ENGINEERING STANDARD

FOR

ACCESSIBILITY AND SAFETY OF MACHINERIES

CONTENTS :

PAGE No.

APPENDICES:

0. INTRODUCTION

This IPS Standard Specification covers the minimum requirements to maintain the safety and accessibility of machineries.

In this Specification emphasis is placed on the principles of safeguarding to the extent that a designer, plant engineer or works manager shall be able to apply them to any particular machine or process.

This Standard Specification stresses the importance of built-in safety at the design stage. In so doing, it is hoped that safeguarding might be viewed as a prime feature of the machine and not something which is considered as an after thought.

The safeguarding of machinery is a task which requires careful attention at all times in the interests of industrial accident prevention. It is hoped that this Standard specification will make a worthwhile contribution to the prevention of machinery accidents and that it will serve as a useful guide to those whose task is to safeguard machinery.

1. SCOPE

This Standard Specification contains the general guidelines for safety and accessibility of machineries (pumps, compressors, turbines, fans etc.).

It is intended to be used in refineries, chemical, petrochemical and gas plants and where applicable in production, exploration and new ventures.

This Specification shall be used in conjunction with appropriate IPS Standard for each type of equipment.

2. PRINCIPLES OF MACHINE SAFETY

The basic principles for reducing risk of injury and danger to personnel and damage to machineries that may be applied to hazards are as follows:

a) Identification of hazard(s).
b) Elimination or reduction of hazards in design stage.
c) Use of safeguards.
d) Use of safeworking practice.

A general knowledge of possible hazard will help the designer and manufacturer to be considered when designing and manufacturing machines.

Where the complete prevention of a hazard is impracticable it may still be possible to reduce the degree of injury, e.g. by supplying proper safety equipment and work training of personnel.

The avoidance of injury and damage depends on reliability of these measures.

3. IDENTIFICATION OF HAZARDS

Potential hazards associated with machineries are listed as:

a) improper design;
b) improper lubrication;
c) inadequate cooling;
d) mechanical failure;
e) missing guards;
f) exposure to noise;
g) fire and explosions;
h) inadequate working surface and space;
i) incorrect installation, operation or maintenance.

4. MACHINERY DESIGN

4.1 Safety at the Machine Design Stage

Designers should aim at producing machinery for efficient operation namely to be economic in use and to be safe to construct, install, operate and maintain.

Wherever practicable, dangerous parts should be eliminated or effectively enclosed in the initial design. If they cannot be eliminated, then suitable safeguards should be incorporated as part of the design and if this is not possible, provision should be made for safeguards to be easily incorporated at a later stage.

At the design stage arrangements should be made, where practicable, to eliminate the need to expose any dangerous parts during operation, examination, lubrication, adjustment and maintenance.

Designers of machinery should consider all aspects of the work situation for which the machine intended to be used. The objective is to provide the optimum conditions to achieve the most efficient safe performance of the machinery and the operator. Among the aspects to be considered are the creation of a favorable environment for the operator and others in the vicinity by providing heating cooling, lighting and, where necessary, mechanical aids to reduce physical effort, and by controlling to an acceptable level the emission of heat, light, noise, dust, fumes, vapors and liquids.

4.2 Elimination of Hazards by Design

At the design stage a machine designer should be aware of the hazards listed in section 3 of this Standard. As a first principle, as many of these hazards as possible should be avoided by suitable choice of design features. Secondly, where it is not possible to avoid these hazards, the designer should examine the factors which influence the magnitude of the risk. Speed of movement, force, etc. may influence the degree of injury.

Entanglement hazards may be reduced by reducing speed or distance of movement, by avoiding projections and recesses, by restricting force, torque and inertia, and by aiming for smooth polished surfaces. These measures apply both to machinery and process material. It helps also if the process material and any by-product is discrete rather than continuous.

4.3 Controls

4.3.1 General

Suitable control system shall be provided for each equipment. Controls should be so positioned and spaced as to provide safe and easy operation and there should be ample clearance between each control and other parts of machinery. Controls should be so placed that the operator can reach them easily.

4.3.2 Identification

Controls should be clearly identifiable and readily distinguishable from each other by varying their separation size, shape, color, and by labelling the controls with either words or symbols, indentifying the function or consequence of use of the control.

Controls for starting or stopping a machine should be clearly marked.

4.3.3 Emergency stopping devices

An emergency stopping device is a device which requires deliberate action to bring a machine to rest when danger is recognized. The emergency stop should not be used for normal stopping and should not be relied on as a means of isolation or immobilization.

An emergency stopping device when operated should stop the machine as quickly as possible. An emergency stop is not an alternative to guarding. Care should be taken that the operation of the emergency stop does not, in itself, increase the risk of injury from another source. Handles, bars, push buttons, etc. Used for actuating the emergency stop should be suitably marked, prominently located.

Where there is more than one control or work station, an emergency stop push button should be positioned at each station. Emergency control between and around the work station may also be provided by use of trip wires or pressure sensitive cables. In these circumstances it may be desirable to incorporate a visual indicator. The emergency stop should be located within easy reach.

It is essential that release or resetting of the emergency stopping device does not cause the machine to operate. Restarting should only be by operation of the normal start control.

4.3.4 Warning signals

On installation where the main operating station or start control is in a position from which the dangerous parts of the machinery can not be seen clearly, audible and visual warnings should be operated through a suitable interlock for predetermined time before the machinery starts to operate.

On installations where malfunction of the machinery creates a hazard, suitable warning signals should be given.

These signals should preferably be given automatically and should be both audible and visual.

4.4 Indicators

Where necessary, a qualitative, quantitative or check reading indicator should be provided to warn of danger. Such indicators should be designed to minimize the risk of failing to danger. Explanations of these indicators are as follows.

a) Qualitative

Shows a satisfactory or unsatisfactory state, e.g. a temperature gage which indicates cold-normal-hot.

b) Quantitative

Provides numerical data and as such requires precision in reading, e.g. a pressure gage.

A quantitative indicator should not be used if a qualitative one would suffice.

c) Check reading

Gives information automatically or when demanded as to the state of the equipment, e.g. an indicator light and/or audible alarm.

4.5 Rotating Shafts and Couplings

Every projection such as a setscrew, bolt or key on any exposed revolving part of machinery should be sunk, shrouded or otherwise effectively guarded. Guards for rotating shafts should preferably be fixed with guards of solid construction.

4.6 Hydraulic and Pneumatic Systems

When designing hydraulic circuits, all aspects of possible methods of failure, including control supply failure, should be considered. In each case, components should be selected, applied, fitted and adjusted so that in the event of a failure, maximum safety of personnel should be the prime consideration and damage to equipment minimized.

All components within the system should operate within their manufacturer's specification. All parts of the system should be protected against over pressure. The system should be designed and constructed so that components are located where they are accessible and can be safely adjusted and serviced. Circuits should be designed, constructed and adjusted to minimize surge pressures.

Surge pressure or loss of pressure should not cause hazards. The supplier and purchaser should discuss any special site conditions and the design of the system should take account of these conditions.

4.7 Lifting and Handling

Machinery which cannot be moved or transported by hand, should be equipped or be capable of being equipped with suitable attachment devices for transport by means of lifting gear. Transport personnel should be able to reach the attachment devices safely or provision for automatic attachment should be fitted.

Taking into account the center of gravity, the attachments should be arranged so that the machinery cannot be tipped during correct lifting.

Weight details should be given on the machine, on its packaging or on transport documentation.

All machinery elements, including added fixtures, should be provided with means for their safe removal and replacement, unless their shape, size and weight permit these operations to be carried out safely by hand.

Parts of machinery which can be removed in operation, e.g. tools and devices which on account of their weight cannot be lifted manually, should be marked with weight details. These have to be affixed so that they are clearly legible and visible, whether the details refer to the removable part or the complete machine.

Appendix "A" describes the provisions necessary for installation of hoisting equipped for machineries.

4.8 Lubrication

It is important that excess lubricants should be prevented from reaching the surrounding area and thereby creating a hazard. On machines in which the failure of an automatic lubrication system could cause a danger, such a lubrication system should incorporate a suitable indication of its correct functioning and/or warning of a malfunction.

If the automatic lubrication system fails means should be required to stop the machine as soon as practicable.

For further information on lubrication system of machineries refer to IPS-M-PM-320.

4.9 Relief System

Every pressurized equipment which contains fluids above atmospheric pressure shall be protected by a pressure relieving device or devices as required to prevent the pressure in any element of the system from exceeding its maximum allowable working pressure by more than 10%. In case when sub-atmospheric pressures may occur and the equipment is incapable of withstanding such conditions a vacuum break device shall be fitted.

4.10 Stability

Machines have to be stable, i.e. it is essential that they do not fall over and are not capable of being unintentionally moved by vibration, wind pressure, impact or other foreseeable external forces. If this recommendation cannot be fulfilled adequately by design or stable weight distribution, then stability should be obtained by special safety measures. For example, movements of parts of the machine may be restricted, indicators, alarms or interlocks to prevent tipping may be provided, or the machine may be securely anchored to a foundation.

Both static and dynamic stability should be considered. If special safety measures are required, a warning should be provided on the machine and/or in the operator’s manual.

4.11 Lighting

Local lighting on the machine for the illumination of the work area should be provided when the construction of the machine and/or its guards render the normal lighting inadequate for the safe and efficient operation of the machine. Local lighting should also be provided in areas of regular maintenance which are likely to be poorly lit.

If the position of the lighting has to be adjusted, its location should be such that it does not cause danger to the machine operator while he is making the adjustment.

4.12 Access

Machinery should be so designed as to enable all routine adjustments, lubrication and maintenance to be carried out without removing the safeguard and without extensive dismantling of machinery components.

Ideally, lubrication and routine maintenance facilities should be incorporated in a suitable area, wherever practicable.

All action points, i.e. those points where generally an external action is required to ensure the correct operation of a lubrication system, e.g. filling with lubricant or actuation of a lever, should be easily accessible and situated so as not to cause a hazard. Where necessary, machines should have built-in platforms, ladders or other facilities to provide safe access for any adjustment, lubrication or maintenance but care should be taken to ensure that such platforms or ladders do not give access to exposed dangerous parts of machinery.

Where work platforms are used, they should be so designed as to prevent hazards and provide a level standing space of adequate size with a firm foothold. The stepping areas should be made from materials which remain as slip resistant as practicable under working conditions and suitable guard rails, posts and toe boards should be provided.

The supplier should liaise with the user regarding the safe use of platforms and loads likely to be used.

Platforms shall be positioned so that access is given to all areas where routine maintenance or operator inspection is necessary. Their positioning, however, shall not interfere with maintenance of any parts with respect to accessibility or lifting.

5. SELECTION OF SAFE GUARD

5.1 Guards

In selecting an appropriate safeguard for a particular type of machinery it should be borne in mind that a fixed guard is simple, and should be used where access to the danger area is not required during operation of the machinery or for cleaning, setting or other activities.

Generally, fixed guards shall be provided on all rotating and reciprocating parts which may be hazardous to personnel. Guards shall be also provided for flywheels.

5.1.1 Guard design and construction

5.1.1.1 Design

In designing a safeguarding system the types of guard and their methods of construction should be selected to take account of the mechanical and other hazards involved.

They should provide the minimum interference with activities during operation and other phases of machine life, in order to reduce any incentive to defeat the safeguard.

The guard should, by its design, prevent access to the dangerous parts of the machinery. It should be of robust construction. Sufficient to withstand the stresses of the process and environmental conditions.

If the guard can be opened or removed, this should only be possible with the aid of a tool. Preferably the fastenings should be of the captive type. The guard should be securely fixed in position when the machinery is in motion or is likely to be in motion. Where guards have to be removed periodically, e.g. for such purposes as setting or cleaning, good

design reduces the time required for their removal and replacement to a minimum. Ideally the removal of a single fixing with the appropriate tool should give the access required.

5.1.1.2 Construction

Any guard selected should not itself present a hazard such as trapping or shear points, rough or sharp edges or other hazards likely to cause injury.

Guard mountings should be compatible with the strength and duty of the guard.

In selecting the material to be used for the construction of a guard, consideration should be given to the following.

a) Its ability to withstand the force of ejection of part of the machinery or material being processed, where this is a foreseeable danger. Its ability to provide protection against hazards identified. In many cases, the guard may fulfill a combination of functions, such as prevention of access and containment of hazards.

This may apply where the hazards include ejected particles, liquids, dust, fumes, radiation, noise, etc. and one or more of these considerations may govern the selection of guard materials.

b) Its weight and size in relation to the need to remove and replace it for routine maintenance.

c) Its compatibility with the material being processed.

5.1.1.3 Environmental consideration

The selection of a safeguard should take into consideration the environment in which it is used. In a hostile environment it should be capable of withstanding the conditions likely to be experienced and should not of itself create a hazard as a result of that environment.

If a guard is likely to be exposed to a corrosion risk, special measures should be taken. The use of corrosion resistant materials or corrosion resistant surface coating should be considered.

Machinery should be designed as far as is reasonably practicable to contain coolant so as not to expose persons and the equipment to additional hazards.

5.1.1.4 Noise

While specific guidance on the subject of noise is outside the scope of this code, consideration should be given to noise reduction when designing safety measures for mechanical hazards. It is often possible for guard enclosures to be designed to serve the dual purpose of protection from mechanical hazards and reducing noise emissions. Guard panels should not add to the machinery noise levels because of poor design or fixing. Personal protection equipment can also be used to reduce the effects of exposure to noise.

5.2 Installation Consideration

5.2.1 Layout of machinery and plant

A machine should be installed with due regard to its interaction with other machines and the requirements of the process. Gangways should be wide enough to provide access for the transport of tools and materials as well as personnel. Gangways and other areas to be kept free of obstruction should be clearly defined, e.g. by floor markings.

When required, hazardous areas should be separately identified by a contrasting system.

Space should be provided around each machine to allow clear separation from passing traffic and for the storage of tools and for inspection, necessary attention, and dismantling when required. All phases of machine life should be considered, including cleaning, maintenance, etc., as well as normal operation.

5.2.2 Pipe works

All pipe works and auxiliaries integral to a unit shall be supported in such a way that the possibility of damage due to vibration, thermal expansion and own mass is eliminated.

Pipe works and equipment accessories shall be provided with drainage facilities at low point to prevent damage from freezing during idle time.

5.2.3 Access to machinery for maintenance

To facilitate cleaning and maintenance work without causing interference to adjacent machinery, platforms, safe means of access and lifting appliance suspension points should be built-in, where practicable. In such circumstances it may be necessary to safeguard moving parts which would otherwise be out of reach.

To make maintenance work and subsequent testing to be carried out safely it shall be possible to start and stop any equipment independently of others.

Remotely controlled equipment shall have provisions for stopping at site.

Remotely controlled and automatically controlled equipment shall have a sign in, Farsi language, meaning of :

DANGER:

"THIS EQUIPMENT IS REMOTELY CONTROLLED AND MAY START WITHOUT WARNING"

5.3 Maintenance and Inspection

It is important to recognize that good maintenance is essential to safeguards continued effectiveness.

There should be regular inspection of safeguards to ensure that the requisite standard of safety is maintained.

Reference should be made to supplier’s specification concerning the vital components of a safeguard, e.g. switches, relays and valves, when deciding their useful life.

A routine inspection of all safeguards should be made as part of a planned maintenance program. In addition, some safeguards should be tested as part of the production procedure, the frequency of testing depending on the type of safeguard and its operational characteristics. Inspections of safeguards should be part of any planned maintenance program.

Inspection and testing programs should be carried out by trained and experienced personnel. The degree and extent of training will depend on the complexity of the machinery and the risks arising from its use.

Sometimes when toolsetting or repair and maintenance of machinery and process plant are carried out, the safeguarding arrangements effective during the normal operation of the process need to be disturbed.

When the work has been completed a check should be made to ensure that all the safeguarding arrangements are restored to their proper working condition.

Care should be taken in the maintenance of the normal machinery control and operational functions, some of which have a considerable effect on safety, e.g. programmable systems.

Safe systems of work should be implemented where access is required to a danger area.

6. SAFE WORKING PRACTICE

6.1 General

It is not always possible to eliminate hazards or to design completely adequate safeguards to protect people against every hazard, particularly during such phases of machine life as commissioning, setting, process changeover, programming, adjustment, cleaning and maintenance, where often direct access to the hazardous parts of the machine may be necessary.

There are also a number of types of machinery where, at present, it is recognized that complete safeguarding cannot be provided even for operational activities. For these types of machinery, safe working practices are specified.

It should be emphasized that safety of machinery depends on a combination of hazard minimization measures, safeguards and safe working practices. These should take account of activities during all phases of the machine's life.

Safe working practices should be taken into account at the design stage, since the provision of jigs, fixtures, fittings, controls and isolation arrangements will frequently be involved.

6.2 Practices

It is emphasized that situations involving unguarded machinery under power in any phase of life should be avoided by appropriate design measures wherever technically feasible. Alternatives may include the use of completely different types of machine to achieve the same end product.

When there is no alternative, the following general practices by properly trained and supervised personnel shall be considered:

a) A foreman or other adequately qualified person should be designated as supervisor of the equipment and be responsible for its proper operation and maintenance.

b) The start-up, shut down and emergency procedures for all operations involving the equipment shall be periodically reviewed with the operators.

c) Records shall be kept of oil consumption and all major inspection, examination, repairs, pressure test, etc. carried out on all equipment with a shaft input power exceeding 100 kW.

d) Before dismantling any pressurized component, the machine shall be effectively isolated from all sources of pressure and completly vented to the atmosphere.

e) When maintenance is carried out on electrically driven equipment the electrical switches shall be locked in open position, or other positive means of current interruption shall be employeed, for example taking out the fuses.

f) All safety devices should be maintained to ensure that they always function properly. They shall not be put out of operation and shall be replaced only by devices giving at least the same security. Pressure and temperature gages shall be checked regularly with regard to their accuracy. They shall be replaced whenever they are outside acceptable tolerances.

6.3 Supervisory Control

Where safety from hazards is dependent on people carrying out safe working practices, it is essential that an appropriate degree of managerial and/or supervisory control is exercised. Where risk is minimal, verbal instructions may be quite adequate, but as risk increases it becomes essential to define procedures in writing, in order that they can be supervised more rigorously. Where the risk level is high, e.g. there is a possibility of serious injury or death if the procedure is not

followed correctly, the adoption of a permit to work system is regarded as essential. This will normally involve specification of the controls, etc., for isolation and for internal hazard dissipation, and supervisory checks that they have been operated and secured and that the plant is free of hazard (or that additional practices, such as use of protective equipment, are followed).

An equivalent check is normally required on the procedures for putting the equipment back into operation and, on occasion, checks may need to be made during the authorized work.

The task to be carried out, and the individual responsibilities of those involved, may need to be specified in detail on occasion.

The most common use of a permit to work system is during maintenance operations. In circumstances where a procedure, in the form of a safe system of work, is deemed to be appropriate, it is necessary for management to identify the hazards which are exposed and to develop a safe system of work whereby these hazards are eliminated or as a last resort, recognized by the employee(s) so that personal precautions against possible injury can be taken. Oral instructions, requests or promises are liable to be misheard, misinterpreted or forgotten and are therefore not a satisfactory basis for action on which lives may depend. The unsatisfactory working of such procedures has been proved time and again.

Effective control should be achieved by means of a written system, though even this relies on the human element, for no documentary system can by itself prevent accidents. The system, which is known as a permit to work system, requires formal action on the part of those doing the work, those responsible for it and those authorized to sign such permits. The person responsible for supervising the work should ensure that the person(s) undertaking the work are identified and properly trained and understand the task involved and the precautions to be taken.

A safe procedure is therefore specified forming a clear record of all the foreseeable hazards which have been considered in advance, together with the appropriate precautions taken in their correct sequence and the starting and finishing times for the task and the formal handbook procedures should be documented as appropriate. Trained supervision to ensure that the system operates correctly is required.

Work in potentially hazardous circumstances can be done in safety by the use of this method. The design of a permit to work will depend on the nature and degree of risk, the complexity of the task and the industry to which it relates.

6.4 Information and Training

6.4.1 General

There are various ways in which information should be provided for users of machinery or for persons who may be in the vicinity of machinery. These include training manuals, instruction manuals, instruction placards and warning labels.

All information should be presented clearly in Farsi (and other languages where necessary) and be in a logical sequence with good illustrations. Where applicable, standard symbols should be used.

6.4.2 Instruction placards and warning labels

Warning labels on the machinery may be appropriate for :

a) commissioning and installation, e.g. to indicate lifting Procedures or the exposure of dangerous parts prior to the fixing of safeguards during the commissioning phase;

b) operation of the machine, e.g. to indicate dangerous machinery behind a guard, such as drive systems or electrical control equipment, or to inform about safeworking procedures, e.g. the need to wear eye or ear protection.

Warning labels should be clear and concise using, where practicable, standard symbols and colors.

Instruction placards may be used in the area adjacent to the machinery to explain the legal requirements.

6.5 Installation, Operation and Maintenance Instructions

The supplier should provide with each machine sufficient information, including drawings, to enable the correct installation, safe operation and maintenance of the machine with particular reference to the following:

a) transport;

b) unloading and lifting including the weight of the machine and its attachments, with indication where it should be lifted;

c) commissioning and installation, i.e. the limits of travel of all moving elements should be shown;

d) start-up, including preparation before start-up ;

e) operation, including description of controls and functions;

f) close-down;

g) setting/processchangeover/programming;

h) adjustment;

i) cleaning;

j) lubrication, refuelling, recharging;

k) repair, including information on foreseeable failures and fault finding.

For all the phases of machine life, the potential hazards should be identified and the safeguards to protect against the hazards, the safeworking and operational procedures required (including emergency procedures) and the emergency equipment which may be needed should be described.

For machinery supplied without tooling, the supplier should indicate that the user may need to provide additional safeguards to the standard guarding in certain circumstances.

For machinery supplied with tooling for a specific workpiece or a range of workpieces, the supplier should indicate the need to review the original safeguards if tooling and/or workpiece considerations are changed.

6.6 Training

Supervisors and work people alike should be trained formally in the correct knowledge and application of safe practices at their machinery and this is particularly applicable to young persons.

This is particularly important for those phases of machine life where risk is higher, e.g. due to the removal of safeguards. Safety training should, where possible, form part of an integral program covering all aspects of the work to be undertaken.

6.7 Personnel Protection

In considering methods of safeguarding machinery, it may also be necessary to consider the provision of personal protection equipment to minimize the risk of injury.

This may include special clothing, including safety head and foot wear, hearing defenders, eye protection or breathing apparatus. All those required to wear personal protection equipment should be given training in its proper use, care and maintenance.

APPENDICES

APPENDIX A

HOISTING EQUIPMENT SELECTION

A.1 Hoisting Facilities

This Appendix discusses the main factors on which a decision should be taken on whether to provide, or omit, hoisting facilities and kind of hoists to be selected.

A.2 Classification of Equipment

The four most important factors affecting a decision on whether to provide permanent roofing, with or without side walls and hoisting facilities above rotating equipment, or to install the equipment in the open air are:

1) The category to which an item of rotating equipment belongs.
2) The local climatic conditions.
3) The location of the equipment in the plant.
4) Economic considerations.

A.3 Categories of Rotating Equipment

The following categories can be distinguished.

Category 1

Multi-stage turbo machines generally built in accordance with API Standards 612, 616 and 617, such as turbo compressors, turbo generators, gas-turbine driven compressors, etc., having a "maintenance" weight of the heaviest part greater than 1000 kg and/or a power rating greater than 5000 kW.

Category 2

Multi-stage turbo machines, without an installed spare, built to the same standards as Category 1, but having a "maintenance" weight of the heaviest part, up to and including 1000 kg and/or a power rating up to and including 5000 kW.

Category 3

a) Those items of rotating equipment described under Category 2, but having an installed spare.
b) Turbo compressors and turbo generators built in accordance with API Standards 611 and 617.
c) Electric-motor-driven multi-stage compressors in accordance with API Standard 6l7.
d) Reciprocating compressors in accordance with API Standard 618.
e) Diesel/gas engine driven compressors, generators, pumps having a power rating up to and including 250 kW.

Category 4

Auxiliary and general-purpose equipment of types normally falling outside categories 1, 2 and 3, e g. pumps in accordance with API Standard 610, including water pumps.

A.4 Climatic Conditions

In respect of the degree of protection required for the equipment and the maintenance area in relation to climatic conditions, the following climatic conditions can be distinguished :

- cold to moderate with periodical winds, rain, frost and snow
- desert with priodical sand storms
- tropical with monsoon-type rainfall
- tropical and dry
- off-shore marine-cold climate
- off-shore marine-tropical climate.

A.5 Weight to be Lifted

The type of hoisting facilities provided will have an influence on the time required to carry out maintenance activities and thus are linked to the category of the equipment.

The weight of the parts to be lifted and whether equipment is to be completely stripped at site shall be taken into account in the selection of the hoisting gear.

The following permanent hoisting facilities are considered :

a) Electric/pneumatic overhead traveling crane.
b) Overhead traveling crane, chain-driven with electric/pneumatic/chain hoist.
c) Jib crane with an electric/pneumatic hoist.
d) Hoist beam with an electric/pneumatic hoist.
e) Hoist beam with trolley for a chain block.
f) Special lifting equipment such as special hoists, jacking equipment, cradles, etc., which may for example be used for the removal/manoeuvring of hot gas generators out of gas turbine enclosures or any other special lifting device required to facilitate maintenance.

A.6 Location of the Equipment

The location of the equipment in the plant and its accessibility for maintenance by mobile cranes shall also be considered in the selection and specification of hoisting facilities.

A.7 Economic Considerations

Consideration shall be given to whether a planned overhaul is normally expected or whether there is a real chance of an emergency breakdown.

For a planned overhaul or internal inspection, the necessary protection and hoisting facilities can be prepared well in advance and sufficient time is also available for restoring the unit to its original weatherproof state, so that it is again suitable for outdoor use.

Experience has shown that the equipment belonging to categories 1 and 2 which cover equipment mostly controlled by and varying with processes, is by its nature more sensitive and therefore has a greater chance of breaking down.

Permanently available overhead cranes and protection shorten the repair time. If rotors have to be lifted or fitted with the help of a mobile crane, damage to the rotor or labyrinths is more likely to occur as all movements are less controllable.

Equipment of categories 1 and 2 should be provided for that reason with suitable permanent hoisting facilities. These hoisting facilities, preferably electrically driven, should have the following capabilities:

hoisting speed slow	between 0.30 - 0.40 m/min + jog facility
hoisting speed fast	between 4.5 - 5.5 m/min
traverse traveling speed	between l0 - 8 m/min + jog facility
traveling speed	between l8 -15 m/min + jog facility

The slower speeds shall apply for a lifting weight of l5 tons or more.

When permanent hoisting facilities with associated steel structures are provided, there is no economic justification for omitting a simple roof cover in such a case, provided that the roof remains very simple and sophisticated constructions are not required.

In severe climates, e.g. cold, desert environment, hot tropical with rainfall, a roof with sidewalls, partly open to allow disposal of dangerous gases, will give better protection for machinery and maintenance crew.

The ultimate selection of the hoisting facilities shall be subject to agreement by the Company.

TABLE A.8 - SELECTION GUIDE FOR HOISTING FACILITIES CLIMATIC CONDITIONS

CATEGORY	OFF-SHORE MARINE		OFF-SHORE MARINE	OFF-SHORE MARINE	REMARKS
	COLD TO MODERATE WITH PERIODICAL RAIN, FROST AND SAND	DESERT WITH PERIODICAL SAND STORMS	TROPICAL WITH MONSOON-TYPE RAINFALL	TROPICAL DRY	GENERAL: THE HAZARDS AREA CLASSIFICATIONS SHALL BE CONSIDERED IN THE SELECTION OF THE HOISTING EQUIPMENT.
1	- ELECTRIC OR PNEUMATIC OVERHEAD TRAVELLING CRANE (A.S.A) - SPECIAL LIFTING EQUIPMENT (A.S.F) - ROOF AND (PARTLY* OPEN) SIDE WALLS * PARTLY CLOSED TYPE WALLS			- ELECTRIC OR PNEUMATIC OVERHEAD TRAVELLING CRANE (A.S.A) - SPECIAL LIFTING EQUIPMENT (A.S.F) - SIMPLE ROOF WITH PARTLY* SIDE WALLS * PARTLY CLOSED TYPE	A.S.F ONLY WHEN APPLICABLE - WHEN REQUIRED BY THE AREA CLASSIFICATION A PNEUMATIC OVERHEAD TRAVELLING CRANE SHALL BE SELECTED FOR OFF SHORE INSTALLATIONS ONLY
2	- OVERHEAD TRAVELLING CRANE, CHAIN DRIVEN WITH ELECTRIC PNEUMATIC OR CHAIN HOIST (A.S.B) - SPECIAL LIFTING EQUIPMENT (A.S.F) ROOF AND (PARTLY* OPEN) SIDE WALLS * PARTLY CLOSED TYPE			- OVERHEAD TRAVELLING CRANE, CHAIN DRIVEN WITH ELECTRIC PNEUMATIC OR CHAIN HOIST (A.S.B) - SPECIAL LIFTING EQUIPMENT (A.S.F) SIMPLE ROOF WITH PARTLY* SIDE WALLS * PARTLY CLOSED TYPE	A.S.F ONLY WHEN APPLICABLE WHEN REQUIRED BY THE AREA CLASSIFICATIONS A PNEUMATIC OVERHEAD TRAVELLING CRANE SHALL BE SELECTED FOR OFF SHORE INSTALLATIONS ONLY
3	- OVERHEAD TRAVELLING CRANE, CHAIN DRIVEN WITH ELECTRIC PNEUMATIC OR CHAIN HOIST (A.S.B) - JIB CRANE WITH ELECTRIC/PNEUMATIC HOIST (A.S.C) - ONE HOIST BEAM WITH ELECTRIC/PNEUMATIC HOIST OR CHAIN BLOCK (A.S.D) SPECIAL LIFTING EQUIPMENT (A.S.F)			- OVERHEAD TRAVELLING CRANE CHAIN DRIVEN WITH ELECTRIC PNEUMATIC OR CHAIN HOIST (A.S.B) - JIB CRANE WITH ELECTRIC/PNEUMATIC HOIST (A.S.C) - ONE HOIST BEAM WITH ELECTRIC/PNEUMATIC CHAIN BLOCK (A.S.D) - SPECIAL LIFTING EQUIPMENT (A.S.F)	- TURBO MACHINES AND RECIPROCATING COMPRESSORS WITHOUT INSTALLED SPARES SHOULD BE PROVIDED WITH A SIMPLE ROOF - RECIPROCATING COMPRESSORS WITH INSTALLED SPARES MAY BE INSTALLED IN THE OPEN AIR IF NOT ACCESSIBLE BY A MOBILE CRANE AND THE MAINTENANCE WEIGHT IS GREATER THAN 100 kg A JIB CRANE/HOIST BEAM SHALL BE PROVIDED - ALL INTERNAL COMBUSTION ENGINE UNITS SHOULD BE UNDER A SIMPLE ROOF OR BE IN AN ENCLOSURE IF CYLINDERS ARE IN LINE AND MAINTENANCE WEIGHT IS GREATER THAN 100 kg A HOIST BEAM SHALL BE PROVIDED - IF THE ENGINE IS V FORM AND/OR INTEGRAL WITH A COMPRESSOR AND THE POWER RATING IS GREATER THAN 250 kW, A CHAIN DRIVEN OVERHEAD TRAVELLING CRANE SHALL BE PROVIDED A.S.F ONLY WHEN APPLICABLE
4	- ONE HOIST BEAM FOR CHAIN BLOCK (A.S.F) - SPECIAL LIFTING EQUIPMENT (A.S.F)			- ONE HOIST BEAM FOR CHAIN BLOCK (A.S.F) - SPECIAL LIFTING EQUIPMENT (A.S.F)	IF THE EQUIPMENT IS LOCATED SUCH THAT A SMALL WHEELED HOOKABLE CRANE CANNOT BE MANOEUVRED AROUND THE EQUIPMENT IF THE MAINTENANCE WEIGHT IS GREATER THAN 100 kg IF NOT ACCESSIBLE BY MOBILE CRANE A.S.F ONLY WHEN APPLICABLE

Note:

The above crane selection table states order of prefence.