey in Mahul and Ambapada villages and reported on 16.7.2013 that in Mahul area, 67.1 per cent population had complaints of breathlessness more than three times in a month, 76.3 per cent reported the complaints in all season, 86.6 per cent complained of eye-irritation and 84.5 per cent had history of persisting chocking sensation in chest. On pulmonary function testing, 7.3% had mild restriction and

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5% had mild obstruction from Chereshwar CHS ltd. Similar observations were recorded for Ambapada village where 66.5 % reported cough as a complaint, 61.3% reported eye irritation, 51.4% reported choking sensation in chest, 53.3% had complaints of frequent colds and running nose and 81% reported strong smell in the area. Further, from the report of the expert committee dated 1.1.2019, it is clear that sources of pollution are the activities of the said respondents. Therein, it was found that Benzene, Styrene Toluene, Xylenes, Diethylbenzene, Trimethylbenzene and Dichlorobenzenes emerged as dominant VOCs present in significant concentrations at one or the other place in the area among total 21 VOCs detected in the area. It was found:

> *"Concentration of Benzene has been found below the odour threshold value of 0.47 ppm in work zone as well as in ambient air but concentration values are found to be higher than the annual standard prescribed for ambient air i.e. 5 pg/m^3. Maximum value of Benzene in ambient air found to be 88.67 pg/m^3[0.0277 ppm] and maximum value in work zone found to be 540 pg/m^3[0.16 ppm]. It is worth to mention that Benzene is predominantly handled by BPCL refinery in the area.*
>
> *Concentration of Styrene has been found above the odour threshold value of 0.0028 ppm in work zone as well as in ambient air. Maximum value of Styrene in ambient air found to be 775 pg/m^3[0.182 ppm] and maximum value in work zone found to be 225 pg/m^3 [0.0528 ppm]. The Styrene monomer is only handled by Logistics companies namely M/s Sealord Ltd and M/s Aegis Logistics Pvt. Ltd.*
>
> *Concentration of Toluene has been found much above the odour threshold value of 0.021 ppm in work zone as well as in ambient air. Maximum value of Toluene in ambient air found to be 639.50 pg/m^3[0.169 ppm] and maximum value in work zone found to be 5000 pg/m^3 [1.32 ppm]. The Toluene handled by both the refineries namely HPCL, BPCL and logistics company M/s Aegis Logistics Pvt. Ltd. as well.*
>
> *Concentration of Xylenes has been found above the odour threshold value of 0.012 ppm in work zone as well as in ambient air. Maximum value of Xylenes in ambient air found to be 365.4 ug/m^3[0.0842 ppm] and maximum value in work zone found to be 1000 pg/m^3[0.23 ppm]. The Xylene is handled by both the refineries namely HPCL, BPCL and logistics company*
> *M/s Aegis Logistics Pvt. Ltd. as well."*

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15. Thus, the Tribunal held:

> *"18.* ***We are of the view that once there is damage to the air quality adversely affecting the health of the inhabitants, no polluter can escape liability for the polluting activities. Even a suspect polluter can be held accountable precautionary principle as well as prohibitory remedial action can be required to be taken. Action may be closure of unit, requiring steps to check pollution and also requiring payment of compensation for damage to the environment. The principle of precaution, which is established norm for sustainable development, involves the anticipation of harm and taking measures to avoid it or to choose the least environmentally harmful activity***.[4] *Lack of full scientific certainty shall not be used as a reason for post-poning cost-effective measures to prevent environmental degradation.*[5] *Action may be closure of unit, requiring steps to check pollution and also requiring payment of compensation for damage to the environment.*
>
> *19. In the present case, liability of respondent nos. 1, 9 and 10 has been fully established. The authorities have failed to perform their duties. The remedial action, apart from invoking the principles of "Polluter Pays", has to be in the form of an integrated action plan."*

16. It is not permissible for the Tribunal to revisit the findings which have attained finality. It stands conclusively established that there is high level of air pollution affecting public health of the inhabitants of the area for the last more than six years. The respondents have been held to be contributors to such pollution. Their plea that they have no liability has no merit. Only issue is of quantum. A credible expert committee report has gone into the matter on scientific principles. Whether one or other pollutants is released cannot be conclusive for exoneration when contribution to pollution is finally established. Some amount of estimation is unavoidable. No doubt the estimation cannot be without

[4] (1999) 2 SCC 718
[5] (2005) 13 SCC 186

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any basis and reasonable opportunity is to be given to those on whom liability is fastened.

Direction on 30.06.2020 on conclusion of hearing:

17. In view of above, on conclusion of hearing on 30.06.2020, the Tribunal, by way of abundant caution and to provide full opportunity, directed CPCB to provide the basis of calculation to the respondents without prejudice to its stand that the basis was the data furnished by the said units themselves. The respondents were allowed to file further written submissions. Liberty was also given to the CPCB and the applicants to further respond to the stand of the respondents.

V. Further report of CPCB dated 10.7.2020 as per order dated 30.6.2020 and objections/applications filed by ALL and BPCL thereto:

18. Accordingly, the CPCB has filed a report dated 10.07.2020 giving basis for its calculations. The report has assessed the monetary values of damages due to VOC emissions in the air which might have resulted in health and property damages in nearby areas. In order to assess the cost of damages, suitable econometric method has been employed which can lead to justifiable assessment. The report focuses on various methodologies by which assessment could be carried out for emissions. The methodology and assumptions used in the process of evaluation of monetary estimates of damages are as follows:

> ***"3.3.1 Environmental Damages Cost Assessment***
>
> *I. Environmental damage cost assessment (EDCA) is a 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*

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retain the ecosystem in its pristine condition to avail the maximum benefits to human for a long term. EDCA is generally carried out using below 3 steps.

II. ***Identification of pollutant***

The concentration of pollutant types emitting beyond the standards is analysed.

III. ***Identification of the EDCA method***

Based on the pollutant concentration the likely occurring damages are scrutinized upon which suitable methodology is selected.

IV. ***Damage Cost Assessment Monetary Loss due to the release*** *of pollutants is quantified.*

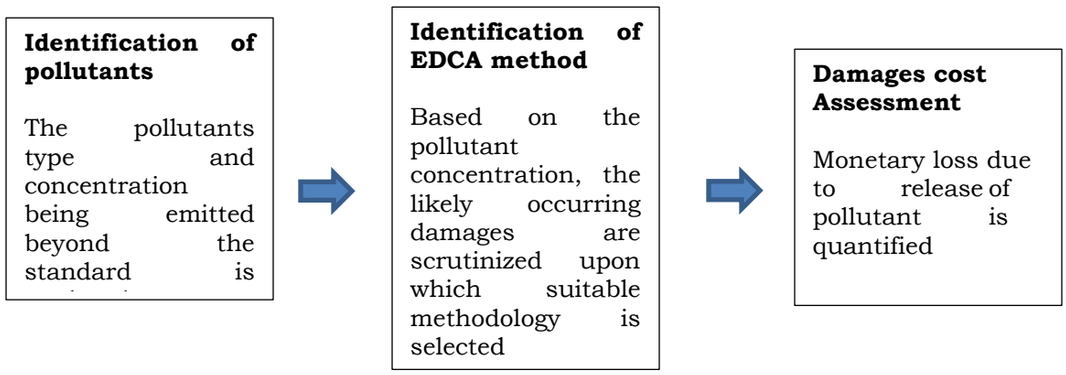

Figure 1: Generic pathway towards Environmental damage cost assessment

In view of above generic steps, the damages cost assessment methodology is finalised for VOC emissions in Mahul area. Given that VOC emissions are estimated on the basis of AP42 method, it is important to consider more than one method to evaluate the environmental damages in monetary terms to bring robustness in the evaluation procedure. For the current estimates, Contingent Valuation Method (CVM) and Value Transfer Method (VTM) is used which are evaluated in subsequent sections. These methods are chosen since detailed break up data on individual components concentration of VOCs i.e. concentration benzene, toluene etc from all process units was not made available from the industries in detail and hence health damage related estimate could not be carried out which would have been the ideal case for damages assessment. The individual emissions would have been used in the modelling also in order to figure out the exposure of population in and around the area of industries. Due to lack of above critical data, EDCA has been carried out based on other econometric methods which are devoid of modelling and other techniques. Further, the current estimation is based on AP42 and deals with emissions on per unit time basis for which no standard exists. Hence absolute value is considered for damage estimations.

3.3.2 Willingness to Accept (WTA)

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One of the most widely used methods of CVM is Willingness to Pay (WTP) or in this case WTA. WTA is defined as a central concept in assessing the external costs of environmental pollution where the person affected by pollution governs the minimum cost which is acceptable to him for the lost goods and/or services. It attempts to translate people's preferences for environmental goods, living environment and willingness to avoid environmental health effects. With reasonable assumptions and proper questionnaire, a detailed WTA can be calculated. For the current study, population size is taken as 32000 based on 1 km2 population density of the area. Statistically significant sample size is taken to represent the population. For current, WTA sample size is taken as 312 with confidence level is 95%, confidence interval is 5%. Detailed study is carried out in the region using a questionnaire. The questionnaire and responses for WTA study is given in ***Annexure I****. The WTA study uses the assumption that during the questionnaire study, the respondent is answering based on understanding of the problem holistically hence time factor related to damages becomes ambiguous and that the response is valid for the time frame in which the question is asked and represents cumulative impacts till date.*

Damage cost due to VOCs is calculated by using Willingness to accept method (WTA), by using the following equation 1.

$$EDCA\ (INR) = Total\ VOC * Willingness\ to\ accept\ in\ INR \quad \ldots\ldots(1)$$

Where, Total VOC = VOC emissions from industries per year = ton/year

3.3.3 Value Transfer Method

In order to substantiate the claims and to verify the analysis done through WTA, VTM method is also used. It is used to estimate economic values for ecosystem services or damages by transferring the available information from studies already completed in another location and/or context. Value transfer method is not a valuation method as such, but it is a method that involves transferring economic estimates from previous studies of similar changes in environmental quality to value the environmental change at the policy site. In the current study, valuation studies conducted by CE Delft are being used which provide the latest estimates based on guidance document released in 2019. The CE Delft air quality damages guidance document has given the high, median and low values for each of air pollutants which can be adapted for policy site i.e. the

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Mahul site[6]. It is important that correct assumptions are taken in order to ensure healthy application of the VTM. The reference study conducted in the Neatherlands needs to be applied in Mumbai which needs a normalisation factor as per the guidance manual on manual on value transfer methods for ecosystem services by United Nations Environmental Programme (UNEP)[7]. The normalization factor used in the current study is population density ratio of reference and policy site. The formulae used for the application of VTM used are given as follows:

For the calculation of environmental damage cost assessment for total VOC emissions from industries following equation is used.

*EDCA (INR) = Total VOC * Damage cost * purchasing power parity* inflation * (Population density) normalization (2)*

Where, Total VOC = VOC emissions from industries per year = ton/year

Population density normalization is taken by doing the ratio of population density of the present study to the population density of reference study which is shown in below equation 2.

(Population Density) normalization =

$$\frac{\text{Population density of present location study}}{\text{Population density of reference study}} \quad \text{--- 2}$$

*The population density of the Netherlands as per 2018 data of about 411 persons per square kilometer **[3]** as reference study and population density of Chembur is about 20999 persons per square kilometer present location study. Population density normalization is about 51. The purchasing power parity values for India and Netherlands are taken from OECD database.*

*The damage cost per ton of the load used for the study for VOC pollutants individually and is represented in **Table 2**. In order to estimate the damages done due to the emitting of pollutants, the CPCB discharge standards have been taken into consideration.*

Table 2: Damage Cost for VOC pollutants in Euro per ton (2017)

Pollutant	**Damage in Euros per kg (2015)**

[6] ***https://www.cedelft.eu/en/publications/2113/envionmental-prices-handbook-2017***
[7] ***http://www.zaragoza.es/contenidos/medioambiente/onu/1097-eng_Guidance_manual_on_value_transfer_methods_for_ecosystem_services.pdf***

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	Low Sensitivity	***Central Value***	***High Sensitivity***
VOC	*1.61*	*2.1*	*3.15*

*The euro figure is converted into Indian Rupees using the inflation and exchange rate for 2017**.** The damage cost estimated is then inflated for the year 2019 by using Eq (1) and inflation from 2015 to 2019 for Euros is about 1.04. Based on above methodologies the estimation for environmental damages can be carried out. Ideally breach of standards should be looked into while evaluating environmental damage.*

4. Study area

*The proposed study is to be carried out in areas of Mahul and Ambapada of Mumbai region as shown in **Figure 2**. Study area is covered with petrochemical industries which emits large amount of VOCs. The focus is to estimate monetary health damages due to release of VOC's from 4 polluting units namely, 1) Hindustan Petroleum Corporation Limited, (2) Bharat Petroleum Corporation Limited, (3) Aegis Logistics Limited, and (4) M/s Sea Lord Containers Limited. Mahul area is densely populated with residential colonies. Traffic intensity is high at this site due to loading and unloading of petro chemical product at this site.*

5. Emission Estimation of HPCL

HPCL Mumbai Refinery, is one of the most complex refineries in the country, and is constructed on an area of 321 acres. It is first of India's modern refineries and symbolizes the country's industrial strength and progress in the oil industry. Mumbai Refinery has grown over the years as the main hub of petroleum products. The current installed capacity of the refinery is 7.5 MMTPA.

5.1 Emission from Storage Tanks

*Emissions from different types of storage tanks were estimated by calculating withdrawal losses, rim seal losses, deck fitting losses, standing storage losses and working losses as shown in **Table 1**. Total emission from storage tanks are 161.47 kg/day as shown in **Table 3**.*

Table 3. Emission for Storage tank at HPCL

Losses from storage tanks	***Losses (lb/yr)***
Withdrawal losses	*27113.6*
Rim seal losses	*44083.5*

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Deck fitting losses	*52689.9*
Standing storage loss	*2008.7*
Working loss	*5075.0*
Total	*130,970.7 lb/yr*
	161.47 kg/day

5.2 Emission from Process Vents

Emission estimation of VOCs was calculated from different process vents such as CCU, CRU, SRU and Flares as described below

5.2.1 Catalytic Converting Unit (CCU)

The FCCU at HPCL, Mumbai refinery was commissioned in 1999 and was designed for 132 m^3/hr feed rate. The unit was operating at 130-135m3/hr. Catalyst activity was also suppressed to operate the unit in a distillate maximizing mode rather than naphtha maximizing mode. HPCL, Mumbai refinery has two CCU units, Old FCCU (OCCU) and New FCCU (NFCCU) units. Old FCCU has a capacity of 0.950 MMTPA and New FCCU has a capacity of 1.227 MMTPA. As the HPCL has claimed that CCU unit has no emission it would be covered under LDAR emission.

5.2.2 Catalytic Reforming Units (CRU)

CRU Unit in HPCL, Mumbai Refinery is designed for a capacity of 7,35,600 metric tons per annum. HPCL has claimed that CCU unit has no emission it would be covered under LDAR emission.

5.2.3. Sulphur Recovery Units (SRU)

Assuming the SRU unit is run for 365 days in a year and the SRU at HPCL, Mumbai Refinery is a controlled unit with emission control efficiency of at least 98%. HPCL has claimed that CCU unit has no emission it would be covered under LDAR emission.

5.2.4. Emissions due to Flares

Accurate estimates of emissions from flares are difficult to obtain because they do not lend themselves to conventional emissions-testing techniques, and only a few attempts have been made to characterize flare emissions. Therefore, to date, there are limited direct emissions test data for flares. Recent developments in

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testing protocols, such as the DIAL technique, provide a direct emissions measurement technique for flares. However, DIAL measurements provide only a snapshot in time. Details of Estimation due to flares are presented in ***Table 4****.*

Table 4: VOC Emission Factors and Estimation for Flare Unit

Sr. No.	***Component***	***Emission Factor EFi(tons/yr/bbl /cd)***	***Emission Ei =CapxEFi***
1.	*Benzene*	*9 E-06*	*1.73*
2.	*Toluene*	*7 E-06*	*1.35*
3.	*Xylene*	*6 E-06*	*1.16*
4.	*Methyl tertiary-butyl*	*3 E-06*	*0.58*
5.	*Hexane*	*1 E-05*	*1.93*
6.	*Formaldehyde*	*1 E-06*	*0.19*
7.	*Ethylbenzene*	*2 E-07*	*0.04*
8.	*1,3-Butadiene*	*7 E-06*	*0.13*
Total VOC Emissions (ton/yr)			***7.11***
Total VOC Emissions (lb/yr)			***1.4 x 10^4***

The specific gravity of feed crude oil was assumed as 0.85 as an average value for ease of calculations. Total emissions from flare was 1.4 x 10^4 lb/yr (17.26 kg/day).

5.3 Emissions Due to Wastewater Generated by Various Processes

Assumptions for wastewater treatment plant were taken from AP-42. Total VOCs emission from wastewater treatment plant was found 350 kg/day but HPCL claimed it with 94% emission mitigation operating since 2010 so it was found as 21kg/day.

5.4 Emissions due to Equipment Leaks

Leaks are typically identified using EPA Method 21 (via an organic vapor analyser [OVA] or using optical leak imaging techniques; other remote sensing techniques can also be used to identify leaks. Although direct measurement methods provide the most accurate means of quantifying equipment leak emissions, few, if any, refineries have or will implement direct measurement of equipment leak emissions. According to the emission estimation protocol by USEPA, Direct measurement (high-volume sampler or bagging) is the highest ranked method for estimation. Hence, the test results provided by HPCL, Mumbai refinery for the fiscal year, 2016-17 has been used here.

Table 5: VOC Emissions Due to Equipment Leaks LDAR Testing

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Sr. No.	Unit	Monitored Points	No. of Points Where Leaks were Found	Total Leak Kg/day
1	Hydrogen Generation Unit	2630	9	0.023
2	Fuel Refinery	4867	0	0.013
3	FCCU	200	0	0
4	GCU	482	0	0
5	FR/LPG/PROPENE UNIT	710	6	0.025
6	Hexane Manufacturing Unit	1071	1	0
7	NAPTHA UNIT	385	0	0
8	ATF	299	0	0
9	NMP Unit	508		
10	LPG Treating Unit	230	0	0
11	Fuel Refinery Extension	3865	4	0.013
12	New FCCU	1405	5	0.009
13	Tank Truck Loading Gantry	3987	0	0
14	CCR/NSU/NHT	2107	5	0.006
15	ISOM	1328	6	0.027
16	Prime -G	1151	3	0017
17	Diesel Isothermic Unit	1043	0	0
18	Lube Oil Based Stock	1734	4	0.02
19	Liquefied Petroleum Gas	1544	10	0.024
			Total (kg/day)	**0.17**

5.5 Emission due to Loading Gantries

As HPCL has claimed in response to NEERI mail loading gantries is NA.

The total emissions due to the existing units at HPCL, Mumbai Refinery, processes, storage tanks, flares and wastewater treatment is approximately 199.9 kg/day. Data of individual VOCs were not provided so emission estimation of total VOCs was calculated

Table 6: VOCs Emission from HPCL Unit/ Services

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Units/ Services	***VOCs Estimation (kg/day)***
Storage Tanks	*161.47*
CCU	*Covered under LDAR*
CRU	*Covered under LDAR*
SRU	*Covered under LDAR*
Flares	*17.26*
Wastewater Plant	*21*
LDAR testing	*0.17*
Losses from Loading	*NA*
(kg/day)	*199.9*

6. Emission estimation of BPCL

Bharat Petroleum Corporation Limited (BPCL). BPCL is India's Maharatna public-sector enterprise operating in the Oil and Gas sector. BPCL started its journey under the name of Bharat Refineries Ltd. which was formed when Government of India undertook Burma Shell Refineries Limited (BSR) in 1952. It was commissioned in 1955 with a design capacity to process 2.2 million metric tons per annum (MMTPA) of crude oil and later renamed as Bharat Petroleum Corporation Limited in 1977. BPCL's refinery was the first in India to process the newly found indigenous crude (Bombay High). Bharat Petroleum Mumbai Refinery (BPCL - MR) is located at Mahul, Mumbai, Maharashtra. Refinery has achieved capacity to process 12 MMT of crude oil per annum. The main products of the refinery are LPG, Naphtha, C3, Lube Oil Blending Stock (LOBS), Motor Spirit, Kerosene, Jet Fuel, HSD Oil, LSHS, Mineral Turpentine, Bitumen, Benzene and Toluene. Mumbai Refinery of BPCL is spread over a total area of 454 acres. The study aimed at understanding all sources of emissions in the study region.

6.1 Total emission from Storage Tanks

Emissions from different types of storage tanks were estimated by calculating withdrawal losses, rim seal losses, deck fitting losses, standing storage losses and working losses as shown in ***Table 1****. The total emissions due to storage tanks are approximately 113.83 kg/day as shown in* ***Table 7****.*

Table 7. Emission for Storage tank at BPCL

Losses from storage tanks	***Losses (lb/yr)***
Withdrawal Losses	*21351.52*
Rim Seal Losses	*38488.34*

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Deck Fitting Losses	*17292.89*
Standing Storage Loss	*2918.37*
Working Loss	*12285.44*
Total	*92336.56*
Total VOC (kg/yr)	*113.83 kg/day*

6.2 Emissions from Process Vents

6.2.1 Catalytic Converting Unit (CCU)

When direct emissions monitoring or site-specific emissions factors are not available, AP-42 directs that the default emissions factors should be used to calculate the emissions from the CCU regenerator vent. Hence, VOCs emission factors given in AP-42 for the individual compounds are used to calculate the emissions. The emission factors used in ***Table 5-4*** *in the AP-42 of USEPA, protocol document have been used for the calculations.* ***Table 8*** *gives the estimation of VOCs from Catalytic Converter Unit.*

Table 8: VOC's Emission Factors and Estimation for Catalytic Converter Unit (CCU)

Sr. No.	***Compound***	***Emissions Factor (lb/MMbbl)***	***VOC emissions = EF x Capacity of unit*(lb/yr)***	
			CCU	***FCCU***
			(7.76 MMbbl /yr)	***(5.5 MMbbl/yr)***
1	*Acetaldehyde*	*20*	*155.2*	*110*
2	*Acetone*	*2.4*	*18.624*	*13.2*
3	*Acrolein*	*1*	*7.76*	*5.5*
4	*Benzene*	*18*	*139.68*	*99*
5	*Bromomethane*	*2.1*	*16.296*	*11.55*
6	*1,3-Butadiene*	*0.033*	*0.25608*	*0.1815*
7	*Ethylbenzene*	*0.24*	*1.8624*	*1.32*
8	*Formaldehyde*	*260*	*2017.6*	*1430*
9	*Methylene chloride*	*6.7*	*51.992*	*36.85*
10	*Phenol*	*8.7*	*67.512*	*47.85*
11	*Toluene*	*3.5*	*27.16*	*19.25*
12	*Trichlorofluoromethane*	*2.4*	*18.624*	*13.2*
13	*Xylene*	*3.2*	*24.832*	*17.6*
Total (lb/yr)			***2547.40***	***1805.50***
	Total due to CCU (lb/yr)		***4352.90***	
	Total VOC (kg/yr)		***1958.80***	
	Total VOC (kg/d)		***5.37***	

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6.2.2 Sulphur Recovery Units (SRU)

The exhaust gas from the Sulphur Recovery Unit (SRU) is commonly referred to as "tail gas." The sulphur recovery plant consists of one or more SRU operated in parallel and may also contain one or more catalytic tail gas treatment units and/or a thermal oxidizer to combust the tail gas (Table 9).

Table 9: VOC's Emission Factors and Estimation for SRU Component

SRU Component	
SRU train A feed in MMTPA	*0.015*
SRU train B feed in MMTPA	*0.015*
total SRU Feed in MMTPA	*0.03*
total SRU Feed in MTPA	*30000*
total THC/VOC emissions using the emission factor for THC emissions in lb/lton	*0.045*
VOC emission through SRU in MTPA	*1350*
VOC emission through SRU in kg/day (without TGTU)	*3698.63*
SRU Efficiency (TGTU commissioned) (%)	*99.9*
VOC emission through SRU in kg/day	***3.70***

6.2.3 Estimation due to Flares

Accurate estimates of emissions from flares are difficult to obtain because they do not lend themselves to conventional emissions-testing techniques, and only a few attempts have been made to characterize flare emissions. Therefore, to date, there are limited direct emissions test data for flares. Recent developments in testing protocols, such as the DIAL technique, provide a direct emissions measurement technique for flares. However, DIAL measurements provide only a snapshot in time. Unless the flow and composition of the flare gas is highly stable, inaccuracies build as these measurements are extrapolated to annual emission rates. Continuous monitoring of the gas stream prior to combustion in the flare is generally the most accurate means of assessing flare emissions.

- *Flare gas avg Molecular Weight for Apr- Dec 2019 = 24.5*
- *Density of Flare gas at 25^{o} C* *= (101325*24.5) / (298*8.314)*

  = 1002 g/m3

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= 1.002 kg/m3

- *Flare gas flow from Apr- Dec 2019 = 3262 MT*

*= (3262*1000)/ 1.002*

= 3255489 m3

- *As per USEPA, Flare Emission Factor for lightly smoking flare is 40 ug/L i.e. 0.04 X 10^{-3} g/L = 0.04 g/m3*
- *Hence Present VOC emission due to Flare = 3255489* 0.04*

= 130219 g

= 130219/275

= 473 g/day

- *VOC emission due to Flare in year 2019-20 (till Dec-19) = 0.47 kg/day*

6.3 Emissions Due to Wastewater Generated by Various Processes

As BPCL provided the details of waste water plant in closed tank so standing loss and working loss calculated for VOCs emission it was calculated as 270 kg/day but as BPCL claimed 90% recovery so it was found as 27 kg/day.

6.4 Emissions Due to Equipment Leaks

*At BPCL MR, as defined in the GSR 186 (E), Fugitive Emission/ Leak Detection and Repair is followed on yearly basis for each plant which is a function of preventive maintenance. Leaks as and when detected are attended and checked again through post repair schedule. LDAR (Leak VOCs Emission Estimation for HPCL Refinery 9 Detection & Repair) program has been revised and carried out on quarterly basis as per GSR 186 (E) rule for all process plants (**Table 4**). The LDAR survey carried out during year 2019-20 is given in **Table 10**. Average estimated VOCs Emission is **15.82 kg/day**.*

Table 10: VOC Emissions Due to Equipment Leaks LDAR Testing

Sr. No	Plant Name	Total component wise plant surveyed	Year 2019-20	
			Q1	Q II
1	ARU	1038	0.366	0.285
2	1SOM	2900	0.469	0.540
3	ISOM-NHT	1057	0.303	0.200
4	MTBE	228	0.047	0.065
5	RFU	1176	0.160	0.269

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6	TANK AREA	627	0.055	0.024
7	DHDS	1578	0.156	0.385
8	OLD SRU	582	0.240	0.054
9	RMP SRRU	1518	0.100	0.533
10	TGTU-I	33	0.007	0.015
11	TGTU-2	33	0.009	0.012
12	CCR	3740	0.693	1.227
13	CCR-NHT	1198	0.491	0.366
14	HCU	1575	0.475	0.494
15	LOBS	1575	0.293	0.500
16	NHGU	334	0.121	0.202
17	TDU GANTRY	352	0.071	0.161
18	LPG	1811	0.293	0.594
19	BOILE HOUSE -I	791	0.083	0.169
20	CCU	1688	0.116	0.623
21	CDU-4	1063	0.290	0.216
22	CPP	493	0.049	0.256
23	DHT	2987	0.305	0.305
24	FCCU	1765	0.191	0.015
25	MINAS	736	0.083	0.076
26	PUMP HOUSE -I	1356	0.433	0.317
27	PUMP HOUSE-5	3186	0.210	0.790
28	BBU	168	0.069	0.091
29	CDU-3	1460	0.398	0.468
			6.576	9.25
Total VOC emission			**1**	

6.5 Losses from Loading Gantries

Loading losses are the primary source of evaporative emissions from rail tank car, tank truck, and marine vessel operations. Loading losses occur as organic vapors in "empty" cargo tanks are displaced to the atmosphere by the liquid being loaded into the tanks. These vapors are a composite of vapors formed in the empty tank by evaporation of residual product from previous loads, vapors transferred to the tank in vapor balance systems as product is being unloaded, and vapors generated in the tank as the new product is being loaded. losses from the loading gantries from different products are given in ***Table 11****.*

Table 11: Emission Calculations for Tank Truck Loading Gantries- Bharat Petroleum Corporation Limited

Sr.	Product	Quantit	Saturat	True	Molecula	Temp	Temp	Loading Loss

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No.		y Loaded (MT)	ion Factor (S)	Vapour Pressure (P)	r Weight	of Product Loaded deg C	of Product Loaded Rankine	lb/1000 gal	lb	Kg	kg/day (i.e. till Jan-2020= 306 days)
1	LDO	17421	0.5	0.00013	190	32	549.27	0.00028	1.36	0.61	0.002
2	MTO	63226	0.5	0.021	130	32	549.27	0.03096	616.42	277.39	0.906
3	Benzene	35092	0.5	2.61	78	32	549.27	2.30907	24248.46	10911.81	35.660
4	Toluene	12764	0.5	0.773	92	32	549.27	0.80662	3125.15	1406.32	4.596
5	LSHS	7440	0.5	0.00013	190	32	549.27	0.00028	0.58	0.26	0.001
6	Jet Fuel (ATF)	26194	0.5	0.021	130	32	549.27	0.03096	255.38	114.92	0.376
7	Bitumen	33551	0.5	0.00013	190	32	549.27	0.00028	2.62	1.18	0.004
8	SBP	4524	0.5	2.4	80	32	549.27	2.17773	3392.79	1526.76	4.989
9	SK	3201	0.5	0.021	130	32	549.27	0.03096	31.21	14.04	0.046
											46.58

Total loss from loading gantries was found 46.58 kg/day but as BPCL claimed loading loss post vapour recovery it was found as 10.35 kg/day

The overall emission from all units at BPCL refinery is presented in **Table 12**.

Table 12: VOCs Emission at BPCL Unit/ Services

Units/ Services	VOCs Estimation at BPCL (kg/day)
Storage Tanks	113.83
CCU	5.37
SRU	3.70
Flares	0.47
Wastewater Plant	27
LDAR testing	15.85
Losses from Loading	10.35
(Kg/day)	176.57

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The total emissions due to the existing units at BPCL, Mumbai Refinery, processes, storage tanks, flares, LDAR, gantries and the wastewater treatment are found as 176.57 kg/day. Data of individual VOCs were not provided so emission estimation of total VOCs were calculated.

7. Emission Estimation from Aegis Logistics limited

M/s. Aegis logistics Limited is situated at Plot No. 72, Mahul Village, Trombay, Mumbai – 400074. The unit is located in Industrial zone (I-3) as per duly approved and authorised development plan of MCGM and this entire area has been functioning as an industrial zone for more than 40 years wherein two major public sector refineries viz. Aegis installation is purely transit storage facility for liquid products and no manufacturing or processing activity has been carried out. The storage facility is spread in 80937 Sq. M, commissioned in 1977 and having a storage capacity of 195850 KL of Petroleum products and Chemicals and 20000 MT of LPG. Total 54 nos. of storage tanks are installed out of which 2 are for LPG. Out of 52 Liquid Storage Tanks, 17 Tanks are IFR Tank out of which 6 nos. with Dome Roof and 11 nos. with Cone Roof type and all the roofs are welded and closed and double wiper seals, primary seal vapour mounted and secondary seal Rim mounted. Fixed Roof Tanks are provided with PV valves and activated Charcoal absorbers.

7.1 Emissions from Storage Tanks

Emissions from different types of storage tanks were estimated by calculating withdrawal losses, rim seal losses, deck fitting losses, standing storage losses and working losses as shown in Table 1. The total emissions due to storage tanks are approximately 369.89 kg/day.

Table 13: VOCs Emission at Tank site in ALL

Standing storage loss	*135156.31 lb/yr*
Working loss	*164862.71 lb/yr*
Total	*300019.02 lb/yr*
Total Emission in Kg/day	***369.89** kg/day*

7.2 Emission from ETP

VOCs emission from ETP for Aegis was calculated as 2.61 kg/day.

7.3 Emission from Loading Gantries

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Total emission of VOCs from loading gantries was found 436.11 kg/day but as Aegis logistic claimed it with 99.99% recovery so it found as 0.04kg/day.

Table 14: VOCs Emission at ALL Unit/ Services

Units/ Services	***VOCs Estimation (kg/day)***
Storage Tanks	*369.89 Kg/day*
Flares	*NA*
Wastewater Plant	*2.61 kg/day*
LDAR testing	*NA*
Losses from Loading	*0.04 Kg/day*
(Kg/day)	*372.54Kg/day*

Total emission from Tank site, Waste water plant and loading gantries was found as 372.54 kg/day. Data of individual VOCs were not provided so emission estimation of total VOCs were calculated

8. Emission Estimation of Sea Lords

M/s. Sealord Containers Limited is situated near BPCL Refinery Main Gate, Mahul Village, Ambapada, Mumbai. The unit is located in Industrial zone (I-3) as per duly approved and authorized development plan of MCGM and this entire area has been functioning as an industrial zone for more than 40 years. This storage facility is spread in 29480 Sq. M, commissioned in 2007 and having a storage capacity of 75000 KL of Petroleum products and Chemicals. Total 10 nos. of storage tanks are installed out of which 5 tanks are of 10000 KL each and remaining 5 tanks are of 5000 KL capacity each. Out of 10 nos. of storage tanks 8 nos. of tanks with Dome Roof type and all the roofs are welded and closed and with double wiper seals, primary seal vapour mounted and secondary seal Rim mounted. 2 Nos. of Fixed Roof Tanks are provided with PV valves and activated Charcoal absorbers. Tanker loading bays are provided with Fume extraction system with Brine Condenser followed by activated carbon absorber, water scrubber.

Emissions from different types of storage tanks were estimated by calculating withdrawal losses, rim seal losses, deck fitting losses, standing storage losses and working losses as shown in ***Table 1****. The total emissions due to storage tanks are approximately 0.103 kg/day.*

Table 15: VOCs Emission at Tank site in Sealord

Standing storage loss	*68.18 lb/yr*
working loss	*14.98 lb/yr*
Total	*83.171 lb/yr*
	0.103g/day

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8.1 Emission from ETP

Total VOCs emission from ETP was found as 0.16kg/day.

8.2 Emission from loading gantries

Emission from loading gantries was found 173.66 kg/day but as Sealord claimed it with 99.99% recovery so it was found as 0.27kg/day.

Total emission from Tank site, Waste water plant and loading gantries was found as 0.53 kg/day. Data of individual VOCs were not provided so emission estimation of total VOCs was calculated.

Table 16: VOCs Emission at Sealord Unit/ Services

Units/ Services	***VOCs Estimation (kg/day)***
Storage Tanks	*0.103 Kg/day*
Flares	*NA*
Wastewater Plant	*0.16 kg/day*
LDAR testing	*NA*
Losses from Loading	*0.27 Kg/day*
(Kg/day)	*0.53 Kg/day*

9. Environmental Damages Cost Assessment

VOCs are the gases that were emitted into the air from the process, some are more harmful by themselves, and some can cause cancer. In addition to this, VOCs can react with other gases and leads to the formation of other air pollutants after they were in the air. High-level exposure to VOC emissions affects human health and leads to leukaemia and also leads to skin emanations during sleep. The high-level concentration of VOC is considered to be very harmful to the people who are residing in the polluted areas since VOC pollutants have a deep effect on the health of humans. Exposure to VOCs can affect the eye, throat and nose irritation as well as upper respiratory infections, allergic reactions, nausea, and headache, etc. and also cause disorders in the blood including reduced red blood cells and anaemia. It can also aggravate existing respiratory diseases such as bronchitis and pneumonia. Regarding long term exposure to outdoor air pollution, it can cause chronic respiratory diseases, lung cancer, heart diseases as well as acute respiratory infections in the case of children.

The current method of determining VOC related externalities utilises WTA method as explained above. A detailed survey was conducted in order to understand WTA. Following images indicate the collection of data as required in WTA.

Table 17 *gives the details of the responses received for the WTA survey.*

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Table 17: Number of people responded for willingness to accept

Total Respondents	*312*
Not interested in WTA	*168*
Willing to pay	*144*
Respondent on the cost of for avoidance / abatement WTA	*138*

Statistical analysis was conducted in order to understand the variation in the environmental damages costs calculations based on WTA. ***Table 18*** *gives the descriptive statistics.*

Table 18: Statistical Description for willingness to accept

Statistical Description	
Parameter	***Value in ₹/kg/month***
Mean	*306.4*
Standard Error	*30.7*
Median	*175*
Mode	*100*
First Quartile	*100*
Second Quartile	*175*
Third Quartile	*500*
Minimum	*10*
Maximum	*2000*
Count	*130*
Largest (1)	*2000*
Smallest (1)	*10*
Confidence Level (95.0%)	*60.81*

Based on the statistical description given in ***Table 18*** *and the equations explained in methodology section for the*

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willingness to accept, the damage assessment for the industries can be calculated. ***Table 19*** *gives the range of damage cost for VOCs emission based on descriptive statistics.*

Table 19: Range of Damage Cost for VOC pollutants

Environmental damages	***Rs/year/ton of Pollutant***
First Quartile (Lower Range)	*12,00,000*
Second Quartile (Medium Range)	*21,00,000*
Third Quartile (Upper range)	*60,00,000*

For value transfer method, the equations described in the methodology section are used to get the values related to environmental damages. ***Table 20*** *gives the VTM values for environmental damages.*

Table 20: VTM values for per ton of VOC emission

Environmental damages	***European study converted (Rs/ton)***
Low Sensitivity	*₹ 20,32,022*
Medium Range	*₹ 26,50,463*
High Sensitivity	*₹ 39,75,694*

The total VOCs emitting in the Chembur region, Mumbai from HPCL, BPCL, Aegis, and Sealord are 72.96, 64.45, 135.65, 0.19 tons/year. We have used the WTA values as WTA values are in close agreement to VTM values (median range values) and hence either values can be used. However, the survey represents actual Indian conditions and hence are closer to ground situation. The range of values based on first, second and third quartile of WTA is given in ***Table 21*** *for all the industries. It is recommended to use second quartile number since it represents a statistically better number, however decision can be made on any of the quartile depending upon the severity of situation.*

Table 21: Damage cost for Industries in 2019 ₹ Values

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Company	***Emissions (Kg/day)***	***Emissions (Tons/year)***	***Damage Cost (1st quartile) in Million Rupees (M₹)***	***Damage Cost (2nd quartile) in M₹***	***Damage Cost (3rd quartile) in M₹***
HPCL	*199.9*	*72.96*	*87.56*	*153.22*	*437.78*
BPCL	*176.57*	*64.45*	*77.34*	*135.34*	*386.69*
AEGIS	*372.54*	*135.65*	*162.78*	*284.87*	*813.91*
SEALORD	*0.53*	*0.19*	*0.23*	*0.41*	*1.16*

**Based on updated data provided by HPCL, the emissions are re-assessed as 72.96 T/Year against 43.8 T/Year reported earlier.*

Summary of Calculations:

*This present study was conducted to find out total VOCs emitted from various sources and possible impact on the people residing in the area. Emissions were estimated using AP-42 Method, developed by US EPA and a standard method globally practiced for assessments in petroleum industries. It was observed that VOC emissions due to the existing units, processes, storage tanks, flares and wastewater treatment in HPCL were 120 kg/day (**now updated to 199.9 kg/day**). The results of VOCs estimation from various sources in BPCL are 176.57 kg/day. The emissions from Aegis Logistic Limited are 371.65 kg/day and Sealord Containers Limited are 0.53 kg/day.*

*Based on above total emissions and WTA based median valuation, the environmental damages for HPCL, BPCL, AEGIS and Sealords per annum are assessed as Rs 9.19 crores (**now revised to Rs 15.3 Crore**), Rs. 13.5 Crore, Rs. 28.4 Crore and Rs. 0.04 Crore, respectively (Base Year:2019).”*

Objections/applications filed by ALL and BPCL:

19. Thereafter, I.A. No. 213/2020 and I.A. No. 216/2020 have been filed by ALL and BPCL respectively seeking clarification of order dated 30.06.2020. The applicants have sought dispersal models along with assumptions used by the CPCB/NEERI and also calculations and results. It has been submitted that these have been missed out/omitted in the order dated 30.06.2020.

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20. Another interim application (unnumbered) was filed on 10.07.2020 by the HPCL for directions. This application refers to the report filed by the CPCB on 18.03.2020. They have sought all assumptions, calculations, supporting and other such documents/information used by CPCB/NEERI. They have sought CPCB to consider HPCL tank, VOC study report by IIT Madras and M/s Glens Innovation Labs.

21. I.A. No. 235/2020 has been filed by ALL on 22.07.2020 seeking oral hearing. They have submitted that the figure of emission of 376 kg per day is before deploying control measures and the correct figure that is after the control measures is 4.01 kg per day. While arriving at the figure of 4.01 kg per day, they have relied upon assumptions and calculations of IIT Bombay AERMOD dispersion modeling to estimate the concentrations of nine hazardous VOCs at Mahul and Ambapada villages. They have submitted that the calculations provided by the CPCB on 20.07.2020 was made by the CPCB in-house Technical Committee for assessing the VOC emissions which indicate that CPCB itself is not aware of the formulae applied in CPCB report and as such credibility of CPCB report is in serious question.

22. ALL filed their response on the CPCB report of 10.07.2020 on 28.07.2020. It has been submitted that CPCB report erroneously fails to distinguish between products classified as VOCs under Indian Regulatory Standards or USEPA and those not so classified under either standard. The CPCB report erroneously includes all products handled by ALL whether the same have been classified as VOC or VOC Hazardous Air Pollutants (HAPs) as per Environment (Protection) Rules, 1986. They have submitted that if the CPCB/NEERI had considered only the products classified as VOC or VOC (HAPs) as per the EP Act, 1986 and

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EP 4th Amendment Rules, 2012 while preparing the CPCB report then the tank emissions which were recorded by ALL would be nearly 6 kg per day as opposed to erroneous figure of 369 kg per day as mentioned in CPCB report.

23. It has also been submitted by ALL that CPCB has omitted to take into consideration the control efficiencies while calculating tank storage emission of ALL. It has further been submitted that the calculation of estimated emission from ALL has been wrongly calculated by NEERI by not applying correct formula. It has been stated that ALL and SLCL had separately engaged Institute of Chemical Technology (ICT) to carry out a parallel study using the same data as provided to NEERI/CPCB. ALL and SLCL both commissioned SINE, IIT Bombay Company, Energy Enviro Company Private Ltd. (IIT), to carry out a dispersion modeling using AERMOD for VOC emission from their tank terminals located at Mahul. IIT report is said to have concluded that VOC emission load from ALL tank terminal and SLCL tank terminal is 376 kg per day and 1.86 kg per day respectively and assuming that there is no vapor control system at both VFR and ETP tanks and vapor control system with 99% efficiency is installed at filling gantry. The total VOC emission load from ALL tank terminal and SLCL tank terminal is 22.98 kg per day and 1.74 kg per day respectively when assuming that vapor control system with 95% efficiency is installed at both VFR and ETP tanks and vapor control system with 99% efficiency is installed at filling gantry. Their submission is that if the methodology had been applied correctly, the total emission estimates from ALL would have been 18.58 kg per day as opposed to the erroneous figure of 376 kg per day as mentioned in CPCB report.

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24. At a much belated stage on 03.08.2020, written submissions cum objections were filed on behalf of BPCL. They have stated that the reports filed by the CPCB are not only erroneous but the same are fundamentally flawed and no justifiable basis whatsoever has been provided by the CPCB in support of its recommendation of levy of the totally unjustified and exorbitant sum of Rs. 135.30 crores on Respondent No. 9, BPCL. It has further been submitted that CPCB's report has failed to take into account that emissions from the BPCL are well within the legal permissible limits which if taken into account will demonstrate that applicant (BPCL) cannot be penalized for environmental damages. Further, M/s NEERI's VOC calculation has taken into consideration only the theoretical VOC emissions at source and the total calculation does not take into account any threshold limit with regard to emissions beyond standards. They alleged that the clarification report of CPCB clearly demonstrates that they have not even used the dispersion model (AERMOD) as stated in their report dated 18.03.2020.

VI. Final consideration of the report of CPCB and objections of ALL, SLCL, HPCL and BPCL:

25. We have given our thoughtful consideration to the objections filed by ALL, SLCL, BPCL and HPCL and considered the question whether in view of these objections CPCB report is sustainable and should be accepted. In view of oral hearing been concluded and further opportunity of filing objections to the CPCB report having been given, in view of order dated 30.06.2020 passed in presence of the parties, it is not necessary to grant further opportunity of oral hearing, as sought. As already mentioned, we have duly taken into account oral submissions as well written submissions/objections filed by all the parties.

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26. The CPCB has duly provided the details of the assumptions and calculations made by the CPCBs in-house Technical Committee for assessing the quantum of VOC emissions to all the four companies i.e. SLCL, ALL, HPCL and BPCL.

27. CPCB publication National Emission Standards for Petro-chemical Industries notified in 2012 lists 52 VOCs which includes all the VOCs emitted by ALL, SLCL, BPCL and HPCL and all the VOCs emitted by all the four companies, which are listed in the CPCB notification of 2012, have been included in the calculation for assessing the emissions. The CPCB in its reply filed on 30.07.2020 to the averments made by ALL, Respondent No. 2 has stated as follows:

> *"2. … That in reply to averments made by Respondent No. 2 in para 3 & 4, CPCB submits that the Hon'ble NGT vide its order dated 15.07.2019 directed that "on 14.08.2019, in the office of CPCB, the parties will be allowed to peruse the viewpoint of each other, including the documents already submitted from 11.00 AM to 1.00 PM." As per the minutes of the meeting dated August 14, 2019 it was decided that "**All the units were asked to furnish the complete data for calculation for estimation of Volatile Organic Compounds (hereinafter referred to as VOCs), before & after pollution control measures as per the method AP42**". Therefore, Emissions were estimated using AP-42 Method, developed by US EPA and a standard method globally practiced for assessments in petroleum industries.*
>
> *The Hon'ble NGT vide order dated 06.11.2019 directed that "CPCB must carry out the study in-house with the association of such expert/Institutions as may be necessary. The study may now be completed positively within two months. The study should include all the issues mentioned in the order dated 15.07.2019." In compliance of the Hon'ble NGT order,* ***an in-house Technical Committee of CPCB was constituted to study Environmental damage cost estimation due to VOC emissions NEERI, the expert institute fully conversant with VOCs in Mahul area was awarded an assignment "Estimation and Environmental Damage Cost Assessment of VOCs Emissions from specific industries at Mahul and Ambapada region of Mumbai" and to assist the in-house technical Committee of CPCB, for concluding the quantum of VOC emissions, extent of damage done to the environment, damage cost and apportionment, to recover the cost of damage from individual contributors****.*

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The calculations derived by CSIR-NEERI, for CPCB, are based on the data provided by Respondent Nos. 2, 9 and 10. CPCB submitted the report to Hon'ble NGT on 10.07.2020, which contained the Calculations made by CPCB's in-house Technical Committee with the assistance of CSIR-NEERI, for assessing the quantum of VOCs Emissions.

CPCB was directed to provide the basis of calculation of quantum of emissions and therefore the relevant portion of the study containing the basis of calculation along with formulae used were provided to the above stated industrial units, in three Annexures, vide email dated 20/07/2020. The technical communication held with CSIR-NEERI through email, were also forwarded along with the calculations, for reference and better understanding.

Further, the report submitted by CPCB to the Hon'ble Tribunal on July 10, 2020 for Respondent No. 2, ***the total VOCs emissions from storage tanks and ETP have been calculated as 369.89 kg/day and 2.61 kg/day, respectively.***

Considering 99% recovery, VOCs emissions from the loading gantries have been found as 0.04 kg/day. The report containing formulae that have been used to arrive these calculations and findings have been provided to Respondent No. 2.

3. That in reply to averments made by Respondent No. 2 in para 5 & 6, these do not need any comment from CPCB.

*4. That in reply to averments made by Respondent No. 2 in para 7, CPCB submits that t****he calculations derived by CSIR-NEERI, for CPCB, are based on the data provided by Respondent No. 2. CPCB submitted the report to Hon'ble NGT on 10.07.2020, which contained the Calculations made by CPCB's in-house Technical Committee with the assistance of CSIR-NEERI, for assessing the quantum of VOCs Emissions. The same report was provided to the above stated industrial units vide email dated 20/07/2020****.*

5. That in reply to averments made by Respondent No. 2 in para 8, CPCB submits that ***the communication between CPCB and CSIR-NEERI by email dated July 09, 2020 were part of scientific discussions that were necessary to clear the doubts before finalization of the report****. In the draft report submitted by CSIRNEERI, it was wrongly mentioned that no standards exist for certain VOCs in India. For clarification of certain points, CSIR NEERI was communicated by CPCB for making necessary corrections and also for clarification on certain points before submission to Hon'ble NGT. The scientific reports are finalized by the same methodology as followed by CPCB, through data collection, analysis of the data & preliminary assessment, preparation of draft report, critical evaluation of draft report at various stages followed by finalization of Report. Technical discussions amongst various expert institutes involved in any study, are an important part of any study, to arrive at final conclusion.* ***Therefore, technical discussions held***

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between to expert institutes cannot be treated as a question on credibility of any institute, as done by Respondent No. 2*.*

6. That in reply to averments made by Respondent No. 2 in para 9, need no comments from CPCB.

7. That in reply to averments made by Respondent No. 2 in para 10 & 11, CPCB submits that studies conducted by Applicant through external institute. ***CPCB cannot make any comments on the data generated by the industries on their own and /or through other institutes since CPCB was not involved in such studies.***

Further the findings of the CPCB submitted to Hon'ble NGT are based on the study conducted by in-house Committee of CPCB with the assistance of Expert Institute i.e. CSIR-NEERI, in compliance of the orders of Hon'ble NGT, in this matter.

8. That in reply to averments made by Respondent No. 2 in para 12 to 16, these do not need any comment from CPCB."

*9. That in reply to averments made by Respondent No. 2 in para 17, CPCB submits that t****he communication between CPCB and CSIR-NEERI by email dated July 09, 2020 were part of scientific discussions that were necessary to clear the doubts before finalization of the report. In the draft report submitted by CSIR-NEERI, it was wrongly mentioned that no standards exist for certain VOCs in India. For clarification of certain points, CSIR NEERI was communicated by CPCB for making necessary corrections and also for clarification on certain points before submission to Hon'ble NGT. The scientific reports are finalized by the same methodology as followed by CPCB, through data collection, analysis of the data & preliminary assessment, preparation of draft report, critical evaluation of draft report at various stages followed by finalization of Report. Technical discussions amongst various expert institutes involved in any study, are an important part of any study, to arrive at final conclusion. Respondent No. 2 states that Indian Institute of Technology (IIT) conducted dispersion modelling to ascertain the quantity of VOCs emissions. CPCB does not make any comments on the data generated by the industries on their own and /or through other institutes since CPCB was not involved in such studies.***

Further, the findings of the CPCB submitted to Hon'ble NGT are based on the study conducted by in-house Committee of CPCB with the assistance of Expert Institute i.e. CSIR-NEERI, in compliance of the orders of Hon'ble NGT, in this matter."

28. The CPCB in its reply filed on 30.07.2020 to the averments made by ALL, Respondent No. 2 has further stated as follows:

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"2. That in reply to averments made by Respondent No. 2 in para 4, CPCB submits that the Hon'ble NGT vide its order dated 15.07.2019 directed that "on 14.08.2019, in the office of CPCB, the parties will be allowed to peruse the viewpoint of each other, including the documents already submitted from 11.00 AM to 1.00 PM." As per the minutes of the meeting dated August 14, 2019 it was decided that ***"All the units were asked to furnish the complete data for calculation for estimation of VOCs, before & after pollution control measures as per the method AP-42". Therefore, Emissions were estimated using AP-42 Method, developed by US EPA and a standard method globally practiced for assessments in petroleum industries.***

Further, Hon'ble NGT vide order dated 06.11.2019 directed that "CPCB must carry out the study in-house with the association of such expert/Institutions as may be necessary. The study may now be completed positively within two months. The study should include all the issues mentioned in the order dated 15.07.2019." ***In compliance of the Hon'ble NGT order, an in-house technical Committee of CPCB was constituted to study Environmental damage cost estimation due to VOC emissions NEERI, the expert institute fully conversant with VOCs in Mahul area was awarded an assignment "Estimation and Environmental Damage Cost Assessment of Volatile Organic Compounds (VOCs) Emissions from specific industries at Mahul and Ambapada region of Mumbai" and to assist the in-house technical Committee of CPCB, for concluding the quantum of VOC emissions, extent of damage done to the environment, damage cost and apportionment, to recover the cost of damage from individual contributors.***

The calculations derived by CSIR-NEERI, for CPCB, are based on the data provided by Respondent Nos. 2, 9 and 10. CPCB submitted the report to Hon'ble NGT on 10.07.2020, which contained the Calculations made by CPCB's in-house technical Committee with the assistance of CSIR-NEERI, for assessing the quantum of VOCs Emissions.

*CPCB was directed to provide the basis of calculation of quantum of emissions and therefore the relevant portion of the study containing the basis of calculation along with formulae used were provided to the above stated industrial units, in three Annexures, vide email dated 20/07/2020. T****he technical communication held with CSIR-NEERI through email, were also forwarded along with the calculations, for reference and better understanding.***

Further, in the report submitted by CPCB to the Hon'ble Tribunal on July 10, 2020 for M/s ***Aegis Logistics Ltd****, the total VOCs emissions from storage tanks and ETP have been calculated as 369.89 kg/day and 2.61 kg/day, respectively.*

Considering 99% recovery, VOCs emissions from the loading gantries have been found as 0.04 kg/day. The report containing formulae that have been used to arrive these calculations and findings have been provided to M/s Aegis Logistics Ltd.

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Further in the report submitted by CPCB to the Honorable Tribunal on July 10, 2020 for M/s Sealord Containers Ltd, the total VOCs emissions from storage tanks and ETP have been calculated as 0.103 kg/day and 0.16 kg/day respectively.

Considering 99.99% recovery, VOCs emissions from the loading gantries have been found as 0.27 kg/day. The report containing formulae that have been used to arrive these calculations and findings have been provided to M/s M/s Sealord Containers Ltd.

3. That in reply to averments made by Respondent No. 2 in para 5 to 17, CPCB submits that the calculations derived by CSIR-NEERI, for CPCB, are based on the data provided by Respondent No. 2. CPCB submitted the report to Hon'ble NGT on 10.07.2020, which contained the Calculations made by CPCB's in-house Technical Committee with the assistance of CSIR-NEERI, for assessing the quantum of VOCs Emissions. The same report was provided to the above stated industrial units vide email dated 20/07/2020. Considering 99% recovery, VOCs emissions from the loading gantries have been found as 0.04 kg/day. The report containing formulae that have been used to arrive these calculations and findings have been provided to M/s Aegis Logistics Ltd.

4. That in reply to averments made by Respondent No. 2 in para 18 to 28, CPCB submits that the averments are regarding studies conducted by Applicant through external institute. CPCB does not make any comments on the data generated by the industries on their own and /or through other institutes since CPCB was not involved in such studies.

Further, the findings of the CPCB submitted to Hon'ble NGT are based on the study conducted by in-house Committee of CPCB with the assistance of Expert Institute i.e. CSIR-NEERI, in compliance of the orders of Hon'ble NGT, in this matter.

5. That in reply to averments made by Respondent No. 2 in para 29 to 35, CPCB submits that the calculations derived by CSIR-NEERI, for CPCB, are based on the data provided by Respondent No. 2. CPCB submitted the report to Hon'ble NGT on 10.07.2020, which contained the Calculations made by CPCB's in-house Technical Committee with the assistance of CSIR-NEERI, for assessing the quantum of VOCs Emissions. The same report was provided to the above stated industrial units vide Email dated 20/07/2020. The findings of CPCB submitted to Hon'ble NGT are based on the study conducted by In-house Committee of CPCB with the assistance of Expert Institute i.e. CSIR-NEERI, in compliance of the orders of Hon'ble NGT, in this matter.

6. That in reply to averments made by Respondent No. 2 in para 36 to 42, CPCB submits that the averments are regarding studies conducted by Applicant through external institute. CPCB does not make any comments on the data generated by the industries on

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their own and /or through other institutes since CPCB was not involved in such studies.

Further, the findings of the CPCB submitted to Hon'ble NGT are based on the study conducted by in-house Committee of CPCB with the assistance of Expert Institute i.e. CSIR-NEERI, in compliance of the orders of Hon'ble NGT, in this matter.

7. That in reply to averments made by Respondent No. 2 in para 43 to 46, CPCB submits that in compliance of the Hon'ble NGT order, an in-house Technical Committee of CPCB was constituted to study Environmental damage cost estimation due to VOC emissions NEERI, the expert institute fully conversant with VOCs in Mahul area was awarded an assignment "Estimation and Environmental Damage Cost Assessment of Volatile Organic Compounds (VOCs) Emissions from specific industries at Mahul and Ambapada region of Mumbai" and to assist the in-house technical Committee of CPCB, for concluding the quantum of VOC emissions, extent of damage done to the environment, damage cost and apportionment, to recover the cost of damage from individual contributors.

Further, findings of the CPCB submitted to Hon'ble NGT are based on the study conducted by in-house Committee of CPCB with the assistance of Expert Institute i.e. CSIR-NEERI, in compliance of the orders of Hon'ble NGT, in this matter.

8. That in reply to averments made by Respondent No. 2 in para 47 to 54, these do not need any comment from CPCB.

9. That in reply to averments made by Respondent No. 2 in para 55 to 65, CPCB submits that the findings of the CPCB submitted to Hon'ble NGT are based on the study conducted by in-house Committee of CPCB with the assistance of Expert Institute i.e. CSIR-NEERI, in compliance of the orders of Hon'ble NGT, in this matter.

10. That in reply to averments made by Respondent No. 2 in para 66 to 69, CPCB submits that the averments are regarding studies conducted by Applicant through external institute. CPCB does not make any comments on the data generated by the industries on their own and /or through other institutes since CPCB was not involved in such studies.

11. That in reply to averments made by Respondent No. 2 in para 70 to 72, these do not need any comment from CPCB.

12. That in reply to averments made by Respondent No. 2 in para 73, CPCB submits that the calculations derived by CSIR-NEERI, for CPCB, are based on the data provided by Respondent No. 2, 9 and 10. CPCB submitted the report to Hon'ble NGT on 10.07.2020, which contained the Calculations made by CPCB's in-house Technical Committee with the assistance of CSIR-NEERI, for assessing the quantum of VOCs Emissions.

Further, CPCB was directed to provide the basis of calculation of quantum of emissions and therefore the relevant portion of the study containing the basis of calculation along with formulae used

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were provided to the above stated industrial units, in three Annexures, vide email dated 20/07/2020."

29. The CPCB in its reply filed on 30.07.2020 to the averments made by BPCL, Respondent No. 9 has stated as follows:

"2. That in reply to averments made by the Respondent No. 9 in para 3 to 5, CPCB submits that the calculations derived by CSIR-NEERI, for CPCB, are based on the data provided by Respondent No. 10, Hindustan Petroleum Corporation Ltd. (hereinafter referred to as "HPCL"), Respondent No. 9, and Respondent No. 2, Aegis Logistics Ltd. and Sealords Containers Ltd. CPCB submitted the report to Hon'ble NGT on 10.07.2020, which contained the Calculations made by CPCB's in-house Technical Committee with the assistance of CSIR-NEERI, for assessing the quantum of Volatile organic compounds (VOCs) Emissions.

Further, CPCB was directed to provide the basis of calculation of quantum of emissions and therefore the relevant portion of the study containing the basis of calculation along with formulae used were provided to the above stated industrial units, in three Annexures, vide email dated 20/07/2020.

3. That in reply to averments made by the Respondent No. 9 in para 6 & 7, and these do not require any comment from CPCB.

4. That in reply to averments made by Respondent No. 9 in para 8 to 11, CPCB submits that the Hon'ble NGT vide its order dated 15.07.2019 directed that: "on 14.08.2019, in the office of CPCB, the parties will be allowed to peruse the viewpoint of each other, including the documents already submitted from 11.00 AM to 1.00 PM." As per the minutes of the meeting dated August 14, 2019 it was decided that "All the units were asked to furnish the complete data for calculation for estimation of VOCs, before & after pollution control measures as per the method AP-42". Emissions were estimated using AP-42 Method, developed by US EPA and a standard method globally practiced for assessments in petroleum industries.

Further, the NGT vide its order dated 06.11.2019 directed that "CPCB must carry out the study in-house with the association of such expert/Institutions as may be necessary. The study may now be completed positively within two months. The study should include all the issues mentioned in the order dated 15.07.2019." In compliance of the Hon'ble NGT order, an in-house Technical Committee of CPCB was constituted to study Environmental damage cost estimation due to VOC emissions. NEERI, the expert institute fully conversant with VOCs in Mahul area was awarded an assignment "Estimation and Environmental Damage Cost Assessment of Volatile Organic Compounds (VOCs) Emissions from specific industries at Mahul and Ambapada region of Mumbai" and to assist the in-house Technical Committee of CPCB, for concluding the quantum of VOC emissions, extent of damage done to the

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environment, damage cost and apportionment, to recover the cost of damage from individual contributors.

The calculations derived by CSIR-NEERI, for CPCB, are based on the data provided by Respondent Nos. 2, 9 and 10. CPCB submitted the report to Hon'ble NGT on 10.07.2020, which contained the Calculations made by CPCB In-house Technical Committee with the assistance of CSIR-NEERI, for assessing the quantum of VOCs Emissions.

Further, CPCB was directed to provide the basis of calculation of quantum of emissions and therefore the relevant portion of the study containing the basis of calculation along with formulae used were provided to the above stated industrial units, in three Annexures, vide email dated 20/07/2020.

5. That in reply to averments made by Respondent No. 9 in para 12 & 13, and these do not require any comment from CPCB."

30. The CPCB in its reply filed on 30.07.2020 to the averments made by HPCL, Respondent No. 10 has stated as follows:

"2. That in reply to averments made by Respondent No.10 in para 4, CPCB submits that the Hon'ble NGT vide its order dated 15.07.2019 directed that: "on 14.08.2019, in the office of CPCB, the parties will be allowed to peruse the viewpoint of each other, including the documents already submitted from 11.00 AM to 1.00 PM." As per the minutes of the meeting dated August 14, 2019 it was decided that "All the units were asked to furnish the complete data for calculation for estimation of Volatile Organic Compounds (hereinafter referred to as VOCs), before & after pollution control measures as per the method AP-42". Emissions were estimated using AP-42 Method, developed by US EPA and a standard method globally practiced for assessments in petroleum industries.

Further, Hon'ble NGT vide order dated 06.11.2019 directed that "CPCB must carry out the study in-house with the association of such expert/Institutions as may be necessary. The study may now be completed positively within two months. The study should include all the issues mentioned in the order dated 15.07.2019." In compliance of the Hon'ble NGT order, an in-house Technical Committee of CPCB was constituted to study Environmental damage cost estimation due to VOC emissions. NEERI, the expert institute fully conversant with VOCs in Mahul area was awarded an assignment "Estimation and Environmental Damage Cost Assessment of VOCs Emissions from specific industries at Mahul and Ambapada region of Mumbai" and to assist the in-house technical Committee of CPCB, for concluding the quantum of VOC emissions, extent of damage done to the environment, damage cost and apportionment, to recover the cost of damage from individual contributors.

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The calculations derived by CSIR-NEERI, for CPCB, are based on the data provided by Respondent Nos. 2, 9 and 10. CPCB submitted the report to Hon'ble NGT on 10.07.2020, which contained the Calculations made by CPCB's in-house Technical Committee with the assistance of CSIR-NEERI, for assessing the quantum of VOCs Emissions.

Further, CPCB was directed to provide the basis of calculation of quantum of emissions and therefore the relevant portion of the study containing the basis of calculation along with formulae used were provided to the above stated industrial units, in three Annexures, vide email dated 20/07/2020.

3. That in reply to averments made by Respondent No. 10 in para 5, CPCB submits that the report on Comprehensive Action Plan of Chembur/Mahul Area filed by CPCB to Hon'ble NGT on 27.06.2019 states the data that was provided by the above stated four units. The said data shows about figures of overall estimated contents of Benzene, Toluene and Xylene in crude and products / intermediates stored at Hindustan Petroleum Corporation Ltd.

Findings of the CPCB submitted to Hon'ble NGT are based on the study conducted by in-house Committee of CPCB with the assistance of Expert Institute i.e. CSIR-NEERI, in compliance of the orders of Hon'ble NGT, in this matter.

That CPCB does not make any comments on the data generated by the industries on their own and /or through other institutes since CPCB was not involved in such studies.

4. That in reply to averments made by Respondent No. 10 in para 6, do not require any comment from CPCB.

Comments of CPCB on submissions made by Respondent No. 10:

That CPCB submitted the report to Hon'ble NGT on 10.07. 2020. The report contained Calculations made by CPCB's in-house Technical Committee with the assistance of CSIR-NEERI, for assessing the quantum of VOCs Emissions. The calculations made in the report are based on the data provided by Respondent Nos. 2, 9 and 10.

Further, CPCB was directed to provide the basis of calculation of quantum of emissions and therefore the relevant portion of the study containing the basis of calculation along with formulae used were provided to the above stated industrial units, in three Annexures, vide email dated 20/07/2020."

31. The CPCB has clearly stated that as per the minutes of the meeting dated 14.08.2019 all the units were asked to furnish the complete data for calculation for estimation of VOCs before and after control measures

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as per the method AP-42. The emissions were estimated using AP-42 method developed by USEPA and standard method globally practiced for assessment in petroleum industries. While calculating the emissions in their report filed on 18.03.2020, they have used data provided by the units. The CPCB has used 2019 as a base year while calculating damage caused for the past five years. In fact, the data of emissions from 2014 onwards while calculating damage caused would be much more than the base year data of 2019 as the control measures would not have been deployed at that point in time. Therefore, the actual emissions and the damages thereon will be many times more than the results arrived at in 2019. It was because of this reason that the deterrent factor of two was used in the reports submitted on 18.03.2020. Therefore, the contention of the units that data of 'prior to control measures' were used does not hold good. The various agencies engaged by the units e.g. IIT Madras, IIT Bombay, ICT, etc. for calculating the VOC emissions have been engaged only after report was filed by the CPCB on 18.03.2020. Damages assessed is about the past emissions when control measures were not in place and not about the subsequent emissions after deploying control measures.

32. On such issue, difference of opinions of technical experts cannot be ruled out. The fact remains that the Expert Committee of CPCB constituted by this Tribunal is a credible mechanism. If the report is otherwise sound, the same cannot be brushed aside merely because another technical agency engaged by any particular party takes a different view of the matter. We are, thus, unable to accept the different version in the opinions of agencies hired by the parties and focus ourselves to consider whether the report furnished by the Committee constituted by this Tribunal is sound and acceptable.

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33. While it is true that there may be many reasons for presence of VOCs in the atmosphere like vehicular emissions, etc., it cannot be denied that the said four companies e.g. ALL, SLCL, BPCL and HPCL contribute substantially and predominantly to the VOCs in Mahul and Ambapada villages. It is also scientifically proven that VOCs are potential cause for various serious ailments if humans are exposed to it for a long time. The prolonged exposure to HAPs even at miniscule level may weaken the lungs and other organs. Conditions prevailing in the area are sometimes likened to that of 'Gas Chamber'. It was only because of these reasons that the respondent companies had been taking actions to arrest the fugitive emissions which were particularly noticeable after 2015 and of late the industries have acted on implementation of action plan. The CPCB has accordingly assessed the values of VOCs emissions based upon the data provided to them by the companies. In view of the submissions made by the CPCB and above discussion, the objections of the units regarding use of data prior to control measures and the incorrect application of the formula and methodology are untenable. We are satisfied that all the objections raised by the respondent companies have been duly considered by the CPCB's in-house Technical Committee and we are satisfied with the correctness of the conclusion arrived at by the CPCB. No further hearing is necessary in view of clarifications made by the CPCB.

VII. Conclusion:

34. We accept the report and determine liability of the respondents accordingly without deterrent factor. Compensation for the damage caused due to VOC pollutants emitted by the industries is assessed

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considering the 2nd quartile (medium range) costs and the assessed in 2019, in Rs., in crores, as follows:

Company	***Emissions (kg/day)***	***Emissions (Tons/year)***	***Damage Cost Per Year Rs. in Crores***	***Damage Cost for 5 years Rs. in Crores***
HPCL	*199.9*	*72.96*	*15.3*	*76.5*
BPCL	*176.57*	*64.45*	*13.5*	*67.5*
AEGIS	*372.54*	*135.65*	*28.4*	*142.0*
SEALORD (SLCL)	*0.53*	*0.19*	*0.04*	*0.2*
			TOTAL	*286.2*

35. The respective amounts of compensation be kept in ring-fenced (separate) accounts by the BPCL and HPCL and in escrow account by other respondents. A ten-member joint committee comprising two senior nominees of CPCB, representative of MoEF&CC, State PCB, District Magistrate, Mumbai, NEERI, TISS, Mumbai, IIT Mumbai, KEM Hospital, Mumbai and a nominee of Health Secretary Maharashtra, may prepare action plan for restoration measures spread over a span of time, not beyond five years. The State PCB will be nodal agency. Plan may in particular provide for dealing with health issues of the inhabitants and measures for control of pollution in the area, treating Ambapada, Mahul, Chembur and contiguous area (as may be specified by the Committee) to be *Special Air Pollution Control Area* for the restoration plan.

The joint Committee will be free to take assistance from any other expert/institution and invite the respondents to key meetings. It will be open to the Committee to hold virtual meetings. Absence of one or more members for any reason may not hold up the functioning of the Committee if other members feel appropriate to proceed further in such

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absence. The plan may be executed under the same Committee through the respondents themselves or otherwise.

The amount to the extent of compensation determined will be made available for the plan to be executed by the respondents themselves or otherwise as may be decided by the Committee from time to time.

The finalisation and execution of the action plan may be overseen by Justice V.M. Kanade, former judge of Bombay High Court with the assistance of technical experts nominated by CPCB and State PCB. Justice Kanade will be free to take any other independent assistance.

The honorarium and expenses for this task will be provided by the State PCB out of funds available with it.

The Execution Application is disposed of.

A copy of this order be sent to Justice V.M. Kanade, Chief Secretary, Maharashtra, CPCB, State PCB, District Magistrate, Mumbai, TISS, Mumbai, IIT, Mumbai, MoEFF&CC and NEERI by e-mail.

Adarsh Kumar Goel, CP

S. P. Wangdi, JM

Dr. Satyawan Singh Garbyal, EM

August 13, 2020
EA No. 05/2020 in
OA. No. 40/2014
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