ENVIRONMENT MANAGEMENT GUIDELINES
FOR
PROCESS PLANTS

Corporate HSE Department
GAIL (India) Limited
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RESOURCES
INTRODUCTION

1.1 PURPOSE OF THE GUIDELINES

The need for good environmental performance has always been a requirement within the gas industry. Moreover, actions to minimize the release of hydrocarbons to the environment can also lead to improvements in safety performance, healthier working conditions for employees and more cost-effective operations.

The purpose of this guideline is to outline best practices for the optimization of environmental performance in the areas of Air Quality Management, Water and Wastewater Management, Waste Management, Noise Management and Greenbelt Development. This guideline has initially been framed for process plants owing to their larger environmental issues. In its original form this guideline is applicable to GAIL's process plants at Vijaipur, Vaghodia, Gandhar, Usar and Lakwa along with the Petrochemical Plant at Pata.

1.2 ENVIRONMENTAL MANAGEMENT

1.2.1 Underlying Principle for the Guidelines

A fundamental principle presented in these Guidelines is that wherever possible "prevention is better than cure". If an effluent, emission, waste or spill is not generated it does not have to be cleaned up. For storage, the focus should be on maintaining the integrity of primary containment.

To implement this very basic principle across the Gas Processing Plants of GAIL, it is necessary to raise the level of understanding of all personnel on how to operate existing...
equipment and facilities to get the best environmental performance. Improved practices and procedures can eliminate a pollution source at low cost. Designing systems to prevent emissions at source is more cost effective than having to control the effluent once emitted.

1.2.2 Approach

Effective management of environmental issues entails the inclusion of environmental considerations into corporate and facility-level business processes in an organized, hierarchical approach that includes the following steps:

- Identifying environmental aspects and associated risks as early as possible in the facility development or project cycle, including the incorporation of environmental considerations into the site selection process, product design process, engineering planning process for capital requests, engineering work orders, facility modification authorizations, or layout and process change plans.

- Involving environmental professionals, who have the experience, competence, and training necessary to assess and manage environmental impacts and risks, and carry out specialized environmental management functions including the preparation of project or activity-specific plans and procedures that incorporate the technical recommendations that are relevant to the project.

- Understanding the likelihood and magnitude of environmental risks, based on:
  - The nature of the project activities, such as whether the project will generate significant quantities of emissions or effluents, or involve hazardous materials or processes;
  - The potential consequences to workers, communities, or the environment if hazards are not adequately managed, which may depend on the proximity of project activities to people or to the environmental resources on which they depend.

- Prioritizing environmental management strategies with the objective of achieving an overall reduction of risk to human health and the environment, focusing on the prevention of irreversible and/or significant impacts.

- Favouring strategies that eliminate the cause of the hazard at its source, for example, by selecting less hazardous materials or processes that avoid the need for pollution control measures.

- When impact avoidance is not feasible, incorporating engineering and management controls to reduce or minimize the possibility and magnitude of undesired consequences, for example, with the application of pollution control measures to reduce the levels of emitted contaminants to workers or environment.
Preparing workers and nearby communities to respond to environmental accidents, including providing awareness to effectively and safely control such events, and restoring workplace and community environments to a safe and healthy condition.

Improving environmental performance through a combination of ongoing monitoring of facility performance and effective accountability.

1.3 **ENVIRONMENTAL MANAGEMENT GUIDELINES**

Environmental Management Guidelines are formulated for the Gas Processing Plants of GAIL under the following sections:

- Air Quality Management
- Water and Wastewater Management
- Waste Management
- Noise Management
- Greenbelt Development
- Statutory Compliances
- Beyond Compliances
- Resources
AIR QUALITY MANAGEMENT

This guideline is applicable to all the Gas Process Plants of GAIL discharging air emissions to the ambient air. It provides an approach to the management of significant sources of emissions, including specific guidance for assessment and monitoring of impacts.

Emissions of air pollutants can occur from a wide variety of activities during the construction, operation, and decommissioning phases of a project. These activities can be categorized based on the spatial characteristic of the source including point sources, fugitive sources, and mobile sources and, further, by processes such as combustion, materials storage, or other site specific processes. Some of the typical air pollutants emitted from the Gas Processing Plants of GAIL are Hydrocarbon (HC), SOx, NOx, CO and RSPM etc.

Wherever possible, facilities and projects should avoid, minimize, and control adverse impacts to human health, safety, and the environment from emissions to air. Where this is not possible, the generation and release of emissions of any type should be managed through a combination of:

- Energy use efficiency
- Process modification
- Selection of fuels or other materials, the processing of which may result in less polluting emissions
- Application of emissions control techniques
Environmental Management Guidelines for Process Plants

2.1 **GENERAL APPROACH**

Gas Processing Plants with sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:

Emissions do not result in pollutant concentrations that reach or exceed the National Ambient Air Quality Standards (*Table 1*) or any stringent standards prescribed by the respective State Pollution Control Boards in Consent to Establish or Operate under Air (Prevention and Control) of Pollution Act, 1981.
### Table 1: National Ambient Air Quality Standards (Source: CPCB)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Pollutant</th>
<th>Time Weighted average</th>
<th>Concentration in Ambient Air</th>
<th>Methods of Measurement</th>
</tr>
</thead>
</table>
| 1      | Sulphur Dioxide \((\text{SO}_2)\) (\(\mu\text{g/m}^3\)) | Annual* 24 hours**    | Industrial, Residential, Rural and Other Area Ecologically sensitive area (notified by Central Govt.) | • Improved West and Geake
|        |                                  |                       |                              | • Improved West and Geake
|        |                                  |                       |                              | • Ultraviolet fluorescence
| 2      | Nitrogen Dioxide                 | Annual* 24 hours**    |                              | • Modified Jacob & Hochheiser
|        |                                  |                       |                              | • Chemiluminescence
| 3      | Particulate Matter (size less than 10 \(\mu\text{m}\) or PM\(_{10}\) (\(\mu\text{g/m}^3\)) | Annual* 24 hours**    |                              | • Gravimetric
|        |                                  |                       |                              | • TOEM
|        |                                  |                       |                              | • Beta attenuation
| 4      | Particulate Matter (size less than 2.5 microns or PM\(_{2.5}\) (\(\mu\text{g/m}^3\)) | Annual* 24 hours**    |                              | • Gravimetric
|        |                                  |                       |                              | • TOEM
|        |                                  |                       |                              | • Beta attenuation
| 5      | Ozone (O\(_3\)) (\(\mu\text{g/m}^3\)) | 8 hours** 1 hour**    |                              | • UV photometric
|        |                                  |                       |                              | • Chemiluminescence
|        |                                  |                       |                              | • Chemical method
| 6      | Lead (Pb) (\(\mu\text{g/m}^3\)) | Annual* 24 hours**    |                              | • ASS/ICP method after sampling on EPM mg/m\(^3\) 2000 or equivalent filter paper
|        |                                  |                       |                              | • ED-XRF using Teflon filter
| 7      | Carbon Monoxide (CO) (mg/m\(^3\)) | 8 hours** 1 hour**    |                              | • Non Dispersive Infra RED (NDIR Spectroscopy
| 8      | Ammonia (NH\(_3\)) (\(\mu\text{g/m}^3\)) | Annual* 24 hours**    |                              | • Chemiluminescence
|        |                                  |                       |                              | • Indophenol blue method
|        |                                  |                       |                              | • Gas chromatography based
| 9      | Benzene (C\(_6\)H\(_6\)) (\(\mu\text{g/m}^3\)) | Annual* 24 hours**    |                              | • Adsorption and desorption followed by GC analysis
| 10     | Benzo (a) Pyrene (BaP)-particulate phase only (ng/m\(^3\)) | Annual* 24 hours**    |                              | • Solvent extraction followed by HPLC/GC analysis
| 11     | Arsenic (As) (ng/m\(^3\)) | Annual* 24 hours**    |                              | • HPLC/GC AAS/ICP method after sampling on PM 2000 or equivalent
| 12     | Nickel (Ni) (ng/m\(^3\)) | Annual* 24 hours**    |                              | • AAS/ICP method after sampling on EPM 2000 or equivalent filter paper

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* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

- Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.
2.2 **Health and Other Effects of Major Air Pollutants**

2.2.1 **Ground-level Ozone (O$_3$)**

Ground-level ozone not only affects people with impaired respiratory systems (such as asthmatics), but healthy adults and children as well. Exposure to ozone for 6 to 7 hours, even at relatively low concentrations, significantly reduces lung function and induces respiratory inflammation in normal healthy people during periods of moderate exercise. It can be accompanied by symptoms such as chest pain, coughing, nausea, and pulmonary congestion.

2.2.2 **Nitrogen Dioxide (NO$_2$)**

Nitrogen dioxide can irritate the lungs and lower resistance to respiratory infections such as influenza. The effects of short-term exposure are still unclear, but continued or frequent exposure to concentrations that are typically much higher than those normally found in the ambient air may cause increased incidence of acute respiratory illness in children. Nitrogen oxides are important in forming ozone and may affect both terrestrial and aquatic ecosystems. Nitrogen oxides in the air are a potentially significant contributor to a number of environmental effects such as acid rain and eutrophication. Eutrophication occurs when a body of water suffers an increase in nutrients that reduce the amount of oxygen in the water, producing an environment that is destructive to fish and other animal life.

2.2.3 **Particulate Matter (PM$_{10}$ and PM$_{2.5}$)**

Major concerns for human health from exposure to particulate matter are: effects on breathing and respiratory systems, damage to lung tissue, cancer, and premature death. The elderly, children, and people with chronic lung disease, influenza, or asthma, tend to be especially sensitive to the effects of particulate matter. Acidic particulate matter can also damage manmade materials and is a major cause of reduced visibility in many parts.

2.2.4 **Sulphur Dioxide (SO$_2$)**

The major health concerns associated with exposure to high concentrations of SO$_2$ include effects on breathing, respiratory illness, alterations in pulmonary defenses, and aggravation of existing cardiovascular disease. Major subgroups of the population that are most sensitive to SO$_2$ include asthmatics and individuals with cardiovascular disease or chronic lung disease (such as bronchitis or emphysema) as well as children and the elderly. Together, SO$_2$ and NO$_x$ are the major precursors to acid rain, which is associated with the acidification of lakes and streams, accelerated corrosion of buildings and monuments, and reduced visibility.
2.2.5 Lead (Pb)

Exposure to lead mainly occurs through inhalation of air and ingestion of lead in food, paint, water, soil, or dust. Lead accumulates in the body in blood, bone, and soft tissue. Because it is not readily excreted, lead can also affect the kidneys, liver, nervous system, and other organs. Excessive exposure to lead may cause anaemia, kidney disease, reproductive disorders, and neurological impairments such as seizures, mental retardation, and/or behavioural disorders. Even at low doses, lead exposure is associated with changes in fundamental enzymatic, energy transfer, and other processes in the body. Foetuses and children are especially susceptible to low doses of lead, often suffering central nervous system damage or slowed growth.

2.2.6 Carbon Monoxide (CO)

Carbon monoxide enters the bloodstream and reduces oxygen delivery to the body's organs and tissues. The health threat from CO is most serious for those who suffer from cardiovascular disease. Healthy individuals are also affected, but only at higher levels of exposure. Exposure to elevated CO levels is associated with visual impairment, reduced work capacity, reduced manual dexterity, poor learning ability, and difficulty in performing complex tasks.

2.3 Point Sources

Point sources are discrete, stationary, identifiable sources of emissions that release pollutants to the atmosphere. They are typically located in process plants. Within a given point source, there may be several individual ‘emission points’ that comprise the point source. Point sources are characterized by the release of air pollutants typically associated with the combustion of fossil fuels, such as Nitrogen Oxides (NO\textsubscript{x}), Sulfur Dioxide (SO\textsubscript{2}), Carbon Monoxide (CO), and Particulate Matter (PM), as well as other air pollutants including certain Volatile Organic Compounds (VOCs) and metals that may also be associated with a wide range of industrial activities. Emissions from point sources should be avoided and controlled through the combined application of process modifications and emissions controls.

2.4 Stack Emissions

Exhaust gas emissions produced by the combustion of gas or other hydrocarbon fuels in turbines, boilers, compressors, pumps, and other engines for power and heat generation are a significant source of air emissions from natural gas processing facilities. Incineration of oxygenated byproducts also generates CO\textsubscript{2} and Nitrogen Oxides (NO\textsubscript{x}) emissions.
Emissions related to the operation of power sources should be minimized through the adoption of a combined strategy which includes a reduction in energy demand, use of cleaner fuels, and application of emissions controls where required.

The stack height for all point sources of emissions, whether ‘significant’ or not, should be well designed to avoid excessive ground level concentrations due to downwash, wakes, and eddy effects, and to ensure reasonable diffusion to minimize impacts. For sites where there are multiple sources of emissions, stack heights should be established with due consideration to emissions from all other project sources, both point and fugitive. Non-significant sources of emissions, including small combustion sources, should also use proper stack design.

2.5 Fugitive Emissions

Fugitive emissions in Gas Processing Plants of GAIL may be associated with leaks in tubing, valves, connections, flanges, packings, open-ended lines, floating roof storage tank, pump, and compressor seals, gas conveyance systems, pressure relief valves, tanks or open pits/containments, and loading and unloading operations of hydrocarbons.

The main sources and pollutants of concern include Volatile Organic Compound (VOC) emissions from storage tanks during filling and due to tank breathing, floating roof seals in case of floating roof storage tanks, wastewater treatment units. Additional sources of fugitive emissions include nitrogen gas contaminated with methanol vapour from methanol storage facilities, methane (CH₄), carbon monoxide (CO).

2.5.1 Prevention and Control of Fugitive Emissions

Some of the recommendations to prevent and control fugitive emissions from Gas Processing Plants include the following:

- Regularly monitoring fugitive emissions from pipes, valves, seals, tanks, and other infrastructure components with vapour detection equipment, and maintenance or replacement of components as needed in a prioritized manner.

- Maintaining stable tank pressure and vapour space by:
  - Coordinating filling and withdrawal schedules, and implementing vapour balancing between tanks, (a process whereby vapour displaced during filling activities is transferred to the vapour space of the tank being emptied or to other containment in preparation for vapour recovery).
  - Using white or other colour paints with low heat absorption properties on exteriors of storage tanks for lighter distillates such as gasoline, ethanol, and methanol to reduce heat absorption.
Selecting and designing storage tanks in accordance with internationally accepted standards to minimize storage and working losses considering, for example, storage capacity and the vapour pressure of materials being stored.

Use of supply and return systems, vapour recovery hoses, and vapour-tight trucks / railcars / vessels during loading and unloading of transport vehicles.

Use of bottom-loading truck / railcar filling systems and

Where vapour emissions contribute or result in ambient air quality levels in excess of health based standards, secondary emission controls should be installed, such as vapour condensing and recovery units, catalytic oxidizers, vapour combustion units, or gas adsorption media.

2.6 VENTING AND FLARING

Venting and flaring are an important operational and safety measure used in Gas Processing Plants of GAIL to ensure gas is safely disposed off in the event of an emergency, power or equipment failure, or other plant upset conditions. Unreacted raw materials and by-product combustible gases are also disposed off through venting and flaring. Excess gas should not be vented but instead sent to an efficient flare gas system for disposal.

Some of the recommendations to minimize gas venting and flaring from Gas Processing Plants of GAIL include the following:

- Optimization of plant controls to increase the reaction conversion rates.
- Recycling unreacted raw materials and by-product combustible gases in the process or utilizing these gases for power generation or heat recovery, if possible.
- Providing back-up systems to achieve as high a plant reliability as practical and
- Locating the flaring system at a safe distance from residential areas or other potential receptors, and maintaining the system to achieve high efficiency.

Emergency venting may be acceptable under specific conditions where flaring of the gas stream is not appropriate. For example, if in any process there is a stream containing high concentrations of carbon dioxide which, if sent to a flare system, would extinguish the flare’s flame; venting of such streams to a safe atmospheric location is an acceptable option. Standard risk assessment methodologies should be utilized to analyze such situations. Justification for not using a gas flaring system should be fully documented before an emergency gas venting facility is considered.
WATER AND WASTEWATER MANAGEMENT

Wastewater management at GAIL includes wastewater collection and treatment, storm water management, water conservation, and wastewater and water quality monitoring.

3.1 Industrial Process Wastewater

Process wastewater and other wastewater from gas processing plants of GAIL, which may be containing dissolved hydrocarbons, oxygenated compounds, and other contaminants, should be treated at the onsite Wastewater/ Effluent Treatment Plant (WWTP/ETP). Recommended process wastewater management practices include:

- Prevention and control of accidental releases of liquids through inspections and maintenance of storage and conveyance systems, including stuffing boxes on pumps and valves and other potential leakage points, as well as the implementation of spill response plans;

- Provision of sufficient process fluids let-down capacity to maximize recovery into the process and to avoid massive process liquids discharge into the oily water drain system;

- Design and construction of wastewater and hazardous materials storage containment basins with impervious surfaces to prevent infiltration of contaminated water into soil and groundwater.
Hydrocarbon contaminated water from scheduled cleaning activities during plant shut-down, hydrocarbon-containing effluents from process leaks, and heavy-metals containing effluents from fixed and fluidized beds should be treated via the facility’s Effluent Treatment Plant.

Additionally, the generation and discharge of wastewater of any type should be managed through a combination of:

- Water use efficiency to reduce the amount of wastewater generation
- Process modification, including waste minimization, and reducing the use of hazardous materials to reduce the load of pollutants requiring treatment
- If needed, application of wastewater treatment techniques to further reduce the load of contaminants prior to discharge

### 3.2 Wastewater Treatment

Techniques for treating gas processing plants wastewater include source segregation and pre-treatment of concentrated wastewater streams. Typical wastewater treatment steps may include: grease traps, skimmers, dissolved air floatation, or oil / water separators for separation of oils and floatable solids, filtration for separation of filterable solids, flow and load equalization, sedimentation for suspended solids reduction using clarifiers, biological treatment, typically aerobic treatment, for reduction of soluble organic matter (BOD), chemical or biological nutrient removal for reduction in nitrogen and phosphorus, chlorination of effluent when disinfection is required, and dewatering and disposal of residuals in designated hazardous waste landfills.

Through use of these technologies and good practice techniques for wastewater management, facilities should meet the standards prescribed for wastewater discharge as per the Consent to Operate or by Central Pollution Control Board or the respective State Pollution Control Board. The standard for discharge of treated wastewater based on the type of the receiving source is given below in Table 2. The Minimum National Standard for discharge of effluents from gas processing plants has not yet been developed. In such a case the Minimum National Standard available for Petroleum Oil Refinery is applicable to gas processing plant which is given below in Table 3.
### Table 2: General Standards for Discharge of Environmental Pollutants

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Parameter</th>
<th>Inland Surface Water (a)</th>
<th>Public Sewers (b)</th>
<th>Land for irrigation (c)</th>
<th>Marine Coastal Areas (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Colour and odour</td>
<td>All efforts should be made to remove colour and unpleasant odour as far as practicable.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Suspended solids, mg/l</td>
<td>100</td>
<td>600</td>
<td>200</td>
<td>For process waste water-100 For cooling water effluent-10 percent above total suspended matter of influent</td>
</tr>
<tr>
<td>3.</td>
<td>Particle size of suspended solids</td>
<td>Shall pass 850 micron IS sieve</td>
<td>-</td>
<td>-</td>
<td>Floatable solids, max. 3mm</td>
</tr>
<tr>
<td>4.</td>
<td>Dissolved solids (inorganic), mg/l Max.</td>
<td>Omitted</td>
<td>Omitted</td>
<td>Omitted</td>
<td>Omitted</td>
</tr>
<tr>
<td>5.</td>
<td>pH value</td>
<td>5.5 to 9.0</td>
<td>5.5 to 9.0</td>
<td>5.5 to 9.0</td>
<td>5.5 to 9.0</td>
</tr>
<tr>
<td>6.</td>
<td>Temperature</td>
<td>Shall not exceed 50°C above the receiving water temperature</td>
<td>-</td>
<td>-</td>
<td>Shall not exceed 50°C above the receiving water temperature</td>
</tr>
<tr>
<td>7.</td>
<td>Oil and grease, mg/l Max.</td>
<td>10</td>
<td>20</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>8.</td>
<td>Total residual chlorine, mg/l Max.</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>9.</td>
<td>Ammonical nitrogen (as N), mg/l Max.</td>
<td>50</td>
<td>50</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>10.</td>
<td>Total Kjeldahl nitrogen (as N), mg/l Max.</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>11.</td>
<td>Free ammonia (as NH₃), mg/l Max.</td>
<td>5.0</td>
<td>-</td>
<td>-</td>
<td>5.0</td>
</tr>
<tr>
<td>12.</td>
<td>Biochemical Oxygen Demand (5 days at 20°C), mg/l</td>
<td>30</td>
<td>350</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>13.</td>
<td>Chemical Oxygen Demand, mg/l Max.</td>
<td>250</td>
<td>-</td>
<td>-</td>
<td>250</td>
</tr>
<tr>
<td>14.</td>
<td>Arsenic (as As), mg/l Max.</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>15.</td>
<td>Mercury (as Hg), mg/l Max.</td>
<td>0.01</td>
<td>0.01</td>
<td>-</td>
<td>0.01</td>
</tr>
<tr>
<td>16.</td>
<td>Lead (as Pb), mg/l Max.</td>
<td>0.1</td>
<td>1.0</td>
<td>-</td>
<td>2.0</td>
</tr>
<tr>
<td>17.</td>
<td>Cadmium (as Cd), mg/l Max.</td>
<td>2.0</td>
<td>1.0</td>
<td>-</td>
<td>2.0</td>
</tr>
<tr>
<td>18.</td>
<td>Hexavalent Chromium (as Cr⁶⁺), mg/l Max.</td>
<td>0.1</td>
<td>2.0</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>19.</td>
<td>Total Chromium (as Cr), mg/l Max.</td>
<td>2.0</td>
<td>2.0</td>
<td>-</td>
<td>2.0</td>
</tr>
<tr>
<td>20.</td>
<td>Copper (as Cu), mg/l Max.</td>
<td>3.0</td>
<td>3.0</td>
<td>-</td>
<td>15</td>
</tr>
<tr>
<td>21.</td>
<td>Zinc (as Zn), mg/l Max.</td>
<td>5.0</td>
<td>15</td>
<td>-</td>
<td>15</td>
</tr>
<tr>
<td>22.</td>
<td>Selenium (as Se), mg/l Max.</td>
<td>0.05</td>
<td>0.05</td>
<td>-</td>
<td>0.05</td>
</tr>
<tr>
<td>23.</td>
<td>Nickel (as Ni), mg/l max.</td>
<td>3.0</td>
<td>3.0</td>
<td>-</td>
<td>5.0</td>
</tr>
<tr>
<td>24.</td>
<td>Boron (as B), mg/l Max.</td>
<td>Omitted</td>
<td>Omitted</td>
<td>Omitted</td>
<td>Omitted</td>
</tr>
<tr>
<td>25.</td>
<td>Percent Sodium Max.</td>
<td>Omitted</td>
<td>Omitted</td>
<td>Omitted</td>
<td>Omitted</td>
</tr>
<tr>
<td>26.</td>
<td>Residual Sodium Carbonate, mg/l Max.</td>
<td>Omitted</td>
<td>Omitted</td>
<td>Omitted</td>
<td>Omitted</td>
</tr>
<tr>
<td>27.</td>
<td>Cyanide (as CN), mg/l Max.</td>
<td>0.2</td>
<td>2.0</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>28.</td>
<td>Chloride (as Cl), mg/l Max.</td>
<td>Omitted</td>
<td>Omitted</td>
<td>Omitted</td>
<td>Omitted</td>
</tr>
<tr>
<td>29.</td>
<td>Fluoride (as F), mg/l Max.</td>
<td>2.0</td>
<td>15</td>
<td>-</td>
<td>15</td>
</tr>
<tr>
<td>30.</td>
<td>Dissolved Phosphated (as P), mg/l Max.</td>
<td>5.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>31.</td>
<td>Sulphate (as SO₄), mg/l Max.</td>
<td>Omitted</td>
<td>Omitted</td>
<td>Omitted</td>
<td>Omitted</td>
</tr>
<tr>
<td>32.</td>
<td>Sulphide (as S), mg/l Max.</td>
<td>2.0</td>
<td>-</td>
<td>-</td>
<td>5.0</td>
</tr>
<tr>
<td>33.</td>
<td>Phenolic compounds (as C₆H₅OH), mg/l max.</td>
<td>1.0</td>
<td>5.0</td>
<td>-</td>
<td>5.0</td>
</tr>
<tr>
<td>34.</td>
<td>Radioactive Materials Alpha emitters, UC/ml Max.</td>
<td>10⁴</td>
<td>10⁴</td>
<td>10⁴</td>
<td>10⁻⁷</td>
</tr>
<tr>
<td></td>
<td>Beta emitters, UC/ml Max.</td>
<td>10⁻⁶</td>
<td>10⁻⁶</td>
<td>10⁻⁷</td>
<td>10⁻⁷</td>
</tr>
</tbody>
</table>
### Table 3: MINAS for Discharge of Effluent

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Parameter</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>pH</td>
<td>6.0-8.5</td>
</tr>
<tr>
<td>2.</td>
<td>Oil &amp; Grease</td>
<td>5.0</td>
</tr>
<tr>
<td>3.</td>
<td>BOD 3 day, 27°C</td>
<td>15.0</td>
</tr>
<tr>
<td>4.</td>
<td>COD</td>
<td>125.0</td>
</tr>
<tr>
<td>5.</td>
<td>Suspended Solids</td>
<td>20.0</td>
</tr>
<tr>
<td>6.</td>
<td>Phenols</td>
<td>0.35</td>
</tr>
<tr>
<td>7.</td>
<td>Sulphides</td>
<td>0.5</td>
</tr>
<tr>
<td>8.</td>
<td>CN</td>
<td>0.20</td>
</tr>
<tr>
<td>9.</td>
<td>Ammonia as N</td>
<td>15.0</td>
</tr>
<tr>
<td>10.</td>
<td>TKN</td>
<td>40.0</td>
</tr>
<tr>
<td>11.</td>
<td>P</td>
<td>3.0</td>
</tr>
<tr>
<td>12.</td>
<td>Cr (Hexavalent)</td>
<td>0.1</td>
</tr>
<tr>
<td>13.</td>
<td>Cr (Total)</td>
<td>2.0</td>
</tr>
<tr>
<td>14.</td>
<td>Pb</td>
<td>0.1</td>
</tr>
<tr>
<td>15.</td>
<td>Hg</td>
<td>0.01</td>
</tr>
<tr>
<td>16.</td>
<td>ZN</td>
<td>5.0</td>
</tr>
<tr>
<td>17.</td>
<td>Ni</td>
<td>1.0</td>
</tr>
<tr>
<td>18.</td>
<td>Cu</td>
<td>1.0</td>
</tr>
<tr>
<td>19.</td>
<td>V</td>
<td>0.2</td>
</tr>
<tr>
<td>20.</td>
<td>Benzene</td>
<td>0.1</td>
</tr>
<tr>
<td>21.</td>
<td>Benzo (a) - Pyrene</td>
<td>0.2</td>
</tr>
</tbody>
</table>

**Notes:**

i. Concentration limits shall be complied with at the outlet, discharging effluent (excluding discharge from sea water cooling systems) to receiving environment (surface water Bodies, marine systems or public sewers). In case of application of treated effluent directly for irrigation/horticulture purposes (within or
outside the premises of refinery), make-up water for cooling systems, fire fighting, etc., the concentration limits shall also be complied with at the outlet before taking the effluent for such application. However, any use in the process such as use of sour water in desalter is excluded for the purpose of compliance.

ii. In case of circulating seawater cooling, the blow-down from cooling systems shall be monitored for pH and oil & grease (also hexavalent & total chromium, if chromate treatment is given to cooling water) and shall conform to the concentration limits for these parameters. In case of reuse of treated effluent as cooling water make-up, all the parameters (as applicable for treated effluent) shall be monitored and conform to the prescribed standards.

iii. In case of once through cooling with seawater, the oil & grease content in the effluent from cooling water shall not exceed 1.0 mg/l.

### 3.3 COOLING WATER MANAGEMENT

Cooling water may necessitate high rates of water consumption, as well as the potential release of high temperature water, residues of biocides, and residues of other cooling system anti-fouling agents. Some of the recommended cooling water management strategies are:

- Looking for water conservation opportunities which may include:
  - Use of closed circuit cooling systems with cooling towers rather than once-through cooling systems
  - Limiting condenser or cooling tower blowdown to the minimum required to prevent unacceptable accumulation of dissolved solids
  - Use of air cooling rather than evaporative cooling, although this may increase electricity use in the cooling system
  - Use of treated waste water for cooling towers
  - Reusing/recycling cooling tower blowdown

- Use of heat recovery methods or other cooling methods to reduce the temperature of heated water prior to discharge.

- Minimizing use of antifouling and corrosion-inhibiting chemicals through proper selection of depth for placement of water intake and use of screens, selection of the least hazardous alternative with regards to toxicity, biodegradability, bioavailability, and bioaccumulation potential and dosing according to local regulatory requirements and manufacturer recommendations.
3.4 STORMWATER MANAGEMENT

Stormwater includes any surface runoff and flows resulting from precipitation, drainage or other sources. At GAIL, typical stormwater runoff may contain suspended sediments, petroleum hydrocarbons, Polycyclic Aromatic Hydrocarbons (PAHs), coliform, etc. Rapid runoff, even of uncontaminated stormwater, also degrades the quality of the receiving water by eroding stream beds and banks. In order to reduce the need for stormwater treatment, the following principles should be applied:

- Stormwater should be separated from process and sanitary wastewater streams in order to reduce the volume of wastewater to be treated prior to discharge.
- Surface runoff from process areas or potential sources of contamination should be prevented.
- Where this approach is not practical, runoff from process and storage areas should be segregated from potentially less contaminated runoff.
- Where stormwater treatment is deemed necessary to protect the quality of receiving water bodies, priority should be given to managing and treating the first flush of stormwater runoff where the majority of potential contaminants tend to be present.
- When water quality permits, stormwater should be managed as a resource for meeting water needs at the facility.
- Oil water separators and grease traps should be installed and maintained as appropriate at refuelling facilities, workshops, parking areas, fuel storage and containment areas.

3.5 HYDROSTATIC TESTING WATER MANAGEMENT

Hydrostatic testing of equipment and pipelines involves pressure testing with water to verify their integrity and to detect possible leaks. Chemical additives (typically a corrosion inhibitor, an oxygen scavenger, and a dye) may be added. In managing hydro-test waters, the following pollution prevention and control measures should be implemented:

- Testing for the presence of residual biocides and other pollutants of concern to determine the need for dose adjustments or treatment of cooling water prior to discharge.
Using the same water for multiple tests to conserve water and minimize discharges of potentially contaminated effluent

- Reducing the use of corrosion inhibiting or other chemicals by minimizing the time that test water remains in the equipment or pipeline and
- Selecting the least hazardous alternative with regards to toxicity, biodegradability, bioavailability, and bioaccumulation potential, and dosing according to local regulatory requirements and manufacturer recommendations.

If discharge of hydro-test waters to the sea or to surface water is the only feasible alternative for disposal, a hydro-test water disposal plan should be prepared considering location and rate of discharge, chemical use (if any), dispersion, environmental risk, and required monitoring.

### 3.6 Water Conservation

Water conservation programs should be implemented commensurate with the magnitude and cost of water use. These programs should promote the continuous reduction in water consumption and achieve savings in the water pumping, treatment and disposal costs. Water conservation measures may include water monitoring/management techniques, process and cooling water recycling, reuse, and other sanitary water conservation techniques.

- General recommendations include:
  - Storm/Rainwater harvesting and use
  - Zero discharge design/Use of treated wastewater
  - Use of localized recirculation systems in plant/facility with provision only for makeup water
  - Use of dry process technologies e.g. dry quenching
  - Process water system pressure management
  - Project design to have measures for adequate water collection, spill control and leakage control system
3.7 **WATER MONITORING AND MEASUREMENT**

Water monitoring and measurement is an essential element of a water management program. It involves:

- Identification, regular measurement, and recording of principal flows within a facility;
- Regular comparison of water flows with performance targets to identify where action should be taken to reduce water use.

Water measurement (metering) should emphasize areas of greatest water use. Based on review of metering data, ‘unaccounted’ use – indicating major leaks at the facility should be identified and checked.

3.8 **WATER RECYCLING AND REUSE**

Water recycling is reusing treated wastewater for beneficial purposes such as horticulture, landscape irrigation, industrial processes like cooling water or fire water replenishment, toilet flushing, and replenishing a ground water basin (referred to as ground water recharge). Water recycling offers resource and financial savings. Wastewater treatment can be tailored to meet the water quality requirements of a planned reuse. Recycled water for horticulture purposes requires less treatment than recycled water for drinking purposes. Water recycling and reuse should be promoted to the maximum extent possible in a way making the process plants, Zero Effluent Discharge plants. Important wastewater parameters to be monitored at GAIL are presented in the Table 4 below.

**Table 4: Important wastewater parameters to be monitored at GAIL**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>pH</td>
</tr>
<tr>
<td>2.</td>
<td>Suspended Solids</td>
</tr>
<tr>
<td>3.</td>
<td>Total Dissolved Solids</td>
</tr>
<tr>
<td>4.</td>
<td>Biochemical Oxygen Demand</td>
</tr>
<tr>
<td>5.</td>
<td>Chemical Oxygen Demand</td>
</tr>
<tr>
<td>6.</td>
<td>Oil &amp; Grease</td>
</tr>
<tr>
<td>7.</td>
<td>Phenol</td>
</tr>
<tr>
<td>8.</td>
<td>Sulphides</td>
</tr>
<tr>
<td>9.</td>
<td>Cyanides</td>
</tr>
</tbody>
</table>

**Note:**

However, the conditions of Consent to Operate from respective SPSBs to be followed as applicable.
WASTE MANAGEMENT

A waste is any solid, liquid, or contained gaseous material that is being discarded by disposal, recycling, burning or incineration. It can be by-product of a manufacturing process or an obsolete commercial product that can no longer be used for intended purpose and requires disposal.

Solid (non-hazardous) wastes generally include any garbage, refuse. Examples of such waste include domestic trash and garbage, inert construction / demolition materials, refuse, such as metal scrap and empty containers (except those previously used to contain hazardous materials which should, in principle, be managed as a hazardous waste), and residual waste from industrial operations, such as boiler slag, clinker, and fly ash.

Hazardous waste shares the properties of a hazardous material (e.g. ignitability, corrosivity, reactivity, or toxicity), or other physical, chemical, or biological characteristics that may pose a potential risk to human health or the environment if improperly managed. Wastes may also be classified as “hazardous” based on its inclusion in Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2008. The typical hazardous wastes generated at GAIL’s processing plants or petrochemical unit are presented in the Table 5 below.

Table 5: Typical Hazardous Wastes at GAIL

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Hazardous Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Used Oil</td>
</tr>
<tr>
<td>2.</td>
<td>Slope / skimmed Oil</td>
</tr>
<tr>
<td>3.</td>
<td>Oily WWTP Sludge</td>
</tr>
<tr>
<td>4.</td>
<td>Empty Mercaptan Drums</td>
</tr>
<tr>
<td>5.</td>
<td>Molecular Sieves (Petrochemical Unit)</td>
</tr>
</tbody>
</table>
4.1 **WASTE MANAGEMENT**

Facilities that generate and store wastes should practice the following:

- Establishing waste management priorities at the outset of activities based on an understanding of potential environmental risks and impacts and considering waste generation and its consequences.

- Establishing a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes.

- Avoiding or minimizing the generation of waste materials, as far as practicable.

- Recovering and reusing waste where its generation cannot be avoided but has been minimized.

- Treating, destroying, and disposing of waste in an environmentally sound manner where it cannot be recovered or reused.

4.1.1 **Waste Prevention**

Processes should be designed and operated to prevent, or minimize, the quantities of wastes generated and hazards associated with the wastes generated in accordance with the following strategy:

- Substituting raw materials or inputs with less hazardous or toxic materials, or with those where processing generates lower waste volumes.

- Applying manufacturing process that convert materials efficiently, providing higher product output yields, including modification of design of the production process, operating conditions, and process controls.

- Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off-specification, contaminated, damaged, or excess to plant needs.

- Instituting procurement measures that recognize opportunities to return usable materials such as containers and which prevents the over ordering of materials.

- Minimizing hazardous waste generation by implementing stringent waste segregation to prevent the co-mingling of non-hazardous and hazardous waste.

4.1.2 **Recycling and Reuse**

In addition to the implementation of waste prevention strategies, the total amount of waste may be significantly reduced through the implementation of recycling plans, which should consider the following elements:
Environmental Management Guidelines for Process Plants

- Evaluation of waste production processes and identification of potentially recyclable materials.

- Identification and recycling of products that can be reintroduced into the manufacturing process or activity at the site e.g. neutralization of empty ethyl Mercaptan drums and reuse of those neutralized drums as tree guards inside plant premises.

- Investigation of external markets for recycling by other industrial processing operations located in the neighbourhood or region of the facility e.g. sale of skimmed/slope and waste oil to MoEF authorized recyclers for recovery of reusable materials.

- Establishing recycling objectives and formal tracking of waste generation and recycling rates.

4.1.3 Treatment and Disposal

If waste materials are still generated after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, waste materials should be treated and disposed of and all measures should be taken to avoid potential impacts to human health and the environment. Selected management approaches should be consistent with the characteristics of the waste and local regulations, and may include one or more of the following:

- On-site or off-site biological, chemical, or physical treatment of the waste material to render it non-hazardous prior to final disposal.

- Treatment or disposal at permitted facilities specially designed to receive the waste. e.g. composting operations for organic non-hazardous wastes, properly designed, permitted and operated landfills or incinerators designed for the respective type of waste, or other methods known to be effective in the safe, final disposal of waste materials.

- Treatment and disposal of Bio-medical wastes in compliance with Bio-Medical Waste (Management & Handling) Rules, 1998 at the facilities authorized by the respective SPCBs.

4.2 Hazardous Waste Management Practices at GAIL

Hazardous wastes should always be segregated from non-hazardous wastes. If generation of hazardous waste cannot be prevented through the implementation of the above waste management practices, its management should focus on the prevention of harm to the environment, possible onsite treatment and disposal based on the type of waste as follows:

- Understanding potential impacts and risks associated with the management of any generated hazardous waste during its complete life cycle.
The empty ethyl Mercaptan drums should be neutralized following the standard operating procedure and used as tree guards inside the plant premises.

Skimmed/slope oil and waste oil should be auctioned to the MoEF authorized recyclers for recovery of reusable materials and such recyclers should be made to ensure that the end products are disposed off in environmentally sound manner.

The hazardous wastes which are not of any commercial value and do not have any reusable part in them should be sent to incinerators or secured landfills on case to case basis.

Ensuring that contractors handling, treating, and disposing of hazardous waste are authorized by the Ministry of Environment and Forests (MoEF) for the given purpose.


4.2.1 Waste Storage

Hazardous waste should be stored so as to prevent or control accidental releases to air, soil, and water resources. Following precautions should be taken for the same:

- Waste should be stored in a manner that prevents the co-mingling or contact with other type of wastes.
- It should allow for inspection between containers to monitor leaks or spills.
- Storage should be in closed containers away from direct sunlight, wind and rain.
- Secondary containment systems should be constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment.
- Adequate ventilation should be provided where volatile wastes are stored.
- Segregation and proper labelling of different type of wastes.
- Clearly identifying (label) and demarcating the area, including documentation of its location on a facility map or site plan.
- Conducting periodic inspections of waste storage areas and documenting the findings.

4.2.2 Transportation

On-site and Off-site transportation of waste should be conducted so as to prevent or minimize spills, releases, and exposures to employees and the public. All waste containers designated for off-site shipment should be
secured and labelled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site. It should be accompanied by a shipping paper (i.e., manifest) that describes the load and its associated hazards, consistent with the guidelines provided in Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008.

4.3 **E-Waste Management**

The E-waste (Management & Handling) Rules, 2011 were notified in May 2011 and came into effect from May 01, 2012. These rules apply to every producer, consumer or bulk consumer, collection centre, dismantler and recycler of e-waste involved in the manufacture, sale, purchase and processing of electrical and electronic equipment or components.

E-waste has been defined as “waste electrical and electronic equipment, whole or in part or rejects from their manufacturing and repair process, which are intended to be discarded”. Whereas Electrical and electronic equipment has been defined as “equipment which is dependent on electrical currents or electromagnetic fields to be fully functional”.

The electrical and electronic equipment (EEE) have valuable materials and hazardous/toxics substances in their components. The electronic products and electrical equipment after their useful life may not cause any harm if it is stored safely in households/stores. However, if the E-waste is opened-up and attempts are made for retrieval of useful components or material in an un-scientific manner or if the material is disposed in open, then it may cause health risks and damage to environment. E-waste can be considered as a resource that contains useful material of economic benefit for recovery of plastics, iron, glass, aluminium, copper and precious metals such as silver, gold, platinum, and palladium and lead, cadmium, mercury etc. However, at the same time presence of heavy metals (As, Cd, Hg, Pb etc.) and other toxic substances such as polychlorinated bi-phenyls (PCBs), etched chemicals, etc. may pose risk to health and environment during handling and recovery operations.

Therefore, the presence of hazardous and toxic substances in the component of e-waste necessitates environmentally sound management of e-waste including collection and recycling/treatment in an environmentally sound manner.

4.3.1 **Objectives of E-Waste (Management & Handling) Rules, 2011**

The E-waste (Management & Handling) Rules, 2011 have been notified with primary objective to channelize the E-waste generated in the country for environmentally sound recycling which is largely controlled by the un-organized sector who are adopting crude practices that results into higher pollution and less recovery, thereby causing wastages of precious resources and damage to environment.
The E-waste Rules place main responsibility of e-waste management on the producers of the electrical and electronic equipment by introducing the concept of “Extended Producer Responsibility” (EPR). Extended Producer Responsibility is a responsibility of any producer of electrical or electronic equipment, for their products beyond manufacturing until environmentally sound management of their end of life products. Thus, the producer is responsible for their products once the consumer discards them. Under this EPR, producer is also entrusted with the responsibility to finance and organize a system to meet the costs involved in complying with EPR.

4.3.2 Applicability of E-Waste (Management & Handling) Rules, 2011 to GAIL

GAIL (India) Limited comes under the category of Bulk Consumers. Bulk Consumers are bulk users of electrical and electronic equipment such as central government or state government departments, public sector undertakings, banks, educational institutions, multinational organizations, international agencies and private companies that are registered under the Factories Act, 1948 and Companies Act, 1956.

4.3.3 Responsibility of Bulk Consumers

As per these rules a bulk consumer has to ensure that the e-waste generated by them have to be channelized to authorized collection centres or registered dismantler or recycler or is returned to the producer through its pick up or take back services or through its collection points. The bulk consumer has to maintain records of e-waste generated by them in the format prescribed by the E-waste (Management & Handling) Rules, 2011 and make such records available for scrutiny to State Pollution Control Board whenever demanded.

4.3.4 E-waste Management Procedure

The following procedures should be followed for management of e-waste:

i. All the concerned departments should maintain a record of e-waste generated in the department.

ii. The e-waste generated by the various departments should be sent to the material store and stored at demarcated places.

iii. The inventory of e-waste should be maintained in Form-2 at material store and to be made available for scrutiny to the State Pollution Control Board whenever demanded.

iv. The e-waste should be disposed off by either of the following methods in the order of priority:


   b. Return of the e-waste to the respective producers through their pick up/take back services/collection points.
c. Sale to MoEF/CPCB/SPCB authorized recyclers through tendering process. In such cases recyclers would need to issue requisite Certificate of Safe Disposal of e-waste in line with MoEF/CPCB/SPCB stipulations.

v. In case of donation of the used equipment, a certificate should be obtained from the beneficiary organization that the organization will ensure safe disposal at the end of its life cycle as per statutory requirements.

vi. Awareness about e-waste handling policy and procedures should be generated among employees.

vii. E-waste management practices should be made a part of internal and external safety audits.

4.3.5 Categories of Electrical and Electronic Equipment covered under the Rules

The categories of electrical and electronic equipment covered under the E-waste (Management & Handling) Rules, 2011 are listed in the Table below.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Categories of Electrical and Electronic Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Information Technology and telecommunication equipment:</td>
</tr>
<tr>
<td></td>
<td>Centralized data processing:</td>
</tr>
<tr>
<td></td>
<td>Mainframes, Minicomputers</td>
</tr>
<tr>
<td></td>
<td>Personal computing</td>
</tr>
<tr>
<td></td>
<td>Personal Computers</td>
</tr>
<tr>
<td></td>
<td>Laptop Computers</td>
</tr>
<tr>
<td></td>
<td>Notebook Computers</td>
</tr>
<tr>
<td></td>
<td>Notepad Computers</td>
</tr>
<tr>
<td></td>
<td>Printers including cartridges</td>
</tr>
<tr>
<td></td>
<td>Copying equipment</td>
</tr>
<tr>
<td></td>
<td>Electrical and electronic typewriters</td>
</tr>
<tr>
<td></td>
<td>User terminals and systems</td>
</tr>
<tr>
<td></td>
<td>Facsimile</td>
</tr>
<tr>
<td></td>
<td>Telex</td>
</tr>
<tr>
<td></td>
<td>Telephones</td>
</tr>
<tr>
<td></td>
<td>Pay telephones</td>
</tr>
<tr>
<td></td>
<td>Cordless telephones</td>
</tr>
<tr>
<td></td>
<td>Cellular telephones</td>
</tr>
<tr>
<td></td>
<td>Answering systems</td>
</tr>
<tr>
<td>II.</td>
<td>Consumer electrical and electronics:</td>
</tr>
<tr>
<td></td>
<td>Television sets (including LCD &amp; LED)</td>
</tr>
<tr>
<td></td>
<td>Refrigerator</td>
</tr>
<tr>
<td></td>
<td>Washing Machine</td>
</tr>
<tr>
<td></td>
<td>Air Conditioners (excluding centralized AC plants)</td>
</tr>
</tbody>
</table>
NOISE MANAGEMENT

Noise is defined as unwanted sound or the sound which causes pain and annoyance. The principal sources of noise in natural gas processing facilities include large rotating machines (e.g. compressors, turbines, pumps, electric motors, air coolers, fired heaters, DG sets). During emergency depressurization, high noise levels can be generated due to release of high-pressure gases to flare and/or steam release into the atmosphere.

Noise prevention and control is important as noise affects us in hearing, ability to communicate and behaviour. Undoubtedly, lesser noise can make the environment friendlier and life becomes pleasant.

5.1 Prevention and Control

Noise prevention and mitigation measures should be applied where predicted or measured noise impacts from an operation exceed the applicable noise level guideline at the most sensitive point of reception. The preferred method for controlling noise from stationary sources is to implement noise control measures at source. Methods for prevention and control of sources of noise emissions depend on the source and proximity of receptors. Noise reduction options that should be considered include:

- Selecting equipment with lower sound power levels.
- Installing suitable mufflers on engine exhausts and compressor components.
- Installing acoustic enclosures for equipment casing radiating noise.
- Improving the acoustic performance of constructed buildings.
Environmental Management Guidelines for Process Plants

- Installing vibration isolation for mechanical equipment.
- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding if possible.
- Taking advantage of the natural topography as a noise buffer during facility design.

In case of ongoing construction activities following precautions may be considered for reduction in noise level:

- Acoustic barriers should be placed near construction sites.
- There should be fencing around the construction site to prevent people coming near the site.
- Materials need not be stockpiled and unused equipment to be placed between noisy operating equipment and other areas.
- Constructing temporary earth bund around the site using soil etc. which normally is hauled away from the construction site.
Greenbelt refers to a buffer zone created beyond which industrial activity may not be carried on. Greenbelts are present not only for the purpose of protecting sensitive areas to maintain ecological balance but are also maintained so as to act as a natural sink for harmful gases released from various sources. Plants, the main greenbelt component, act as a sink and as living filters to minimize air pollution by absorption, adsorption, detoxification, accumulation and/or metabolization without sustaining serious foliar damage or decline in growth, thus improving air quality by providing oxygen to the atmosphere.

Greenbelt helps to:

- Mitigate gaseous emissions.
- Arrest accidental release.
- Effective in wastewater reuse.
- Maintain the ecological balance.
- Control noise pollution to a considerable extent.
- Prevent soil erosion.
- Improve the Aesthetics.

Eco-development conservation and pollution abatement through greenbelt are the two major components so vital for industrial activity. Greenbelt development plan for industrial estate depends upon:

- Climatic factors
- Soil and water quality
Nature and extent of pollution
Assimilation capacity of the eco-system

Nature of the plants selected for development of greenbelt should be as follows:

- Fast growing
- High and thick canopy cover
- Preferably perennial and evergreen
- Have large area index
- Indigenous
- Resistant to specific air pollutants
- Should maintain the ecological and hydrological balance of the region
Environmental Compliance means conforming to environmental laws, regulations, standards and other requirements. In recent years, environmental concerns have led to a significant increase in the number and scope of compliance imperatives across all regulatory environments. Being closely related, environmental concerns and compliance activities are increasingly being integrated and aligned to some extent in order to avoid conflicts, wasteful overlaps and gaps.

The pollution Control Acts and Rules issued by the Ministry of Environment and Forests (MoEF) and being implemented by the Central Pollution Control Board and the respective State Pollution Control Boards which are relevant to our industry have been compiled in the Table below.
### Table 7: Summary of main legislations by MoEF for protection of the environment

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Acts/Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Water (Prevention and Control of Pollution) Act, 1974</td>
</tr>
<tr>
<td>2.</td>
<td>Water (Prevention and Control of Pollution) Rules, 1975</td>
</tr>
<tr>
<td>3.</td>
<td>Water (Prevention and Control of Pollution) Cess Act, 1977</td>
</tr>
<tr>
<td>5.</td>
<td>Air (Prevention and Control of Pollution) Act, 1981</td>
</tr>
<tr>
<td>6.</td>
<td>Air (Prevention and Control of Pollution) Rules, 1982</td>
</tr>
<tr>
<td>7.</td>
<td>The Environment (Protection) Act, 1986</td>
</tr>
<tr>
<td>8.</td>
<td>The Environment (Protection) Rules, 1986</td>
</tr>
<tr>
<td>13.</td>
<td>Noise Pollution (Regulation and Control) Rules, 2000</td>
</tr>
<tr>
<td>14.</td>
<td>Ozone Depleting Substances (Regulation) Rules, 2000</td>
</tr>
<tr>
<td>15.</td>
<td>Batteries (Management and Handling) Rules, 2001</td>
</tr>
<tr>
<td>16.</td>
<td>Biological Diversity Act, 2002</td>
</tr>
<tr>
<td>17.</td>
<td>Biological Diversity Rules, 2004</td>
</tr>
</tbody>
</table>
Global warming and climate change have come to the fore as a key sustainable development issue. Many governments are taking steps to reduce GHG emissions through national policies that include the introduction of emissions trading programs, voluntary programs, carbon or energy taxes, and regulations and standards on energy efficiency and emissions. As a result, companies must be able to understand and manage their GHG risks if they are to ensure long-term success in a competitive business environment, and to be prepared for future national or regional climate policies. A well-designed and maintained corporate GHG inventory developed through proper GHG Accounting techniques can serve several business goals.

In line with this GAIL (India) Limited has also started GHG Accounting of its sites.

**8.1.1 Greenhouse Gases (GHGs)**

The six greenhouse gases covered by the Kyoto Protocol are as follows:

- Carbon Dioxide (CO\(_2\)),
- Methane (CH\(_4\)),
- Nitrous Oxide (N\(_2\)O),
- Hydro Fluorocarbons (HFCs),
- Perfluorocarbons (PFCs) and
- Sulphur Hexafluoride (SF\(_6\)).
8.1.2 Global Warming Potential

Global Warming Potential (GWP) is a relative measure of how much heat a greenhouse gas traps in the atmosphere. It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of carbon dioxide. A GWP is calculated over a specific time interval, commonly 20, 100 or 500 years. GWP is expressed as a factor of carbon dioxide (whose GWP is standardized to 1). For example, the 20 year GWP of methane is 72, which means that if the same mass of methane and carbon dioxide were introduced into the atmosphere, that methane will trap 72 times more heat than the carbon dioxide over the next 20 years. Water vapour is not considered to be a cause of man-made global warming because it does not persist in the atmosphere for more than a few days.

The following table shows the Global Warming Potential for greenhouse gases reported by the United Nations Framework Convention on Climate Change (UNFCCC).

<table>
<thead>
<tr>
<th>Greenhouse Gas</th>
<th>Formula</th>
<th>100-year GWP (SAR)</th>
<th>100-year GWP (AR4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide</td>
<td>CO₂</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Methane</td>
<td>CH₄</td>
<td>21</td>
<td>25</td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>N₂O</td>
<td>310</td>
<td>298</td>
</tr>
<tr>
<td>Sulphur hexafluoride</td>
<td>SF₆</td>
<td>23,900</td>
<td>22,800</td>
</tr>
<tr>
<td>Hydrofluorocarbons (HFCs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HFC-23</td>
<td>CHF₃</td>
<td>11,700</td>
<td>14,800</td>
</tr>
<tr>
<td>HFC-32</td>
<td>CH₂F₂</td>
<td>650</td>
<td>675</td>
</tr>
<tr>
<td>Perfluorocarbons (PFCs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perfluoromethane</td>
<td>CF₃</td>
<td>6,500</td>
<td>7,390</td>
</tr>
<tr>
<td>Perfluoroethane</td>
<td>CF₂</td>
<td>9,200</td>
<td>12,200</td>
</tr>
<tr>
<td>Perfluoropropane</td>
<td>CF₃</td>
<td>7,000</td>
<td>8,830</td>
</tr>
<tr>
<td>Perfluorobutane</td>
<td>CF₄</td>
<td>7,000</td>
<td>8,860</td>
</tr>
<tr>
<td>Perfluorocyclobutane</td>
<td>c-CF₅</td>
<td>8,700</td>
<td>10,300</td>
</tr>
<tr>
<td>Perfluoropentane</td>
<td>CF₆</td>
<td>7,500</td>
<td>13,300</td>
</tr>
<tr>
<td>Perfluorohexane</td>
<td>C₆F₁₄</td>
<td>7,400</td>
<td>9,300</td>
</tr>
</tbody>
</table>

**NOTE:**

The GWP values in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) in 2007 were refined from the IPCC Second Assessment Report (SAR) values used previously and still in much of the literature. Under the Kyoto Protocol, the Conference of the Parties decided that the values of GWP calculated for the IPCC Second Assessment Report are to be used for converting the various greenhouse gas emissions into comparable CO₂ equivalents when computing overall sources and sinks.
Global Methane Initiative (GMI), Natural Gas STAR International is a voluntary partnership between the United States Environmental Protection Agency (US EPA) and the international oil and natural gas industry to identify and promote cost-effective technologies and practices to reduce methane emissions.

Now in its 19th year domestically and 6th year internationally, EPA’s Natural Gas STAR Program has provided significant economic and environmental benefits in terms of reducing methane emissions and increasing revenue to companies through increased gas sales and improved operational efficiency. Since 1993, Natural Gas STAR domestic and international Partners have reduced methane emissions by more than 30 billion m³, saving an estimated $3.2 billion worth of gas through the implementation of over 80 cost-effective technologies and practices. This demonstration of industry ingenuity and commitment illustrates that active participation in the Natural Gas STAR International Program not only offers quantifiable environmental benefits but also allows Partners to improve operational efficiency, maximize revenues, improve safety, and enhance each company’s competitive edge in the marketplace.

GAIL (India) Limited joined the Natural Gas STAR International Program in August 2011. In doing so, GAIL agreed to work with the US EPA in identifying and implementing projects to cost effectively reduce methane emissions. GAIL and US EPA launched their partnership by conducting a measurement study at GAIL’s Vijaipur facility that same month.

In 2012, US EPA and GAIL cooperated on an in-country methane emissions measurement study and analysis to identify and quantify baseline methane emissions levels at two GAIL sites Hazira and Jhabua. The study was conducted using GasFindIR infrared camera technology to identify emission sources; and a combination of turbine meters, Hi-Flow samplers, and bagging techniques to measure their emission rates.

From the above study it was understood that equipment leak emissions constitute a significant source of air pollutants. It was also evident that most of the fugitive emissions are not visible to the naked eyes and hence not taken care of during the routine maintenance activities. Therefore, it is important that sites should look for similar opportunities and take initiatives to plug invisible sources of emissions.
RESOURCES

The sources of information for various environmental Acts, Rules, Regulations and Notifications issued thereunder have been compiled in the below table.

**Table 9: Sources of Information**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Details</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><a href="http://envfor.nic.in/">http://envfor.nic.in/</a></td>
</tr>
<tr>
<td>2.</td>
<td>Central Pollution Control Board (CPCB)</td>
<td><a href="http://cpcb.nic.in/">http://cpcb.nic.in/</a></td>
</tr>
<tr>
<td>3.</td>
<td>Centre on Control of Pollution</td>
<td><a href="http://cpcbenvis.nic.in/">http://cpcbenvis.nic.in/</a></td>
</tr>
<tr>
<td>4.</td>
<td>Directorate General, Factory Advice Service and Labour Institutes (DGFA)</td>
<td><a href="http://www.dgfasl.in/">http://www.dgfasl.in/</a></td>
</tr>
</tbody>
</table>
ENVIRONMENT MANAGEMENT GUIDELINES
FOR
PROCESS PLANTS

Corporate HSE Department
GAIL (India) Limited