

Block: Sustainable Management of the Industry

Forum: Regulatory issues: governance, risks and compliance - GRC



Assimilation of Noise Footprint within Petroleum Refinery and Adoption of Strategy for its Control and Sustainable Management of Human Health

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Abstract

Inclusion of assessments with respect to noise exposure, audiometry and development of noise footprints as terms of reference for carrying out Environmental Impact Assessment studies by statutory authorities in India, brought a new dimension towards sustainable management of human health. The development of a noise footprint involves an initial survey for identification of monitoring locations, determination of representative sampling days, monitoring, plotting of noise contours and interlinking with audiometric results.

This poster shall portray the noise footprint of an Indian petroleum refinery developed by the authors. In order to assess the extent of noise pollution within the refinery and at the periphery, a survey was carried out to identify 300 strategic locations around various noise generating sources. Noise levels were monitored at these locations both daytime and night time. The same has been mapped and noise contours are plotted for the entire area of the refinery complex.

Abstract (Contd.)

It has been found that the ambient noise levels at the boundary wall of the refinery due to existing refinery operations are even conforming to the permissible residential area noise limits of 55 dB(A) for daytime and 45 dB(A) for night time as per Indian Environmental (Protection) Act and Rules. The maximum noise level at the boundary due to noise transmission from the refinery operations alone is found to be around 40 dB.

Parallel audiometric tests were carried out for 58 personnel working at various locations within the refinery complex. It has been observed that some of the personnel working around heavy noise generating equipment were diagnosed with either sensor neural/ mixed hearing loss or severe Conductive type hearing loss in both ears. A strategy is formulated based on the results and further mitigation measures were implemented. These include installation of acoustic hoods, increasing green cover by planting additional 5000 trees/plants/climbers.

Realizing the importance of assessing existing noise pollution in operating plants and its impact on occupational health of the employees, the Statutory authorities in India have made it must for the development of existing noise footprint in the operating plant, assessment of noise exposure of operating personnel and audiometry tests on them to assess for any hearing loss. These assessments are set as terms of reference by Statutory authorities of India for carrying out Environment Impact Assessment studies and to grant consent for up-gradation/ expansion of the operating plant.

Hence, the noise assessment became one of the important constituents and part of Environment Impact Assessment studies being carried out in India. This new development has resulted in assessment and ensure of sustainable management of human health.

Noise pollution impacts human health and in turn reduce productivity. Noise causes tinnitus, tiredness, stress and nervousness. Severe tinnitus can disturb the ability to sleep, and cause irritability and depression. Excessive noise raises blood pressure. Impact noises over 140 dB cause immediate nerve damage to the ear.

Noise pollution in a refinery complex is mainly due to

- Construction activities
- Plant operations

Construction noise comes from operation of construction equipment and activities. These include motors running, tool use, and impact, among other things. Hearing loss is common among construction workers.

Process operations such as venting, rotating machinery, generators, turbines etc. generate significant noise levels.

Ambient Air Quality Standards in Respect of Noise (as per Statutory Regulations of India)

Area Code	Category of Area/ Zone	Limits in dB(A)	
		Day Time	Night Time
(A)	Industrial Area	75	70
(B)	Commercial Area	65	55
(C)	Residential Area	55	45
(D)	Silence Zone	50	40

Note:-

1. Day time shall mean from 6.00 a.m. to 10.00 p.m.
2. Night time shall mean from 10.00 p.m. to 6.00 a.m.
3. Silence zone is an area comprising not less than 100 meters around hospitals, educational institutions, judicial courts, religious places or any other area which is declared as such by the competent authority.

OSHA Regulations for Noise Exposure

Allowed to be Unprotected	At this Noise Level
Up to 8 Hours	90 decibels
Up to 4 Hours	95 decibels
Up to 1 Hour	105 decibels

Development of Noise Footprint within the Plant:

Thorough survey of the entire plant operational complex is necessary to identify critical and strategic locations around various process units, noise generating process equipment, storage area, unloading facilities, heavy vehicular movement path and refinery boundary. Noise level measurements shall be carried out at these identified locations.

Any temporary activity that is not relevant to regular plant operations viz. construction activity, abnormal operation, may take place during noise measurement process and impact instant noise levels. Hence, one set of noise level measurement at each location will not truly reflect the actual scenario of noise environment. Therefore, the noise measurement process shall be planned taking consideration in to local temporary disturbances and sampling days shall be accordingly decided. Multiple sets of noise levels at different time instants shall be measured at each location and consistent noise level among these readings shall be considered while developing noise footprint.

Noise contour maps shall be developed from the measured noise levels at various identified locations in the plant. Identify high noise areas from the noise contour maps. Review the operating processes at these areas and identify the probable source of high noise. Further study can be made in the high noise zones to find ways to mitigate the noise and bring to comfortable levels.

Also, review the extent of exposure of operating personnel to high noise environment in the identified areas. Protective gear be suggested to operating personnel susceptible for prolonged exposure to high noise environment beyond OSHA permissible exposure levels. Regular audiometric tests are recommended for these personnel to monitor their occupational health and any adverse findings should reflect in their relocation to safer places.

Noise Footprint of an Indian Petroleum Refinery - Case Study:

In order to assess the extent of noise pollution within and at the periphery of the existing operating Indian petroleum refinery, an extensive survey was carried out around various process units, storage tankage area and the refinery boundary. Identified 300 critical and strategic locations around various noise generating process and other equipment, unloading facilities, along the heavy vehicular movement path and refinery battery limits.

As the noise levels at the refinery boundary will be influenced by disturbances outside the refinery complex as well, the locations for noise measurements were selected around 50 meters inside the refinery boundary to mitigate the effect of outside disturbances. The noise levels at the refinery boundary were obtained by considering noise attenuation.

As the number of identified critical locations for noise measurements are huge, for easy identification of locations grids were marked on plant layout drawing. Positioned the critical locations on these grids and labeled them for ease of recording the noise measurements and easy retrieval.

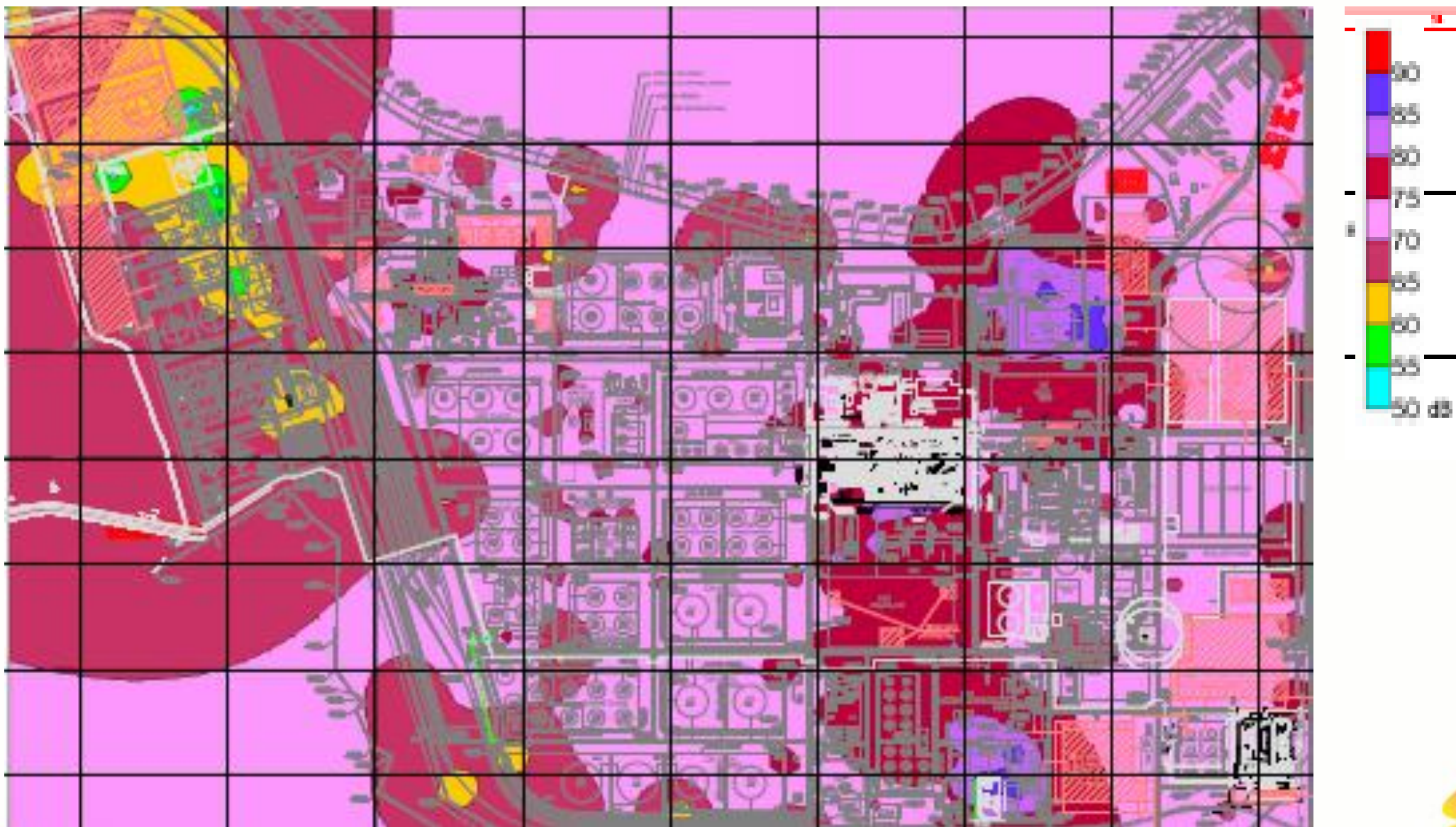
As the noise levels will be impacted in day time due to background noise and other disturbances, these are expected to be higher than corresponding noise levels in night time. Day time noise levels are expected to affect mostly operating personnel, however, the night time noise levels affect the surroundings as well which may cause disturbance and inconvenience to inhabitants around the plant complex. Therefore, it is prudent to establish the noise footprint at both day and night times. In the present case, noise levels were measured at all identified critical locations in both day and night times.

Noise contours were plotted for the entire area of the refinery complex at both day and night times using measured noise levels. These noise contour maps were used for further study on impact on occupational health.

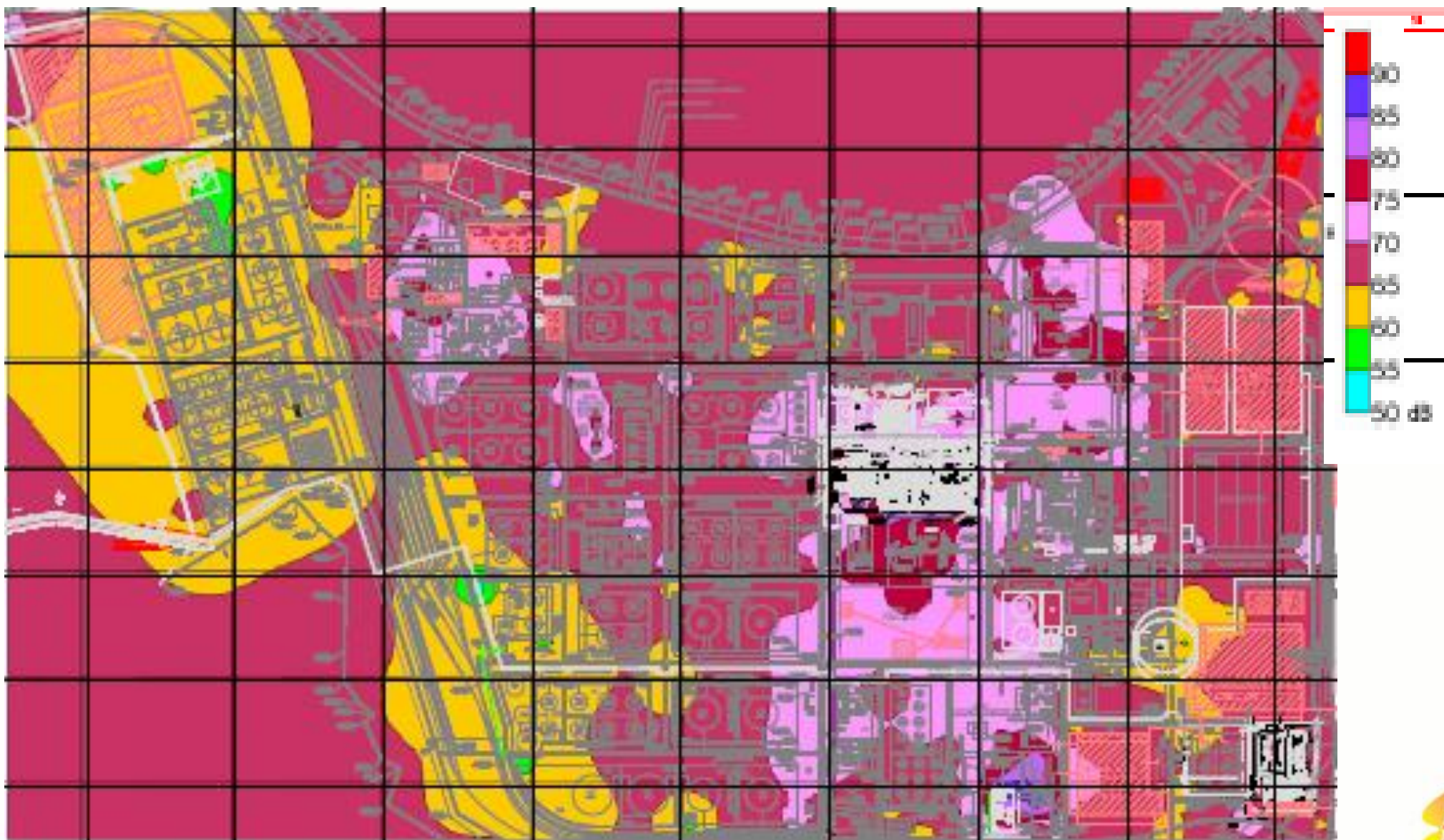
Refinery Layout indicating Grids and Noise Measurement Locations



Noise Contours in Day-Time



Noise Contours in Night-Time



Findings from the Noise Footprint Study:

- Maximum noise level at the refinery boundary due to process operations alone is 40 dB in day time and 30 dB in night time. These noise levels are within and conforming to the standards prescribed under Environmental Protection Act Rules viz. 75 dBA (day time) and 70 dBA (night time). These are even conforming to the permissible residential area noise limits of 55 dBA for daytime and 45 dBA for night time.
- Maximum noise level recorded inside the refinery is 95 dB in day time and 92 dB in night time. These areas are not frequented by operating personnel.
- Otherwise the noise levels within the refinery in both day and night times are much less than 90 dB, the permissible limit for 8 hour continuous exposure, thus complying to OSHA guidelines.

Audiometric Tests on Refinery Personnel to Assess Occupational Health:

Audiometric tests were carried out parallel for 58 personnel working at various locations within the refinery complex. Locations were categorized as “noise hazardous area”, “non-noise hazardous area” and “non-hazardous area”. The operators located in the process units who are exposed to noise environment often during working shift were grouped into “noise hazardous area” category. Operational people located in control room and other buildings within the process units who are not often exposed to noise environment during working shift were grouped into “non-noise hazardous area” category. Other employees located in administrative buildings outside the operational area were grouped into “non-hazardous area” category.

Few of the personnel working around heavy noise generating equipment were diagnosed with severe Conductive type hearing loss in both ears. Otherwise, no hearing loss in majority of employees located in noise hazardous area.

Conclusions:

High noise areas were identified from the noise contours. Further study was carried out to identify the sources of high noise. Methods devised for mitigation of high noise and personnel protection. Apart from recommendation of engineering solutions such as de-tuning of frequencies, provision of acoustic lining/ hoods etc., the mitigation measures include increasing green cover by planting additional 5000 trees/ plants.

The impact of noise generated from the operations in the refinery complex were found to be insignificant at the plant boundary and were not contributing to noise environment in the vicinity of the refinery. Also, these were found to be complying to noise regulations applicable in India.

Personnel exposure levels to noise environment were evaluated further and found to be complying with OSHA regulations on noise exposure.

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Author Biography

Graduated in Mechanical Engineering and done Post Graduation in Machine Design. Presently working as Head of Engineering & Technology Development Department with Engineers India Limited.

Having 24 years of experience in Vibration and Noise studies; Vibration studies of rotating and reciprocating machines; Acoustic study of reciprocating machines; Noise studies of piping and equipment; Piping stress analysis; Studies of expansion joint failures in the piping;

Presently accredited as Functional Expert in Noise & Vibration by Quality Council of India. Involved in various Environment Impact Assessment studies.