

## **SAFETY REQUIREMENTS : HEALTH, SAFETY & ENVIRONMENT**

### **1.0 HEALTH, SAFETY & ENVIRONMENT POLICY.**

The objective of this document is to provide and establish safe & environment friendly work practices at all construction sites as per our corporate health, safety and environment policy given below.

#### **Commitment**

Together, we have the highest concern and commitment for protecting the Health and Safety of all employees, contractors, customers and the communities in which we operate and for conservation of the Environment.

We will comply with all Statutory Regulations and may even go beyond these for the benefit of our environment.

We consider Health, Safety and Environmental aspects are an integral part of our business planning and operation processes.

#### **Policy**

Based on these guiding principles, we shall :

#### **Demonstrate our commitment by .....**

Providing and maintaining safe facilities and working conditions.

Recognising that all employees have responsibility for their own safety and actions which could affect the safety of others.

Adoption of appropriate technologies to minimise the impact of our activities on the Environment.

#### **Establish clear objectives and targets to .....**

Improve continuously for prevention of accidents & occupational illnesses and minimising any impact of our activities on the environment.

Promote learning through training and sharing of experiences and best practices; including with contractors, customers and the public, wherever required..

Inculcate values and attitudes conducive to achieve excellence in Health, Safety and Environmental performance.

#### **Provide means to achieve our mission by .....**

Assigning clear roles and responsibilities at all levels and periodically reviewing and recognising contribution to HSE objectives.

Allocating adequate resources.

Fostering a spirit of participation by all employees in Health, Safety and Environmental conservation efforts.

Creating appropriate forums for deliberations on Health, Safety and Environmental issues.

#### **Monitor performance by .....**

Periodically auditing work processes, systems & practices and promptly correcting deficiencies.

Incorporating HSE performance as a parameter for assessing the overall performance of Employees, Business Units, Contractors and Business Associates.

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Commensurate with above corporate HSE policy, policy of E&P to ensure health, safety and environmental protection at every construction site is as under:

- i. Adopting sound and safe engineering practices for each project at design and construction stage.
- ii. Taking due care to not cause any intentional damage to the environment

during process of construction or material handling or both.

iii. All major projects shall be audited by a multimember team. The time gap between two consecutive safety audits at long duration project sites shall be around six months.

iv. Every audited construction site and material warehouse shall conform to audit recommendations through compliance report to HQ.

v. Every near miss and accident at construction site shall be reported immediately on-line by official present at incident location.

vi. Investigation of any accident at construction site shall be done by a multimember team to determine root cause of accident and to recommend necessary changes in ground condition to prevent repetition of similar incident.

vii. Workshop for contractors on Factory act, Minimum wages act, ESI & EPF acts, Contract labour and Building workers acts.

viii. Workshops for contractors on industrial first aid procedures.

ix. Increasing awareness through holding competitions among all categories of staff and contract workers on safety slogan, safety suggestions and detection of unsafe conditions and near misses.

x. Delivering safety talks and holding safety committee meetings periodically with active participation from workers.

xi. Observing National Safety Week and Fire Service week and World Environment day appropriately.

**1.1 IMPLEMENTATION OF SAFETY & ENVIRONMENTAL REGULATIONS** The contractor shall at his own expense arrange and comply with all safety provisions as stipulated by owner/ Bureau of Indian Standards / Electricity act / OISD / Andhra Pradesh State Pollution Control Board and other acts as applicable in respect of all personnel, directly or indirectly employed by contractor for the work. The contractor shall ensure that he, his sub-contractor and workers employed by him shall comply with all safety / environmental regulations issued from time to time by owner.

The contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the safety & environmental requirements. If any injury to workers or loss or damage due to accident and / or environmental pollution to any property or a portion thereof occur as a result of failure on part of the contractor to comply with such regulations, the contractor shall be held responsible for the consequences thereof and shall keep owner harmless and indemnified.

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## **2.0 OISD & BIS CODES OF PRACTICES**

*The contractor shall abide by the following OISD codes:*

*i. OISD – STD -105 Work Permit System*

*ii. OISD – GDN – 192 Safety Practices During Construction The contractor shall abide by the following BIS codes:*

1) IS:3764-1992- Excavation work-code of safety.

2) IS:4014(Part 1&2)-1967-Safety regulations for steel tubular scaffolding. 3)

IS:3696(Part 1) -1987-Safety code for scaffolds.

4) IS:3696(Part2)-1987 –Safety code for Ladders.

5) IS:7293-1974-Safety code for working with construction machinery. 6)

IS:4081-1986-Safety code for blasting and related drilling operations.

7) IS:3016-1982-Code of practice for fire precautions in welding and cutting operations.

8) IS:4130-1991-Demolition of buildings-Code of safety.

9) IS:5216(Part 1&2)-1982-Recommendation on safety procedures and

practices in Electrical work.

10) IS:5121-1969-Safety code for piling and other deep foundations. 11)

IS:10667-1983-Guide for selection of industrial safety equipments for protection of foot and leg. IS:1989(Part 2)-1986-Leather safety boots and shoes for heavy metal industry.

12) IS:6994(Part 1)-1973-Specification for safety gloves: Part1-Leather and cotton gloves.

13) IS:2925-1984-Specification for industrial safety helmets.

14) IS:3521-1983-Industrial safety belts and harnesses.

### **3.0 LEGISLATION ON ENVIRONMENTAL POLLUTION CONTROL**

*The contractor shall abide by the following legislation:*

1) Water (Prevention & Control of Pollution) Act 1974 & Rules.

2) Air (Prevention & Control of Pollution) Act 1981 & Rules.

3) Environment (Protection Act) 1986 & Rules

4) Hazardous Wastes (Management & Handling) Rules 1989

5) Public Liability Insurance Act 1991 & Rules.

6) Noise Pollution (Regulation & Control) Rule, 2000

### **4.0 OWNER'S OBLIGATIONS ON SAFETY & ENVIRONMENT**

The layout planning of the site shall be done by owner. Suitable and adequate space shall be provided to the contractor for his site office and storage of materials / equipment. However, approach to work spot and road around it, if required for movement of men and machineries for construction purpose, shall be made by contractor at his own cost. Electric power source and drinking water facilities at one point of site shall be provided by owner. Disaster Management Plan for the site shall be prepared by owner wherein the contractor shall be assigned a role, which shall be obligatory.

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### **5.0 CONTRACTOR'S OBLIGATIONS ON SAFETY & ENVIRONMENT**

Any safety & environmental impact mitigation action plan prepared by owner shall be binding on contractor and the contractor shall adhere to the same.

The following practices shall be mandatory on part of contractor::

### **6.0 SAFETY POLICY OF CONTRACTOR**

The contractor shall have a safety policy, which shall deal with the following issues:.

Arrangements for training at all levels with particular attention to key workers such as workers working at height, crane operators etc, whose mistakes can be especially dangerous to other workers.

Safe methods or systems of working in hazardous condition. The duties and responsibilities of supervisors and key workers. System to circulate all information / instructions / policies.

Arrangements for setting up of safety committees.

The selection and monitoring of sub-contractors (if any).

The upkeep and maintenance of tools/machineries/safety appliances in perfect working condition.

Feed back system and corrective measures wherever required.

### **7.0 ENVIRONMENT POLICY OF CONTRACTOR**

The Contractor shall have an environmental policy, which shall deal with following matters

Commitment to not to cause adverse impact on ecologically sensitive areas.

Environmental Impact mitigation measures.

Feed back system & corrective measures, wherever required.

### **8.0 ROLE OF SAFETY CUM ENVIRONMENT IN-CHARGE**

The contractor shall designate a person possessing required experience and skill in safety and environmental issues as "Safety cum Environment In-charge". His main duties shall consists of :

Observance of safety action plan for the work and conditions stipulated in the tender/agreement.

Providing and maintenance of safety facilities like access roadways, pedestrian routes, barricades and overhead protection.

Providing and installation of safety signs.

Circulating safety practices for each trade.

Testing of lifting machineries such as cranes and goods hoists and lifting gears such as ropes and shackles and obtaining certification from competent authority.

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Inspection and maintenance of access facilities such as scaffolds and ladders.

Inspection and cleaning of welfare facilities such as toilets, clothing, accommodation and canteens.

Explaining the relevant parts of the safety plan to each worker group.

Playing role in Disaster management plan.

Identifying unsafe practice / equipment and rectifying the same.

Dissemination of information on safety and environment protection

Attending safety committee meetings and implementing all decisions taken by safety committee.

Ensuring proper use of personal protective equipment.

Delivering Safety talk to workers.

Implementing all Environmental Impact Mitigation measures.

### **9.0 ROLE OF SUPERVISOR**

Good planning and organization at work site and assignment of clear responsibility to supervisors are fundamental to safety and environment protection. Each supervisor shall ensure within his field of competence and domain the following:-

Working condition and equipment are safe.

Workplace safety is ensured.

Workers are trained for the job they are supposed to do.

Workplace safety measures are implemented.

The best alternative to ensure safety and environment protection is adopted within available resource and skill.

Necessary personal protective equipments are available and used by workers.

Safety caution boards are displayed at right place.

Unsafe practices are eliminated.

Arranging rescue of workers, in case of accident.

Playing his role in disaster management plan.

Arrange tool box safety meeting frequently.

Informing safety cum environment in-charge in case of any violation of safety practices.

Informing safety cum environment in-charge in case of any violation of Environmental Impact Mitigation measures.

## 10.0 ROLE OF WORKER

Every worker shall follow safety practices and environmental impact mitigation measure conveyed to him by the contractor's supervisor. He shall take care of his tools and use personnel protective equipment in accordance with safety practices.

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## 11.0 SAFETY COMMITTEE AT SITE

The safety committee shall include representative of OWNER, representative of contractor identified as safety cum environment in-charge and representatives of various trades from workers. Ratio between OWNER representatives and that of contractor and various trades taken together shall be 1:1.

### ***Model code of practice:***

Safety committee is a key part of safety in the workplace. They shall accomplish the following::

- a) Central focus : Overall look at safety requirements and to foresee problems that might otherwise cause difficulties.
- b) Sounding board. The committee is a visible and approachable body for safety or environmental complaints, suggestions, and the like.
- c) Central coordination. The coordination of safety training activities shall be accomplished by the safety committee.

An effective safety committee encourages safety awareness, gets a large number of employees actively involved in the safety program over time, helps motivate employees to follow sound safety practices. An effective employee safety structure provides a feedback mechanism to identify and correct new safety hazards at the earliest stage. Once the safety committee structure is in place and working well, it is a natural vehicle for employee involvement, preparation and introduction of new safety rules, new preventative practices, and safety procedures on new equipment.

Primarily safety committee shall look in to following:

- a) Detection of Hazard and determination of risks to workers, equipment, property and environment.
- b) Deciding actions to mitigate risks
- c) Drawing Disaster Management Plan
- d) How the committee can help management to enforce safety rules and environmental Impact mitigation measures.
- e) How to implement safety suggestions
- f) How to ensure compliance from workers.

Ideally safety committee members should play following roles:

- a) Set a good example. Committee members must set a good example. They must be above average in their safe work habits and their positive attitude about safety and environment..
- b) Be visible. Names of safety committee members should be posted prominently in their departments.
- c) Conduct safety inspections. Safety committee members should perform safety inspections. Members know the safe—and the unsafe—way to perform the jobs. Hence, they are right men to correct unsafe situation.
- d) Investigate accidents. Safety committee should investigates all lost work day accidents and record the findings.
- e) Hold regular meetings. Safety committees must meet at least once a month,

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and for their meetings to be effective the following matters must be considered:

Safety cum environment in-charge shall in general act as chairperson cum

secretary

Preparing agenda & issuing in advance of the meeting to:

- keep discussions on track
- allow members to prepare for the meeting

Issuing Minutes within two days containing:

- written summary of proceedings
- names of attendees
- number of absentees
- responsibilities for implementation assigned
- timing of implementation assigned
- cost of implementation
- any approvals required
- completed recommendations
- uncompleted recommendations
- accident review (if any)
- safety training activities

Duties of Safety Committee members shall be as under:

Work safely yourself—set the example in the site.

Attend and actively participate in safety committee meetings.

Speak to your fellow workers if you believe that they are engaged in an unsafe work practice; report things which you feel you can't handle.

Listen to employee suggestions about safety and bring those that appear to have merit to the notice of safety committee.

Before each safety committee meeting review minutes and open items affecting your section of job and have answers or a progress report on each item for the meeting.

***Model code of practice for Safety Talks:***

Safety talks should be delivered by any one of Safety Committee members by rotation. Duration could be anything depending on interest of audience and capacity of speaker to deliver oration.

The speaker may like to use this opportunity to convey various decisions taken in Safety Committee to workers. He may prepare talk on following suggested topics or any topic of his choice but of relevance. Political or human relation related topic must not feature in Safety talks.

i. Housekeeping

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ii. Use of Safety Shoes

iii. Use of Safety Helmet

iv. Wearing of Safety Harness

v. Safety from Cement and stone dust.

vi. Checking scaffold before climbing

vii. Right use of ladders.

viii. Use of materials and tools while on scaffold.

ix. Fall protection, i.e. toe boards, anchoring of safety harness, positioning of safety net.

x. Handling of Asphalt

xi. Precautions during excavation.

xii. Electrical faults.

xiii. Safety from hanging live wires and high tension lines.

xiv. Entering confined space.

- xv. Safety from toxic materials and fumes.
- xvi. Right posture for lifting weights.
- xvii. Slipping, tripping, drowning and falling hazards.
- xviii. Eye protection from arc welding and dust.
- xix. Precautions during operation of lifting appliances.
- xx. Safety during erecting shuttering.
- xxi. Safety during stripping of shuttering.
- xxii. Safety during use of concrete mixers and pouring of concrete.
- xxiii. Precaution during demolition of any structure.
- xxiv. Right storage of safety belts and other PPEs.
- xxv. Working on steep roof.
- xxvi. Safety from vehicles.
- xxvii. Need of communication and looking for safety of one another.
- xxviii. Look around safety.
- xxix. Air and water pollution.
- xxx. Nearby medical facilities.
- xxxi. Sun stroke and remedies
- xxxii. First aid in case of injury.
- xxxiii. Protection from AIDs.
- xxxiv. What to do if accident happens.

## **12.0 WORKING CONDUCT**

No one shall enter any part of the worksite other than for the purpose of carrying out the work. Contractor's personnel shall abide by all rules and regulations stipulated, including the following:

Smoking inside the premises of a working location is strictly prohibited except in the designated areas.

No source of ignition shall be taken to job site unless covered by a Hot Work Permit.

Personnel must also strictly adhere to the approved protective clothing and equipment requirements.

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It is essential that good house keeping is practiced at all time to keep the work area neat and clean. No material on any of the site of work shall be so stacked or placed as to cause danger and inconvenience to any person.

Consumption of liquor, drugs or any other intoxicating substances shall be totally banned.

## **13.0 SITE PLANNING AND LAYOUT**

Proper advance planning shall be done in all matters including the following:

Details regarding location of workshop / fabrication yard/ quality control laboratory / store yard / electrical installations / construction machineries, medical and welfare facilities, lighting etc. shall be decided and identified. The working sequence.

Clear access to work location.

Identifying and providing emergency exit.

Displaying warning notices at vulnerable locations and routes for vehicles..

## **14.0 HOUSE KEEPING**

Maintain tidiness during construction by cleaning up rubbish/scrap/spilled oil and grease.

Keeping gangways, working platforms and stairways clear of equipment and

material not in immediate use. Removing or hammering down any nails projecting from timber etc.

Arrange all machinery such as welding machine, generators, cutting machine etc. in such a way that equipment are segregated and protected.

Check all machines at periodic intervals.

Do not accumulate saw dust and other combustible waste to avoid fire.

#### **15.0 LABOUR ACTS:**

The Contractor shall comply with all provisions of applicable Labour Acts, such as

(a) The Minimum Wages Act 1948.

(b) The Factories Act 1948

(c) The Contract Labour (Regulations & Abolition) Act 1970

(d) The Building & other Construction Workers Act 1996.

(e) The Employees State Insurance Act 1948

(f) The Employees Provident Funds & Miscellaneous Provisions Act, 1952.

(g) Any other applicable Act.

#### **16.0 LABOUR WELFARE MEASURES:**

The contractor shall extend all welfare measures to his workmen in line with provisions given in labour acts mentioned in previous clause 15. Some of those are reproduced below:-

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First Aid box

Treating injuries by a qualified and experienced medical practitioner.

Arrangement for hospitalization, if needed.

Payment of wages / PF / ESI etc. as per relevant labour act and maintaining proof of the same.

Ensuring fitness of workers and maintaining hygiene.

Arrangements for clean & cold drinking water.

Separate toilet and washing and resting facilities for male and female workers.

Canteen facility, if obligatory under contract labour act..

Crèche, if obligatory under contract labour act.

#### **17.0 ROLE OF SUB-CONTRACTORS**

It shall be responsibility of the contractor to ensure that all sub-contractors engaged by him in accordance with terms of agreement with OWNER, comply with all safety practices and environment protection measures mentioned here and conveyed to him subsequently.

#### **18.0 PERSONAL PROTECTIVE EQUIPMENT**

Personal protective equipment shall be of approved make and are essential for avoiding injuries to workers on the job. A register showing stock and issue of PPE shall be maintained by the contractor. The most common personal protective equipment are described below.

##### **18.1 SAFETY SHOES**

Suitable safety footwear conforming to relevant BIS code shall be worn by personnel, considering the nature of works and hazards such as:

Risk of crushing by heavy objects.

Penetration by sharp objects.

Penetration by chemicals or harmful liquids.

Weld spatter.

Leather safety shoes with steel toe caps shall be used for all heavy manual work and general construction. Shoes shall be abrasion resistant and suitable



for wet and muddy conditions. Soles shall be slip resistant type. Light low-cut leather safety shoes with slip resistant soles shall be used for climbing job. Gum boot shall be used while working with bitumen, chemicals, mud and muck etc.

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## **18.2 HAND GLOVES**

Hand gloves are mainly used to protect the hand from hazards of material handling, heat, electrical shock. etc. Various types of hand gloves are available. Some of those are described below:

Flame-resistant gauntlet gloves made of leather or other suitable material. They may be insulated for heat.

Rubber gloves suitable for working in low voltage, medium voltage and high voltage.

Hand gloves made of asbestos for handling hot bitumen and other hot work. Hand gloves made of special material for protection against chemicals. Hand Gloves shall conform to relevant BIS code.

## **18.3 SAFETY HELMETS**

Safety helmets shall be of yellow colour with chin strap. All workers are expected to wear safety helmet while inside the construction site. Sufficient number of safety helmets shall be kept at site for visitors. Safety helmets used by helpers of excavators shall have suitable arrangement to carry load on head. Safety helmet shall conform to relevant BIS code.

## **18.4 SAFETY JACKET**

All workers shall wear yellow colour jackets made of good quality cotton with trade name printed on back and front in bold letters. Safety cum Environment incharge and supervisors shall wear jackets of green colour made of good quality cotton with designation printed on back and front in bold letters.

## **19.0 PROTECTIVE CLOTHING DURING WELDING AND HANDLING TOXIC/HAZARDOUS MATERIALS**

Welders shall wear aprons or overalls and gloves made of flame resistant material. Hand held welding face shield shall be used for any welding job. Full face shield with respiratory filters shall be used for specialized welding jobs. For handling toxic or hazardous materials proper impervious overalls, gum boots, gloves; facemask and respiratory equipment like canister masks shall be used. All equipment shall conform to relevant BIS code.

### **19.1 GOGGLES**

Goggles shall be used to avoid risk from:

- Flying particles / dust ingress.
- Chemical splash – Radiation glare.
- Hot sparks or metal splatter.
- Harmful vapours. -

Sand / grit blasting.

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Goggles shall be single piece constructed of clear impact resistant plastic and fitted with adjustable elastic straps. Goggles shall conform to relevant BIS code.

## **20.0 HEARING PROTECTION**

Hearing protection shall be worn by personnel involved with works in areas where noise level exceed 85 dB (A noise level beyond which normal

conversation becomes difficult) on a continuous or regular intermittent basis. Protection is available in two basic types; 1) an external cup type defender which fits over the outside ear and 2) internal disposable type of ear plugs usually made of compressible foam, which fits inside ear. Whenever practicable, equipment generating high noise levels shall be fitted with sound mufflers and located at maximum possible distance away from any work place .

For overhead welding ear protection in the form of wool or rubber plugs shall be done.

All equipment shall conform to relevant BIS code.

## **21.0 WARNING SIGNS AND BARRIERS**

The contractor shall arrange necessary material to secure the work site and to warn the general public or other workers of hazards. This shall include

- Warning signs.
- Warning lights and signs in traffic control zone.
- Barricades around excavations including illuminating warning signs.

## **22.0 RESPIRATORY PROTECTION / MASK**

Whenever there is doubt about the presence of toxic substances or the gases injurious to health, a respirator must be worn. The type of respirator to be used shall depend upon the hazard and work conditions.

The simplest masks are disposable paper types. These are only effective against nuisance dusts. There are three types of half-face masks with filters.

For protection against airborne particles, e.g. stone dust, with a coarse filter fitted in the cartridge (these filters have a specific lifetime and should be changed as necessary).

For protection against gases and fumes, e.g. when using paints containing solvents, with a filter containing activated carbon.

A combination filter containing both a dust and gas filter. Cartridge must be replaced regularly.

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A full facemask could be fitted with the same types of filter, and it also protects the eyes and face.

Self-contained breathing apparatus with a full-face mask fed with air at positive pressure is another alternative and it must be used in confined spaces and whenever supply of air or oxygen is insufficient.

Users must be trained in the use of self-contained breathing apparatus and must know the manufacturer's specifications.

All equipments shall be thoroughly checked prior to use to ensure:

Oxygen Cylinders are full and gauges function correctly.

All connections are proper

Facemasks are in order.

All equipment shall conform to relevant BIS code.

## **23.0 SAFETY BELTS / HARNESSES**

The majority of fatal accidents in construction sites are due to fall from height.

There are many types of safety belt and safety harness available depending on nature of work. A full safety harness should always be used in preference to a safety belt.

Safety belts / harnesses shall conform to relevant BIS code and worn by all workers working at a height greater than 2 mts above ground level.

Details of Safety Belts / Harnesses are given in 26.5 "Working at Height".

## **24.0 LIFE JACKET AND LIFEBUOYS**

For working over or near large and deep-water body this life saving device

should be used. Life Jacket shall be tested for leak and usefulness before start of work. It shall conform to relevant BIS code.

## **25.0 RAIN COAT**

Rain coat shall be provided to workers during rainy season. The colour of rain coat shall be yellow. It shall conform to relevant BIS code.

## **26.0 SAFE CONSTRUCTION PROCEDURES / PRACTICES**

### **26.1 EARTH EXCAVATION**

- i) The site of the excavation or trench should be sloped or battered back to a safe angle of repose usually 45 degree or be supported with shoring by timbering or other suitable means to prevent collapse. The type of support necessary will depend on the type of excavation, type of soil, the nature of ground and the ground water condition. Adequate timbering or sheeting shall be provided where excavation is deeper than 1.5 M. 100 mm wide "Safety tape" of yellow colour with one meter long phosphorescence band after every three meter shall be used to encircle excavated pit of any depth. For any pit of depth one meter or more, one meter high fence with a mid rail made of bamboo or steel pipes shall be provided for preventing people / animals from slipping into the pit. If the pit is by the side of vehicular drive way, in addition a prominent board shall be put up saying "Excavation in Progress".
- ii) Pumping out of accumulated water from pit is to be done at regular intervals. Run-away water shall be prevented from entering the excavated area, as such water can cause erosion of soil and sudden collapse of earth.
- iii) If the excavation is carried out without shoring, necessary angle of repose shall be maintained at all times.
- iv) Labourers shall not be allowed to sleep or take rest inside the pit. Protection against insects / poisonous snake shall be provided.
- v) Excavated earth shall be stacked at least one meter away from cutting edge to avoid collapse of trench and sliding of heaped earth into trench.
- vi) Contractor shall ensure that the excavation does not damage any existing underground cables, pipelines, foundation of adjoining buildings or structures etc. Wherever excavation is near any adjoining building or structure, proper precaution shall be taken.
- vii) Before working / entering inside an existing excavated pit it shall be ensured that it is free from any toxic gasses or explosive gases. The underground water present in the pit shall be checked for acid content, if there is possibility of seepage of industrial affluent.
- viii) Adequate access to and escape from the excavated trench in the form of ladders provided at every thirty meters or less shall be ensured. Crossovers over excavated trench shall be provided at suitable interval for movement of workers.
- ix) If the excavated trench is adjacent to any parking space for vehicles, adequate and well-anchored stop blocks shall be provided on the surface to prevent vehicles from falling in to trench while reversing.

Relevant BIS codes shall be followed for safe practices.

### **26.2 PILING AND OTHER DEEP FOUNDATIONS**

*The following precautionary measures shall be taken:*

Piling machine operators shall be over 18 years of age and properly trained.

Prior to piling, all underground services shall be located and made safe

There shall be a firm level base for the crane. If necessary crane mats shall be provided.

The workers shall use necessary personal protective equipment. All cranes, lifting appliances and lifting gear must have appropriate certificates of testing and shall be of capacity required for the job.

Particular attention shall be provided to the risk of damage to lifting gear from sharp edges.

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Cranes used for lifting or lowering workers, must be fitted with a dead man's handle and lowering shall be done under power.

Relevant BIS Safety Code for piling and deep foundations shall be followed.

### 26.3 WORKING IN BASEMENT / UNDERGROUND TANK

Fatal and serious accidents could occur if proper precautions are not taken before entering confined space like basement or underground tank.. The following precautions shall be taken:

i) Entry into the confined space shall be allowed only against Hot work permit. ii) Air circulation shall be ensured. Hot work in such places shall be taken up only after ensuring that ample supply of fresh air is available using additional blowers etc.

Proper ventilation shall be ensured by opening manholes (either ends if available) and fixing a wind sail or forced circulation of air. Old tanks shall be filled with water and washed with water before entering into it. Sludge shall be cleared / removed from outside of the confined space, to the extent possible, before entering.

iii) Workers shall be allowed entry in the confined space, only after ensuring absence of toxic and explosive gases. Purging of gases may be done by filling the underground confined space with water.

iv) Everyone inside the confined space shall wear rescue harness, with lifelines attached to a point outside the confined space. Whenever workmen are allowed to enter a vessel or underground tank or confined space, it is necessary to keep one person (alert and trained) at each manhole or entry point. The person should keep watch through manhole and offer rescue assistance so as to ensure prompt pulling out of the workers from confined space in case of emergency. Proper communication system between confined space and outside shall be maintained.

v) A proper procedure for rescue in an emergency shall be laid down, with specific duties allocated to specific persons.

vii) An experience supervisor shall supervise the entire operation.

viii) Monitoring of air supply must continue while work in progress.

ix) Only trained workers shall be allowed entry into confined space.. x) The following equipment shall be provided.:

Toxic gas meter, Oxygen meter and Explosive meter

Rescue harnesses with adequate length of rope taking into account the location of work site.

Hand torches or lamps safe for use in a flammable atmosphere.

Appropriate self contained breathing apparatus.

First aid equipment.

Fire fighting equipment.

An audible alarm for summoning help.

Resuscitation equipment.

Means of communication between confined space and outside.

Boards & barricades.

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## 26.4 DEMOLITION

Demolition is a dangerous process and workers shall use requisite personal protective equipment.

Demolition must be supervised by supervisor with thorough knowledge not only on demolition procedure, but also on the principles of structural construction.

A survey of the physical characteristics and design of the structure to be demolished must be carried out in order to choose a safe method of demolishing. The demolition action plan shall be drawn by the contractor including drawings or sketches showing the sequence of operations, the machinery and equipment to be used, personal protective equipment required etc. Before demolition begins, all service connections to the structure shall be disconnected. Arrangements must be made to erect a fence of height two meter encircling the structure under demolition

It is dangerous to leave isolated walls or parts of a wall standing alone, as those are liable to collapse from the effect of high winds and hence necessary supports should be given in such cases.

Debris should not be allowed to build up against walls or floors with the consequent risk of the structure getting overloaded.

Vapour present inside the structure must be checked for toxic nature before starting demolition work.

Protective measures should be taken against dust, fumes, chemical deposits, asbestos, glass wool etc. while carrying out demolition work.

Disposal process and pit / yard should be identified for safe disposal of debris.

Relevant BIS safety code for demolition of structures shall be followed.

## 26.5 WORKING AT HEIGHT

Scaffolds accidents occur primarily to the following reasons:

- Faulty design

- Faulty erection

- Weak foundation

- Inadequate strength of structural members

- Inadequacy of platforms, guard-rails and toe-boards.

Scaffolds are designed for live loads of workers and building materials, besides their own dead weight. However, a scaffold is usually designed only in case of important structures, like bridge girder/slab, very long beam/very large slab in buildings etc. In case of day today scaffoldings for general civil constructions / colour washing / painting / plastering etc., scaffolds are usually not designed, but erected based on experience.

Scaffolds may be constructed of either timber, sal ballies, bamboo, or metal.

Those may be single scaffold or double scaffold for light duty or heavy duty, as

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the case may be. Single scaffolds are recommended for carpenter, painter and similar trade. Double scaffolds are recommended for masons and similar trade.

All scaffolds should conform to IS:3696(Pt.1)-1987. As bamboo and metal scaffoldings are used, salient features of those scaffoldings are given below:

Single Pole Bamboo Scaffolds :

Single scaffold consists of one row of upright poles or standards, placed not

more than 1.8mt centres, fixed at suitable distance from the wall and connected horizontally by ledgers (bamboo placed horizontally ) spaced vertically at 1.5 to 1.8mt centres. Cross members (putlogs), supported on ledger on one side and hole in the wall on other side, are provided at 1.2mt centres.

#### Double Pole Bamboo Scaffolds:

It consist of two rows of up-rights or standards. The inner row is placed next to wall and other row placed 1.2 to 1.5mt away from the wall. As in earlier case, ledger is provided every 1.5 to 1.8mt vertically. However, in this case , putlogs shall rest entirely on ledgers at both ends.

Every single or double pole scaffolds, shall be effectively tied with adjacent structure. Diagonal face bracing or zig zag face bracing shall be provided on single pole scaffold and outer row of double pole scaffold. The maximum distance between braced bays in any lift of scaffold shall not exceed 10mt.

#### Quality of Bamboo

Bamboo should be reasonably straight, sound, free from splits, knots dry rot, worm holes and any other defect, which tend to reduce strength of bamboo. The mean diameter shall not be less than 80mm in case of single pole scaffold and 100mm in case of double pole scaffold, subject to minimum diameter of 50mm at thinner end. The slenderness ratio, i.e. L/d ratio shall not exceed 50, where L is the legnth of up-right or standard between putlogs. The diameter of bamboo shall not be measured at knot points.

Where it is necessary to extend a up-right, the overlapping distance between two up -rights shall not be less than 600mm.

#### Maximum Height of Bamboo Scaffolds

IS:3696(Pt 1) has recommended use of Bamboo Scaffolds for heights upto 18mt, subject to conforming to provisions given there-in.

#### Platform Width for Working on Scaffolds

\_ Where platform is not more than 2mt above ground or floor: For Painters, Decorators etc 300mm (min)

For other types ,i.e., mason etc. 500mm (min)

\_ Where platform is more than 2mt above ground floor: For Painters, Decorators etc 900mm (min)

For other types ,i.e., mason etc. 1200mm (min)

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#### Railings & Toe Boards

Railings consisting of top rail at a level of around 1000mm above platform and an intermediate rail halfway between top rail and platform shall be provided for all working platforms higher than 2mt above ground or floor.

The platform edges shall be provided with 150mm high toe board to eliminate hazards of toolbar or other objects falling from platform. Where scaffolds are erected over areas, where people work or pass, the space between top rail and toe board shall be enclosed by tarpaulin or PVC sheets.

#### Means of Access

A safe and convenient means of access shall be provided to all platform level of scaffolds. Conventional means of access are the following:

Ladder

Stairway

Ramp

Ladder:

To ensure safe use of ladder, the following steps should be followed:

Erecting ladders in the "four up-one out position" (i.e 75 degree angle

between ladder and ground)

Lashing ladder securely with the structure.

Using non-slip devices, such as, rubber shoes or pointed steel ferrules at the ladder foot, rubber wheels at ladder top, fixing woollen battens, cleats etc.

When ladder is used for climbing over a platform, the ladder must be of sufficient length, to extend at least one meter above the platform, when erected against the platform in "four up-one out position".

Portable ladders shall be used for flights not more than 4mt. Above 4mt flights, fixed ladders shall be provided with at least 600 mm landings at every 6mt or less.

The width of ladder shall not be less than 300mm and rungs shall be spaced not more than 300mm.

#### Stairway

For scaffolds exceeding 4mt height, stairway are safest means of access. It shall conform to the following:

Treads and risers shall be of uniform width and height in any one flight.

Minimum width of 1000mm.

No unbroken vertical rise of more than 4mt.

Maximum angle of ascent 50 degrees.

Stair railings on all open sides.

Hand rails on all enclosed sides.

Railings and toe boards on all landings.

#### Ramp

Ramp shall conform to the following:

Open sides of ramp shall be protected by railing and toe board, where ramp is 1.5mt or more above ground or floor.

Where slope is more than 1 in 4, footholds shall be provided by stepping laths of minimum size 50 x 30mm at interclass not exceeding 450mm.

Maximum permissible slope is 2 in 3.

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#### Metal Scaffolds

With the evolution of concept of designing multi -storied and long span structures, metal scaffolds came into practice, mainly due to following advantages.

Ease of assessing strength of scaffolds structure.

Reusable many more times than bamboo.

Possibility of human error while erection, is much less than in case of bamboo scaffolding.

Aesthetically neat and good looking.

Metal scaffolds shall conform to IS:2750 - 1964, in addition to IS3696(Pt 1).

Scaffold tubes are usually 40mm N.B., mild steel continuous weld conforming to IS:1239 or IS1161, grade YST 210, of lengths varying between 4.5mt to 6mt.

These are manufactured and marketed by various agencies. As such, it is essential to obtain guarantee certificate from the manufacturer about safety and stability of metal scaffolds under likely worst combination of loads.

#### Other General Safety Requirements for all types of Scaffolds

Erection, alteration and removal shall be done under supervision of experienced personnel.

Use of barrels, boxes, loose bricks etc., for supporting platform shall not be permitted.

Every platform and means of access shall be kept free from obstruction.

Each supporting member shall be securely fastened and braced

Where planks are butt-joined, two parallel putlogs shall be used, not more than 100mm apart, to give support to each plank.

Platform plank shall not project beyond its end support to a distance exceeding four times the thickness of plank, unless it is effectively secured to prevent tipping. Cantilever planks shall be avoided.

If Grease, mud, gravel, mortar etc., fall on platform or scaffolds, these shall be removed immediately to avoid slipping.

Workers shall not be allowed to work on scaffolds during storms or high wind. After heavy rain or storms scaffolds shall be inspected by site-in-charge before reuse.

All scaffolds or platforms shall be fastened with adjacent structure, and if independent, scaffolds shall be braced properly.

Scaffolding shall be erected on firm and level ground. In case of loose soil, the soil should be compacted by watering and ramming, besides using wooden base plate of minimum thickness 30mm for erecting standards.

All members of metal scaffolding shall be checked periodically to screen out defective /rusted members. All joints should be properly lubricated for easy tightening.

Clear access to scaffolds shall be maintained at all times. For prohibiting entry of unauthorised persons in scaffolds area, barricades should be put up and warning notices prominently displayed.

If scaffolds are used, where public movement is anticipated, entry of public should be prohibited for the duration of the job.

Where lifts are provided to hoist premixed concrete, reinforcement etc., to upper floors, barricades should be raised to prevent accidental entry of

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workers under the lift. Such lifts shall not be used for hoisting people, unless those are designed specifically for that purpose.

Dismantling of scaffoldings shall be done in a pre-planned, sequential manner in order to maintain stability throughout the process. If necessary, additional tying, bracing may have to be done to prevent sudden collapse of scaffolds structure.

Before initiating dismantling process, precautions should be taken to ensure removal of all loose materials from the scaffolds.

Use of scaffolds, under dismantling process, must be prohibited.

Wearing safety helmets shall be made mandatory within 10mt from scaffolds.

**Dismantling of Form -work**

Action for dismantling form-work, used for supporting concrete casting, must be done after expiry of requisite number of days after casting and proper curing.

Untimely dismantling of form-work may cause total collapse of structure. Bottom shuttering of chajia or sun-shed should not be removed, till the attached lintel is properly secured by brickwork, to avoid failure of lintel due to toppling / torque.

In case of casting of multi-storied framed structure, casting of upper floor should be avoided till expiry of minimum curing period of lower floor. But, if essential, bottom shuttering of the lower floor shall be suitably strengthened by additional props.

**INDUSTRIAL SAFETY BELTS & HARNESSES**



Primary functions of safety belt & harness are to minimise injury after a fall. Despite providing proper scaffolds, railing etc, possibility of slipping and falling can not be over-ruled. This equipment is the last check to prevent worker from getting fatal injury.

Four types of safety belts & harness are available in the market, depending on nature of various jobs. Failure to choose right type of safety belt & harness may lead to endangering life of worker at the time of need. All safety belts and harness shall conform to IS3521-1989.

Type Consists of Permissible fall Used for

I

Waist belt with safety line

Not more than

0.6mt

Building / Structural maintenance.

II

Waist belt with two shoulder straps & safety line

Not more than

1.8mt.

Construction, structural erection.

III

Waist belt with two hoisting straps & safety line, with provision for leg straps.

Not more than

0.6mt.

Working in confined atmosphere and rescuing. IV

Waist belt with pole strap.

- Working on electric line pole.

Proper choice of anchoring point for anchoring the safety-line is essential. At many instances, the workers have met with fatal accidents due to anchoring with

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weak supports. Sometimes anchoring points are found to be chosen by mistake in such a way, that should a person fall, he would hit against a rigid structure due to swinging action of the safety line. Hence anchoring point for safety-line needs to be judiciously chosen. Where proper anchoring points are not likely to be available, action should be taken in advance to provide for hooks and fixtures. The shock absorbing capacity of the safety-line is critical for reducing impact of fall. A stiff safety-line, would arrest a fall suddenly, resulting in an abnormal impact load on body of the worker, causing injury. According to IS3521, safetyline should be made of nylon or polyester or synthetic fibre. It shall not break under minimum tensile load of 2000kg. The minimum diameter of test specimen shall be 10mm. Performance test of the Safety belt & Harness shall be carried

out as per annexure - B of IS3521, by dropping an articulated anthropometric dummy weighing 100+5 kg with an overall height of 1.6mt to 1.8mt, and waist not more than 1000mm circumference.

#### INDUSTRIAL SAFETY NETS

Industrial Safety Nets are designed to catch workers and / or debris falling whilst working on high buildings or structural fabrications.

The safety net should be installed as close to the work level as possible.

Sufficient clearance should be maintained between the safety net and the ground or structure below, in order to accommodate full deflection of the net under impact.

IS 11057-1984 specifies requirements for two types of safety nets. Suitable for use at maximum duty height (\*) upto 6mt

Suitable for use at maximum duty height (\*) upto 1mt

(\* The maximum vertical distance between working level and the level at which safety net is to be placed in use.)

Salient features are as under:

Minimum nominal size shall be 4mtX 3mt.

Shall be made with square or diamond mesh and the length of mesh side shall not be more than 100mm.

In case of multi layer nets, all layers shall be joined together and fitted to a common border cord or cords.

A continuous length of net, with no joints shall be used.

When in use (without any load, except dead weight of the net), the sag at centre of the net shall be between one-fifth and one-fourth of the length of the shorter side.

Performance shall be tested by actual drop test of a sand bag weighing 140kg, in accordance with appendix A of IS-11057-1984. (Safety nets are available with an overlay net to catch small tools and debris. But, the performance test shall be carried out only after removing such overlay net.)

The deflection at the centre of the net during above drop test, shall not exceed 2mt or one-half of the length of the shortest side, whichever is more.

Manufacturer shall declare the duty height at which net conforms to IS11057 by fixing labels marked with indelible ink at two different positions on the net. The labels should also contain following information.

\_ Manufacturer's name or trade mark

\_ Nominal size of safety net.

\_ Date of manufacture.

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\_ Deflection at centre of the net during above drop test.

#### ROOFTOP LADDERS

Asbestos cement sheets are usually used as industrial roofing material. These are very brittle. In some cases GI sheets are used, which when rusted, become fragile. The collapse of fragile roofs, while walking on it, can cause fall from rooftops. These roofing materials are often laid on slopes, causing additional hazards of slips and falls from edges. For working on fragile and / or slopping roof, the following safety measures shall be taken:

Crawling boards or roof top ladders shall be used.

While working, the worker should always stay on those and remember not to step on the roof surface, which may give way.

Before commencing any work on fragile roof, the site-in-charge shall verify

the availability of crawling board or roof top ladder and competence of workers to use those equipment.

#### 26.6 STORAGE TANKS / SPHERES / BULLETS

The safety of tanks depends more on the standards and quality of inspection applied at all stages of construction than any other single feature. The contractor shall ensure adherence to relevant code and all safe practices required during construction of tanks including handling of plates from storage yard to fabrication yard

##### 26.6.1 FABRICATION

Before commencing the fabrication work, work area is to be made free from combustible materials, used asbestos cloth and place proper fire extinguisher near work site.

While gas cutting of structural items, there is a possibility of back fire to the portable gas cutting set and hence cutting torch, rubber hoses pressure gauges shall be checked thoroughly at regular intervals.

All personal protective equipment shall be worn by welder.

Loose nylon or polyester dresses shall not be used during work.

All gas cylinders to be kept, in upright position and avoid mishandling.

##### 26.6.2 ERECTION

Proper supports to be provided on both sides of plate after erection by guy ropes/wires/cranes to hold the plate in position and to avoid falling of plates on ground.

Only proper structural supports shall be used for workmen standing purpose and not boxes / drums etc. .

Holes in plate work to assist in erection are not permitted. Lugs nuts, clamps etc. to assist in erection may be attached to tank shell plate by welding for erection.

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The tank shell shall be safeguarded from damage due to wind by provision of steel wire guy ropes or cables after erection of 3<sup>rd</sup> shell or 3 M height whichever is less until completion of roof.

Support for steel scaffolding shall be checked. Each scaffolding shall be tied up with other to avoid fall of welder from a height due to shifting/sliding of scaffolding from its position.

To avoid accident at height “jacking up method” shall be adopted from safety point of view.

Suitable capacity of crane and authorized driver shall be deployed for operation.

##### 26.6.3 WELDING AND GAS CUTTING

Adherence to relevant codes and employment of qualified and tested welder are two basic requirements for welding and gas cutting process. Hazards such as electricity, heat/flame, flammable gas etc. are present in this process. Hence following precautions must be followed while carrying out these operations.

Hot work permit shall be obtained wherever applicable before commencement of the work.

All fire precautions as stipulated in IS:3016 (code of practice for fire precautions in welding and cutting operations) shall be followed while welding/gas cutting.

Fire extinguishers, sand buckets, water and gunny bags shall be provided when hot work is in progress. Gas cylinders used for gas cutting and welding

shall

- Be of approved make.
- Be stored upright, and is kept away from hot work and care shall be taken to prevent heating of gas cylinders.
- Gas cylinder valves shall always be checked and shall be closed when not in use.
- Be stored in a well-ventilated area.
- Be fitted with safety caps when not in use.
- Not be lifted by nozzle and rolled.

All gas and oxygen regulators shall be fitted with Flashback arrestors, being non-return valves designed to prevent an explosive mix developing in cylinder.

Checking for leaks shall be with help of soapy liquid applied to each joint and under no circumstances shall a naked flame be applied to any part of the cylinder.

When working at a height, do not place cylinders directly beneath the working area, as molten metal may fall onto the hoses, causing leaks and possibly igniting the gasses.

During electric arc welding process, very high ultra violet radiation is generated. The welder and any person working in close proximity, in order to prevent permanent damage to the eyes must wear suitable eye protection. When not in use, power supply to the holder and electrode shall be turned off.

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Hose shall be in good condition, and properly clamped. Welding cable shall have proper insulation with minimum number of joints.

All equipments shall be properly earthed, and cables properly insulated and connected.

ELCB / RCCB shall be provided in every welding circuit. Earthing shall be dedicated for each circuit. Diesel generating set shall have separate earthing. Circuit shall always be made by cables of right quality and cross section only. Diesel generating set shall be connected with welding transformer through switch board fitted over a rigid support at height of 100 cm from ground with appropriate ELCB / RCCB.

The welder or welding operator shall be insulated from both the work and metal electrode and holder. The bare metal part of an electrode holder shall never be permitted to touch the operator's bare skin or wet clothing. Consistent use of well insulated electrode holders and cables, dry clothing on hands and body and insulation from the ground shall be helpful in preventing contact with electricity.

Electrode should never be changed with bare hand or wet gloves or when standing on wet floor / ground.

Frame of welding unit (portable/stationary) should be grounded using correctly rated wire/strip and earth pit.

Resistance to earthing must be checked daily before start of work.

Receptacles of power cables for portable welding unit should be used so that it is impossible to remove the plug without opening the power supply switch.

If cable is worn, exposing bare conductors, it must be immediately replaced / insulated.

Welding cables shall be kept dry and free of grease and oil to prevent premature breakdown of the insulation.

Cables laid on the floor/ground shall be protected in such a way that they will not interfere with safe passage or become damaged or entangled.

Welding cables shall be kept away from power supply cable or high tension wires.

Welding cables shall not be coiled or looped around any structure.

While coupling several lengths of cables for use as a welding circuit, insulated connectors on both the ground and electrode holder line shall be used if occasional coupling and uncoupling is necessary.

Supervisor shall ensure that the portion in the circuit of liquid or gas circulation e.g. the storage tank, pipelines, valves, pumps etc. where welding/cutting work is to be carried out, is blanked or isolated and purged with inert gas or washed thoroughly, so as to make absolutely certain that no inflammable liquid/gas is present in an amount, which can catch fire under action of heat, spark, flame, welding spatter or red hot objects. The area shall be checked and ascertained that concentration of combustible gas in the air is within permissible limit.

Goggles, if used, shall be for welding with right shade conforming to ANSI Z 87.1 or BIS.

The shade number of the glass to be used for various purpose/ process shall be as under:

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#### OPERATION SHADE NO. OF THE GLASS

Soldering 2

Torch brazing 3 or 4

Gas cutting (1" to 6") 4 or

5 Gas cutting (over 6") 5 or

6 Gas welding 5

Shielded metal arc welding 10

*Other personal protective equipment shall be as under:*

\_ Protective cloth/apron long enough to cover wrists and forearms against heat, sparks, molten metal and radiation. Leather or asbestos apron can be used for this purpose.

\_ Flame resistant

gloves \_ Safety shoes

\_ Helmet / shoulder cover for over head welding as necessary

\_ Safety harness while working at heights

\_ Ear protection (wool or rubber plugs) in case of noise pollution

or overhead welding.

\_ In a confined place or where fumes/gas emissions cannot be below the toxic level, respiratory protective equipment duly certified for the exposure by reputed Government organization, like DGFASLI, shall be used.

Space of more than 284 cum. per welder should be provided.

Clothing should be free from oil & grease. Collars and cuffs should be buttoned and turned up inside. Pockets should be eliminated from the front vests, shirts and apron

After welding or cutting is completed a warning sign should be provided to keep workers away from heated surfaces.

Electrode rod stubs should be kept in a proper waste container

Gas cylinders for each type of gas should be stored separately. They should

be kept away from any source of heat and shielded from direct sun light. If stored, the store must be well ventilated. The cylinders in use should be retained upright in a rack or trolley and not be left free standing.

While unloading /loading gas cylinder nozzle valve guard cap must be properly fitted and cylinder shall be unloaded over rubber/soft mat.

Regulators, noses, torches and other Oxy-fuel gas equipment should be kept free. from grease, oil and other combustibles.

Lubricants should never be used on Oxy-fuel gas equipment

Oxygen should never be substituted by compressed air

Oxygen pressure reducing regulator, hose or other pieces of apparatus should never be used with any other gases.

Oxygen cylinder should never be used without first connecting a suitable pressure-reducing regulator to the cylinder valve.

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Acetylene cylinder should be turned & kept in such a way that the valve outlet will point away from oxygen cylinder

While opening acetylene cylinder valve, key or spindle should not be turned more than one and one-half turns -

Gas cylinder should not be lifted by nozzle and rolled

All gas and .oxygen regulators shall be fitted with flash back arresters ,being no return valve design to prevent an explosive mix developing in cylinder

Checking for leaks shall be by means of soapy liquid applied to each joint and under no circum stance shall a naked flame be applied to any part of the cylinder.

When working at height do not place cylinder directly beneath the working area as molten metal may fall on the hoses causing leaks & possibly igniting the gas

Acetylene cylinder key for opening valve must be kept on valve stem while cylinder is in use so that it may be quickly turned off in case of emergency

Acetylene should never be used at pressures in excess of 15 PS.I. The use of higher pressures is prohibited by all insurance authorities and by law in many localities

The gas hoses should be in a good condition and easily distinguishable and protected against heat, sharp objects, dirt, oil & grease.

LPG Cylinders, if used, should be stored kept in a well-ventilated place and there should be no excavations, drains or basements nearby.

LPG cylinders should never be stored below ground level or closer than 3 M to cylinders containing oxygen or materials which are toxic and corrosive.

Cylinders full or empty should never be stored upright with the valve uppermost.

The valve of empty LPG cylinders should be kept closed, if they are left open, air will diffuse into the cylinder and may form an explosive mixture.

For storage of large numbers of gas cylinders regulations of NFPNA/OISD/CCOE should be observed.

If an outlet valve of acetylene cylinder becomes clogged with ice or frozen, it should be thawed with warm water (not boiling), applied only to the valve. A flame should never be used. This is because the fusible safety plugs on acetylene cylinder melts at about boiling point of water.

Cylinders are not designed for temperatures in excess of 54°C and hence storage/handling should be done keeping this in mind.

Never bring cylinders into tanks

Portable fire fighting facilities and first aid facilities should be made available in ready condition

Adequate water should be made available at work spot for emergency requirements

BIS Code IS: 3016-1982 on "code of practice for fire precautions in welding and cutting operations" shall be referred for further safety measures.

## **27.0 PRECAUTIONS IN ELECTRICAL WORK**

Electrical hazards are different from other types of hazard found in construction work because the human senses provide no advance warning. It is the voltage that determines the current through the body. Since reduced voltage reduces the

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severity of electric shock, attempt shall be made to work with reduced voltage of 110 V wherever possible.

Some of the basic safety steps to be ensured by contractor at construction sites are given below:

- 1) Only authorized persons with license issued by State Electricity Boards or any other Government regulatory body, shall carry out operation and maintenance of electrical systems.
- 2) Work permit and isolation of the electrical system before taking up the work must be ensured.
- 3) Proper protective equipments like rubber hand gloves, insulated apron etc. shall be used. FLP fittings /enclosure as per IS: 2148 and certified by CCOE, Nagpur should only be used in Zone-1&2 area. Capacitors should be relieved of charges before working on them
- 4) Check for defective cables, loose joints in conduits, damaged fuse boxes, loose pins, faulty sockets and defective earthwire. Cable joints must be properly insulated and protected.
- 5) Do not overload electrical equipment. All circuits shall be provided with dedicated ELCB / RCCB. There shall also be dedicated earthing for each circuit.
- 6) Use right type of tools for the jobs.
- 7) After maintenance of flameproof fittings, ensure that the fittings meet requirements of flameproof standards.
- 8) Power supply cable shall be laid at least 45 cm below ground level from source to the work place.
- 9) Tag with marking should be provided on each cable for identification and correct connections to terminals must be ensured
- 10) The route and depth of any underground cables should be determined and power should be switched off if possible before execution of work for the existing cable
- 11) Jointing of cable shall always be made using proper junction box and flameproof junction box when in hazardous areas even in case of temporary connections. Power cables should not be tied in knots; it should be looped instead.
- 12) All equipments LT or HT that are likely to cause hazard shall be turned off and segregated. All base terminals etc. shall be insulated, Rubber mats shall be used for LT/HT switch room, where applicable.
- 13) All electrical equipments like wires, switch board etc., shall be protected against rains or leaking water lines etc. In wet condition switches shall not be operated until it is dried up properly. Switches starters shall be placed

well above ground level.

14) Proper earthing shall be provided for all electrical items and effectiveness of earthing shall be checked every time before commencing work/switching on the electrical system.

15) Electrical items shall be handled after isolation and care shall be taken to identify and replace damaged electrical items. Guard wire shall be provided for aboveground HT wires.

16) Ensure all ELCBs and RCCBs are of good quality and conform to correct ratings.

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17) Always plug of right specification should be used for taking connection from a socket.

18) Cables should be kept out of the way of other workers (or with proper guard/warning) and are not in contact with water

19) Moving parts of all equipment should be properly guarded.

20) All electrical transmission and operational equipment must observe safety clearances as stipulated in IE Rules.

21) Fail safe features should be available for interlocking mechanism.

22) Suitable overcurrent tripping device should be provided in the electrical Circuit.

23) Earth leakage relay with high sensitivity should be provided in the electrical system.

24) Earth pits should be tested periodically and certified by the licensed electrician

25) Before working on an electrical line fuse should be physically removed and the line is isolated and a suitable locking mechanism must be provided to prevent accidental switching/fixing fuses by other persons. A notice board displaying "Men at work" message should be placed. The section of circuit under repair should be connected to earth.

26) Temporary switchboards at site must conform to the following:  
structures are firm and strong

fully protected from rain and dust

properly grounded

all connections are made with right size lugs

suitably barricaded

rubber mat of correct rating is provided on floor

Danger band indicating system voltage should be displayed

27) No electrical equipment /cables/parts should be touched with wet hand/cloths

28) Lightning arrestors should be provided .

29) Electrical maintenance workman working around a wet area near a fuse box must use wooden platform with rubber mat, insulated tools and rubber boots.

30) All electrical installation including incomer line, temporary distribution board, electric motor and machine must be installed as per IE Rules with proper earthing and must be inspected and certified by a licensed electrician at periodic intervals.

31) IS: 5216-1982 -" Recommendations on safety procedures and practices in Electric Works" shall be referred for further safety measures.

## **28.0 SAFETY IN RADIOGRAPHY WORKS**

Planning and procedure for radiography initially shall be formulated by



contractors and submitted to proper authority. Procedure shall be thoroughly discussed by all related persons for familiarization. All radiation equipment and radioactive materials shall be stored, handled, transported or disposed off, so that, no person receives unnecessary dose of radiation. Shield ability of the radioactive materials container shall be inspected every six months. Warning signs and posters shall be displayed. Radiography shall be performed under the

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direction of radioactive supervisors/officer responsible for this work. Supervisor and source must possess valid BARC certificate indicating-

1. Type & strength of source
2. The serial number of radiography camera
3. Names of radiographer
4. Training/competency of person handling the source

All workers shall be experienced and knowledgeable of the work such as radiation procedure, operation of radiation apparatus and effects of radiation on the body.

The following spaces or areas shall be classified as restricted areas.

- a) Storage place of radioactive materials
- b) Any area where the radiation exists at levels such that large portion of the body could receive a dose in excess of 30 milligram per week.
- c) Emergency storage area for radiation apparatus or radioactive material capsules.

Warning signs, labels and fence shall be provided for restricted area to prevent trespassing.

The area covered within a radius of 5 Mts. from the radiation working spot or location and subject to a dose of radiation in anyone hour in excess of 50 milligrams shall be called the radiation area and trespassing in that area shall be strictly prohibited.

All workers entering the restricted area shall wear film badges sensitive to radiation. All workers who could receive a dose of radiation in excess of 100 milligrams per day shall wear a pocket dosimeter and the dose of radiation received shall be recorded everyday. The dose of radiation shall be checked by the supervisor for each radiation exposure when the dose of radiation exceeds 100 milligrams. In such case, suitable alternative for shortening the radiation time, reinforcing the shield plate etc. shall be arranged. During radiation work, dose of radiation at the boundary shall be measured and recorded.

The radiography supervisor shall measure and record the surface dose rate of restricted area every day as under:

- a) Date of measurement
- b) Measuring method
- c) Description and capacity of apparatus
- d) Measured condition
- e) Results of measurement
- f) Name of measurement
- g) Any action taken

Radioactive materials shall be stored separately from other material or equipment. The storage place shall be 10 cm or more above the ground and locked to prevent unauthorized entry. Radioactive materials shall be stored in a case made of lead of ample thickness with a lock on the exterior surface of the

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case. The description of materials, quantity and danger sign shall be distinctly

visible.

## **29.0 WORKING WITH MACHINERIES / MATERIAL HANDLING EQUIPMENT**

### **29.1 General**

Many accidents place while handling materials at site. It is 'highly hazardous operation. Hence special attention by contractor is required in this respect. Following precautions are essential:

Safe working space for all handling equipment shall be provided. Proper material stockyard should be made and all material should be stacked /arranged/kept in orderly manner with proper moving space for handling machinery. Proper wooden sleepers should be provided below steel plates and such other materials.

Mixers, winches, cranes, bending machines etc., shall be overhauled regularly as per manufacture's advice/maintenance schedule.

Proper warning boards/signs shall be provided when machineries like cranes, hoists are being operated.

Brakes, clutches of winches shall be checked on regular basis. Chains, ropes, belts shall be inspected and repaired/changed as necessary.

All moving parts of the material handling equipment must be provided with suitable guards.

Lifting ropes should be inspected for kinking, loose wires, high strands, corrosion, nicking, lubrication, change in diameter /cross section

Slings and other lifting materials, which are not suitable for use should be promptly withdrawn and destroyed

Lifting chains should be inspected for bent links, cracks in weld areas or any other section of link, traverse nicks and gauges and corrosion pits.

Elongation of the lifting chain link due to over loading should be inspected before using it.

Maximum allowable wear at any point of link of the lifting chain is given below: -

**CHAIN SIZE (mm) MAXIMUM ALLOWABLE**

WEAR(mm)	6	1	10	2	12	3	16	3.5	20	4	22	4.4	25	4.8	28
	5.5	31	6.4	35	7	40	8	45	8.7						

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For lifting hook, if the throat opening exceeds 15% of the normal opening, it should be replaced. When inspecting the hook, measurement must be made between the shank and narrowest point of the hook opening

A chain used for lifting should not be spliced by inserting a bolt between two links

Strain should not be put on a kinked chain

Hammer should not be used to force a hook over a chain link

A safety hook fitted with a latch to prevent displacement of loads should only be used for material handling/lifting

IS: 7293-1974 (Code of Practice for Working with Construction Machinery) shall be referred for further safety measures.

## 29.2 CRANES

All works involving the use of crane shall be properly planned in advance and the following shall be ensured

The crane is capable of lifting the load. Safe load capacity should be clearly marked on jibs, winches, pulleys, slings and ropes. All job cranes should have an automatic safe load indicator which alerts the operator

The condition of the ground at the crane location is satisfactory to support the crane and the load

The rotation of the cab and, therefore the boom is not restricted. Suitable matting or plates are available to protect underground services and paving. All slings shackles, hooks etc. are of correct rating and in good condition  
Cranes and lifting equipments must be inspected and carry a valid test certificate issued by an accredited testing agency.

Crane hooks are to be fitted with properly functioning safety clips to prevent displacement of the sling from the hook during the lift.

Driver of the crane must be watchful and must ensure before driving the vehicle either forward or reverse that no one is near the wheel of the vehicle and no one is trying to climb the vehicle while moving. .

Crane operators and signalers must be trained and sufficiently experienced. There should always be a signaller or a signaling system such as a telephone, if the crane operator cannot see the load throughout the lift. Hand signal shall be clear and distinct and shall follow recognized code or system. Workers must use safety shoes and helmets. They are also required to wear gloves and other PPE s for handling materials.

Raising, lowering and braking of jib should not be done abruptly in order to prevent it from snapping.

No part of the crane or crane load should be closer than 4 Mts. to live overhead power lines.

For movement of crane or other material handling equipment ,ramp gradient should not exceed 1 in 10

No person should be allowed to stand or work under lifted load.

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## 29.3 MANUAL HANDLING

Assistance should be obtained if the load is too heavy or awkward for manual handling. Clear walkway to the destination and safe stack should be ensured before handling the load manually. Following procedure should be followed while lifting a load manually:

Stand close to the load on a firm footing and with feet about 30 cm apart

Bend the knees and keep your back as straight as you can

Take a firm grip on a load ..

Breathe in and throw the shoulders backwards

Straighten the legs & continue to keep the back as straight as you can

Make sure that your view is not obstructed by the load

Keep the load close to the body

Lift slowly and smoothly

When carrying the load ,avoid twisting spine to turn, move your feet instead  
One person shall not pull more than 63 kg.

The weight unit for lifting by a worker is 18 kg and hence should be fixed as upper limit of load to be lifted by worker

If two or more workers are lifting, one should give instructions to ensure that the team works together

Type of clothing is very important in manual handling of material.  
Clothing should be such that it allows easy movement of arms and will not catch in machinery or on a load.

### **30 VEHICLE SAFETY**

All vehicles used for carrying workers and construction materials must undergo preventive maintenance and daily checks.

Contractor shall maintain a register for this purpose for each vehicle.

All documents related to the vehicle shall be kept in vehicle for checking. -

Driver with proper valid license shall only be allowed to drive the vehicle.

Routes shall be leveled, marked and planned in such a way so as to avoid potential hazards such as overhead power lines and steep sloping ground.

Speed limit shall be specified.

While reversing the vehicle, help of another worker should be enlisted and his instructions should be complied at all times during reversing and sound signal should be provided before reversing

An unattended vehicle should have the engine switched off.

Foot injuries to drivers and their assistance during loading and unloading are common and they should wear safety boots and shoes.

Wherever possible one-way system shall be followed.

Head clearance must be ensured on the route of the vehicle and no vehicle shall be allowed to deviate from its route.

Overloading, carrying unauthorized passengers etc. shall not be allowed.

Load on vehicle should be evenly distributed, properly secured and normally should not project beyond the plan of vehicle. If some degree of projection is unavoidable, it should be clearly shown by the attachment of red flags.

Load should be properly secured

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The body of a tipper lorry should always be lowered before driving the vehicle off.

Signs/signals/caution boards etc. should be provided on the routes.

### **31 SAFE OPERATION OF PLANT, TOOLS AND EQUIPMENT**

The following four basic principles shall be applied for the safe use of hand and power tools.

1. To choose right tool for the job
2. To use only tools in good condition
3. To use tools correctly, and only for the purpose they are intended
4. To maintain and store tools properly.

Electrical tools shall be checked to ensure that the supply voltage is as per requirement.

Electrical tools shall always be properly earthed.

High speed rotating equipments such as grinders shall be fitted with protective guards.

Static load on shoulder or arm due to continuous holding of a tool at a raised

position or gripping of a heavy tool should be avoided

Awkward wrist angles to be avoided

Uncomfortable posture and pressure on the palm or joints of the hand should be avoided.

Repair or discard the tool, if tool heads mushroom, tool jaws open out and cutting tools loose their edge

Tools handle should have a firm grip

Tools should be properly cleaned and stored

Air connection to pneumatic tools should be clamped and secured properly.

Electrical cable/pneumatic tube should be protected against damage

Socket, terminal boxes, fuses etc. must be of high quality and properly covered and protected

Correct fuse should be used for the electrical tools.

Power tools shall never be left operating unattended.

Spark arrestor shall be fitted to all equipment exhausts where risk of presence of combustible gases exists.

Periodical inspection shall be done.

### **32 WORKING OVER WATER**

Falling into water and drowning and getting carried away by water current is an ever-present danger when working over or adjacent to large water bodies. The following precautions should always be followed:

Working platform should be made secured and there shall be no tripping hazards such as tools, wires, timbers, bricks etc. Surface should not be slippery.

Access ladders, guard rail and toe board for the working platform should be firmly held.

Safety helmet should always be used.

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A life jacket should be used

A safety harness or net shall be used.

Lifebuoys fitted with lifelines should be kept ready in hand for immediate use.

Availability of safety boat (motor driven with self-starter for tidal/fast flowing river) should be ensured.

Availability of alarm system should be ensured

### **33 PIPELINE CONSTRUCTION SAFE PRACTICES**

I. Handling and storage of pipes a) Bare Pipes

\* Unloading, loading, stockpiling and transportation of bare pipes should be done using suitable means and in a manner to avoid denting, flattening or other damages to pipes

\* Pipes should not be allowed to drop but should be lifted or lowered from one level to another by suitable equipment

\* Lifting hooks when used, should be equipped with a plate curved to fit the curvature of the pipe

\* Pipe when stockpiled, should be placed on a suitable skid to keep it clear of the ground.

\* The stacks must be properly secured against sliding and should consist of pipes of the same diameter and wall thickness

\* Personal Protective Equipment like safety shoe and glove should be used by worker while handling pipes.

## b) Coated Pipes

- \* Coated pipe shall be handled by means of slings and belts of proper width made of non-metallic/ non-adhesive materials
- \* Belts/slings when used should be cleaned to remove hard materials such as stone, gravel etc.
- \* Coated pipes should not be bumped against any other pipe or any other objects
- \* Rolling, skidding or dragging of coated pipes should be strictly avoided
- \* Coated pipes at all times should be stacked completely clear from the ground so that the bottom row of pipes remains free from any ground contact. Pipelines should be stacked at a slope so that during rain, water does not collect inside the pipe.

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- \* The coated pipes may be stacked by placing them on ridges of sand and covered with a plastic film.
- \* Stacks should consist of limited number of layers so that the pressure exercised by the pipe's own weight does not cause damages to the coating
- \* The weld lead of pipes should be positioned in such a manner so as not to touch adjacent pipes
- \* Coated pipes stacked in open storage yard should be suitably covered on top to decrease direct exposure to sunlight
- \* The ends of the pipes during handling and stacking should always be protected with end protectors

## II. Swabbing and Night capping

To ensure that all dirt and objects likely to cause obstruction in the interior of the pipe are removed, each length of pipe should be thoroughly scrubbed prior to alignment and welding. At the end of each day's work a steel plate or nightcap should be adequately secured over open ends of incomplete section of the pipeline to prevent ingress of extraneous objects and ground or floodwater. . III.

## Inspection of field welds

In case of cross-country pipeline and where specifically specified, all weld joints should be radiographed to ensure the soundness of welding joints to avoid failure of joints, which may create serious pollution or environmental problem.

## IV Coating Inspection in the field

Where pipeline coating is carried out in the field, all bare and primed pipe should be kept free from dust and grease, oil etc. Before the pipeline is lowered into the trench the coating should be thoroughly inspected both visually and by using holiday detector. Any visible damage should be repaired and the pipeline shall be retested.

## V. Lowering and Backfilling

Equipment used for lowering the pipeline from the skids and positioning it finally in the trench should be sufficiently padded at points of contact with the pipe to prevent damage to the protective coating

- \* Slings used for lowering the pipe should be made of canvas or equally non-abrasive material and of a width not less than the diameter of the pipe.
- \* The trench should be clear of loose rocks, lumps or other objects that might prevent the coated pipe from bearing evenly on the trench bottom.

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- \* When digging soil from beneath the pipe in order to remove slings, care

should be taken to avoid damage to the protective coating. The coating should subsequently be inspected and any damage shall be repaired.

- \* In waterlogged areas it may be necessary to provide additional weighting or screw anchors to prevent floatation of pipeline.

- \* No lowering should be done after sunset without proper lighting arrangement

- \* Minimum 3 side booms should be used and mounting of counter weights should be ensured on side booms for lowering the pipes.

#### VI. Road, Rail and Water Crossing

- \* Where work being done either adjacent to or any public or private road; warning signs and night time warning lights should be provided and maintained.

- \* Crossing will frequently necessitate laying the pipeline at greater depth than normal and may therefore call for special measure to support the trench or boring pit.

- \* Where crossings are made by open cut, the work should be programmed so as to minimise the amount of time that the normal traffic or flow is interrupted. Where necessary temporary conduits or pumping system should be provided to maintain the flow in water courses

#### VII. Trenching

- \* Barricading should be made while trenching in heavy traffic area.

- \* Sign boards should be provided while trenching in heavy traffic area

- \* Trench cross over shall be provided at every 30 Mts. of its length while trenching

- \* Lighting should be provided for night working

- \* Shoring should be provided for trench support

- \* Underground service connections should be identified and marked prominently

- \* Excavation tools should be properly insulated to avoid electric shocks

- \* Evacuation of workers should be ensured before blasting

- \* Entry of workers in site, where blasting is planned to be done, should be allowed after inspection and clearance from qualified Blaster

Requirements of safe procedure as stipulated in BIS Code IS:4081-1986 for blasting and drilling must be observed during blasting operation.

#### VIII. Pipeline Marks

Distinctive markers should be created at all crossings to indicate the alignment of the pipeline and should give information about ownership, diameter, the nature of content, the normal direction of flow and the location of the crossing. A telephone number for use in emergencies shall also be displayed.

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### **34.0 STORAGE OF HAZARDOUS MATERIALS**

Harmfulness of materials shall be identified and proper care shall be taken against fire/health hazards e.g. against asbestos fibre/rope, sand/shot blasting, paints, handling leaded container and tank, furfural liquid etc. Waste materials and consumables like woods, papers, and plastic pieces etc. shall be cleared on regular basis. Petroleum products/solvents used for cleaning etc. shall be kept away from working site specially when hot work is in progress. No smoking board/signs etc. shall be used in sites where such materials are stocked. Paints shall be stored in separated areas. The quantity of paint stored in actual working areas shall be as minimum as practicable. The ingestion of paint shall always be avoided. Food and drink shall not be brought, stored, prepared or consumed in

areas where paints are stored, handled or used. Smoking in such areas shall be prohibited. The inhalation of paints, dusts or fumes shall always be avoided by the use of local ventilation or extraction. Where fumes or dusts are unavoidable, then suitable approved respirators or facemasks shall be worn. All personnel who handle and use paints shall wear appropriate protective clothing (such as, gloves, eye protection and overalls). Splashes of paint on skin shall be treated promptly by copious washing with water or an approved cleaning agent. (Solvent shall not be used for personal cleaning).

### **35 CLASSIFICATION & WORKING IN HAZARDOUS ZONES**

Hazardous (flammable atmosphere) zones are classified as zone-O, zone-1 and zone- 2. All other areas are unclassified but not necessarily non-hazardous. In these areas, safety precautions must be observed in order to eliminate risk of explosion. Zone-O is defined as the vapour space in and directly around product storage tanks. Zone-1 is defined as an area where vapours, may be expected at all times. For zone 2, flammable vapours may be expected to be presently when a failure to equipment or plant occur. Unclassified areas cannot be assumed to be always non-hazardous, therefore must be checked prior to issue of work permits, Following precautions shall be taken while working in hazardous areas.

#### **35.1 NON-SPARKING EQUIPMENT**

Sparks can be produced from electrical tools/devices, and where two surfaces collide. In order to avoid risk of sparking, only tools approved for use in hazardous zone-1 shall be used. The condition of all equipments used within hazardous zones shall be checked by OWNER Engineer. Where chipping or scraping is necessary in a hazardous area, several precautions shall be taken such as; the surface being chipped or scraped shall be kept moist with water at all times ; Air driven jackhammers may be used where atmosphere has been certified to be safe and the impacting surfaces must be submerged in water.

#### **35.2 CHECKING OF WORKERS**

Workers are to be checked for matchboxes, lighters and other spark producing items. If workers are found to be carrying any such item, the same shall be taken into custody by security at the entry point.

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#### **35.3 SAFETY CHECKS**

In all cases where work is to be carried out within hazardous zones, OWNER Engineer shall check the area using an explosimeter for the presence of flammable vapours. The explosimeter shall be verified before each use, for its smooth functioning. Should there be any indication of flammable vapours, steps shall be taken to reduce the vapour content of the surrounding atmosphere. If found safe after re-checking by explosimeter, the work permit shall be issued.

#### **35.4 FIRE SCREEN WALL**

Fire screen shall be provided to segregate area where hot works, such as welding & cutting, is planned to be done from surrounding. To construct fire screen, the following shall be complied with:

Members shall be made of appropriate size MS pipes, MS structurals, strong enough to withstand the wind, live and dead loads. The bottom of columns shall be properly grouted.

Good quality G.I. Sheets free from damage and holes shall be used as screening wall. G.I. Sheets shall be properly tied up with the structure.

The height of fire screen wall shall be decided based on the level at which hot work is supposed to be carried out. For example, in case of above ground tanks fabrication by jacking up method, a fire screen of 6 M height is sufficient



where as in the other case it is required to have a height equal to height of structure to be fabricated.

### **36. WORK PERMIT SYSTEM**

If work is to be performed in a hazardous area, a duly authorized written work permit shall be obtained by the contractor from OWNER or any official duly authorized by OWNER for this purpose. This is a document authorizing contractor to carry out the work concerned, warning him of the possible hazards and spelling out precautions needed for the job to be done safely. The contractor shall be fully aware of the details of the work permit system and shall obtain the same signed by authorized person before starting the job. Based on the nature, the work shall be undertaken either under Cold Work Permit or Hot work / Entry to confined space permit or Electrical isolation and energisation permit. Permits and certificates are to be issued by OWNER Engineer or any official duly authorized by OWNER for this purpose with overall responsibility for the work area. All work permits shall carry serially printed numbers. The printing of all work permits shall be done by the contractor in adequate quantity at his own cost. 36.1 COLD WORK PERMIT:

Work falling under the category of cold work such as opening process machinery, blinding & deblinding, tightening of flanges, hot bolting, painting etc. shall be performed through Cold Work Permit.

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This Permit shall be in minimum two copies. The original should be in yellow colour and the copy should have the word "Copy" printed in large yellow letters. Original shall be issued to the contractor, retaining the duplicate in the book. (Ref. Annexure-I)

#### **36.2 HOT WORK / ENTRY TO CONFINED SPACE PERMIT:**

All hot work such as welding, grinding, gas cutting, burning, shot blasting, soldering, chipping, excavation, open fire, use of certain non-explosion proof equipment etc. shall be carried out through Hot Work Permit. Entry and operation of petrol or diesel driven vehicles or equipment without spark arrester in hazardous area also falls in the category of hot work, and shall be performed under the hot work permit.

The confined space entry permit is required for the protection of personnel entering a confined space such as Vessels, boilers, storage tanks, large diameter piping etc against hazards such as oxygen deficiency, toxic and flammable materials, falling objects, power driven equipment etc. Excavation more than 1.2 meter deep, entry on floating roof tank when the roof is more than 3 meter down from the top, space located below ground level such as pits, drain, channels etc. also fall under the confined space.

For excavation work regardless of the depth, permission from various sections shall be obtained with precautions to be taken for the underground facilities viz; sewers, telephone lines, cables, pipelines etc.

This work permit shall be in minimum three copies. The original should be in pink colour and copies should have the word "COPY" printed in large pink letters. Original shall be issued to the contractor, duplicate to the Safety Section and triplicate retained in the book. (Ref. Annexure-II)

#### **36.3 ELECTRICAL ISOLATION AND ENERGISATION PERMIT**

Before issuing any work permit, it is essential that the equipment / facility to be worked on is electrically safe and electrical power is isolated to the extent necessary for the safe conduct of the authorized work.. Permit for electrical isolation and energisation shall be in triplicate and in two sections with tear off

facility. Section-A shall be used for electrical isolation and Section-B for energisation. The original should be in light blue color and copies should have the word "COPY" printed in large letters in light blue colour. Original along with a copy shall be issued to the electrical section for electrical isolation / energisation. Electrical section authorized person on isolation / energisation of the equipment / circuit shall return the original to the issuer keeping copy for record. (Ref. Annexure-III)

#### **36.4 SCAFFOLDING FITNESS CERTIFICATE**

For all temporary scaffolds erected by contractor, fitness certificate, in format given in Annexure IV, shall be issued by OWNER site in charge after due checking to his satisfaction .

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#### **36.5 TEMPORARY ELECTRICAL CONNECTION FITNESS CERTIFICATE**

For all temporary electrical connections taken by contractor including diesel generating sets, fitness certificate, in format given in Annexure V, shall be issued by OWNER site in charge after due checking to his satisfaction.

### **37. ACCIDENT REPORTING AND CLASSIFICATION**

#### **37.1 ACCIDENT REPORTING**

All employees must be encouraged to report any near miss incident that has or could have caused injury, illness, damage to property, or interruption in work. The reporting of such incident helps in analyzing what went wrong and enables steps to be taken to prevent recurrence. The accident reporting forms the basis for objective investigation of the accident and will bring out essential and contributory factors leading to it. The necessary decisions then can be taken to prevent recurrence in future.

#### **37.2 CLASSIFICATION OF ACCIDENTS**

Accidents are classified as follows:

##### **a) Near Miss**

It is a 'narrow escape' where accident, major loss or injury did not occur. Such incidents must be reported locally and the working conditions leading to it must be investigated.

##### **b) Fatality**

A death resulting from work injury is covered under this category irrespective of the intervening time between injury and death.

##### **c) Permanent total disability**

Personal injury which incapacitate a person completely and results in termination of employment.

##### **d) Permanent partial Disability**

Any injury which results in complete loss or permanent loss of use of any part of body or any permanent impairment of the function of the body.

##### **e) Lost Work-Day Case**

Any injury excepting permanent partial disability which renders the injured person unable to perform any regular job on any day after the day of receiving the injury.

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##### **f) Restricted work case**

After the injury, the injured person can not perform his normal duties or regular job.

##### **g) Lost work days**

The number of calendar days on which the injured person was temporarily unable to work.

h) Restricted Work days

The total number of calendar days from the start of Restricted work, by the injured persons, till he returns to his regular job.

i) Medical treatment cases

The injury requiring medical treatment under order from a physician but does not involve Lost work Days, or restricted workdays.

### 37.3 REPORTING

Contractor shall notify OWNER as under:

Lost time injuries / Fatality / Injury which may cause total or partial disability to injured etc -immediately.

Fire and Miscellaneous Events-  
immediately. First Aid injuries-Within a day.

### 38 SAFETY TRAINING

Training is a pro-active measure. The contractor shall engage only those workers who are proficient in their respective jobs. It is responsibility of contractor to impart job knowledge to all workers and supervisors before engaging them for any work. It is also binding to the contractor to depute persons for safety training, if arranged by OWNER.

### 39 DOCUMENTATION

Following documents shall be maintained by contractor at site: \_ Safety & Environment Policy

\_ Safety committee minutes of meeting

\_ Critical machinery/equipment fitness certificate. \_

Stock register of Personnel Protective Equipment.

\_ Maintenance registers for major machineries/equipment.

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\_ Accident / incident investigation

reports. \_ Various work permits.

\_ Earthing test certificates. \_

Materials test certificates.

\_ P.F., Contract Labour, ESI registration.

\_ All records & registers as required under Contract Labour (Regulation & Abolition Act) 1970 and Building & Other Construction Workers Act 1996.

### 40 ENVIRONMENT PROTECTION

Contractor should ensure that the work carried out by him does not change the quality of air, water & soil at the work site & surrounding areas. Disposal of surplus earth, rubbish, scrap etc. shall be done in Eco-friendly manner. The contractor shall ensure that the greenery is protected to the extent possible while executing the work.

### 41 ENVIRONMENTAL IMPACT MITIGATION MEASURES

The best way of impact mitigation is to prevent the event occurring. All efforts should be made to locate the developmental activities in a area free of agricultural lands, cyclones, earthquakes, ecologically sensitive, erosion, forests, flooding, human settlements, land slides, natural scenic beauty, water logging. In case this is not feasible, the next step is to look at the raw materials/technologies/processes alternatives which produce least impact i.e. adopting or using processes or technologies which are efficient and produce recyclable wastes/minimum waste/wastes that can be easily disposed, without affecting the environment. However if the developmental activity produce the adverse impact, action has to be taken to mitigate the same. Following are the suggested methods, which shall be taken in to consideration by the contractor to

choose right technology for executing the work:

#### **41.1 AIR**

Attenuation of pollution on pathway or protection of receptor through green belts.

Particulate removal devices such as : cyclones, settling chambers, scrubbers, electrostatic precipitators, and bag houses.

Gas removal devices using absorption (liquid as a media), adsorption (molecular sieve), and catalytic converters.

Uses of protected, controlled environment, such as oxygen masks, Houston Astrodome, etc.

Control of stationary source emission (including evaporation incineration, absorption, condensation and material substitution)

Use of masks

Dilution of odourant (dilution can change the nature as well as strength of an odour)

Odour counteraction or neutralize (certain pairs of odours in appropriate concentration may neutralize each other)

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Odour masking or blanketing (certain weaker malodours may be suppressed by a considerably stronger good odour)

#### **41.2 NOISE**

The mitigation measure may include damping, absorption, dissipation and deflection methods. Common technique involve constructing sound enclosures, applying mufflers, mounting noise sources on isolators, and/or using materials with damping properties.

Performance specifications for noise represent a way to insure the procured item is controlled.

Ear protective devices should be used. When an individual is exposed to steady noise levels above 85-dB (A), in spite of the efforts made to reduce noise level at the source, hearing conservation measures should be initiated. **41.3 WATER**

Conjunctive use of ground/surface water, to prevent flooding/water logging/depletion of water resources. Included are land use pattern, land filling, lagoon/reservoir/garland canal construction and rainwater harvesting and pumping rate.

Minimize flow variation from the mean flow.

Segregation of different types of wastes.

Storing of oil wastes in lagoons should be minimized in order to avoid possible contamination of the ground water system.

Surface runoff from oil handling areas should be treated for oil separation before discharge into the environment. If oil wastes are combined with sanitary sewage, oil separation will be necessary at the waste water treatment facility.

All effluents containing acid/alkali/organic/toxic wastes should be processed by treatment methods. The treatment methods may include biological or chemical processes. The oil water separator of appropriate size based on catchment area shall be provided.

The impact due to suspended solids may be minimized by controlling discharge of wastes that contain suspended solids; this includes sanitary sewage and industrial wastes. Also, all activity that increases erosion or

contributes nutrients to water (thus stimulating alga growth) should be minimized.

Waste-containing radioactivity should be treated separately by means of dewatering procedures and solids or brine should be disposed of with special care.

#### **41.4 LAND**

The environmental impact of soil erosion can best be mitigated by removing vegetative cover only from the specific site on which construction is to take place and by disturbing the vegetation in adjacent areas as little as possible. Land clearing activities should be kept to the absolute minimum.

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Disturbing the existing vegetation and natural contour of the land as little as possible can mitigate increases in surface runoff. Vegetation along watercourses should not be cleared indiscriminately. Neither should potholes or swamps be drained unless absolutely necessary for successful completion of the activity.

Construction activities that result in the soil being laid bare could be scheduled in such a way that some type of vegetative cover appropriate to the site could be established prior to the onset of intense rain or windstorms. If grass is to be seeded, mulch of straw will help to protect the soil from less extreme erosive forces until vegetative and root development begins.

Natural drainage patterns can often be maintained by preparing sodden waterways or installing culverts.

Steep slopes can be terraced, thereby effectively reducing the length of slope.

Check dams built near construction sites can reduce the quantity of eroded soil particles reaching free-flowing streams or lakes.

Use of "floating" foundations and height restrictions in earthquake zones and increased foundation height, wall strength and roof support in areas periodically subject to cyclones can reduce the hazards.

All forms of temporary structures should be avoided from the flood plain and all permanent structures should be raised to a height above the level which flood waters can be expected to reach once every 100 years (100-year flood). Installation of underground drainage structures helps to reduce sediment loads.

Engineering plans can be drawn to reduce the area of earth cuts on fills below what might otherwise be acceptable, provide physical support for exposed soil or rock faces, concentrate or distribute-as appropriate the weight loading of foundations to areas or state better able to support that weight.

Use small charges for mining/blasting.

Restricting the number, frequency and area of movement of heavy machinery.

Compatibility between adjacent land uses can best be assured by providing a green belt between the proposed activity and nearby properties where any significant degree of incompatibility is likely to result.

#### **41.5 ECOLOGY**

Intruding as little as possible on their habitat can best mitigate the impact of activities on animals. If such animals use the area where the activity will take place, the activity should be concentrated to the maximum extent possible in

those parts of the area that they least often frequent.

During the planning phase of an activity, an attempt should be made to avoid extending into the home range wild animals. If this is not feasible, the activity should be completed, as quickly as possible, and regular and sustained use of the area over time should be minimized.

Regular or sustained intrusions of men or equipment into nesting areas of birds should be avoided to the maximum possible extent, especially while are being incubated by the adults and until the young have left the nest. The

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sanitation cuttings of non-commercial individual trees should destroy no known nests.

Restricting the input of polluting substances into watercourse, estuaries and the open sea can mitigate impacts upon fish and shellfish populations. Additionally, when a part of the activity involves water level control, changes in such levels should be programmed to be extent, it is possible to do so in a way that will minimally disturb nesting and feeding habitat.

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## APPENDIX-I

### COLD WORK PERMIT

Sl.No. \_\_\_\_\_

Work clearance from \_\_\_\_\_ hrs of date \_\_\_\_\_ To \_\_\_\_\_ hrs of date \_\_\_\_\_ (Valid for the shift unless renewed)

Issued to (Department / Section / Contractor) \_\_\_\_\_

Exact Location of work (Area / Unit / Equipment no. etc) \_\_\_\_\_

Description of work \_\_\_\_\_

#### THE FOLLOWING ITEMS SHALL BE CHECKED BEFORE ISSUING THE PERMIT

(Tick mark in the appropriate box. Checklist items marked with asterisk ( \* ) shall be complied by receiver)

Sr

no.

item

Don e

Not

Reqd.

Sr no.

Item Done

Not Reqd

.

1 Equipment / Work Area

inspected

6 Equipment water flushed

2 Surrounding area checked,  
cleaned and covered

7 Equipment properly

steamed / purged

3 Equipment

blinded/disconnected / closed /

isolated / wedge opened

8 Proper ventilation and

lighting provided  
4 Equipment properly  
drained and depressurized

9\*

Area cordoned off & caution  
boards / tags provided.

5 Equipment electrically isolated  
and tagged vide

Permit no. -----

-

10 Gas test: HCs / Toxic

etc. HCs = %

LEL

Toxic gas = ppm

**Remarks:**

1. The activity has the following expected residual hazards (Tick the relevant items): Lack  
of Oxygen / H<sub>2</sub>S, Toxic Gases / Combustible gases / Pyrophoric Iron / Corrosive Chemicals  
/ Steam – Condensate / Others \_\_\_\_\_

2. Following additional PPE to be used in addition to standards PPE (Helmet, Safety Shoes,  
Hand gloves, Boiler suit): Face Shield / Apron / Goggles / Dust Respirator / Fresh Air Mask  
/ Lifeline / Safety Belt / Airline / Earmuff etc.

3. Additional precaution if any:

---

Issuer Name & Designation Issuer Signature Receiver Name & Designation Receiver Signature

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**Closing of the work permit:**

Receiver : Certified that the subject work has  
been completed / stopped and area cleared

Issuer: Verified that the job has been completed  
and area cleared and is safe from any hazard.

**Date &**

**Time**

**Name &**

**Designation**

**Signature Date**

**& Time**

**Name &**

**Designation**

**Signature**

**Clearance renewal**

Time

Date

From To

Additional

precautions if any,

Otherwise mention

"NIL" Issuer's Name,

Designation &

Signature

Receiver's Name,

Designation

and Signature

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**General Instructions:**

1. The work permit shall be filled up carefully and accurately in clear handwriting

ensuring that complete information is provided in all the sections / subsections. Sketches should be provided wherever possible to avoid miscommunication.

2. Appropriate safe guards and required personnel protective equipment (PPEs) shall be determined by a careful analysis of the potential hazards and the operations to be performed prior to starting the work.
3. Requirement of standby personnel from Process / Maintenance / Contractor / Fire / Safety etc if any shall be mentioned in the additional requirement.
4. In case of fire alarm / siren, all work must immediately be stopped.
5. For renewal of work clearance, the issuer shall ensure that the conditions are satisfactory for the work to continue. If the conditions have changed, it may be necessary to issue a new permit or amend the existing permit.
6. This clearance on the same permit can be renewed / extended upto a maximum of seven calendar days.
7. This permit must be available at work site at all times.
8. On completion of the work, the permit shall be closed.

The industry may add other relevant instruction based on their operating and maintenance practices.

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## APPENDIX -II

### WORK PERMIT

for

### HOT WORK / ENTRY TO CONFINED SPACE

Sl.No.\_

Work clearance from \_\_\_\_\_ hrs of date \_\_\_\_\_ To \_\_\_\_\_ hrs of date \_\_\_\_\_ (Valid for the shift unless renewed)

Issued to (Department / Section / Contractor)

Exact Location of work (Area / Unit / Equipment no. etc) \_\_\_\_\_

Description of work \_\_\_\_\_

#### THE FOLLOWING ITEMS SHALL BE CHECKED BEFORE ISSUING THE PERMIT

(Tick mark in the appropriate box. Checklist items marked with asterisk (\*) shall be complied by receiver)

Sr

no

Item Done Not  
Reqd

Sr

no

Item Done Not  
Reqd

#### A General points B For Hot work / Entry to confined Space

1 Equipment / Work Area inspected 1 Proper ventilation and Lighting providing

2 Surrounding area checked, cleaned and covered

2 Proper means of exit / escape provided

3 Sewers, manholes, CBD etc and hot surfaces nearby covered

3 Standby personnel provided from Process / Maint / Contractor / Fire /



Safety dept.

4 Considered hazard from other operations  
and concerned persons alerted.

4 Checked for oil and Gas trapped  
behind the lining in Equipment

5 Equipment blinded/disconnected / closed /  
isolated / wedge opened

5\* Shield provided against spark

6 Equipment properly drained and  
depressurized

6\* Portable equipment / nozzles  
properly grounded

7 Equipment properly steamed / purged 7\* Standby persons provided for entry to  
confined space

8 Equipment water flushed

9 Iron sulfide removed / kept wet **C For Vehicle Entry**

10 Equipment electrically isolated and tagged  
vide permit no.

11\* Spark Arrestor on the mobile equipment /  
vehicle provided.

11 Gas test : HCs = %LEL

Toxic gas = ppm, O2 =  
%

12\* Running water hose / Fire extinguisher  
provided. Fire water system available.

### **D For Excavation works**

13\* Area cordoned off and Precautionary  
tags / Boards provided.

1 Clearance obtained for excavation / road  
cutting / Dyke cutting from concerned  
depart.

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### **REMARKS:**

1. The activity has the following expected residual hazards (Tick the relevant items): Lack of  
Oxygen / H<sub>2</sub>S, Toxic Gases / Combustible gases / Pyrophoric Iron / Corrosive Chemicals /  
Steam – Condensate / Others

2. Following PPEs to be used in addition to standards PPEs (Helmet, Safety Shoes, Hand  
gloves, Boiler suit): Face Shield / Apron / Goggles / Dust Respirator / Fresh Air Mask /  
Lifeline / Safety Belt / Airline / Earmuff etc.

3. Additional precautions if

any:\_\_\_\_\_

---

Issuer Name & Designation Issuer Signature Receiver Name  
and Designation

Receiver Signature

### **Clearance renewal**

Time

Date

From To

Gas Test Values

for HC's, Toxic,

O<sub>2</sub> etc

Additional

precautions if any,

Otherwise

mention "NIL"

Issuer's Name,

Designation

& Signature

Receiver

Name,  
Designation  
and Signature  
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### **Closing of the work permit:**

**Receiver:** Certified that the subject work has been completed / stopped and area cleaned.

**Issuer:** Verified that the job has been completed and area cleaned and is safe from any hazard.

**Date &**

**Time**

**Name &**

**Designation**

**Signature Date**

**& Time**

**Name &**

**Designation**

**Signature**

### **General Instructions:**

1. The work permit shall be filled up carefully and accurately in clear handwriting ensuring that complete information is provided in all sections / subsections and none of column is left blank. Sketches should be provided wherever possible to avoid miscommunication.
2. Appropriate safe guards and required personnel protective equipment shall be determined by a careful analysis of the potential hazards and the operations to be performed prior to starting the work.
3. In case of fire alarm / siren, all work must immediately be stopped.
4. Only certified vehicle / engines and permitted type of electrical equipment and tools are allowed in operating areas.
5. Welding machines should be located in non-hazardous and ventilated areas.
6. No hot work should be permitted unless the explosive meter reading is Zero.
7. When a person is entering confined space, the receiver must keep minimum two standby designated persons at the manhole or entry point.
8. Before box up of any vessel manhole cover, ensure that no men / materials are inside the vessel.
9. For renewal of work clearance, the issuer shall ensure that the conditions are satisfactory for the work to continue. If the conditions have changed, it may be necessary to issue a new permit or amend the existing permit.
10. This clearance on the same permit can be renewed / extended upto a maximum of seven calendar days.
11. This permit must be available at work site at all times.
12. On completion of the work, the permit must be closed and kept as record.
13. The industry may add other relevant instructions based on their operating and maintenance practices.

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## **APPENDIX -III**

### **Electrical Isolation / Energisation Permit**

#### **Section-A: Isolation Permit.**

Sl.No. \_\_\_\_\_

**Request for Isolation:** Date: \_\_\_\_\_

Time: \_\_\_\_\_

Department / Section / Area issuing the permit

Equipment number to be isolated: \_\_\_\_\_

Name of the equipment / circuit to be isolated: \_\_\_\_\_

The above-mentioned equipment / circuit shall be de-energized and isolated from all live conductors to carry out the maintenance work by \_\_\_\_\_ section / for operational requirement.

\_\_\_\_\_  
**Issuer Name Designation Signature**

**Certificate of Isolation:** Date: \_\_\_\_\_

Time: \_\_\_\_\_

Certified that Equipment / Circuit no. \_\_\_\_\_ of \_\_\_\_\_ plant has been electrically isolated by switches / isolators / links / fuses (tick as applicable) and the danger tag is put on the supply panel. Actions in respect of electrical isolation have been recorded in the electrical shift logbook.

\_\_\_\_\_  
**Name of Authorized Person Designation Signature**

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### **Section-B: Energisation Permit.**

Sl.No. \_\_\_\_\_

***Request for Energisation:*** Date: \_\_\_\_\_

Time: \_\_\_\_\_

Department / Section / Area issuing the permit \_\_\_\_\_

Equipment number to be energized: \_\_\_\_\_

Name of the equipment / circuit to be energized: \_\_\_\_\_

Work on the above mention equipment / circuit has been completed and all the applicable permits closed. This equipment / circuit may be energized.

\_\_\_\_\_  
**Issuer Name Designation Signature**

**Certificate of Energisation:** Date: \_\_\_\_\_

Time: \_\_\_\_\_

Certified that Equipment / circuit no. \_\_\_\_\_ of \_\_\_\_\_ plant has been electrically energized and the danger tag removed from the supply panel. This is also recorded in the electrical shift logbook.

\_\_\_\_\_  
**Name of Authorized Person Designation Signature**

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### **APPENDIX -IV**

#### **Scaffolding fitness certificate**

(Name of contractor ) \_\_\_\_\_

Project \_\_\_\_\_

Exact location of scaffolding \_\_\_\_\_

Date of inspection \_\_\_\_\_

Type of scaffolding & height \_\_\_\_\_

Purpose \_\_\_\_\_

We have personally checked the scaffolding and declare it as fit for use.

Signature of site in-charge \_\_\_\_\_

Signature of contractor's representative \_\_\_\_\_

Date: \_\_\_\_\_

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### **APPENDIX -V**

#### **Temporary electrical connection fitness certificate**

(Name of contractor ) \_\_\_\_\_

Project \_\_\_\_\_

Exact location of electrical temporary connection \_\_\_\_\_

Date of inspection \_\_\_\_\_

Purpose \_\_\_\_\_

We have personally checked the temporary electrical connection and workability of  
ELCB/RCCB and declare it as fit for use.

Signature of site in-charge \_\_\_\_\_

Signature of contractor's representative \_\_\_\_\_

Date: