IS 3034 : 1993
(Reaffirmed 1998)

भारतीय मानक

औद्योगिक भवनों की अग्नि से सुरक्षा : विद्युत उत्पादन और वितरण स्टेशन — रीति संहिता

(दूसरा पुनरीक्षण)

Indian Standard

FIRE SAFETY OF INDUSTRIAL BUILDINGS: ELECTRICAL GENERATING AND DISTRIBUTING STATIONS — CODE OF PRACTICE

(Second Revision)

First Reprint MAY 1999

UDC 699·81·725·4 : 621·311 : 006·76

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

August 1993

Price Group 8

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Fire Safety Sectional Committee had been approved by the Civil Engineering Division Council.

A continuous supply of electric power is of primary importance to almost all human activities, particularly for the industrial sector. Fire or explosion in a power station may completely curtail supply of electrical power for considerable time in addition to causing extensive property damage to the building and equipment.

Importance of fire safety for the electrical generating and distributing stations has been increasingly recognised due to occurrences of several devastating fires in such premises in the recent past. Therefore, considering the fact that any fire in such occupancies may completely disrupt the life of the community, seriously hamper several industries served by them, and also may involve replacement of highly valuable equipment, it is necessary that every attempt should be made to prevent or at least minimize the occurence of fires in these occupancies. Installation of equipment having built-in safety measures in the premises and judicial suppression or isolation of fire risks will therefore reduce both the frequency of outbreaks of fire as well as contain its spread to other areas. Further, with the adoption of suitable fire safety norms with regard to design, layout and construction of buildings and other structures, choice of materials for construction, etc, the premises can be rendered more safe from fire risk point of view.

This standard was published in 1966 and revised in 1981. This second revision incorporates certain modifications based on the suggestions received from various organizations. Some of the important changes relate to provisions in respect of fire protection for turbo-generator buildings, switch gear rooms, cable galleries, flammable oil storage, coal handling plants, transformer yards and such other hazardous areas.

The important fire safety and fire protection requirements for a power plant which should receive attention are given in this standard. Where necessary, references to relevant Indian Standards have also been made. Any fire safety measures other than those covered in this standard, if prescribed in the relevant statutory rules and regulations should also be adhered to. The Committee responsible for the preparation of this standard is given at Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

FIRE SAFETY OF INDUSTRIAL BUILDINGS: ELECTRICAL GENERATING AND DISTRIBUTING STATIONS — CODE OF PRACTICE

(Second Revision)

1 SCOPE

This standard lays down the fire safety requirements regarding building construction, various process hazards and facilities, storage areas, etc, pertaining to electricity generating stations (where electricity is generated from conventional sources using coal, oil, gas turbines, diesel generator sets, and the distributing stations).

NOTE — This standard does not deal with the fire safety requirements of nuclear power plants and hydro-electric power stations.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 GENERAL

3.1 The main fire risk areas in a thermal power station are:

a) Control room;
b) Switch gear room;
c) Cable ways and races;
d) Coil and oil storage;
e) Coal handling system including conveyor belts;
f) Transformer houses;
g) Coal houses;
h) Coal mills; and
j) Bunkers.

3.2 The following are also the areas having high damage potential in a thermal power station:

a) Turbo-generator including lubricating and jacking oil systems, turbo-generator supporting structures and floor areas around the turbine;
b) Hydrogen cooling and seal oil equipment;
c) Boiler feed pump turbine including lubricating and jacking oil services, and supporting structures including floor areas around the pump;
d) Burner front areas of the boiler including fuel oil lighting up headers and pipe work basement floor immediately beneath the burner front, and the boiler casing area above the burner wind box;
e) Oil filled generator, station unit and auxiliary transformers, reactor tranformers including associated cooler and conversation tanks;
f) Auxiliary boilers, oil burner pumps;
g) Diesel driven pump/engine units and their fuel and storage tanks;
h) Bulk hydrogen stores; and
j) Hydrogen generation plant.

3.3 Apart from mechanical hazards of gas turbines, the hazards from fire mainly arise from fuel explosion fires due to leak in the fuel system or lubricating and seal oil systems. Surface temperatures of combustible chambers will be higher than ignition temperature of fuel and lube oil.

3.4 The distribution stations such as load despatch centres and sub-stations also cause fire hazards arising from oil-field transformers, switch gear, cable galleries/tunnels, etc.

3.5 The planning for the fire protection scheme should start right from the design stage of the plant, thereby ensuring that adequate and suitable fire protection measures, both active and passive are incorporated not only while finalising the plant design itself, but right up to the completion stage.

3.6 In the fire protection system for the power plant, due consideration shall be given to the danger of smoke logging in all locations, in addition to safeguarding against other likely gaseous toxic products, the provision of adequate means of escape shall also be given due consideration in the interest of life safety.

4 BUILDING CONSTRUCTION AND RELATED REQUIREMENTS

4.1 The structural elements of all buildings of an electrical generating/distributing station shall be of Type 1 construction, complying with the requirements as given in IS 1642 : 1989.

4.2 Provision for smoke ventilation, preferably of automatic type shall be made, over the generator floor to permit escape of heat and large volumes of smoke likely to be generated. The requirements of fire venting shall conform to the provisions contained in relevant Indian Standards.

4.3 A normal ventilation rate of minimum 2 cycles per hour shall be maintained for large area turbine halls. For extraction of smoke from fire, a volume change rate of 12 changes per hour shall be obtained depending on fire load, room height, size, etc. In case the start of the smoke extraction is delayed, the volume change rate shall have to be increased even up to 30 changes per hour. Smoke vents of approved design shall be incorporated in cable tunnels/ galleries, plant rooms, switch board rooms, etc and provision made for the attachment of portable extraction unit, if not already served by a fixed smoke extraction installation.

4.4 To achieve compartmentation, the plant shall be sub-divided into individual fire areas, to be maximum extent feasible. Reduce the spread of fire between such areas and the consequential damage, and also to achieve easy control and extinguishment of fire. Such subdivision by fire barriers or separation walls of minimum 2 hours fire resistance shall be provided in the following cases:

a) Where turbine hall houses more than one unit, a fire barrier/separation wall shall be provided for each unit beneath the operating floor in the turbine and electrical bays;

b) Between TG hall and control room/computer room/instrument room;

c) Between TG hall and electrical switchgear room (unit-wise barriers needed);

d) Between the TG hall and cable galleries (unit-wise barriers needed);

e) Between TG hall and boiler house;

f) Between TG hall and coal pulverisers;

g) Between TG hall and administrative building;

h) Between staircases and lift shafts and the rest of the building;

j) Between storage of flammable liquids and rest of the building;

k) Between transformer yard/outdoor transformers and other nearby building, in case a clear distance of 15 m is not available;

m) Between individual oil-field transformers containing oil in excess of 2 000 litres in case clear distance as specified in IS 1646 : 1982 is not maintained;

n) Between battery rooms and other adjoining areas, and

p) Between cable galleries of each unit.

4.5 The doors provided in the separation walls between these fire areas shall be self-closing fire-check doors of fire rating equal to that of the fire wall.

4.6 Windows/Ventilators/Glass panels in fire separation walls (for example, for control rooms or computer rooms) shall be provided with preferably clear fire resisting glass panels of minimum 45 minutes fire resistance or with automatic fire resistant shutters or automatic water curtain.

4.7 Cellular or foamed plastic materials (such as expanded polystyrene, polyurethane foam etc) shall not be used as interior finish or insulation in any part of the building. Where interior finish (wall linings, false ceilings, etc) is unavoidable, they shall be non-combustible material and of Class 1 flame spread (*see* IS 12777 : 1989).

4.8 Air conditioning for the control room shall provide a pressurised environment to preclude the entry of smoke in the event of a fire outside the control room.

4.9 Plastic ducts, including fire retardant types shall not be used for ventilating systems.

4.10 Provision shall be made in all fire areas of the plant for removal of all liquids, including fire fighting water, directly to safe areas. The drainage facilities shall be adequate to cater to all of the following emergencies:

a) The spill of the largest single container of any flammable or combustible liquids in the area;

b) A minimum flow of 3 600 lpm for fire fighting operations for at least 20 minutes; and

c) A maximum design discharge of fixed fire suppression system operating for a minimum of 20 minutes.

4.11 Floor draining from areas containing flammable or combustible liquids shall incorporate suitable flame traps or flame arresters, conforming to IS 11006 : 1984.

4.12 The building or compartment housing the coal pulverising equipment shall be constructed in accordance with IS 3595 : 1984. The doorway openings in the separating walls shall be provided with sills of not less than 15 cms height with provision of ramps on either side.

4.13 Switch gear wherever applicable, oil-circuit breakers and transformers shall be housed preferably in detached single storey building of Type 1 construction (*see* IS 1642 : 1989).

4.14 The building used for storage purposes shall confrom to the requirements of IS 3594 : 1991.

4.15 The safety distance separating various buildings shall be in accordance with IS 1643 : 1988, and the means of exit requirement shall be in accordance with IS 1644 : 1988.

4.16 Distance separating fuel oil storage tanks, open storage of oil drums, etc shall be in accordance with the relevant statutory requirements.

4.17 The power station buildings and switch yards shall be provided with lightning protection conforming to IS 2309 : 1989.

5 POWER STATION FACILITIES

5.1 Coal Storage and Handling

The safety requirements for the coal storage and handling and other associated equipments in the power station shall conform to the provisions contained in IS 3595 : 1984. However, certain aspects which need special attention are enumerated below.

5.1.1 The belt conveyor system installed for handing coal shall preferably be of enclosed type so as to prevent the escape of dust in the power house area and these shall be thoroughly bonded and grounded to minimize static discharges. Dust collectors should preferably be located outdoors, wherever necessary.

5.1.2 The conveyor belt shall preferably be of fire resistant material conforming to IS 3181 : 1978. The openings in the walls and floors through which the conveyor belt system passes shall be adequately protected with properly designed water spray nozzles capable of providing the necessary particle size and pressure, to cover top and bottom sides of the conveyors near the openings. These water spray nozzles shall be controlled by an automatic valve actuated by fire detectors with a manual override.

5.1.3 Regular inspection with remedial maintenance shall be undertaken to reduce coal spillage problems and therefore the fire risks.

5.1.4 Special care shall be taken against the risk of fire while belts are being vulcanised or when welding is being carried out in the vicinity of conveyors.

5.1.5 The major fire hazard in bunkers is caused by stagnant coal which may remain for long periods in bunkers even though they are continuously in use. The chances of the stagnant coal catching fire are greatly aggravated by any draught of air through the coal in the bunkers. In the event of a fire in the bunkers, the two main hazards are the production of highly toxic CO gas and also generation of thick smoke in a confined space. Therefore, it is highly essential to ensure proper ventilation to the bunker area.

5.2 Turbo-Generators

5.2.1 While many of the older units are open design and air cooled, all newer and larger units are totally enclosed and hydrogen, or water cooled, or use a combination of liquid and gas for cooling. The stator winding may be liquid cooled and the rotor gas cooled by use of hydrogen. Mechanical of electrical failure of the generators are possible with resultant fire hazards.

5.2.2 Some of the air cooled generators are provided with CO_2 extinguishing systems for the windings. Hydrogen cooling is generally used for larger machines (capacity exceeding 200 MW). The generator control equipment is usually provided with devices to monitor the hydrogen gas pressure and purity. To prevent gas leakages, oil pressure gland seals (oil seals) are provided. One of the essential fire safety requirements in hydrogen cooled generators is to maintain the H_2 purity at about 95 percent to make explosion risks minimum. However, there is explosion hazard in the oil system and also in the event of hydrogen leak through the oil seals. The hazard of a TG fire incident may be increased if hydrogen is released in the event of mechanical failure or severe vibration. Fire is the most common result of H_2 leakage. A few incidents have occurred where escaping H_2 has mixed with air and exploded.

5.2.3 The H_2 cylinders used for cooling shall be placed outdoors or in a separate well ventilated room with exhaust. Where H_2 is supplied from a central storage outside, an emergency shut-off valve shall be installed on the supply line at an accessible location which may be operated from the control room. When H_2 cooled generators are taken out of service for inspection, or repairs, and during restoration to service, an inert gas, such as CO_2 shall be used to purge the line to prevent the formation of an explosive H_2 air mixture.

5.2.4 Periodical checks for H_2 leaks shall be made at the generator and sealing system.

5.2.5 Major fire risks in turbo-generators arise from the leakage or escape of combustible lubricating and hydraulic fluids contained in the lubricating or governor seals, and jacking oil systems. The risk normally extends to the floor areas which house the lubricating systems and within the radius of an oil spray pattern cascading from a failure of bearing oil supply headers.

5.2.6 A bund wall shall surround and contain the main labricating oil, jacking and flushing oil package unit are, to prevent spread of oil to surrounding floor areas.

5.2.7 Concrete or concrete protected steel shall be used for the supporting structure of turbo-generator units. Exposed steel construction is acceptable if protected by an automatic deluge sprinkler system (if, facilities exist for 'leg-wetting').

5.3 Fuel Oil Storage

5.3.1 The fire safety requirements for all the fuel oil storage facilities in the power plant shall conform to the relevant statutory requirements. Apart from these, some of the other important requirements are:

a) Only the minimum quantity required for day's requirements shall be stored in the TG house presmises;

b) All internal storage tanks shall be provided with a trough or catchpit, having the same capacity as the tank, for collecting leakages, which shall be equipped with a drain pipe, leading back to the main supply tank or safer areas; and

c) All above ground storage tanks installed in-doors shall comply with the following provisions:

   i) The individual capacity of any tank shall not exceed 10 000 litres;

   ii) The aggregate capacity of such tanks shall not exceed 2 00 000 litres; and

   iii) The building/compartment housing storage tanks shall be segregated from other building/compartment by separating walls, and all openings shall be protected by fire resisting doors of 2 hours rating and a brick or concrete liquid-tight ramp at least 150 mm in height.

5.3.2 An in-door storage tank shall not be filled otherwise than from open air through a permanently fixed metal pipe, the inlet of which shall be fitted with a screwed cap or valve. The fill pipe, shall extend into the tank so that its outlet is within 5 cm of the tank bottom.

5.3.3 All oil tanks shall be fitted with a vent pipe leading into open air, the open end being covered with a standard flame arrester conforming to IS 11006 : 1984.

5.3.4 For storage located in-doors, overflow pipes shall be carried outside the building, and deliver the oil into a catch pit or other safe position and the pipe shall terminate in a water seal container at least 30 cm below the surface of water.

5.3.5 *Outdoor Oil Storage*

5.3.5.1 External hydrant system for the power plant should be extended to cover the outdoor storage tanks with 63 mm double outlet covering the entire area. The oil tanks should also be protected by 38 mm fixed water monitors at vantage points so as to provide water for cooling of the tanks.

5.3.5.2 The oil storage tanks should also have fixed foam fire extinguishing system in conformity with IS 12835 (Part 1) : 1989.

5.4 Lubrication Oil Risks

5.4.1 The fire risk of the lubrication system of the turbo generator may be considerably reduced by using completely separate circuits for the lubricating system and the control system. The risks arise from an escape of combustible lubricants and hydraulic fluids contained in the systems.

5.4.2 An oil fire generally follows an escape of fluid on to hot steam surfaces, impregnation and absorption of oil into laggings and leakage into electrical equipment.

5.4.3 The continuous leakage and absorption of combustible oils into lagging covering steam pipes, turbine casing, etc give rise to lagging oil fires.

5.4.4 The seal oil and the jacking oil systems are also subject to the same risks.

5.4.5 There shall be arrangement for collecting leakages of lubricating oil from the distributing pipe installations by adopting any one of the following methods:

a) By running the oil lines in steel-lined trough, specially provided for this purpose; and

b) By employing the double pipe system that is running the pressurised supply pipe inside a large pipe acting as a leakage collector, which shall also act as a return pipe.

5.4.6 Where it is not practicable to separate oil risks from hot pipes and components sufficiently shielding/deflecting plates and protection cladding shall be provided at suitable point and place.

5.5 Boiler Plant

5.5.1 The details in respect of the fire safety aspects of the boiler plant installation and auxiliary equipment shall conform to the provision contained in IS 8633 : 1977.

5.5.2 The fuel delivery to the burners shall be of proper temperature and pressure as recommended by the manufacturer.

5.5.3 *Furnace and Its Control Unit*

The manually operated dampers of the boilers shall be such that they may not close off more than 80 percent of the internal cross-sectional area of the smoke pipe.

5.5.4 The automatically operated dampers of the boilers shall be of type to maintain safe damper openings at all times and arranged to prevent starting of burner unless the damper is opened at least 20 percent of the internal cross-sectional area of the smoke pipe.

5.5.5 Readily accessible shut off valves shall be provided in oil supply line near each oil burner.

5.5.6 Every boiler shall be equipped with the following safety control devices:

a) Electrical ventilation interlocking mechanisms which would prevent the fuel pumping circuit from being put into operation without closing the ventilating fan-motor circuits;

b) Pre-ventilation time delay which would prevent the furnaces from being fired until and unless the furnace had been ventilated for a pre-determined period of time;

c) Anti-flooding device to prevent abnormal discharge of oil at the burner; and

d) Flame failure safeguard which would automatically cut off flow of fuel in the event of accidental extinguishment of the burner flame.

5.5.7 No maintenance work shall be undertaken on a furnace without completely purging the interior of all traces of flammable gases and vapours and unless satisfactory results are obtained by checking with a cumbustible gas indicator (explosive meter).

6 ELECTRICAL EQUIPMENT AND INSTALLATIONS

6.1 General Requirements

6.1.1 The electrical equipment and installations of the power stations shall conform in all respects to the relevant guidelines given in IS 1646 : 1982.

6.1.2 Gasoline, benzene, ether, alcohol and similar flammable cleaning fluids shall not be used on energized electrical apparatus. The use of such flammable cleaning fluids on de-energized apparatus may, however, be permitted provided the apparatus is not energized within half an hour of such use.

6.1.3 None of the flammable solvents mentioned in **6.1.2** shall be used in the vicinity of electrical equipment from which spark may be received.

6.1.4 Every electrical equipment shall be kept free of deposits of oil, grease, carbon dust, etc.

6.1.5 Each and every electrical equipment shall be effectively earthed to avoid any flask/spark.

6.2 Cables and Cable Galleries etc

6.2.1 The fire protection requirement for cable galleries, cable runs, etc shall conform to the provisions contained in IS 12459 : 1988, including the fire protection requirements such as segregation of cable runs into compartments, use of fire resistant cables in critical areas and groups of cables, sealing of penetrations in the walls and floors by use of fire stops, fire detection and alarm systems, and the extinguishing systems.

6.3 Transformers

6.3.1 All transformer installations shall comply with the provisions of IS 1646 : 1982 in addition to the following:

a) As a protection against excessive damage due to occurrence of faults, transformers fitted with conservators shall be protected with Buchoz Relay;

b) All transformers shall be equipped with oil temperature alarms or excess current relay protection;

c) The bushings, insulators, and contacts of taps changing gears shall be kept scrupuluosly clean at all times; and

d) The level and dielectric strength of the transformer oil shall be checked at periodic intervals, and in the event of presence of a large quantity of sludge the oil shall be renewed.

6.3.2 In addition to the usual cable clamps above floor level, cables shall also be clamped immediately below floor level. Each cable or group shall, where possible, be protected by a pipe or cover of heat resisting material rising to a height of at least 45 cm above floor level or terminating just below cable gland, sealed at the bottom and filled with sand or small pebbles.

6.3.3 Whenever possible, all jute shavings shall be removed from cables in switch rooms, basements and tunnels.

6.3.4 Where cables rest on the floor of tunnel or basements, they shall be separated into groups by vertical barriers of tile brick, or concrete and the trenches so formed shall be filled with small pebbles. Alternatively, the cables may be separately clamped and each cable run shall be separated by a minimum clear space of 75 mm.

6.3.5 The cable shall not be routed near hot steam pipe, turbine, pulverised coal pipe and near hot gas ducts. Wherever it is unavoidable fire resistant cables shall be used.

6.3.6 Power cables and control cables shall run in separate trenches, wherever possible.

6.4 Battery Room

6.4.1 Motor generator sets and/or convertors or rectifiers together with necessary switch and control gear shall be mounted separately (preferably in separate rooms as far as possible) and away from the batteries.

6.4.2 The storage batteries in all attendant equipment, except compact metal clad unit shall be mounted away from all other apparatus, in a position free from dust, and shall be well ventilated.

6.4.3 The batteries shall stand directly on durable, non-absorbant and non-conducting material, such as glass, porcelain or glassed earthenware. The materials shall rest on a bench which shall be kept dry and insulated from earth. If constructed of wood it shall be slatted and treated with anti-sulphuric enamel.

6.4.4 The batteries shall be so arranged on the bench that a potential difference exceeding 12 V shall not exist between adjoining cells. The batteries exceeding 20 V shall not be bunched or arranged in circular formation.

6.4.5 All combustible materials within a distance of 60 cm measured horizontally shall be protected with hard asbestos sheets or similar material. No object shall be suspended directly over the batteries.

6.4.6 The charging circuit shall be provided with double or triple pole switches and fuses. Where a motor generator is employed, the motor shall be provided with double or triple pole switches and fuses and automatic battery and cut-out shall be placed in the generator circuit. Any sub-circuit shall be provided with a fuse rated at not more than 7 ampere in each live conductor.

6.4.7 The charging control panels shall be of durable, non-ignitable, non-absorbant, non-conducting material and together with rectifiers, transformers and supports for resistance of lamps, shall be on a bench which shall be kept dry and insulated from earth. If constructed of wood, it shall be slatted and treated with anti-sulphuric enamel.

6.4.8 If batteries are charged through resistance or lamps, unless enclosed in metallic enclosure, shall be at least 60 cm away from the nearest battery.

6.4.9 All permanent wiring shall be securely run and protected, against mechanical injury and efficient terminals or connection shall be supplied from which connection to batteries may be made. Rubber insulated wiring or any other type of combustible insulated wiring, if on insulators, shall not be run in such a position that a fire arising at any battery could reach it. All conductors connecting the supply terminals to batteries shall have either rubber or tough compound insulation without tape or braid.

6.4.10 If the source of supply in the mains has one conductor earthed, the lamps or other resistances shall be connected on an earthed lead and the batteries connected direct to earth conductors.

6.4.11 No celluloid cased storage batteries shall be allowed for use.

6.4.12 All china clay or other insulators shall be kept free of dust, and all casing, conducts, wood or metal work likely to be affected by acid spray or fumes shall be protected by acid resisting paint, varnish or compound. All exposed current carrying metal and terminals shall be coated with petroleum jelly.

6.4.13 Suitable exhaust fans shall be provided for the removal of gas from the battery rooms. Battery rooms shall be provided with ventilation to limit the concentration of hydrogen to one percent by volume.

7 ILLUMINATION

7.1 For effective fire fighting purposes, the minimum illumination required for all working places, such as turbine houses etc is 100 lux, and for control rooms is 150 lux.

8 FIRE PROTECTION MEASURES

8.1 Electrical generating and distribution stations come under the occupancy classification of Industrial Buildings, G-3 (*see* IS 1641 : 1989).

8.2 The extent and nature of the fire protection measures as well as exit facilities to be provided will depend on various factors like size and location of the station, risks involved, availablity of outside help for major fire fighting. However, all the power stations, irrespective of their size, shall provide for adequate the protection/fire fighting arrangement and exit facilities.

8.3 Generating stations may vary in size from small municipal stations to large multi-unit power stations, including super thermal power stations.

8.4 The modern trend is to locate power station in relatively remote areas with hardly any other assisting fire service within reasonable distance. This isolated location makes it all the more necessary for power stations to have an independent full fledged and well maintained fire fighting service of their own. Further, in order to enable quick response to any fire outbreak and to limit the response time to accepted standards, that is, within 5 minutes, it is necessary that a well trained and adequate fire fighting services is available within the premises.

8.5 Turbo-Generators and Supporting Structures

8.5.1 The fixed water spray type protection system shall be used for controlling a fire involving large quantities of lubricating oil on turbine generators. This shall consist of two systems of water protection, one for areas below the operating floor of the turbo generator and designed to extinguish pool fires and also providing protection against heat generated by three-dimensional or spray fires. The other is a water spray system for oil fires at or around the bearing housings. Fixed CO_2 or dry chemical extinguishing systems have been found to be inadequate for basic protection of turbo-generator because of the likelyhood of re-ignition and, further, these extinguishing media may not be sufficient to cope with a long duration fire. However, in some cases fixed dry chemical or CO_2 systems backed by water spray systems should be provided.

8.5.2 Fixed high velocity water spray systems, designed to discharge a flow of 10 lpm/m² shall cover completely all oil systems, oil piping, pumps, coolers and all similar associated equipments including adjacent floor areas. The water spray systems shall be divided into convenient zone, and each zone shall have sufficient number of projectors to cover the risk adequately. The number and groups of projection zones are related to the size of turbo-generator unit and its lubricating plant and auxiliaries. Typical zone arrangements shall cover the following areas of seal oil systems, coolers and pipe work, governor gear, excitor, main lubricating tank and pumps, lubricating oil pipe work, turbo generator and boiler feed pump, exposed steel equipment, foundation support legs, rate of rise fire detectors in accordance with IS 2175 : 1988 shall be provided. The heat detectors shall be provided at strategic points and arranged to give early warning of any unusual high temperature conditions in the area.

8.5.3 Automatic control of the extinguishing systems in this area is more effective than manual control. However, manual over-ride shall also be provided. Zone control deluge operating valve shall be carefully sited so as to be operable without fire or smoke hazard to the operator during a fire. This may be achieved by careful location of the valve assemblies away from protection zones, or by enclosures of the valves in protective cubicles, at the same time affording the operator a good view of the protected zones. Access routes to control valves shall not involve exposure hazards to the operating persons.

8.5.4 The water spray systems shall incorporate isolation facilities so as to enable periodic testing, maintenance etc.

8.5.5 Normally all cut off valves shall be locked open.

8.5.6 The internal hydrant (landing valves) shall be provided for protection of the turbo-generator building including turbine operating floors and basement areas.

8.5.7 The hydrant system shall have sufficient pressure to allow the generation of low expansion foam from hand branches for fighting static/ running oil fires.

8.6 Turbine Driven Feed Pumps

8.6.1 The fixed high velocity water spray system shall cover completely all the systems, oil pipe to the pumps, coolers and other similar associated equipment including adjacent floor areas, as for the main turbine. The fire detection system as well as the water spray system shall be of the same type as for the turbo-generator.

8.6.2 To enable fire fighting to be successfully carried out facilities shall be provided for easy smoke disposal, by provision of sufficient controllable top and bottom ventillation.

8.6.3 In the event of a fire involving or close to a turbo-generator or its auxiliaries, it may be safer to shut down the unit so as to limit the damage only to that directly resulting from the fire.

8.7 Hydrogen Equipment

8.7.1 Any hydrogen equipment that is sited in the turbo generator shall be positioned in such a way that the area and the equipment are well ventilated and directed into the open air.

8.7.2 Spark free tools shall be used in an area where gas may be present.

8.8 Transformers

8.8.1 No fixed fire protection equipment (such as high velocity spray) is required on transformers below 10 MVA or in the case of oil filled transformers with oil capacity of 2 000 litres and below. For all other transformers high velocity water spray system shall be provided. This system shall be separately mounted and designed to take into account the possibility of a transformer explosion. The water spray deluge valve house shall be located outside the transformer fire zones and protected from radient heat and other fire effects. The actuation of this system shall be automatic but manual operating valves shall also be provided.

8.8.2 The high velocity spray system for the transformers should be well designed to have adequate coverage of the entire transformer unit including the conservation tanks, the bushings and the bottom area. The positioning of the nozzles should be such to protect all surfaces of the transformer and to give discharge rate for the system not less than 10 lpm/m² of the

area to be protected. The automatic high velocity water spray shall be of pre-active with quartzoid bulbs.

8.8.3 Fire barriers walls shall be provided between transformers where they are less than 15 m apart or where the oil capacity exceeds 2 000 litres.

8.8.4 The transformer shall be so designed as to permit the safe testing of the fire protection system, with discharge of water, while on load.

8.8.5 There shall be arrangements for containment of the spilled oil. For generator transformers and other large transformers the drainage system as well as storage, pit shall be sufficient to accommodate at least the total volume of the oil and an allowable volume of fire fighing water. The drain pipes shall be provided with standard type of flame arresters.

8.8.6 The fire protection systems covering the generator transformers, associated oil conservator tank and cooler batteries shall be designed to meet the single risk concept so that simultaneous deluge over all the three risk zones is possible.

8.8.7 The electrical clearances for high velocity spray system shall be as given in Table 1.

8.9 Switch Gear

8.9.1 Gas filled circuit breakers (such as SF_6 or sulphur-hexafluoride) and vaccum breakers are the least fire hazardous as compared to the oil breakers or air-blast breakers. Hydrant protection shall be in close proximity to these risks.

8.9.2 For an enclosed switch gear room automatic Halon or CO_2 total flooding extinguishing system is considered preferable to water spray. Switch rooms shall be provided with controllable ventilators.

8.9.3 All cable entries in the switch gear room shall be effectively sealed by use of fire stops (*see* IS 12459 : 1988).

8.9.4 All switch gear rooms shall be kept clear and free from any accumulated debris or flammable material.

8.9.4.1 The following 6·6 kV and 415 V switch boards may preferably be housed in separate rooms:

a) Unit switch boards (with separate room for boards of each unit),
b) Station switch boards, and
c) Unit switch boards.

8.9.5 Switch gear rooms shall be pressurised by the ventilation system to prevent ingress of dust. Suitable interlocks shall be provided to switch off the pressurised ventilation system before the centralised extinguishing gas system is to be put into operation.

Table 1 Clearance from Water Spray Equipment to Live Un-Insulated Electrical Components

(*Clause* 8.8.7)

Nominal Line Voltage	Nominal Voltage to Ground	Design BIL	Minimum Clearance
kV	kV	kV	mm
To 15	To 9	110	178
23	13	150	254
34·5	20	200	330
46	27	250	432
69	40	350	635
115	66	550	940
138	80	650	1 118
161	93	750	1 321
196-230	114-132	900	1 600
		1 050	1 930
287-380	166-220	1 175	2 210
		1 300	2 489
		1 425	2 769
		1 550	3 048
500	290	1 675	3 327
		1 880	3 607
500-700	290-400	1 925	3 886
		2 100	4 267
		2 300	4 674

NOTES

1 BIL values are expressed as kilovolts (kV), the number being the crest value of the full wave impulse test that the electrical equipment is designed to withstand.

2 When the design BIL is not available, and when nominal voltage is used for the design criteria, the highest minimum clearance listed for this group shall be used.

8.9.6 Smoke detectors of ionisation and optical types shall be employed in the switch gear rooms on cross-zoning principle with suitable time delay devices incorporated. Proven intelligent, micro processor based detection/suppression system shall be preferred.

8.9.7 Fixed automatic gaseous extinguishing of local application type shall be ideal in the switch gear system.

8.10 Control Room

8.10.1 For control room of Class I and II of power generating units as well as distribution stations shall have fire barrier/separation walls between the main TG hall/any other adjacent

room. The control room shall have 2 hours fire resistance with smoke stock fire check doors of the same rating.

8.10.2 All cable entries/openings in the control room shall be effectively sealed.

8.10.3 The room shall be kept clear and free of any waste material whenever glass panels are provided, it shall be of clear fire resisting glass having minimum 45 minutes fire resistance or fitted with automatic resistant shutters/automatic water curtain.

8.10.4 The AC system shall be automatically switched off before the extinguishing system is put into operation.

8.10.5 Smoke detectors of ionisation and optical types shall be provided in the Control room on cross-zoning principle with suitable time delay devices incorporated. Proven intelligent, microprocessor based detection/suppression system shall be preferred.

8.10.6 'ON' and 'OFF' type sprinkler system, CO_2 or Halon extinguishing system shall be provided for control room. In this case 'ON' and 'OFF' type should be preferred.

8.11 Cable Galleries

8.11.1 The experience of Power Station cable fires had been that in many cases, several units, if not the whole station, got seriously affected by a single fire. PVC is not easily flammable but burns freely in fairly high temperature conditions producing copious quantities of dangerous fumes and gases including HCL gas. These gases are toxic and highly corrosive. The cable galleries, separating rooms etc shall be provided with facilities for ventillation and means for controlling it from outside. Apart from the need to clear smoke and toxic gases in the event of a fire, ventillation may be necessary for temperature control of the galleries on areas.

8.11.2 To limit the spread of fires along cable ways fire barriers shall be installed in accordance with the requirements of IS 12459 : 1988.

8.11.3 Access and exit ways large enough to allow a man wearing breathing apparatus and carrying other fire fighting equipment to pass through shall be provided. The distance between such exit ways shall not exceed 30 m in the cable runs. The cable galleries or runs shall be provided with automatic fixed fire fighting installations using water, CO_2 halon or high expansion foam. However, water spray sprinkler system is generally preferred. The design of sprinklers and projectors shall ensure that no rack or cable is left unprotected. Automatic sprinkler system for the cable galleries shall be designed for a density of not less than 12 lpm/m^2 over area of 232 m^2. Water spray system shall have the same density.

8.11.4 Smoke detectors of ionisation and optical type shall be provided in the control room on cross-zoning principle with suitable time delay devices. Proven intelligent micro processor based detection/suppression system shall be provided. Alternatively heat detectors of linear type covering all the cable racks/trenches shall be installed.

8.11.5 Where high expansion foam or gas exgtinguishing systems are used, the system shall actuate only after all persons inside have been evacuated.

8.11.6 Self-contained BA sets shall be available for ready use by trained personnel at strategic points near the entry to the cable galleries.

8.11.7 All cable galleries/tunnels shall be maintained in a neat and tidy conditions. These shall not be used for storage/dumping of scrap or any other article including electrical spares.

8.11.8 The means of escape shall be clearly indicated and all exit ways shall be kept clear. The controlled access procedure shall be enforced for the cable galleries, tunnels etc for employees on regular work or inspection duties.

8.11.9 Floors of all cable galleries/tunnels shall have a slope of suitable gradient leading to a sump of adequate capacity for collecting seepage and other water including water used for fire fighting. An automatic sump pump of suitable capacity shall be installed at each sump to pump out the water to the surface drain.

8.12 Coal Storage and Handling Equipment

8.12.1 Coal handling plant shall be provided with an early warning fire detection system for moving and stationery fire detectos such as rate of rise/infra-red/linear heat detectors/optical beam should be adopted.

8.12.2 The fire protection measures for open storage of coal and coal handling equipment, as prescribed in IS 3595 : 1984 shall be provided. In addition, the following measures shall also be complied with.

8.12.2.1 After determining the location and extent of a fire in a coal storage yard, the coal should be dug out and the heated coal removed. Moisture accelerates oxidation, and therefore it has got to be ensured that the seat of the fire is attacked. For this, the use of Extended Branch Pipe (*see* IS 11101 : 1984) shall be helpful.

8.12.2.2 Caution has to be exercised while applying extinguishing water jets on coal and coal handling equipment to avoid raising of a coal dust cloud which may result in a dust explosion.

8.12.2.3 For enclosed structures adequate explosion venting provision shall be made.

8.12.2.4 Static electricity hazards shall be minimised by the permanent bonding and grounding of all equipment including conveyor belts, pulley idlers, motor drives, etc.

8.12.2.5 Automatic sprinkler system shall be designed for a minimum of 10 lpm/m² density over 232 m² area. Water spray system shall have the same density.

8.12.2.6 Conveyors that are below grade or enclosed present special hazards for fire fighting, and need to be maintained properly.

8.12.2.7 The actuation of detection system shall automatically shutdown the conveyor belts in the area involved.

8.12.2.8 On detection of a fire dust collectors and fans shall automatically shut-down.

8.12.2.9 Carbon monoxide (CO) gas detection system shall be desirable for pulverizers to give early warning about conditions leading to fires and explosions.

8.12.2.10 The planed hydrant system should cover the coal storage and handling areas/ equipments also. The escape route in overhead conveyor system, adequate means of escape shall be provided particularly in long enclosed conveyor belts. In the later case, exit doors shall be provided at intervals of not greater than 50 metres, fitted with escape rungs, which would enable persons inside the closed conveyor system to escape in case of fire/explosion.

8.13 Boiler Plant Fire Protection

8.13.1 Boiler furnaces shall be protected with automatic sprinkler water spray, foam or foam water sprinkler systems covering the burner front oil hazard.

8.13.2 Boiler furnaces and boiler front areas shall be provided with automatic fire detection systems based on rated type fire detection system in accordance with IS 2175 : 1988.

8.13.3 Boiler front fire protection systems shall be designed to cover the fuel oil burners and igniters, adjacent fuel oil piping and cable up to a 6 m distance from the burner and igniter including structural numbers and walk-ways at these levels. The sprinkler systems shall be designed for a density of 10 lpm/m² over 232 m² area. Water spray system shall have the same density.

8.13.4 Entire boiler plant shall be protected by wet riser system with landing valves at all levels and connected to the hydrant water mains.

8.14 Electrostatic Precipitator

8.14.1 Once a fire is detected the ESP unit should go into emergency shut-down immediately. Once the flow of air and fuel to the fire have been stopped and the electrostatic precipitator has been shut-down and de-energised, the precipitator doors may be opened and water jet/spray directed as required.

8.15 Gas Turbine Generators

8.15.1 Certain areas of the turbine operate at high temperature and have slow cooling rate after shut-down. Surface temperature of the combustion chamber will be higher than the ignition temperature of fuel and lube oil.

8.15.2 The lubricating and hydraulic seal oil systems require similar type of fire protection as in the case of steam turbine driven generators. Isolated installations may be protected with an automatic sprinkler water spray system.

8.15.3 Where the generator is installed in an enclosure, a CO_2 system may be provided.

8.15.4 In gas turbine generator and accessory compartments, to extinguish fires in electrical equipment by CO_2 system, the rate of discharge shall be such that a 34 percent concentration is attained within one minute after actuation, and 30 percent concentration shall be maintained throughout the deceleration period but not less than twenty minutes. All metal surfaces shall be cooled to below auto-ignition temperature of the oil. The minimum concentration as mentioned above shall be achieved after taking into account the possible leakage.

8.15.5 The fuel system shall be inter-locked with automatic fire extinguishing system so that the fuel supply is automatically shut off upon operation of the fire extinguishing system.

8.15.6 The emergency shut down controls shall provide tripping arrangement for over-speed, excessive vibration, flame-out and high exhaust temperature.

8.16 Water Supplies for Fire Fighting

8.16.1 The water supplies for fire fighting for Power Stations shall by and large, conform to the provisions contained in IS 9668 : 1990 and internal Hydrant System to IS 3844 : 1989 and External Hydrant System to IS 13039 : 1991. In addition, the following requirements shall also be taken into account.

8.16.1.1 The water supplies shall be planned on the basis of the requirement of the largest fixed fire extinguishing system demand plus the maximum demand from the hydrant mains of not less than 3 600 l/m for minimum of 4 hours duration for power stations falling under the category of classes 1 and 2, and for a minimum of 3-hours duration for the lower categories. Pumping capacity of the water supply system for fire fighting shall be based on the requirements mentioned above. It shall be ensured that no tapping is done from the fire

fighting mains to meet the requirements of process units or other services. The water mains shall be of adequate size as prescribed in relevant Indian Standards and shall be of wrought or mild steel (located and wrapped) pipe [galvanised and ungalvanised/UPVC/GRP/Centrifugal cast (spun) iron/stainless steel]. If the mains are laid in high corrosive situations, it may be desirable to cathodic protection or coating and wrapping or both, if required.

8.16.1.2 The fire fighting pumps shall be of automatic starting with manual stopping and in conformity with IS 12469 : 1988.

8.16.1.3 The main reservoir shall have replenishment arrangement for complete re-filling operation which shall preferably be accomplished automatically.

8.16.1.4 The water mains shall be looped around the main power block and the pipe sizes shall be designed to cater to future expansion, needs.

8.16.1.5 The interior fire protection mains/risers shall be considered as an extension of the yard main and shall be provided with at least 2 valve connections with sectional control valves.

8.16.1.6 For the entire power station area only 'Branch Pipe Universal' conforming to IS 2871 : 1983 shall be provided in the hose cabinets as spray nozzles having sheet-off capability shall be ideal for use on electrical equipment.

8.17 Manual Fire Alarm System

8.17.1 The entire plant area, including administrative and other buildings shall be provided with manual fire alarm system with call boxes deployed at various strategic locations. The system shall conform to the requirements given in IS 2189 : 1988. The control panels of the fire alarm system shall be located both in the plant control room as well as the fire station control room.

8.18 Lightening Protection

8.18.1 Lightening protection for the power station building and outdoor bulk oil storage areas shall be provided.

8.19 Emergency Power

8.19.1 All generator units require emergency power for operation of the turning gear, bearing oil pumps, seal oil pumps control. units, besides meeting the requirements of emergency services like emergency lighting of all vital areas, means of escape, fire fighting pumps etc. A set of station batteries is a reliable supply for each load. Separate battery banker shall be provided for each unit and control centre. In addition, emergency stand by power is necessary in the form of diesel generator. These units will provide backup power to the station battery system and shall be designed to have capability of sufficient power for automatic and 'dead' start. In addition, emergency lamps with adequate illumination shall be provided at strategic locations which shall automatically operate on the failure of the mains supply.

9 FIRE PROTECTION FOR POWER PLANTS DURING CONSTRUCTION

9.1 The potential fire hazards during construction of Power Stations are considerable, and call for observance of stringent fire precautions. An above average level of fire protection is necessary during this phase due to life safety consideration of the large number of on-site personnel, high value of materials, and long duration of the construction period.

9.2 The availability of essential fire protection equipment, and minimisation of fire risks during construction activities are particularly important.

9.3 Construction schedule shall be co-ordinate so that planned permanent fire protection systems are installed and placed into services as soon as possible, at least prior to the introduction of any major fire hazards.

9.4 Minimum fire detection and fire extinguishing measures shall have to be provided for all locations where fire hazards are present, like storage of construction materials, storage of flammable materials, fire safety of welding and cutting and other building operations.

9.5 A fire trained supervisor shall be available at the construction site to ensure that all essential fire safety precautions are observed.

9.6 Where practical, the permanent fire hydrant system for the plant shall be installed well ahead of the completion of the project so that fire fighting water supplies shall be available even during construction period. Where this is not practicable, a minimum number of water tanks of not less than 1·25 lakh litres capacity with replenishing arrangements shall be available at strategic locations in the plant area which may be utilised as emergency water supply for fire fighting even after commissioning of the plant. A minimum of 2 hours duration water supply for fire fighting shall be available at the construction site.

9.7 Portable Fire Extinguishing System

9.7.1 In addition to the fixed water extinguishing systems, sufficient number of first aid fire fighting equipment like different types fire extinguishers shall be available for development at various fire risk areas as per IS 2190 : 1992. It is essential that the fire extinguishers are inspected, maintained in accordance with IS 2190 : 1992.

9.8 Maintenance of Fire Protection System/ Equipment

9.8.1 All the fire protection system/equipment or devices shall be inspected and maintained regularly to ensure for their safe operation at all times. The suggested schedule for each inspection, testing and maintenance is given in Table 2. Proper records of such maintenance shall be maintained.

10 REQUIREMENT OF MAJOR FIRE FIGHTING APPLIANCES/EQUIPMENT AND MANPOWER

10.1 On account of the reason that the power stations are generally located in relatively remote areas with hardly any other assisting fire service within reasonable distance, it is necessary for the power stations to be provided with an independent full-fledged and well maintained fire service of their own. Quick response to a fire outbreak by fire fighting service is vital as it makes a difference between a small fire or a major fire with catastrophic loss. In other words, power station fire brigades shall be in a position to tackle a fire, control and extinguish it before any damage is done.

10.2 Requirement of Major Fire Fighting Appliances/Equipments

10.2.1 *Major Appliance/Equipment for Power Stations of Installed Capacity Less than 50 MW (Class IV Power Stations)*

10.2.1.1 There may not be any need for any major fire fighting appliances for generating stations of this category provided the station is located within 8 km from the nearest municipal fire brigade possessing adequate fire fighting appliances. In case it is located at a further distance, or if the municipal fire appliances are not available, a Trailer Fire Pump conforming to IS 944 : 1979, or a higher capacity Portable Pump conforming to IS 12717 : 1989 shall be provided with skeleton fire staff.

10.2.1.2 The Power Station shall have a hydrant system, and also at least 3 Static water tanks deployed at strategic locations, of minimum 1·25 lakh litres capacity. The following shall be provided:

a) The v/m equipment, minimum of 25 lengths of 63 mm dia fire fighting hose of 20 m lengths each (15 lengths of type 'A' of IS 636 : 1988, and 10 lengths U/L hose conforming to IS 4927 : 1992);

b) Branch Pipe Universal, conforming to IS 2871 : 1983 — 4 No.

c) Foam-making Branches FB 5x — 2 No.

Table 2 Fire Equipment Inspection, Testing and Maintenance Frequency Schedule

(*Clause* 9.8.1)

Item	Weekly	Monthly	Semiannual	Annual
Supervisory Alarm Circuits	X	T		
Fire and Smoke Detectors		A	M/T	
Manual Fire Alarms		T	M/T	
Sprinkler Water Flow Alarms		M/T		
Sprinkler and Water Spray Systems	X	A	M	T
Foam Systems	X	A	M	T
Halogenated Agents, Chemical and CO_2 Systems	X	A	M	T
Fire Pumps and Booster Pumps	T	M		T
Water Tanks and Alarms	X	A	M/T	
P I V's and OS and Y Valves	X	X		M/T
Fire Hydrants and Associated Valves		X	M/T	
Fire Hose and Standpipes		X		
Portable Fire Extinguishers and Hose Nozzles		X		M
Fire Bridage Equipment		X		T
Fire Doors	X	T		
Smoke Vents		X		M/T
Emergency Lighting		X/T		
Radio Communication Equipment		T		

where

X = Inspection

T = Operational Test

M = Maintenance

A = Alarm Test (Transmitters)

NOTES

1 Testing of these systems should be done where possible after necessary precautions have been taken to eliminate any hazardous conditions which would result from the discharge of the extinguishing agent.

2 On systems where flow testing is not practical, a representative number of nozzles should be removed and checked for signs of blockage. In these cases the annual test will consist of a trip test of deluge preaction valves or valve operations as applicable.

3 This is a test to verify pump operability only.

4 Performance tests to be conducted under load to verify that the pumps meet design conditions.

5 Valves not locked to be inspected weekly. Valves locked or electrically supervised to be inspected monthly.

6 Testing of standpipes to include water flow at highest elevations.

d) Foam-making FB 10 x — 1 No.
e) Mechanical Foam compound [IS 4989 (Part 1) : 1985] — 200 L
f) BA sets (Positive Pressure type) — 4 No.
g) Blower and Exhauster for fire-fighting as per IS 941 : 1985 — 2 No.
h) Water Jel Blankets (Fire Blankets) (1·80 × 1·50 m) — 2 No.
j) Water Jel Blankets (for burns) (0·90 × 0·75 m) — 4 No.
k) Water Jel Container — 1 No.

10.2.2 The above scales of equipment and fire protection systems shall be equally applicable to load despatch centres in the grid systems, and also for major distribution stations (220 kV substations and abo).

10.2.3 *For Generating Stations of Installed Capacity from 50 MW to 199 MW (Class III)*

The following equipments shall be provided:

Type of Appliances	*No.*	*Manning Pattern*
1. Foam and CO_2 C/T (Conforming to IS 951 : 1987)	1	Round the clock
2. Water Tender Type 'B' conforming to IS 950 : 1980	1	Reserve
3. Large capacity portable pump conforming to IS 12717 : 1989	1	Reserve
4. Portable Water/ Foam Monitors	2	(No separate manpower required)
5. B A sets (Positive Pressure type)	8 sets	
6. High Pressure Charging sets (for B A Sets)	1 No.	(at HQ)
7. Blower and Exhauster for fire fighting, conforming to IS 941 : 1985	2 No.	
8. Water Jel Blankets (1·80 × 1·50 m)	4 No.	
9. Water Jel Blankets (0·90 × 0·75 m)	8 No.	
10. Water Jel Container	2 No.	
11. Foam compound	1 000 litres	
12. Dry Chemical Powder Trailer of 150 kg capacity	1 No.	

10.2.4 *For Major Power Stations Having Installed Capacity Over 200 MW up to 999 MW (Class II)*

The following equipments shall be provided:

Type of Appliances	*No.*	*Manning Pattern*
1. Foam and CO_2 C/T	1	Round the clock
2. Dry Chemical Tender 2 000 kg conforming to IS 10993 : 1984	1	Round the clock
3. Water Tender type 'B'	1	
4. High Capacity Portable Pump (conforming to IS 12717 : 1989)	1	Reserve
5. Portable Water/ Foam Monitors	2	No separate manpower required
6. 13·5 m Light alloy extension ladder with props	1	No separate manpower required
7. B A sets (Positive Pressure type)	18	
8. High Pressure Charging Set	1	
9. Trailer/Portable Flood Light Unit	1	
10. Jeep 4 × 4	1	
11. Blower and Exhauster	4	
12. Water Jel Blankets (1·80 × 1·50 m)	8 No.	
13. Water Jel Blankets (0·90 × 0·75 m)	16 No.	
14. Water Jel Container	4 No.	
15. Foam Compound	20 000 litres	
16. Dry Chemical Powder Trailer of 150 kg capacity	1 No.	
17. High Expansion Foam Generator	1 No.	

10.2.5 *Super Thermal/Power Stations Having Installed Capacity Exceeding 1 000 MW (Class I)*

The following equipments shall be provided:

Type of Appliances	*No.*	*Manning Pattern*
1. Foam and CO_2 C/T	1	Round the clock
2. Water Tender type 'B'	1	Round the clock

Type of Appliances	*No.*	*Manning Pattern*
3. Dry Chemical Tender 2 000 kg	1	Round the clock
4. Emergency Tender conforming to IS 949 : 1985	1	As reserve
5. Hydraulic Platform 22 m Height (indigenously fabricated)	1	As reserve
6. Portable Water/ Foam Monitors	4	Reserve
7. 13·5 m light alloy extension ladders	2	
8. Trailer/Portable Flood Light Unit	1	
9. Jeep 4 × 4	1	
10. B A sets (Positive Pressure type)	24	
11. High Pressure Charging Set	1 set	
12. Blower and Exhauster	4 No.	
13. Water Jel Blankets (1·80 × 1·50 m)	16 No.	
14. Water Jel Blankets (0·90 × 0·75 m)	32 No.	
15. Water Jel Containers	8 No.	
16. Foam Compound	50 000 litres	
17. Dry Chemical Powder Trailer of 150 kg capacity	1 No.	
18. High Expansion Foam Generator	2 No.	

NOTE — Considering the large area of the Super Thermal Power Stations and also for facilitating quick turnouts it may be necessary to deploy the operational equipment at two fire stations, a main Fire Station and Sub-Fire Station, both having update communication arrangement to help easy mobilisation in case of emergency.

10.3 Requirement of Manpower for Manning the Fire-fighting Appliances

10.3.1 The manpower requirements has to be based on the number of fire fighting appliances to be kept manned round the clock (day and night). The scales of manpower required for each type of appliance shall be as per the norms prescribed by the Standing Fire Advisory Council of the Government of India and also as per guidelines given in IS 6070 : 1983. The fire crew, computed as per the scales prescribed above shall work in three shifts. A reserve of 33⅓ percent of the total strength required for shift duties shall also be provided, to cater for leave, absence, training requirements, etc. it has to be ensured that the designated strength of crew for each shift is available for speedy turn at all times for quick response to fire calls.

10.3.2 For generating stations of installed capacity less than 50 MW the following minimum manpower shall be maintained:

Assistant Station Officer — 1

Leading Fireman (L/F)/
Fireman (F/M) — 1 (per shift)

The norms shall apply for manpower requirements for major substations also.

10.3.2.1 In addition to the full time fire fighting staff, selected members of the security/plant staff shall have also to be imparted basic training in fire fighting/fire prevention duties who may also be utilised for fire fighting duties in emergency.

10.3.3 For Class III, Class II, and Class I category Power Stations the manpower requirements shall be computed as per scales laid down by the Standing Fire Advisory Council/IS 6070 : 1983.

10.3.4 In addition to the above, one qualified fire officer of senior rank shall also be necessary for each power station, depending upon the category, as overall incharge of the Power Station Fire Brigade for ensuring proper training, control and supervision of the entire fire fighting staff. He shall also be responsible for all the fire protection arrangements in the Power Station.

10.3.5 Considering the large area of Super-thermal Power Stations, facilitate quick turn out it may be necessary to deploy the operational manpower at two Fire Stations — a Main Fire Station and a Sub Fire Station, both having up-to-date communication facilities to help easy mobilisation in case of emergency.

10.4 Fire Stations

10.4.1 Power Stations authorised for full time Fire Brigades with major fire fighting appliances shall have well designed Fire Stations for housing appliances and fire fighting staff. They shall be so located that the response time for fire appliances are kept to a minimum not to exceed 5 minutes. The design of the Fire Stations shall conform to the Standard Fire Station requirements as prescribed by the Standing Fire Advisory Council.

11 FIRST-AID FIRE FIGHTING

In the entire Power Station area, first-aid fire fighting equipment like fire extinguishers shall be deployed. It is essential that these extinguishers are periodically inspected and maintained in accordance with the provisions contained in IS 2190 : 1991.

12 FIRE EMERGENCY ORDERS

12.1 Each Power Station shall have a Fire Emergency Plan formulated so as to facilitate organised actions to be taken in case of fire by staff at various levels, during day-light hours as well as night. These orders shall also contain the instructions on fire prevention measures and the fire fighting organisation.

12.1.1 The Fire Emergency Orders shall also contain a Mutual Aid Scheme for mobilising assistance by way of equipment and trained manpower from neighbouring units, if available.

12.2 Periodical mock fire drill shall be conducted so as to check the alertness and efficiency of Plant staff as well as fire fighting staff, and records maintained.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
636 : 1988	Non-percolating flexible fire fighting delivery hose (*third revision*)
941 : 1985	Specification for blower and exhauster for fire fighting (*second revision*)
944 : 1979	Functional requirements for 1 800 l/min trailer pump for fire brigade use (*second revision*)
949 : 1985	Functional requirements for emergency (rescue tender) for fire brigade use (*second revision*)
950 : 1980	Functional requirements for water tender type B for fire brigade use (*second revision*)
951 : 1987	Functional requirements for crash tender for air fields (*third revision*)
1641 : 1988	Code of practice for fire safety of buildings (general): General principles of fire grading and classification (*first revision*)
1642 : 1989	Code of practice for fire safety of buildings (general): Details of construction (*first revision*)
1643 : 1988	Code of practice for fire safety of buildings (general): Exposure hazard (*first revision*)
1644 : 1988	Code of practice for fire safety of buildings (general): Exit requirements and personal hazard (*first revision*)
1646 : 1982	Code of practice for fire safety of buildings (general): Electrical installations (*first revision*)
2175 : 1988	Specification for heat sensitive fire detectors for use in automatic fire alarm system (*second revision*)
2189 : 1988	Code of practice for selection, installation and maintenance of automatic fire detection and alarm system (*second revision*)
2190 : 1992	Code of practice for selection, installation and maintenance of portable first-aid fire extinguishers (*third revision*)
2309 : 1989	Code of practice for the protection of buildings and allied structures against lighting (*second revision*)
2871 : 1983	Specification for branch pipe, universal for fire fighting purposes (*first revision*)
3181 : 1978	Fire resistant conveyor belting for underground use in coal mines (*first revision*)
3594 : 1991	Code of practice for fire safety of industrial buildings: General storage and warehousing including cold storage (*first revision*)
3595 : 1984	Code of practice for fire safety of industrial buildings: Coal pulverizers and associated equipments (*first revision*)

IS No.	*Title*
3844 : 1989	Code or practice for installation and maintenance of internal hydrants and hose-reel on premises (*first revision*)
4927 : 1992	Specification for unlined flax canvas hose for fire fighting (*first revision*)
4989 (Part 1) : 1985	Specification for foam concentrate (compound) for producing mechanical foam for fire fighting: Part 1 Protein foam (*second revision*)
4989 (Part 2) : 1984	Specification for foam concentrate (compound) for producing mechanical foam for fire fighting: Part 2 Aqueous film forming foam (AFFF)
4989 (Part 3) : 1987	Specification for foam concentrate (compound) for producing mechanical foam for fire fighting: Part 3 Fluoro protein foam
6070 : 1983	Code of practice for selection, operation and maintenance of trailer fire pumps, portable pumps, water tenders and motor fire engines (*first revision*)
8633 : 1977	Technical requirements for location of boilers installations and boiler houses
9668 : 1990	Code of practice for provision and maintenance of water supplies and fire fighting
10993 : 1984	Functional requirements for 2 000 kg dry powder tender for fire brigade use
11006 : 1984	Flash back arrestor (flame arrestor)
11101 : 1984	Specification for extended branch pipe for fire brigade use
11360 : 1985	Specification for smoke detectors for use in automatic electrical fire alarm system
12459 : 1988	Code of practice for fire-protection of cable runs
12469 : 1988	Pumps for fire fighting applications
12717 : 1989	Functional requirements of fire fighting equipment — High capacity portable pump-set (1 000-1 600 l/min)
12777 : 1989	Fire safety — Flame spread of products — Method for classification
13039 : 1991	Code of practice for provision and maintenance of external hydrant system
12835 (Part 1) : 1989	Code of practice for design and installation of fixed fire extinguishing system: Part 1 Low expansion foam

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Fire Safety Sectional Committee, CED 36

Chairman	*Representing*
SHRI J. N. VAKIL	Tariff Advisory Committee, Bombay
Members	
SHRI K. RAVI (*Alternate* to Shri J. N. Vakil)	
DR R. K. BHANDARI	Institution of Engineers (India), Calcutta
SHRI R. P. BHATLA	Engineers India Ltd, New Delhi
SHRI M. M. KAPOOR (*Alternate*)	
SHRI S. N. CHAKRABORTY	Tariff Advisory Committee, Madras
SHRI P. K. MAJUMDAR (*Alternate*)	
SHRI P. K. CHATTERJEE	Ministry of Defence (DR & DO), New Delhi
SHRI V. K. SHARMA (*Alternate*)	
CHIEF FIRE OFFICER	Municipal Corporation of Bombay, Bombay
SHRI D. PADMANABHA	Tata Consulting Engineers, Bombay
SHRI G. P. MONNAIAH (*Alternate*)	
DEPUTY CHIEF ENGINEER (P & D)	Northern Railway, Ministry of Railways, New Delhi
EXECUTIVE ENGINEER (P & D) (*Alternate*)	
SHRI S. K. DHERI	Municipal Corporation of Delhi, Delhi
SHRI R. C. SHARMA (*Alternate*)	
SHRI S. R. DORAISWAMY	Ministry of Defence (Engineer-in-Chief's Branch), New Delhi
SHRI S. N. LAKSHMANNA (*Alternate*)	
FIRE ADVISER	Ministry of Home Affairs, New Delhi
SHRI P. N. GHOSH	In personal Capacity, New Delhi
SHRI C. P. GOSAIN	Central Public Works Department, New Delhi
SHRI S. C. GUPTA	Lloyds Institution (India) Pvt Ltd, New Delhi
SHRI SANJEEV ANGRA (*Alternate*)	
SHRI M. R. KAMATH	Mather and Platt Ltd, Bombay
SHRI K. R. EASWARAN (*Alternate*)	
SHRI V. M. MADGE	The Hindustan Construction Co Ltd, Bombay
SHRI A. B. PHADKE (*Alternate*)	
BRIJ MALHOTRA	State Bank of India, Bombay
SHRI G. B. MENON	In Personal Capacity, Delhi
SHRI S. R. NARASIMHAN	Central Electricity Authority, New Delhi
SHRI RAJENDRA SINGH (*Alternate*)	
PRESIDENT	Institution of Fire Engineers India, New Delhi
SHRI V. M. RANALKAR	Ministry of Petroleum and Natural Gas, New Delhi
SHRI HARISH R. SALOT	Vijay Fire Protection System Pvt Ltd, Bombay
SHRI RAJESH K. SALOT (*Alternate*)	
SHRI N. L. N. SHARMA	Bharat Heavy Electricals Ltd, Hyderabad
SHRI M. L. KHURANA (*Alternate*)	
DR T. P. SHARMA	Central Buildings Research Institute (CSIR), Roorkee
DR GOPAL KRISHAN (*Alternate*)	
SHRI R. SUNDARARAJAN	National Thermal Power Corporation Ltd, New Delhi
SHRI S. K. CHATTOPADHAYAY (*Alternate*)	
SHRI SUNIL DAS	Metallurgical Engineering Consultants (India) Ltd, Ranchi
SHRI R. N. CHACHRA (*Alternate*)	
SHRI M. S. TYAGI	Ministry of Labour, Kanpur
SHRI P. K. SAKSENA (*Alternate*)	
SHRI D. VENUGOPAL	Loss Prevention Association of India Ltd, Bombay
SHRI T. V. MADHUMANI (*Alternate*)	
SHRI Y. R. TANEJA, Director-in-Charge (Civ Engg)	Director General, BIS (*Ex-officio Member*)

Member Secretary

SHRI HEMANT KUMAR
Joint Director (Civil Engineering), BIS

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards Monthly Additions'.

This Indian Standard has been developed from Doc: No. **CED 36 (4775)**

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 323 01 31, 323 33 75, 323 94 02

Telegrams: Manaksanstha
(Common to all offices)

Regional Offices:		Telephone
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	323 76 17, 323 38 41
Eastern	: 1/14 C.I.T. Scheme VII M, V.I.P. Road, Maniktola CALCUTTA 700054	337 84 99, 337 85 61 337 86 26, 337 91 20
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43 60 20 25
Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600113	235 02 16, 235 04 42 235 15 19, 235 23 15
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	832 92 95, 832 78 58 832 78 91, 832 78 92
Branches	: AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PATNA. PUNE. THIRUVANANTHAPURAM.	

Printed by Reprography Unit, BIS, New Delhi