1 RISK ASSESSMENT

Risk Assessment Is A Careful Examination Of Consequences Resulting From The Undesired Events That Could Cause Harm To People Or Property, So That Sufficient Precautions Can Be Taken. Workers And Others Have A Right To Be Protected From Harm Caused By A Failure To Take Reasonable Control Measures.

Hydrocarbon operations are generally hazardous in nature by virtue of intrinsic chemical properties of hydrocarbons or their temperature or pressure of operation or a combination of these. Fire, explosion, hazardous release or a combination of these are the hazards associated with hydrocarbon operations. These have resulted in the development of more comprehensive, systematic and sophisticated methods of Safety Engineering, such as, Hazard Analysis and Risk Assessment to improve upon the integrity, reliability and safety of hydrocarbon operations.

1.1 OBJECTIVES OF THE RISK ASSESSMENT

As per the requirements stated in the Terms of Reference of the EIA study, the risk assessment study has been undertaken to address the following aspects:

- To identify and assess those fire and explosion hazards arising from production of oil and gas in order to comply with regulatory requirements, company policy and business requirements
- To eliminate or reduce to as low as reasonably practical (ALARP) in terms of risk to human health, risk of injury, risk of damage to plant, equipment and environment, business interruption or loss etc.

1.2 IDENTIFICATION OF HAZARDS IN PRODUCTION OF OIL & GAS FROM FACILITY (ANK 21 & ANK 40S)

Various hazards associated with production of oil and gas is briefly described as below.

1.2.1 Minor crude Oil Spill

A minor oil spill is confined within the well site area. The conditions which can result in minor oil spill are as follows:

**Spillage in Crude oil Storage System:**

Crude Oil spillage from leaking valves, lines and storage tank
**Spillage while crude oil production:**

During the well production operation, there exists a possibility of hydrocarbon gases being released and spillage of crude oil may result from a failure of pipe, lines valves, separator at production facility. Spilled oil should be immediately cleaned once the leakage is controlled.

1.2.2 **Major Oil Spill**

Spillage can only happen in case of major leaks from storage tanks, separators or uncontrolled flow from wells (possibilities are rare as these wells are low pressure wells). Since the reservoir does not have the pressure which will allow the wells to self flow, an artificial lift method (Sucker Rod Pump) is proposed to bring the oil to the surface for commercial production. Therefore possibility of uncontrolled flow from well during production is remote.

Such situation may occur only if, there is a mechanical damage or failure of Emergency Shutdown system or combination of both. Oil is produced with associated gas, therefore, an oil spill arising from a failure system will result in the release of hydrocarbon vapors together Oil.

Since, the produced crude oil is proposed to be transported by Road Tankers to ONGC-CTF, the possibilities of major oil spills due failure / overturning / accident of road tanker/s cannot be ruled out.

1.2.3 **Blowout**

As the formation pressure is very low and with installed Christmas tree, possibilities of well blow out is negligible.

1.2.4 **Hydrogen Sulphide (H₂S)**

Since the available data does not show any content of the H₂S, hence the release of H₂S during production is not envisaged.

1.3 **CONTROL MEASURES FOR ABOVE HAZARDS**

1.3.1 **Control measures for major spills of crude oil from storage tanks, separators and pipe lines**

1) Inspection of tanks / separator during fabrication shall be carried out as per the requirements of the applicable codes, specifications, drawings etc. This inspection requires regular checks on the work at various stages as it progresses. During fabrication, a thorough visual check should be undertaken and the tank should be checked for foundation pad and slope, slope of the bottom plates, proper welding sequence and external & internal surfaces etc.
2) Roof plates shall be inspected for defects like pin holes, weld cracks, pitting etc., at water accumulation locations.

3) Tanks pad shall be visually checked for settlement, sinking, tilting, cracking and general deterioration.

4) Anchor bolts wherever provided shall be checked for tightness, and integrity by hammer testing.

5) All open vents, flame arrestors and breather valves shall be examined to ensure that the wire mesh and screens are neither torn nor clogged by foreign matter or insects.

6) If a tank is insulated, the insulation and weather proof sealing shall be visually inspected for damages.

7) Grounding connections shall be visually checked for corrosion at the points where they enter earth and at the connection to the tank.

8) The tanks shall be inspected for any obvious leakage of the product. Valves and fittings shall be checked for tightness and free operations.

9) The tanks shell shall be visually examined for external corrosion, seepage, cracks, bulging and deviation from the vertical.

10) NDT test for pipeline

11) Hydrostatic testing of tanks shall be carried out.

12) Facility certification from relevant competent authority under petroleum rules to be obtained before starting the operation.

13) OISD standard 244 once implemented should be followed.

1.3.2 Control measures for oil spill from road tankers

1) Proper route of road tankers should be decided in the premises for entry and exit of road tankers. Security persons should guide the tanker drivers to follow the route accordingly.

2) Speed of road tankers in the premises should be strictly restricted.

3) All road tankers / vehicle entering in the production / storage area should be provided with spark arrester at their silencers to avoid spark into open atmosphere in case of leakage / spillage of oil.

4) During loading / unloading – double earthing should be practiced.

5) Proper SOP should be prepared and implemented for connection of road tanker, filling and disconnection.
6) All road tankers utilized should be tested and certified by competent person under petroleum rules.

7) Drivers should be well trained and experience in driving of vehicles carrying Hazardous substances.

1.4 IDENTIFICATION OF HAZARDS BY FIRE AND EXPLOSION INDEX & TOXICITY INDEX

Fire and Explosion Index (F&EI) is an important technique employed for hazards identification process. Consequence analysis then quantifies the vulnerable zone for a conceived incident. Once vulnerable zone is identified for an incident, measures can be formulated to eliminate or reduce damage to plant and potential injury to personnel.

Rapid ranking of hazard of an entire installation, if it is small, or a portion of it, if it is large, is often done to obtain a quick assessment of degree of the risk involved. The Dow Fire and Explosion Index (F&EI) and Toxicity Index (TI) are the most popular methods for Rapid Hazard Ranking. These are based on a formal systematized approach, mostly independent of judgmental factors, for determining the relative magnitude of the hazards in an installation using hazardous (inflammable, explosive and toxic) materials.

The steps involved in the determination of the F & EI and TI are:

- Selection of a pertinent process unit
- Determination of the Material Factor (MF)
- Determination of the Toxicity Factor (Th)
- Determination of the Supplement to Maximum Allowable Concentration (Ts)
- Determination of the General Process Hazard Factor (GPH)
- Determination of the Special Process Hazard Factor (SPH)
- Determination of the F&EI value
- Determination of the TI value
- Determination of the Exposure Area

1.4.1 Hazardous Material Identification Methodology

From the preliminary appraisal of Material Safety Data Sheet, it is observed that high speed diesel, natural gas and crude oil are hazardous. F&EI and TI values have been computed for three phase separator of crude oil and natural gas as well as Crude oil storage tank.
In general, the higher is the value of material factor (MF), the more inflammable and explosive is the material. Similarly, higher values of toxicity factor (Th) and supplement to maximum allowable concentration (Ts) indicate higher toxicity of the material. The tabulated values of MF, Th and Ts are given in Dows Fire and Explosion Index Hazard Classification Guide. For compounds not listed in Dow reference, MF can be computed from the knowledge of flammability and reactivity classification, Th can be computed from the knowledge of the National Fire Protection Association (NFPA) Index and Ts can be obtained from the knowledge of maximum allowable concentration (MAC) values. The MF, Th and Ts values are respectively 16, 0 and 50 for crude oil, 21, 0 and 50 for natural gas, and 10, 0 and 50 for HSD.

General process hazards (GPH) are computed by adding the penalties applied for the various process factor.

Special process hazards (SPH) are computed by adding the penalties applied for the process and natural factors.

Both General process hazards and Special process hazards corresponding to various process and natural factors are used with MF to compute F&EI value and with Th and Ts to compute TI value.

### 1.4.2 F&EI Computation

F&EI value computed for TPS and CTT from GPH and SPH values using the following formula

\[
F&EI = MF \times [1 + GPH (total)] \times [1 + SPH (total)]
\]

### 1.4.3 Toxicity Index (TI)

Toxicity index (TI) is computed from toxicity factor (Th) and supplement to maximum allowable concentrations (Ts) using the following relationship:

\[
TI = (Th + Ts) \times [1 + GPH (total) + SPH (total)]/100
\]

Calculation for F&EI as well as TI is given in table shown below for Natural gas and crude oil.

### Table 1: Fire and Explosion Index for Natural Gas / crude oil

<table>
<thead>
<tr>
<th>Material Factor</th>
<th>Value</th>
<th>Nf=4, Nr=0</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPH</td>
<td>21 / 16</td>
<td>Nf=4, Nr=0</td>
</tr>
</tbody>
</table>

Penalty factor

Penalty factor

Remark
<table>
<thead>
<tr>
<th></th>
<th></th>
<th>range</th>
<th>used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base factor</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>A</td>
<td>Exothermic reaction</td>
<td>0.3-1.25</td>
<td>0.00</td>
</tr>
<tr>
<td>B</td>
<td>Endothermic process</td>
<td>0.2-0.4</td>
<td>0.00</td>
</tr>
<tr>
<td>C</td>
<td>Material handling and transfer</td>
<td>0.2-1.05</td>
<td>0.5</td>
</tr>
<tr>
<td>D</td>
<td>Enclosed or Indoor process unit</td>
<td>0.25-0.9</td>
<td>0.00</td>
</tr>
<tr>
<td>E</td>
<td>Access</td>
<td>0.2-0.35</td>
<td>0.00</td>
</tr>
<tr>
<td>F</td>
<td>Drainage &amp; spill control</td>
<td>0.25-0.5</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td><strong>General process Hazard factor F1</strong></td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td>2</td>
<td><strong>SPH</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Base factor</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>A</td>
<td>Toxic material</td>
<td>0.2-0.8</td>
<td>0.20</td>
</tr>
<tr>
<td>B</td>
<td>Sub atmospheric pressure(&lt;500 mm hg)</td>
<td>0.5</td>
<td>0.00</td>
</tr>
<tr>
<td>C</td>
<td>Operation in or near flammable range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Tank farm storage flammable liquid</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Process upset or purge failure</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Always in flammable range</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>D</td>
<td>Dust Explosion</td>
<td>0.25-2.0</td>
<td>0</td>
</tr>
<tr>
<td>E</td>
<td>Pressure</td>
<td>0.86-1.5</td>
<td>0</td>
</tr>
<tr>
<td>F</td>
<td>Low temperature</td>
<td>0.2-0.3</td>
<td>0</td>
</tr>
<tr>
<td>G</td>
<td>Quantity of flammable / unstable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>F1</td>
<td>F2</td>
<td>F3</td>
</tr>
<tr>
<td>----------</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Liquid or gases in process</td>
<td>0.2-3</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Liquid or gases in storage</td>
<td>0.1-1.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combustible solid in storage, dust in process</td>
<td>0.2-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrosion &amp; Erosion</td>
<td>0.1-0.75</td>
<td>0.1</td>
<td>&lt;0.005 in per year</td>
</tr>
<tr>
<td>Leakage joint and packing</td>
<td>0.1-1.5</td>
<td>0.1</td>
<td>possibility of minor leakage</td>
</tr>
<tr>
<td>Use of fired equipment</td>
<td>0.1-1</td>
<td>0</td>
<td>NA</td>
</tr>
<tr>
<td>Hot oil heat exchange system</td>
<td>0.15-1.15</td>
<td>0</td>
<td>NA</td>
</tr>
<tr>
<td>Rotating equipment</td>
<td>0.5</td>
<td>0</td>
<td>NA</td>
</tr>
</tbody>
</table>

**Special process Hazard F2**: 2.4

Process unit hazard factor (F1×F2)=F3: 3.6

**Fire and Explosion Index (F3×MF)**: 75.6

### TOXICITY INDEX

| Toxicity number Th | Nh=1 | Penalty factor Ts | TLV 0.5 ppm | Toxicity Index | 4.9 |

**Table 2: Conclusion for Fire, Explosion & toxicity Index**

<table>
<thead>
<tr>
<th>Applicable Fire and Explosion index range</th>
<th>1-60</th>
<th>Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>61-96</td>
<td>Moderate</td>
<td></td>
</tr>
</tbody>
</table>

**Notes**: 1. The toxicity index is calculated based on the toxicity number (Th) and the penalty factor (Ts). The toxicity number represents the toxicity level, with a higher number indicating greater toxicity. The penalty factor allows for the adjustment of the toxicity number based on factors such as exposure duration and health effects. The overall toxicity index is the product of these two values, adjusted for the process unit hazard factor (F3). 2. The Fire and Explosion Index is the product of the special process hazard factor (F2) and the process unit hazard factor (F3×MF). 3. The table categorizes the applicability of the index range into 'Light' and 'Moderate' based on the specified index range values.
RISK ASSESSMENT

<table>
<thead>
<tr>
<th>Substance</th>
<th>F&amp;EI value</th>
<th>TI value</th>
<th>F&amp;EI range</th>
<th>TI range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas / Crude oil</td>
<td>75.6</td>
<td>4.9</td>
<td>Moderate</td>
<td>Light</td>
</tr>
</tbody>
</table>

CONCLUSION FOR TOXICITY INDEX

<table>
<thead>
<tr>
<th>Applicable Toxicity index range</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>Light</td>
</tr>
<tr>
<td>6-9</td>
<td>Moderate</td>
</tr>
<tr>
<td>above 10</td>
<td>High</td>
</tr>
</tbody>
</table>

1.4.4 Hazards description

From the above various hazards identified from the proposed project activities are as under:

- Fire and explosion hazard due to natural gas / crude oil.

Other hazards are:

- Occupational health hazards
- Other hazards

Consequences of hazards also depend on prevailing meteorological conditions and population density in surrounding areas.

1.5 CONSEQUENCE ANALYSIS

Oil and gas may be released as a result of jet fire, pool fire & less likely unconfined vapor cloud explosion causing possible damage to the surrounding areas. The extent of the damage depends upon the nature of the release. The release of flammable material and subsequent ignition results in heat radiation, pressure wave or vapor cloud depending upon the flammability and its physical state. It is important to visualize the consequence of the release of such substances and the damage caused to the surrounding areas.

An insight into physical effects resulting from the release of hazardous substances can be had by means of various models. Vulnerability models can also be used to translate the
physical effects occurring in terms of injuries and damage to exposed population and buildings.

Consequence analysis quantifies vulnerable zone for a conceived incident and once the vulnerable zone is identified for an incident, measures can be proposed to eliminate damage to plant and potential injury to personnel. The following likely maximum credible scenarios (Primary) considered for hazard analysis

- Catastrophic failure of crude oil storage tank
- Catastrophic failure / leakage of separator lead to free spread pool fire.
- Full bore failure of pipe from well to separator lead to pool / jet fire.
- Entire inventory leaked out from road tanker / leakage in road tanker lead to free spread pool fire.

### Table 3: Damage Caused at Various Heat Loads

<table>
<thead>
<tr>
<th>Heat Load (kW/m²)</th>
<th>Denoted by</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5</td>
<td>[Red]</td>
<td>Sufficient to cause damage to process equipment. 100% fatal in 1 min. 1% fatal in 10 sec.</td>
</tr>
<tr>
<td>25.0</td>
<td>[Purple]</td>
<td>Minimum energy required to ignite wood infinitely long exposure (non-piloted). 100% fatal in 1 min. Significant injury in 10 seconds.</td>
</tr>
<tr>
<td>12.5</td>
<td>[Blue]</td>
<td>Minimum energy required for piloted ignition of wood, melting plastic tubing. 1% fatal in 1 minute. First degree burn in 10 seconds.</td>
</tr>
<tr>
<td>1.6</td>
<td>[Yellow]</td>
<td>No discomfort even long exposure.</td>
</tr>
</tbody>
</table>

Data considered for release:

1. For storage tank scenario storage full volume considered @ 45 KL of crude oil. Tank is considered in side dyke. Tank diameter is 2.8 meter with height of 7.5 meter.
2. At the time of release 75% full inventory stored inside the tank.
3. For separator, diameter is considered 0.92 meter and height 3.26 meter is considered.
4. As per lay out pipe connected from well to separator is 100 mm sch 40.
5. Tanker is considered of 20 KL and for developing scenarios 80% of tanker is filled with crude oil and position of tanker is considered near storage area at loading station.
Damage area from the above scenarios is presented in the model developed with HAMS-GPS software and tabulated below. It was observed that results for damage distances almost remain same for stability class D & F and hence result for stability class D was tabulated below.

Table 4: Damage distance with heat loss

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Damage distances plotted on plant lay out and show in figure number below</th>
<th>Radiation in KW/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1.6 KW/m²</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Distance in meter from source</td>
</tr>
<tr>
<td>Crude oil storage tank pool dyke fire</td>
<td>Figure 1</td>
<td>Figure 2</td>
</tr>
<tr>
<td>Separator 10% leakage without dyke</td>
<td>Figure 3</td>
<td>Figure 4</td>
</tr>
<tr>
<td>Separator pool fire without dyke</td>
<td>Figure 5</td>
<td>Figure 6</td>
</tr>
<tr>
<td>Full bore failure of pipe from well to separator lead to pool fire</td>
<td>Figure 7</td>
<td>Figure 8</td>
</tr>
<tr>
<td>Full bore failure of pipe from well to separator lead to jet fire</td>
<td>Figure 9</td>
<td>Figure 10</td>
</tr>
<tr>
<td>Road tanker all inventory leakage free spread pool fire</td>
<td>Figure 11</td>
<td>Figure 12</td>
</tr>
<tr>
<td>10% Road tanker all inventory leakage free spread pool fire</td>
<td>Figure 13</td>
<td>Figure 14</td>
</tr>
</tbody>
</table>
All above damage distances were plotted on site layout of ANK 21 and ANK 40S. Site lay out with damage distances represented as figures below. Form the figures it can be observed that damaging distances from all scenarios except Road Tanker Inventory leaked out (i.e. Figure 12 and Figure 14) will be restricted to the boundary of plant premise.

Whereas in some cases, the effect of damage will be minimal outside the plant premises as shown in graphical representation in Figure 1, Figure 3, Figure 5, Figure 7, Figure 9, Figure 11, Figure 13 for EPS#ANK 21 and Figure 2, Figure 4, Figure 6, Figure 8, Figure 10, Figure 12, Figure 14 for EPS#ANK 40S the effect of radiation outside premises will be 1.6 KW/m² and in some case KW/m², which will have negligible impact on human beings. Road tanker scenario has been considered at loading station, near the entry / exit gate of the premises. Hence the damage crosses the boundary of plant premises. However SOP during loading / unloading will be implemented to avoid any such kind of incidences.

Figure 1: Crude oil storage tank pool dyke fire at ANK#21
Figure 2: Crude oil storage tank pool dyke fire at ANK#40S
Figure 3: 10 % Separator leakage and free spread fire at ANK#21
Figure 4: 10% Separator leakage and free spread fire at ANK#40S
Figure 5: Separator leakage and free spread fire at ANK#21
Figure 6: Separator leakage and free spread fire at ANK#40S
Figure 7: Full bore failure of main pipe lead to pool fire at ANK#21
Figure 8: Full bore failure of main pipe lead to pool fire at ANK#40S
Figure 9: Full bore failure of main pipe lead to jet fire at ANK#21
Figure 10: Full bore failure of main pipe lead to jet fire at ANK#40S
Figure 11: Entire road tanker inventory leakage free spread fire at ANK#21

Figure 12: Entire road tanker inventory leakage free spread fire at ANK#40S
Figure 13: 10% road tanker inventory leakage free spread fire at ANK#21
Figure 14: 10% road tanker inventory leakage free spread fire at ANK#40S
1.6 BASIC PREVENTIVE & PROTECTIVE FEATURES

- Adequate water supplies for fire protection. The amount/quantity of the water requirement is based on rate of firewater required for the worst possible fire and the time duration for which the fire will last.
- Structural design of vessels, piping, structural steel, etc.
- Overpressure relief devices
- Corrosion resistance and/or allowances
- Segregation of reactive materials in pipelines and equipment
- Electrical equipment grounding
- Safe location of auxiliary electrical gear (transformers, breakers, etc.)
- Normal protection against utility loss (alternate electrical feeder, spare instrument, air compressor, etc.)
- Compliance with various applicable codes (ASME, ASTM, ANSI, Building Codes, Fire Codes, etc.).
- Compliance of OISD-189 for firefighting equipment
- Fail-safe instrumentation
- Access to area for emergency vehicles and exits for personal evacuation
- Drainage to handle probable spills safely plus fire fighting water hose nozzle sprinkler and/or chemicals
- Insulation of hot surfaces that heat to within 80% of the auto-ignition temperature of any flammable material in the area
- Adherence to the National Electrical Code. The Code should be followed except where variances have been requested/approved.
- Hazard area analysis followed by appropriate intrinsically safe electrical equipment wherever required
- Limitation of glass devices and expansion joints in flammable or hazardous service. Such devices are not permitted unless absolutely essential. Where used, they must be registered and approved by the production manager and installed in accordance with appropriate standards and specifications
- Protection of pipe racks and instrument cable trays as well as their supports from exposure to fire
- Provision of accessible battery limit block valves
- Protection of fired equipment against accidental explosion and resultant fire
8.5 RISKS AND FAILURE PROBABILITY

The term Risk involves the quantitative evaluation of likelihood of any undesirable event as well as likelihood of harm of damage being caused to life, property and environment. This harm or damage may only occur due to sudden/accidental release of any hazardous material from the containment. This sudden/accidental release of hazardous material can occur due to failure of component systems. It is difficult to ascertain the failure probability of any system because it will depend on the components of the system. Even if failure occurs, the probability of fire and the extent of damage will depend on many factors like:

- Quantity and physical properties of material released.
- Source of ignition.
- Wind velocity and direction
- Presence of population, properties etc. nearby.

Frequencies of Loss of Containment (LOCs) for atmospheric tanks as per CPR 18E guidelines are as under:

Basic failure frequencies for catastrophic failure of pressure tank / bullet as well as for full bore failure of pipelines are considered from CPR 18E and they are as under.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Basic failure frequency for Catastrophic failure per year</th>
<th>Failure frequency after application of correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure vessel</td>
<td>5.00E-07</td>
<td>5.50E-06</td>
</tr>
<tr>
<td>pipeline 75 mm &lt;= nominal diameter &lt;= 150 mm</td>
<td>3.00E-07 m-1</td>
<td>3.00E-06 m-1</td>
</tr>
</tbody>
</table>

1.7 OCCUPATIONAL HEALTH AND SAFETY

During the project work lot of activities will be involved such as construction, erection, testing, commissioning, operation and maintenance, where the men, materials and machines are the basic inputs. Along with the boons, the industrialization generally brings several problems like occupational health and safety.

The following occupational health and safety issues are specific to proposed plant activities will arise during project work as well as regular operation of plant:

- Physical hazards
- Electrical hazards
• Noise
• Fire hazards

1.7.1 Physical Hazards

Industry specific physical hazards are discussed below.

Potential physical hazards in proposed plants are related to handling heavy mechanical transport (e.g. trucks) and work at heights (e.g. platforms, ladders, and stairs).

Heavy Loads / Rolling during construction phase

Lifting and moving heavy loads at elevated heights using hydraulic platforms and cranes presents a significant occupational safety hazard. Recommended measures to prevent and control potential worker injury include the following;

- Clear signage in all transport corridors and working areas;
- Appropriate design and layout of facilities to avoid crossover of different activities and flow of processes;
- Implementation of specific load handling and lifting procedures, including:
  - Description of load to be lifted (dimensions, weight, position of center of gravity)
  - Specifications of the lifting crane to be used (maximum lifted load, dimensions)
  - Train the staff in handling of lifting equipments and driving mechanical transport devices
- The area of operation of fixed handling equipment (e.g. cranes, elevated platforms) should not cross above worker and pre-assembly areas;
- Material and product handling should remain within restricted zones under supervision;
- Regular maintenance and repair of lifting, electrical, and transport equipment should be conducted.
- Use appropriate PPE (as per GSPC PPE Policy) Implement work rotations providing regular work breaks, access to a cool rest area, and drinking water and under hygienic facilities.

1.7.2 Electrical Hazards

Workers may be exposed to electrical hazards due to the presence of heavy-duty electrical equipment in plant.

1.7.3 Noise

Noise level at operational site shall be upto moderate level. However, Proper environment management plan has been formulated to control the same
1.7.4 Fire Hazards

Fire fighting system to control the hazard is discussed in previous sections.

1.8 OTHER HAZARDS AND ITS CONTROLS

The other possible hazards at site are as given below:

<table>
<thead>
<tr>
<th>Name of possible hazard or emergency</th>
<th>Its source &amp; reason</th>
<th>Its effects on person, property &amp; environment</th>
<th>Place of effect</th>
<th>Control measures provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building collapse Earthquake</td>
<td>Any natural Calamities Weak structure Over loading</td>
<td>Injuries &amp; Fatalities Building damage.</td>
<td>All building &amp; sheds of the company as given in the Fac. layout</td>
<td>Structure stability is by competent person for all structure. No overloading of structures and building.</td>
</tr>
<tr>
<td>Electrical Installation failure like Transformer, PCC etc.</td>
<td>Overload Loose contacts Short circuit</td>
<td>Fire Suffocation of persons inside the plant</td>
<td>Electrical transformer switch yard Electrical MCC rooms Power plant</td>
<td>Installation as per electricity rules. Other Controls provided Rubber mat provided Earthing provision</td>
</tr>
</tbody>
</table>

1.9 FIRE FIGHTING SYSTEM

1.9.1 General

The fire fighting system shall be installed in line with OISD – STD - 189, for hydrocarbon production facility.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Facility</th>
<th>Capacity/Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Water storage tank for fire fighting</td>
<td>400 m$^3$ (divided in to 2 equal halves of 200 m$^3$)</td>
</tr>
</tbody>
</table>
2 Fire Water pump

para 5.2 of OISD 189

3 Fire water distribution

4” size pipe with a minimum distance of 15.0 meters from the well head area

4 Hydrant

Alongside to cover entire hazardous area and distance between the two hydrants or two monitors should not be more than 30.0 mtrs

5 Monitor

Alongside to cover entire hazardous area and distance between the two hydrants or two monitors should not be more than 30.0 mtrs

6 Above ground piping

Height should be 300-400 mm from the ground and should be supported at every 0.6 m distance.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Place</th>
<th>Quantity of Fire Extinguishers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Separator/group unit area</td>
<td>Appropriate type of Fire extinguishers shall be located at every 15 meter distance in facility as per OISD - 189</td>
</tr>
<tr>
<td>2</td>
<td>Dispatch pump area</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Near storage tank area</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Electrical switch gear area/generator house</td>
<td></td>
</tr>
</tbody>
</table>

**Table 7: First Aid Fire Fighting Equipment at EPS as Per OISD 189**

1.10 **SAFETY ORGANIZATION AND ITS ACTIVITIES**

1.10.1 **Construction and Erection Phase**

A qualified and experienced safety officer will be appointed. The responsibilities of the safety officer includes identification of the hazardous conditions and unsafe acts of workers and advise on corrective actions, conduct safety audit, organize training programs and provide professional expert advice on various issues related to occupational safety and health. He is also responsible to ensure compliance of Safety Rules/ Statutory Provisions.
1.10.2 Operation and Maintenance Phase

On completion of construction phase, the posting of safety officers would be in accordance with the requirement of OMR 1984 and their duties and responsibilities would be as defined thereof.

1.10.3 Strengthening of HSE and Meeting by Safety and quality circle

In order to develop the capabilities of the employees in identification of hazardous processes and improving safety and health, safety and quality circles would be constituted in area of work. The circle normally will meet weekly.

1.10.4 HSE Audit and inspection

HSE audits / Inspections will be carried out at site on bi-monthly basis to -

1. To identify any design deficiencies and also any weaknesses which might have cropped up during modifications / additions of facilities.
2. To ensure that fire protection facilities and safety systems are well maintained.
3. To ensure that operating / maintenance procedures, work practices are as per those stipulated in the manuals and standards, which might have degraded with time.
4. To check on security, training, preparedness for handling emergencies and disaster management etc
5. To check the compliance of statutory regulations, standards, codes, etc.

1.10.5 Safety Training

Safety training would be provided by the Safety Officers with the assistance Corporate HSE department, Professional Safety Institutions and Universities. In addition to regular employees, contractor labors would also be provided safety training. To create safety awareness safety films would be shown to workers and leaflets would be distributed.

1.11 OCCUPATIONAL HEALTH SURVEILLANCE PLAN

All the potential occupational hazardous work places would be monitored regularly. The health of employees working in these areas would be monitored periodically for early detection of any ailment due to exposure.

For Occupational Health monitoring following plan should be implemented:

Medical Surveillance:

All employees/ contractors should go through the medical examination once in two years to ascertain the health status of all workers in respect of Occupational Health hazard to which they are exposed.
**Employee information and training:**

The industry will provide training program for the employees to inform them of the following aspects; hazards of operations, proper usage of nose mask and earplugs, the importance of engineering controls and work practices associated with job assignment(s).

List of Tests to be conducted and recorded:

1. Eyes  
2. Respirator system  
3. Abdomen  
4. Locomotor System  
5. Hernia  
6. Urine  
7. Audiogram  
8. Ears  
9. Circulatory system (Blood Pressure)  
10. Nervous System  
11. Skin  
12. Hydrocele  
14. Chest X Ray

**Medical Examination:**

The following medical checkup/examinations should be done:

1. Comprehensive Pre-employment medical checkup for all employees.
2. X-ray of chest to exclude pulmonary TB, etc.
3. Spirometry test
4. Lung function test.
5. Liver function test (LFT)
6. Audiometer test to find deafness.
7. Vision testing (Near and far as well as colour vision)

**Report of schedule medical examination:**

Report of schedule medical examination should be published within the company and also report to higher management with safety & health magazines published within the company. Also workers whose schedule examinations are pending to be intimated through their respective department heads to avoid any worker / employee left out for schedule medical examination.