

<b>SAFETY CODE FOR IRON &amp; STEEL SECTOR</b>		
MINISTRY OF STEEL, GOVT. OF INDIA	<b>FIRE SAFETY</b>	Doc. No: SC/16
		Rev no. : 00 Effective Date : --

## 1. OBJECTIVE

To provide a generic guideline for Fire safety practices to be observed in Iron & Steel Industries.

Associated Hazard: Fire, Smoke, Heat, Flame and Explosion.

## 2. SCOPE

This code is applicable to all location of Iron and Steel Industries.

## 3.0 PROCEDURE

### 3.1 Definition:

**Fire:** Fire is a chemical exothermic reaction in which energy is released in the form of heat and light.

There are four classes of fire depending on the material under ignition. These can be listed as:

1. **Class A fire:** Fire in solid materials,
2. **Class B fire:** Fire in inflammable liquids,
3. **Class C fire:** Fire in gaseous and electrical installation
4. **Class D fire:** Fire in metals.

**Fire Triangle:** Presence of ignition source, material and oxygen called as Fire Triangle, Fire can be extinguished by removing any one.

Fire Safety arrangement falls into two categories: Fire Prevention and Fire Mitigation.

#### **Fire Prevention**

- i. Fire Prevention should be included in Design phase
- ii. Fire risk Assessment of the site and Preventive control measures to address the hazard and its elimination
- iii. Fire Incident investigation.

**Fire Mitigation:**

- i. Mitigation can be ensured through installation, maintenance and testing of Fire equipment.
- ii. Evacuation of the building through emergency escape.

**3.2 Fire Prevention**

- i. Combustible materials should be avoided in the construction or fabrication of new building.
- ii. For all premises fire risk assessment to be done.
- iii. Flammable liquids, gases and oxidizing agent must be stored and controlled as per their Material Safety Data Sheet.
- iv. Smoking and use of mobile phone, shall be strictly prohibited in the premises of flammable or combustible material storage area, ignition source, heating surface, cylinder storage area, gas prone area and near cutting/welding job.
- v. Storage area should have proper ventilation to avoid vapour accumulation and it should be away from potential source of ignition
- vi. Flammable material should not be stored near exits, electrical equipment or heating Equipment.

**3.2.1 Fire prevention measure during cutting and welding**

- i. If gas cutting and welding is required on material which can be movable for e.g. if two pipes to be joined or required cutting than materials should be moved to designated safe location which must be free from combustible materials such as grease, ideally for an area representing an 11m radius from the point of work.
- ii. If the floor is combustible where the welding is done, then the floor shall be kept wet or covered with damp sand to prevent the risk associated with the activity
- iii. If work is done near walls, where openings and cracks in walls are visible and can allow a big spark can pass through, then it shall be sealed to prevent the sparks from going to the adjacent areas.
- iv. Hot welding shall not be attempted on metal partitions, walls, ceilings or roofs having a combustible covering, nor on walls or partitions of combustible sandwich-type panel construction.
- v. Positive means shall be taken to confine heat, sparks and slag to the welding/cutting activity working area.
- vi. Welding or Cutting not to be done in the presence of flammable/combustible materials.
- vii. Appropriate fire extinguishing equipment shall be immediately available at job place. If normal fire prevention measures are not sufficient enough, additional trained personnel shall be assigned to guard against fire. At least one ABC 4KG/5 kg Dry Chemical Powder (DCP) fire extinguisher, two dry sand filled buckets, two water filled buckets shall be kept at work place.
- viii. Before welding/cutting, ensure containers are cleaned thoroughly with water.
- ix. Welding in centrally air conditioned premise to be avoided. If it is essential to do welding in area catered by centrally air conditioning system, then AC system shall be closed during welding.

### **3.2.2 For cutting/welding job on or near gas lines**

- i. Work permit clearance - authorized personal should take permission before working on or near gas line area.
- ii. Local Fire fighting arrangement with fire extinguishers, sand, water and fire hoses shall be kept ready before starting welding / cutting job on gas lines.
- iii. Person should be trained on the use of Fire extinguishers and hydrant.

### **3.2.3 Fire prevention measures at cylinder storage area:**

- i. All gas cylinders shall be stored in a designated shed having roof top to protect from direct sunlight. Do not expose gas cylinders to temperatures above 45 deg C. Overheating of cylinders can result in build up of pressure and explosion.
- ii. The shed shall be barricaded and proper nomenclature should be displayed.
- iii. Do not store gas cylinders with other combustible materials. Flammable substances, such as oil and other solvents, must not be stored in the same area.
- iv. The storage area must be well ventilated to prevent accumulation of gas in case of leakage.
- v. Flammables and oxidizers must be stored separately in the storage area. The cylinders must be separated by a distance of 6 meters or must be separated by a fire resistant wall of 30 minutes fire resistance.
- vi. LPG cylinders must not be stored within 3m of any compressed gas cylinders (including acetylene).
- vii. Within the storage area, Oxygen should be stored at least 3m from fuel gases cylinders. The use of a fire wall may provide the required separation. If volume is greater than 200 m<sup>3</sup> a separation distance of 5m needs to be executed. Note: Wall must be a minimum of one metre higher than the tallest cylinder.
- viii. Compressed gas cylinders are to be secured with clamping or chain / manila rope or by use of a cylinder stand to ensure they do not fall from their vertical storage position.
- ix. Keep cylinders away from any source of heat and ignition.
- x. Gas cylinders must be stored in a manner that permits quick removal in case of an emergency. Do not store materials over or around the cylinders.
- xi. All fitting shall be of the flame-proof type and wiring shall be in robust conduit to protect it from damage.

### **3.2.4 Housekeeping guidelines for fire prevention at work place:**

- i. Accumulation of waste combustible materials such as paper and wood should be checked at the workplace and collected in designated containers.
- ii. Combustible material trash containers should be covered and empty on regularly interval.
- iii. Leakage or spillage of flammable materials like oil, grease & flammable liquid near ignition sources / heat surfaces shall be arrested promptly.
- iv. Maintain free access to all Electrical Control Points.
- v. Chemicals should be stored safely and have proper labels. Material Safety Data Sheet (MSDS) should be provided at the site.

### **3.2.5 Fire Prevention Measures for Diesel Storage Tank.**

- i. Warning signage's and MSDS shall be displayed.
- ii. Tank level indicator and capacity of tank should be mentioned.
- iii. Fire Hydrants should have adequate pressure and should be accessible.
- iv. Spill control measures should be in place.
- v. Standard Operating Procedure (SOP) for loading and unloading of oil and Emergency preparedness should be in place.
- vi. Combustible and flammable materials should not be stored at nearby tank area.
- vii. Electrical fittings should be flame proof.
- viii. Ensure proper earthing and bonding.

### **3.2.6 Fire Prevention Measures for Propane Installation.**

- i. Warning Sign should be displayed
- ii. Provision to be made to ensure Static Electricity discharged.
- iii. All Electrical fitting should be flame proof.
- iv. Ensure proper earthing and bonding.
- v. Fire hydrant & Water Spray system installed should be pressurized all the time.
- vi. Do not use mobile inside the plant.
- vii. Unloading of bulk Propane transported through bulk tank trucks shall be carried out under the supervision of a responsible person.
- viii. The tank truck shall have suitable spark arrestor of make and designed approved by PESO (Petroleum & Explosive Safety Organisation), Nagpur properly fixed to exhaust.
- ix. Lever indicating close and open status for Quick closing of manifold valve shall be present on the tank truck.
- x. All electrical boxes of the tank truck shall be properly sealed.
- xi. The electrical wiring of the tank truck shall be insulated and provided with suitable over current protection.
- xii. The cabin of the tank truck shall have an readily accessible master switch for switching off the engine.
- xiii. No hot/cold work shall be carried out in the vicinity of unloading operation.
- xiv. Checks shall be carried out for each Tank Truck prior to unloading of Propane.
- xv. Excess flow check valves of the tank shall be functioning.
- xvi. Operator should check the connection for tightness.
- xvii. Check from Roto Gauge that the level of liquid does not exceed more than 90% in the storage tank by level.
- xviii. After making sure that all the valves are closed for liquid and vapour, slowly remove the hose pipe. The liquid hose may have little liquid left in it which will be vented through venting system.
- xix. After removing the hoses, mobile tanker should not be started for at least 10 minutes.

### **3.2.7 Fire Risk/Prevention at OHE EOL corridor**

- i. Provision of Fire Ext. on Loco Engine to prevent from fire in engine, fire on diesel storage Tank & on tarpaulin used during rainy season etc.

- ii. Remove all dry leaf/tree branches etc. near OHE area.
- iii. Never spray water near overhead power lines. Spray water after getting the power clearance from dept.
- iv. Do not keep any combustible and flammable material on loco.
- v. Never climb power poles or transmission towers without valid permit.
- vi. Never climb trees near power lines & overhead line.
- vii. Ensure proper earthing and bonding.
- viii. Never drive over a cable lying on ground or under a low-hanging line.
- ix. Stay away from power cable lying on ground. Maintain a safe distance from the Danger.

### **3.2.8 Fire Prevention in Heavy Earth Moving Machineries**

- i. Oil- bearing hosepipes should be housed separately and away from the hot parts of the engine like turbocharger, exhaust and manifold.
- ii. OEM of HEMM should provide suitable type of fire detection and suppression system
- iii. with periodical testing procedure and maintenance schedule. Maintenance of such fire detection and suppression system be carried out by the experts trained personnel.
- iv. All high pressure hydraulic hose fitted in the engine room must confirm to the specification as laid down by the OEM and their quality to be ensured. The hoses shall be replaced at the prescribed interval or earlier if there is any sign of deterioration.
- v.

### **3.2.9 Fire Prevention in Coal Chemical Handling**

- i. Coal chemicals should be stored in an area reserved for highly flammable liquids.
- ii. Storage tanks should be situated in the open air and their vent pipes should be fitted with flame arresters.
- iii. Tanks should be discharged by means of a pump.
- iv. All metal parts of the tank installation should be earthed and earthing terminals should be provided for attaching to tankers during transfer operations.
- v. Tanks should be situated well clear of process plant and buildings, any fixed source of ignition and boundary fences.
- vi. Naked flames, hot elements and all other ignition sources should be eliminated; smoking should be prohibited: reduced-sparking tools should preferably be used.
- vii. The air in the storage and working areas should be regularly sampled with a gas detector in order to check for leaks. In the event of a serious leak the areas should be evacuated immediately.
- viii. Electrical equipment for use in atmospheres which may contain flammable concentrations of chemical vapor should be intrinsically safe.
- ix. Metal parts of process and handling machines should be electrically bonded together and earthed to prevent the accumulation of static electricity.
- x. Mechanical seal shall be provided for product pumps used for pumping of highly inflammable materials.

### **3.2.10 Fire Prevention in Sulphur Handling**

- i. Sulphur storage area shall be segregated and sulphur should be stored in a cool well-ventilated space.
- ii. Sulphur should not be stored along with chlorates, nitrates, other oxidizing materials, mineral acids or metal powders.
- iii. Sulphur powder should be handled in such a way as to avoid formation of dust clouds.
- iv. Explosive proof light fittings should be used.
- v. Smoking and the use of naked flames should be prohibited in places where sulphur dust may be present.

### **3.2.11 Fire Prevention in Sulphuric Acid Handling**

- i. Storage tanks should be in the open. They should be protected from external corrosion by coating them with a suitable material such as bitumen.
- ii. Storage tanks should be provided with:
  - a. A bund capable of retaining the acid in the event of leakage.
  - b. A liquid indicator. A glass float indicator or a remote-reading pneumatically operated gauge is recommended.
- iii. Sulphuric acid should not be stored with chemicals with which it reacts, or with flammable liquids, gas cylinders, or readily combustible solids.
- iv. The vessels should be protected from the direct rays of the sun.
- v. All storage vessels and storage areas should be clearly marked.
- vi. When there is a danger of hydrogen formation from the acid reacting with metal in processing or in storage:
  - a. Rooms should be well-ventilated.
  - b. Naked flames, hot elements and all other ignition sources should be eliminated.
  - c. Smoking should be prohibited.

### **3.2.12 Fire Prevention in Coal Yards**

- i. Coal to be stacked up to a maximum height of 15 m .
- ii. Stacking to be done in trapezoidal stock pile.
- iii. Temperature monitoring of the pile to be done.
- iv. Hot spots above 70 °C shall be removed.
- v. Coal piles shall be segregated from other area.
- vi. Coal screening, crushing and other operation shall be done in well ventilated area.
- vii. Storage shall be limited for short duration.
- viii. Housekeeping shall be of high standard.
- ix. Smoking shall be prohibited.

### **3.2.13 Fire Prevention in coal/hot coke/hot sinter handling conveyors**

- i. The belt conveyors installed for handling coal, sinter and other raw materials shall be of enclosed type.
- ii. Accumulated heat, dust and muck shall be cleaned regularly and worn out parts shall be immediately replaced.

- iii. The major fire hazard is from the ignition of coal dust and from deposits built-up on the internal surfaces, walkways etc. of the conveyor's junction towers, often ignited by maintenance activities.
- iv. Care must be taken to ensure that hot coal which may have heated up spontaneously while in storage, is not loaded on the belt. The belt must also not be overloaded.
- v. Water spray system may be installed for coal coke and sinter conveyor fire prevention. It is a special fixed pipe water based fire protection system connected to reliable source of water supply and equipped with open type water spray nozzles for specific volumes of water discharge and distribution at surface or area to be protected. Piping system is connected to the water supply through an automatically or manually actuated Deluge Valve, which initiates flow of water through spray nozzles. The actuation of the deluge valve is achieved by operation of automatic detection equipment such as Quartzoid bulb detection systems, electrical linear heat sensing systems or manual push button operation solenoid valve systems.

#### **3.2.14 Fire Prevention in conveyor galleries**

- i. Accumulated heat, dust and muck shall be cleaned regularly and worn out parts shall be immediately replaced.
- ii. There is also a significant fire hazard associated with the conveyor drive unit due to a combination of brake faults, failure of fluid couplings and overfilling of the drive gearboxes as well as that due to an overheated motor which has become inadequately cooled in service due to the build-up of coal / raw material dust.
- iii. The primary causes of conveyor fires fall into three main areas:
  - a. Maintenance activities involving the use of electric or gas welding, gas cutting equipment, or similar activities.
  - b. Failure of part of the conveyor system (usually and idler or a pulley) can lead to localized overheating and eventually, to the ignition of the coal dust, conveyor belting or lubricating oil and greases associated with the plant.
  - c. Rubbing of a belt (running out of center) with steel work resulting in localized overheating and eventually belt catching fire when stopped.
  - d. From the ignition of a quantity of spilt coal dust, either by self ignition or other causes.
  - e. Also ignition of the conveyor belt while transporting hot sinter / hot coke without undergoing proper quenching.
- iv. Care must be taken to ensure that hot coal, which may have heated up spontaneously while in storage, is not loaded on the belt. The belt must also not be overloaded.
- v. Regular maintenance of the conveyor shall be undertaken to ensure freedom from friction due to the spillage of belt over the drive or idle roller and/or its becoming misaligned or slipping off the roller and becoming jammed.

#### **3.2.15 Fire prevention in handling of molten metal and slag**

- i. Ladle shall not be overfilled.
- ii. Alignment of rails used for transportation of hot metal shall be uniform.

- iii. Rail cars carrying hot slag and hot metal shall be in good condition.
- iv. Refractory of the ladle shall be in good condition.
- v. Ladle & thimble shall be heated before pouring of hot metal.
- vi. Dumping of molten slag shall be avoided over accumulated water.
- vii. Care shall be taken to avoid metal reaction in twin hearth furnace
- viii. Standard Operating Procedure (SOP) shall be strictly followed during handling of hot metals.

### **3.2.16 Fire Prevention in transformer substations**

- i. Every oil filled apparatus such as transformer, static condenser, switch gear or oil circuit breaker having an individual or aggregate oil capacity of 200 liters or more shall be housed in a locked weather and fire resistance building.
- ii. A minimum clearance of 750 mm shall be provided between the transformer and other apparatus and enclosing or separating walls.
- iii. Substations and switch gear rooms shall only be used to house the intended equipment. Storage of any kind or any repair work shall not be permitted there in.
- iv. Cable trenches inside substations shall be filled with sand, pebbles or similar non-flammable materials or covered with incombustible slabs. If a number of cables are taken in the trench, it is desirable that cables are taken on racks.
- v. All control gears shall be protected against rodents, reptiles and insects.
- vi. All transformers shall be equipped with Over current relay protection.
- vii. Gas pressure type (Buchholz relay), winding and oil temperature protection to give alarm and tripping shall be provided on all oil type transformers of rating 1000 KVA and above.
- viii. Where a sub-station or a switching station with apparatus having more than 2000 litres of oil is installed, whether indoor or outdoors following precautions to be taken-
  - a. the baffle walls of four hours- fire rating shall be provided between the apparatus-
    - i. where there is a single phase transformer banks in the switch-yards of generating stations and sub-stations
    - ii. on the consumer premises;
    - iii. where adequate clearance between the units is not available
  - b. provision shall be made for suitable oil soak pit. Where use of more than 9000 litres of oil in any one oil tank, receptacle or chambers involved, provision shall be made for the draining away or removal of any leaked / escaped oil and special precautions shall be taken to prevent the spread of any fire resulting from the ignition of the oil from any cause and adequate provision shall be made for extinguishing any fire which may occur.
  - c. Spare oil shall not be stored in the vicinity of any oil filled equipment in any such substation or switching station.
  - d. All the transformers and switchgears shall be maintained in accordance with the maintenance schedules prepared in accordance with the relevant codes of practice of Bureau of Indian Standards.
  - e. The transformers of 10 MVA and above rating or in case of oil filled transformers with oil capacity of more than 2000 liters are to be provided



with fire fighting system its per IS - 3034: 1993 or with Nitrogen Injection Fire Protection system

- ix. The bushings, insulators and contacts of tap changing gears shall be kept scrupulously clean at all times.
- x. The level and dielectric strength of the transformer oil shall be checked at periodic intervals.

### **3.2.17 Fire Prevention in Cable Tunnels**

Electrical cables are usually insulated with polyvinylchloride, which contributes to the rapid spread of fire. The insulation also give-off highly toxic products combustion including corrosive gases, when it is exposed to intense heat or is involved in fire. Fire in cable runs can spread as fast as 20 m/min.

The critical areas are as under:

- Immediately after end termination or joints up to a length of not less than 1m in either direction.
- Crossing or T- crossings or joints up to a length of not less than 1m in either direction.
- Cable passing through high temperature area/high vulnerable area.

Precautions to be taken are -

- i. HT & LT cable in different racks.
- ii. Temperature monitoring of cables
- iii. Good forced ventilation.
- iv. Compartmentation of cable tunnels.
- v. Sealing of entry and exit points of cables.
- vi. Use of good quality cable joints
- vii. For cable above 230 volts, fire resistant coating should be applied just below the end termination up to a length of one meter inside the panel (if space available), just below the panel entry up to a length of one meter, joints up to a length of one meter in both directions and on entire exposed vertical length like connecting different floors etc. Motor terminal box are excluded, but Transformer terminal box included. For cable of voltage 33 kV and above, cable entry to the panel should also be protected with Fire Stop along with fire resistant coating as above.
- viii. For all cables, fire protective paint should be applied on entire length if passing through Fire Prone Area.
- ix. Cable above 230 Volts in cable tunnels /cable trays should be painted up to a length of one meter at an interval of every 30 meter. Cable entry into the vault should be protected with fire barrier / fire stop. If cable below and up to 230 volt (like FO, Control, Instrument, telephone, Power cable etc.) is also passing along the same route within the vicinity of 2 meter from cable >230 volt should also be treated as above.
- x. The wet film thickness of fire resistant coating should be such that after drying 1.6 mm is achieved (Dry film thickness) uniformly on all exposed

sides and also there should not be variation in coating across length than specified.

- xi. Cables above 230 volts in cable tunnel / cable vaults/ Cable trestle should be protected by automatic fire alarm system
- xii. LHS (Linear Heat Sensing cable) may be used for cable tunnel /cable vault / cable trestle.

### **3.2.18 Fire Prevention in Oil Cellars**

- i. Stop valves should be provided at strategic positions to cut off a dangerous leak of oil.
- ii. Self extinguishing grades of oil should be used to minimize fire risk.
- iii. Use of flexible piping should be avoided.
- iv. Pumps working in oil cellars should be periodically checked for faulty bearings and inadequate lubrication.
- v. Either electric or gas welding should not be permitted in the oil cellars.
- vi. Leaks from joints and glands should be attended without delay.
- vii. Spillage of any lubricants, fuel oil, should be cleared by spraying sand and cleaning the surface.
- viii. Spark proof lighting should be provided. Loose wiring or temporary wire connections should not be permitted.
- ix. Wooden doors or windows and partitions should not be allowed.
- x. Waste cotton should be disposed in the bins filled with water so that the cotton will be wet and therefore will not catch fire.
- xi. Smoking should be strictly prohibited. "No Smoking" sign should be displayed at appropriate locations
- xii. The cellars should not be used as store.
- xiii. Unauthorized persons should not be permitted to enter in cellars.
- xiv. The entry and exit to the oil cellars should not be the same and they should be provided in opposite directions and free from any obstruction.

### **3.2.19 Fire Prevention in Cryogenic liquids**

- i. Outside storage shall be protected against the extremes of weather.
- ii. Cryogenic tanks shall be equipped with pressure-relief devices to control internal pressure.
- iii. Do not plug, remove, or tamper with any pressure-relief device.
- iv. Oxygen must be separated from flammables and combustibles by 20 feet or a half-hour fire wall.
- v. Use only oxygen compatible lubricants.
- vi. Boiling and splashing always occur when charging or filling a warm container with cryogenic liquid or when inserting objects into these liquids. Perform these tasks slowly to minimize boiling and splashing.
- vii. Never touch un-insulated pipes or vessels containing cryogenic liquids.
- viii. Use wooden or rubber tongs to remove small items from cryogenic liquid baths.
- ix. Cylinders should not be filled to more than 80% of capacity since expansion of gases during warming may cause excessive pressure buildup.

- x. Liquid oxygen shall not enter the oxygen gas pipe line.

### 3.2.20 Fire Prevention in Gantry Cranes

- i. The control circuit voltage shall not exceed 600 volts for a.c. or d.c. current.
- ii. Electrical equipment shall be so located or enclosed that live parts will not be exposed to accidental contact under normal operating conditions.
- iii. Electric equipment shall be protected from dirt, grease, oil, and moisture.
- iv. Oil cans, oil soaked jute, extra fuses, and other articles shall not be permitted to store in cranes.
- v. Over filling of oil in reducers shall be avoided.
- vi. Leakages from reducer shall be arrested
- vii. Housekeeping in cranes shall be of high standard.

### 3.3 Fire Mitigation

- i. Effective means for detecting an outbreak of Fire and warning people must be established.
- ii. Suitable and Sufficient firefighting and escape equipment and devices should be determined through Fire Risk Assessment.
- iii. Audit and Fire Risk assessment records should be maintained for the minimum period of 3 years.
- iv. Each unit should do internal fire risk assessment audit in an interval of at least three years.
- v. Fire risk assessment should be done by a competent person, one who understand the principal of fire safety.
- vi. Fire Fighting equipment and evacuation route should easy accessible and free from obstruction.
- vii. Adequate Provision must be made for the evacuation of disabled persons.
- viii. Where it is necessary to disable fire Protection & detection system, fire department should be intimate and clearance should be taken from the fire department.
- ix. All regular employees shall be educated regarding use of fire extinguishers and available fire fighting arrangements in and around working area

#### 3.3.1 Fire Extinguishers:

There exists different kind of fire extinguisher for extinguishing different classes. These can be listed as:

- i. **ABC Pressurized Type fire extinguishers:** This type of fire extinguisher is applicable for Class A, B & C type of fire. When extinguisher is squeezed, powder is ejected from the extinguisher.
- ii. **Foam type extinguishers:** Gas/air bubbles are trapped by a foam binding solution in water. These extinguishers are used for fire of Class A & B.
- iii. **Dry chemical Powder (DCP) extinguishers:** Sodium based chemical powders are usually used in these kinds of extinguishers. Fire belonging to Class B & C can be extinguished using these extinguishers.

- iv. **CO<sub>2</sub> Fire Extinguishers:** A cylinder is filled with CO<sub>2</sub> gas under pressure which when released displaces the air supporting and surrounding the combustion. These extinguishers are applicable for Class B & C Fire.
- v. **Clean Agent:** In this type of fire extinguisher, Liquid is stored under pressure that turns to gas on discharge to air. Clean Agent is effective on Class B and C fires typically petrol, oil, etc.

**Application of Fire Extinguishers:**

<b>Class of fire</b>	<b>Type of extinguishers</b>
A. Fires in ordinary combustibles (wood, vegetable fibres rubber, plastics paper and like)	Gas expelled water type and stored pressure type extinguishers and water buckets
B. Fires in flammable liquids, paints, grease, solvents and the like.	Foam type fire extinguisher, Carbon Dioxide, dry powder type & Clean Agent.
C. Fires in gaseous substances under pressure including liquefied gases and live Electrical.	Carbon dioxide, dry powder types, Clean agent and sand buckets.
D. Fires in reactive chemicals, active metals and the like.	Special type of dry powder extinguishers and dry sand buckets.

N.B. Where energised electrical equipment is involved in a fire, the non-conductivity of the extinguishing media is utmost importance and only extinguishers expelling dry powder or carbon-dioxide (without metal horn) shall be used. Once the electrical equipment is de-energised, extinguishers suitable for class A, B, C may be used safely.

**Fire Extinguisher guideline:**

- i. Fire extinguishers should be placed as near as possible to Exit / Entry Doors.
- ii. Extinguishers should be placed in such a way that it shall be available within 15 meters at any point of Place.
- iii. Extinguishers shall be installed on the wall in hanging position. The height of the extinguisher bottom portion shall be 1 (One) M above the floor.
- iv. Extinguisher should not be placed in a position where it is likely to be impacted by Direct Heat, Sun Rays, Rain, moisture etc.
- v. In a confined space, it is generally advisable to place the extinguisher outside the confined space.
- vi. Fire extinguishers should always be accessible.
- vii. Floor Plan with location of Fire Equipment and type of extinguishers should be placed at prominent place/entrance of the Plant.
- viii. Fire extinguishers should not be placed in the Transformer room. It should be placed just outside the room.
- ix. Each and every location allotted for Fire Extinguishers should be marked with Department-wise Serial Number.

- a. The Number should start with FE/1 and so on. The word FE (stand for Fire Extinguisher).
- b. The Type of Extinguisher should also be marked e.g. D.C.P., CO<sub>2</sub>, W/CO<sub>2</sub>, and FOAM.
- c. All letters should be painted by Fluorescent paint of 9 Cm. sizes in White Colour on Red background (30 X 21 Cm.).
- x. One copy of the Master list of the Fire extinguishers with location should be available in department and a copy should be submitted to the Fire Brigade.
- xi. After refilling the fire extinguisher, inspection card indicating the serial numbers of the extinguishers, date of initial charging and the next due date of refilling should be pasted.
- xii. Record of the date of inspection, refilling date, etc., should be maintained.
- xiii. Inspection & Maintenance shall be done quarterly as per the guide line.
- xiv. The HP Test of DCP/ABC Type Fire extinguisher shall be done once in 3 years @ 35kg/cm<sup>2</sup> for 2.5 min & the CO<sub>2</sub> Fire Extinguisher shall be H P Tested once in 5 years @ 250 kg/cm<sup>2</sup> for 2.5 min.
- xv. All employees should be trained on the Operation of Fire Extinguisher with the help of Fire Brigade. Department should ensure that refresher training should be given to the employee's time to time.

### 3.3.2 Fire Hydrant:

Fire Hydrant is a discharge pipe with a valve and nozzle at which water may be drawn from the fire water mains.

**Hose:** A fire hose is a high - pressure hose used to carry water to extinguish fire.

**Nozzle:** Provides an outlet to the high pressure water coming through the hose and directs it towards the fire.

#### **Hose Pipes and Nozzles: -**

- i. Hose boxes/ hose shall be cleaned internally and externally quarterly.
- ii. Damaged hoses should be removed immediately.

#### **Hose Reel:**

Once in a year the hose reels should be completely run out and subjected to operational water pressure to ensure that the hose is in good condition and that the coupling joints are watertight.

#### **Pump & Fire Fighting Pump Room / House:**

- i. Independent water source / Static water tank shall be provided for minimum 2 hrs continue fire fighting.
- ii. If Pump Room is not manned for 24 hours, then shall have Fire Detection & Alarm System. 24 Volt battery is provided to give back up in case of power failure.
- iii. Two (2) independent source of power shall be provided for the Pump operating panel.

### **Fire Hydrant System:**

- i. At least one hydrant point shall be provided for every 30 M distance (for both ordinary & high hazards)
- ii. Necessary Cut – Off / sectionalising Valves shall be provided for easy maintenance of the system.
- iii. Height of the hydrant outlet point shall be 1 M from floor level.
- iv. For farthest / remotest location (horizontal position) the minimum pressure at all the hydrant outlet shall be 5.5 kg/cm<sup>2</sup>.
- v. For highest / top most hydrant point, the minimum pressure at the hydrant outlet shall be 3.5 kg/cm<sup>2</sup>
- vi. Hydrants for the protection of the Fire like combustible / flammable liquids storage tanks shall be provided as per the respective norms such as IS and OISD Guidelines.
- vii. Fixed water monitors shall be provided for the structures having a height more than 15 M (Hydrogen Vessel, Nitrogen Vessel, COGD, Furnaces installation etc ) and a site having Propane Bullet and for the protection of conveyor belt on the ground.
- viii. Fire Hydrant water shall not be used for other purpose like tapping, gardening etc.
- ix. Fire hydrant layout plan with Fire Hydrant Number and location shall be available and displayed at prominent places and layout copy to be submitted to Fire Brigade.

### **Fire Hydrant Inspection, Checks and Maintenance:**

#### **Hydrant System:**

- i. Fire hydrant point shall be checked and test quarterly. The record of all such inspections should be maintained.
- ii. All hydrant valves shall have wheel, lugs & washer in place, so that it can be quickly connected to hose for firefighting.
- iii. Hydrant points shall be kept free from any obstruction as well as Emergency Exists.
- iv. The Painting (Signal Red) of Hydrant post and Line shall be carried out annually.
- v. All the Hydrant points must be numbered.
- vi. All Cut-off / Isolating Valve shall be maintained.

#### **Pumps:**

- i. Pump sets shall be run for at least 5 minutes every week by department representative.
- ii. Diesel Pump shall be run for at least 5 minutes once in a week by department representative.
- iii. Before running the Pumps, two Hydrant Points shall be open.
- iv. Records shall be maintained for the above testing.
- v. Fire Fighting Pump Room shall be checked once in a month

### 3.3.3 Fire detection systems:

Fire detection systems are designed to discover fires early in their development when time will still be available for the safe evacuation of occupants. Early detection also plays a significant role in protecting the safety of emergency response personnel. Property loss can be reduced and downtime for the operation minimized through early detection because control efforts are started while the fire is still small. Most alarm systems provide information to emergency responders on the location of the fire, speeding the process of fire control.

**Addressable Fire Alarm System:** In an analog Addressable system detectors are wired in a loop around the buildings with each detector having its own identity. System may contain one or more loops depending upon the size of the building. An addressable fire alarm systems provide an exact location of the fire. This minimizes the response time of emergency services and first responder.

**Conventional Fire Alarm System:** In conventional fire alarm system detectors give information about specific circuits (zones). System is not applicable for large buildings having too many rooms.

Photo electrical smoke detector: Photo electrical detectors are of two types:

A. Photoelectric Light Obscuration.

B. Photoelectric Light Scattering

**A. Photoelectric Light Obscuration Smoke Detection** — The principle of using a light source and a photosensitive sensor onto which the principal portion of the source emissions is focused. When smoke particles enter the light path, some of the light is scattered and some is absorbed, thereby reducing the light reaching the receiving sensor. The light reduction signal is processed and used to convey an alarm condition

**B. Photoelectric Light-Scattering Smoke Detection** — The principle of using a light source and a photosensitive sensor arranged in such a way that the rays from the light source do not normally fall onto the photosensitive sensor. When smoke particles enter the Light path, some of the light is scattered by reflection and refraction onto the sensor. The light signal is processed and used to convey an alarm condition.

**Linear Heat Sensing Cables:**Linear heat sensing cables detect heat anywhere along the length of the cable. The cable is comprised of two zinc-coated spring steel conductors, individually coated with a heat-sensitive thermoplastic polymer engineered to melt at fixed temperatures. Once the polymer melts, the conductors initiate contact with one another and communicate with the control panel to sound alarms or activate suppressing systems. This detector is suitable for cables galleries and conveyor system.

#### **Auto dialer**

An automatic device that can automatically dial telephone numbers to communicate between any two points in the telephone, mobile phone networks.

Once the call has been established the auto dialer will announce verbal messages to the called party.

**Fire Detectors Installation**

The choice of the initiating devices shall be dictated by the application, type and characteristics of fire risks in the protected area.

S.	Type of Building	Type of Fire System/Detector
1	Office Building- Up to Ten (10) rooms	Conventional/Addressable detector
2	Office Building >Ten (10) rooms.	Addressable Fire System
3	Electrical installation	Addressable System /Smoke cum Heat detector
4	Computer server room	Addressable System /Smoke cum Heat detector
5	Cable Tunnel	Addressable System /Smoke cum Heat detector/Linear Heat Sensing Cables
6	Conveyor System	Linear Heat Sensing Cables
7	Large Halls Above 10 meters height	Beam Type
8	Cellar ( <i>having potential of fume particle generation leading to false alarm phenomenon</i> )	Multi-sensor detector – This type of detectors detects both Heat and Smoke. It combines the characters of two types of detectors, each of which responds to different physical and or chemical characteristics of fire. The purpose of combining sensors in this way is to enhance the performance of the system in detection of fire or its resistance to at least certain categories of false alarms or both. There is significant potential for reduction of many types of false alarm. It is also possible to disable an individual sensor depending on the circumstances at the place of installation.

- Ionization detectors shall not be installed as it contains radioactive element.
- Detectors shall not be in a direct airflow nor closer than 3 ft (1m) from an inlet or forced ventilation.



## Checking & Cleaning procedure for fire detectors:

Persons involved in checking and cleaning of detector shall be well trained

### Checking:

- i. Spray the aerosol fluid on the detectors and observe the detector LED, if the LED turns into red or green and alarm is activated then detector is Ok. If LED doesn't respond, replace the detector.
- ii. Blow hot air on the Heat detector and observe the detector LED. If the LED turns into red or green and alarm is activated then detector is Ok. If LED doesn't respond, remove and clean the detector with vacuum cleaner with brush attached to it. Mount the detector on its base and check again through heat gun. If LED blinks then detector is Ok, or else change the detector.
- iii. Check battery condition with respect to battery voltage. The voltage level shall not fall below the level specified. If the voltage falls below the level specified, corrective action shall be taken and the battery shall be retested otherwise replace the battery.
- iv. Detectors which are not having LED, give signal to the panel. Detector will work if an alarm signal comes to the panel.

### Cleaning:

- i. Remove the detectors (PHS, HT& OSD) from the base and see that its indication as an open fault is coming on the panel or not. The entire detector should be checked one by one.
- ii. After removing, clean the detector with vacuum cleaner with brush attached to it. Restore the detector and spray aerosol to re-confirm its correctness of connection. Heat detector should be cleaned same as other detectors.
- iii. Disconnect AC supply and ensure that system has been changed over to stand-by (battery) power supply.
- iv. Check all the manual call points and see their indication on the panel.

**To ensure the healthiness of FDA System, Audit of FDA System should be done by the line manager preferably every 6 months.** Evacuation Mock drill can be conducted by activating Fire Alarm System. Line Manager is responsible to maintain the healthiness of the FDA System.

### 3.3.4 Emergency preparedness

- i. Fire Detection & extinguishing system should be inspected, tested and maintained by competent agency at regular frequency as specified in the guideline. For e.g. Fire Extinguisher & Fire Hydrant should be checked on Quarterly basis. FDA should be checked Bi monthly and quarterly based on the location. Records of same should be maintained.

- ii. Persons carrying out checking and maintenance of fire equipment should be certified by the fire department.
- iii. Each site/premise should include risk of fire scenario in their emergency plan and appropriate measure for:
  - a. Raising the alarm.
  - b. Evacuation of personnel to the safe area.
  - c. Containment of fire until arrival of emergency services

**References:**

- 1) Tata Steel India Safety Standard: Fire Prevention (SS/GEN-36), Fire Extinguishers standard (SS/GEN-33), Fire Hydrant Safety Standard (SS/GEN-35), New Fire Detection and Alarm System Safety Standard(SS/GEN-37), Fire Safety in Cable Runs (SS/ELEC-09), Compressed Gas Cylinder safety management system Code of Practice (SS/GEN-57)
- 2) Fire mitigation management in SAIL (Committee's report for framing comprehensive guidelines for Modern, Water Tight Fire prevention, control & response system in SAIL)