## 07.04. RISK ASSESSMENT

The objective of risk assessment is to analyze and ensure a safer & healthier working environment as it is an integral part of occupational health and safety. Risk assessment includes the following.

- Hazard analysis
- Evaluation of risk associated with that hazard
- Determination of appropriate ways to eliminate or mitigate the hazard

Risk analysis deals with the identification and quantification of risks, the plant equipment and personnel exposed to accidents resulting from the hazards occurring in the plant. On the other hand, hazard analysis involves the identification and quantification of the various hazards (unsafe conditions) that may exist in the plant.

Hazard and risk analysis involves very extensive studies and requires very detailed design and engineering information. The various hazard analysis techniques that may be applied are hazard and operability studies (HAZOP), fault tree analysis, event tree analysis and failure mode analysis.

Risk analysis involves also the identification and assessment of risks to neighboring public as a result of probable accidents. This requires a thorough knowledge of failure probability, formulation of credible accident scenario etc. As in practice, the risk analysis is confined to Maximum Credible Accident (MCA) scenarios.

The risk assessment study covers the following:

- Identification of potential areas
- Identification of failure cases
- Visualization of the resulting scenarios
- Assessment of overall damage potential of the identified hazardous events and the impact zones from the accidental scenarios
- Specific recommendation on the minimization of the worst accident possibilities
- Preparation of broad Risk/Disaster Management Plan

### 07.04.01 Hazard Identification

Safety audit will be conducted by qualified technical personnel to study the installation and activities of the industry and to suggest measures to protect personnel and property against the risks.

The areas of possible hazardous incidents are given for follow up action:

1) Fire in coal & coke storage yard, and diesel storage tanks
2) Electric short circuit and consequent fire accident
3) Any likely sort of explosion in boiler area
4) Bursting of pipeline joints.
5) Fall from high level structures

**1) Fire in coal & coke storage yard & diesel storage tank**

This may occur on account of external cause. Both coal & coke have very high flashpoint and do not catch fire at normal temperatures. Coal/coke fires are slow progressive in nature and are controlled by spraying plenty of water.

**2) Short circuit and consequent fire accident**

The electrical short circuit may happen in any of the plant area due to poor insulation of the equipment. The proposed project does not have any combustible material so the fire can be controlled by using suitable fire extinguisher provided at site.

**3) Explosion hazard**

Explosion is expected due to bursting of high pressure equipment like boiler, turbine and pipe lines. The water required for boiler is pumped and transferred to the boiler by using high-pressure pumps. Also the high-pressure steam generated in the boiler is sent to the turbine through the pipeline. This pipeline will have flanged joints, with sandwich gaskets in between for better sealing. At times, due to water hammering this gasket fails and leads to bursting of the flange joint.

### 07.04.02 Hazard assessment and evaluation

Preliminary Hazards Analysis (PHA) is based on the philosophy “prevention is better than cure”. This technique, if applied early in the project life cycle, will help eliminate hazards and thus avoid costly design modifications later.

A preliminary hazard analysis has been carried out to identify the major hazards associated with storage areas and the processes of the plant. This is followed by a consequence analysis to quantify these hazards. Finally, the vulnerable zones are plotted for which risk reducing measures are deduced and implemented.

The likely potential hazards associated with the proposed plant are listed in **Table 07 – 11.**

**Table 07 - 11**

**Potential hazard within the facilities and chemical inventory**

| Sl. No. | Facility | Process | Potential hazard | Provision |
|---|---|---|---|---|
| 1 | Fuel Oil storage facility (2X250KL) | Boiler | Pool fire | Provision for fire protection system including foam, safe distance from other process buildings |
| 2 | LDO (2X250KL) | Annealing Furnace | Pool fire | Provision for fire protection system including foam, |

| Sl. No. | Facility | Process | Potential hazard | Provision |
|---|---|---|---|---|
| | | | | safe distance from other process buildings |
| 3 | Coke oven gas | Coke making | Pipe rupture | Provision for fire protection system including foam, safe distance from other process buildings |
| 4 | Blast furnace gas | Iron making | Pipe rupture | Provision for fire protection system including foam, safe distance from other process buildings |

### 07.04.03 Maximum Credit Analysis (MCA) Scenarios

Hazardous substances may get released as a result of failures or catastrophes, which may possibly damage the surrounding area. The results of consequence analysis are useful for understanding the situation and emergency planning.

There is one scenario which is considered for MCA analysis:

- Pool fire due to leakage of furnace oil/LDO tank

As far is coke oven is concerned, the gas is completely burnt and only the hot air sent for recovery of heat. The furnace oil having a calorific value of 10500 kcal/kg is considered for MCA analysis as pool fire due to leakage of furnace oil.

#### 1) Consequence analysis

As stated in Chapter – 2, the process involves consumption of inflammable chemicals like furnace oil and LDO which are stored in the tank with dyke. The storage arrangements are in compliance with OISD norms to tackle any accidents, leakage etc. within the storage area. In spite of above storage arrangement leakage may occur and FO/LDO may catch fire. In view of this conundrum, a detailed risk analysis is carried out, to assess the pool fire.

#### 2) Results and discussions

Furnace Oil/LDO is stored in tanks. As per OISD norms these storage tanks are provided with dykes.

There are two furnace oil tanks of each 250m$^3$ storage facility and two LDO tanks with 250m$^3$ storage facility. The storage tanks are installed in the bunds and the arrangement of storage tanks is shown in the layout.

In this study the total heat radiation intensity resulting from the accidental pool fires to the nearest buildings is estimated. In this case, the nearest building is the cooling water pump house which is about 8m from the oil storage facility.

Pool fire for total catastrophic failure is considered for worst case scenario i.e., burning of one tank of furnace oil with the capacity of 250m$^3$. The result of heat radiation distance calculated using Heskestad formula method for furnace oil pool fire is shown in **Table 07 – 12.**

**Table 07 – 12**
**Heat radiation distance during pool fire for furnace oil**

| Sl. No. | Intensity of fire in KW/m$^2$ | Distance in m |
|---|---|---|
| 1 | 37.5 | 28 |
| 2 | 25.0 | 34 |
| 3 | 12.5 | 48 |
| 4 | 9.5 | 55 |

The risk contours for FO superimposed on plant's general layout for 37.5, 12.5 and 4 kW/m$^2$ are shown in **Fig. 07 - 02**. From the figure it can be seen that risk contour for 37.5 kW/m$^2$, 12.5 kW/m$^2$ and 4 kW/m$^2$ heat radiation intensity falls well within the plant area. It is expected that in case of fire, the heat will not be felt by the public due to plantation and compound wall existing in between the plant area and local habitation. Further, the 4 kW/m$^2$ area will be limited to 84m thus the fringes of the heat radiation may affect the cooling water pump house. In view of this, it is suggested to shift the FO tankers by 10-15m towards east. The general effects of thermal radiation intensity are furnished in **Table 07 - 13.**

**Table 07 – 13**
**Effects of thermal radiation**

| Radiation intensity (kW/m$^2$) | Observed effect |
|---|---|
| 37.5 | Sufficient to cause damage to process equipment. 100% lethality |
| 25 | Minimum energy required to ignite wood at indefinitely long exposures (no piloted). 50% lethality |
| 12.5 | Minimum energy required for piloted ignition of wood, melting of plastic tubing. 1% lethality |
| 9.5 | Pain threshold reached after 8sec; second degree burns after 20 sec. |

| Radiation intensity ($kW/m^2$) | Observed effect |
|---|---|
| 4 | Sufficient to cause pain to personnel if unable to reach cover within 20 sec; however blistering of the skin (second degree burns) 3rd degree burn |
| 1.6 | Will cause no discomfort for long exposure 2nd degree burn |
| 1 | 1st degree burn. |

Similarly, the risk contours for LDO superimposed on plant's general layout for 37.5, 12.5 and 4 $kW/m^2$ are shown in **Fig. 07 - 03**. The result of heat radiation distance calculated using Heskestad formula method for LDO pool fire is shown in **Table 07 – 14.**

**Table 07 – 14**
**Heat radiation distance during pool fire for LDO**

| Sl. No. | Intensity of fire in $kW/m^2$ | Distance in m |
|---|---|---|
| 1 | 37.5 | 24 |
| 2 | 25.0 | 29 |
| 3 | 12.5 | 41 |
| 4 | 9.5 | 47 |
| 5 | 4.0 | 73 |
| 6 | 1.6 | 115 |

From the figure it can be seen that risk contour for 37.5 $kW/m^2$, 12.5 $kW/m^2$ and 4 $kW/m^2$ heat radiation intensity falls well within the plant area. It is expected that in case of fire, the heat radiation will not be felt by the public due to plantation and compound wall existing in between the plant area and local habitation. Further, the 4 $kW/m^2$ area will be limited to 73m thus not affecting any of the plant facilities.

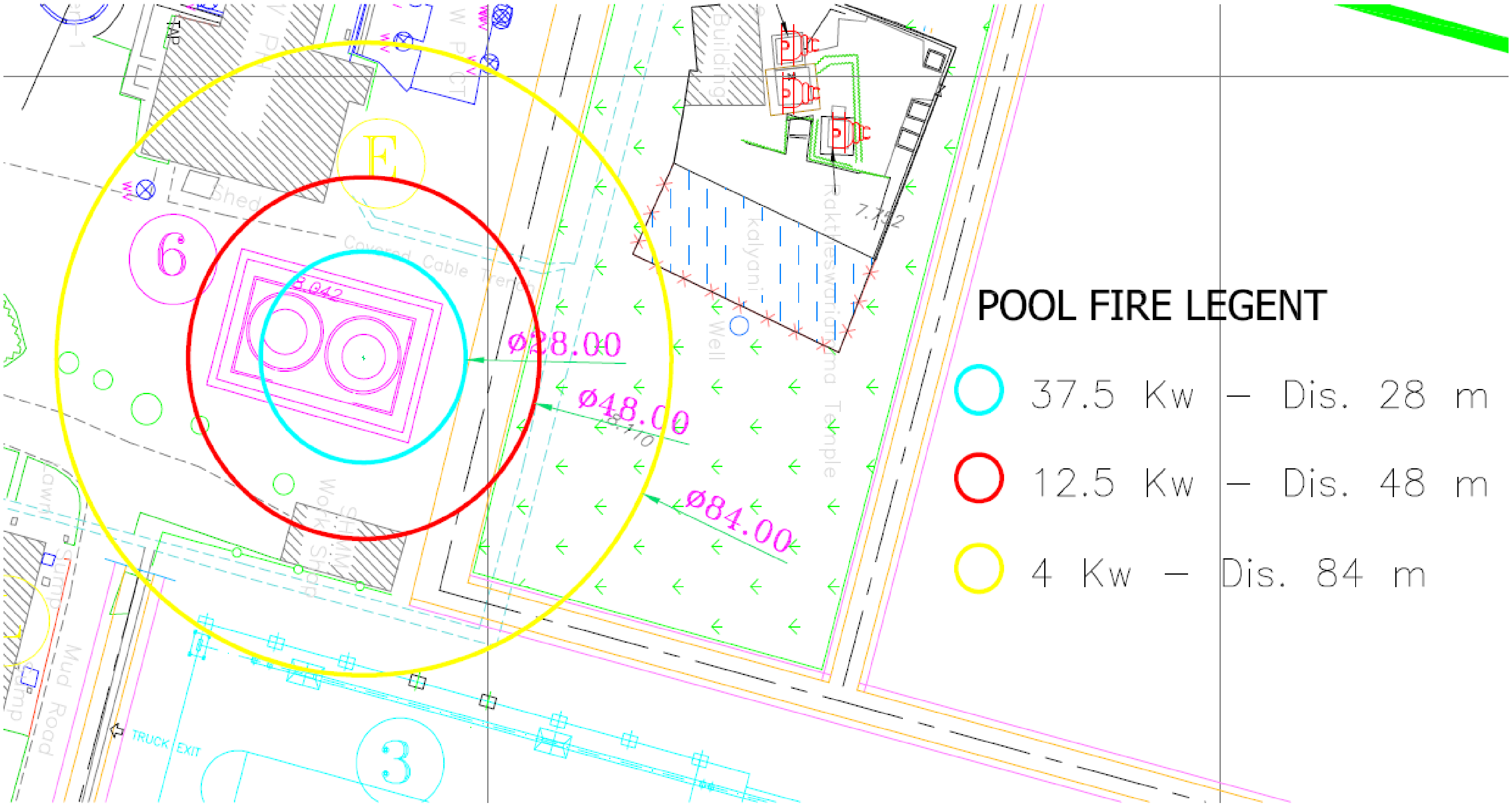


**Fig. 07 – 02 Heat radiation distance during pool fire for FO**

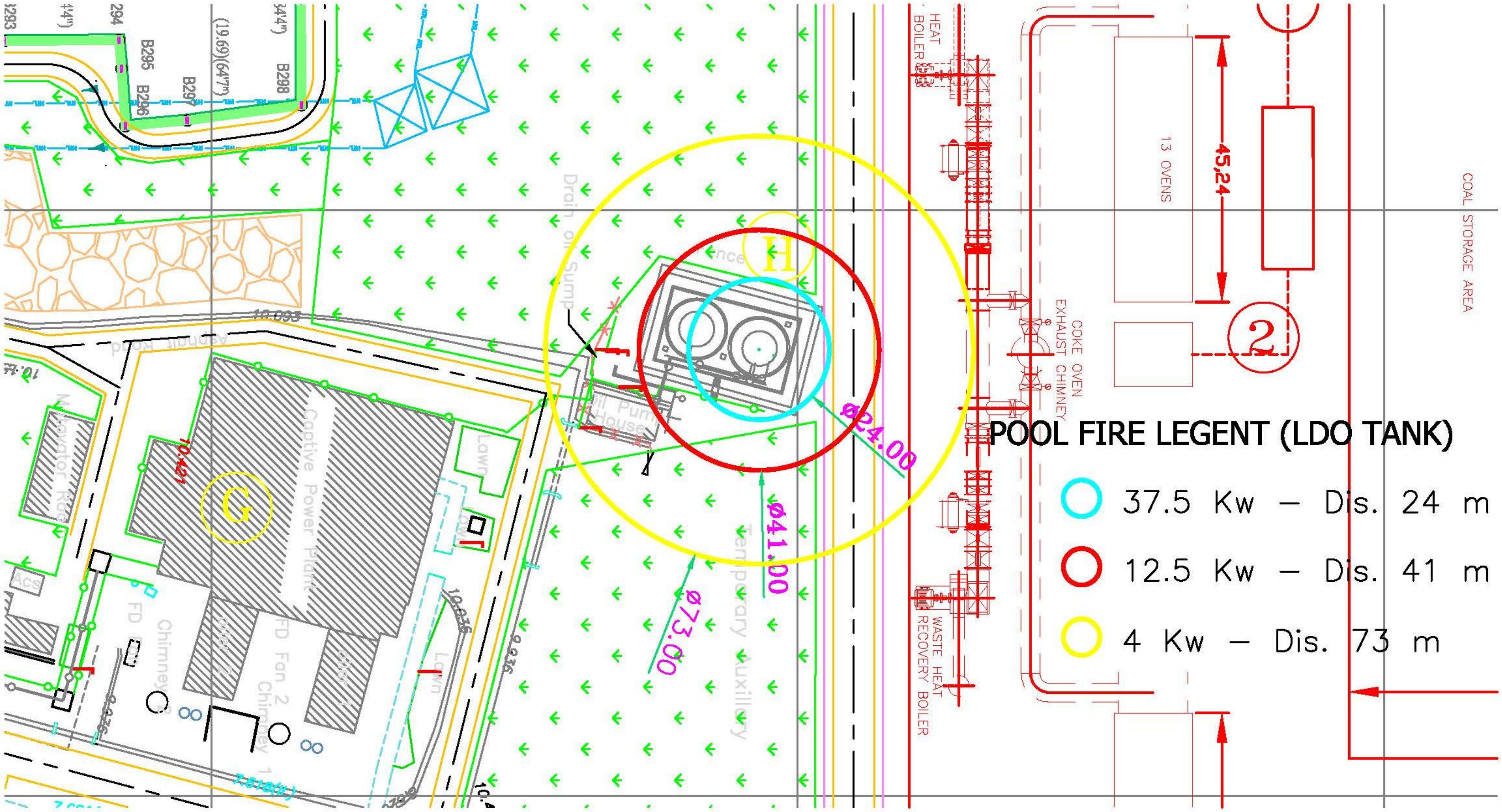


Fig. 07 – 03 Heat radiation distance during pool fire for LD