




KPD-TAY COMPRESSION PROJECT

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OIL & GAS DEVELOPMENT COMPANY LIMITED
KPD-TAY COMPRESSION PROJECT
SPECIFICATION FOR
ELECTRICAL BASIS OF DESIGN

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CLIENT : OIL & GAS DEVELOPMENT COMPANY LIMITED

PROJECT : KPD-TAY COMPRESSION PROJECT

ELECTRICAL BASIS OF DESIGN



OIL & GAS DEVELOPMENT COMPANY LIMITED
KPD-TAY COMPRESSION PROJECT
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1 INTRODUCTION

This philosophy defines the minimum requirements for the Electrical Power Generation, Distribution and Utilization Systems for the **KPD-TAY COMPRESSION PROJECT**. It does not provide an exhaustive definition of the electrical system and equipment, but is intended to give minimum information upon which to base the system detailed design.

The design objective for the electrical power generation and distribution system is that it shall be “fit-for-purpose” and provide high levels of safety, reliability, operability and maintainability while avoiding unnecessary design complication. Particular attention shall be paid to ensure proper isolation, interlocking and inter-tripping facilities for safe installation, operation and maintenance.

CONTRACTOR shall carry out the design, supply, installation supervision and commissioning of supplied package/equipment in compliance of Company's Specifications / Drawings and ensures that selected equipment are as per Company specifications and scope of work, complete in all respect.

In addition to this general specification, detailed specifications & data sheets shall be prepared by CONTRACTOR for all electrical equipment.

1.1 OPERATIONAL SAFETY AND RELIABILITY

The design of the electrical installations shall be based on the provision of a safe and reliable supply of electricity at all times, having availability in excess of 99% or as required to support the overall plant availability. Safe conditions shall be ensured under all operating conditions, including those associated with start-up and shutdown of plant and equipment. The design of electrical systems and equipment shall ensure that all operating and maintenance activities can be performed safely and conveniently and permit periods of continuous operation of at least 5 years.

The insulating and dielectric materials used in all electrical equipment shall be nontoxic and shall not contain compounds that are persistent and/or hazardous environmental contaminants, e.g. polychlorinated biphenyls (PCBs) and Askarel.

The design of the electrical installation and equipment shall ensure that easy and adequate access is provided for all operational and maintenance purposes. Special attention shall be paid to provisional and temporary installations required for the erection of permanent installations to ensure compliance with basic rules for good working practice and safety and to cope with increased hazards which may exist in temporary installations.

1.2 CODES AND STANDARDS

The entire electrical installation Works shall be carried out by Licensed Contractor, authorized to undertake such Works under the provisions of the Electricity Act and the Electricity Rules as adopted and modified up to date by the Government of Pakistan.

All design, construction, installation Works of the various electrical systems shall comply and be carried out in accordance with the latest editions of the relevant Standards, Codes, Acts, Rules, Regulations and bye Laws. Particular reference shall be made to:

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- International Electro Technical Commission (IEC).
- Institute of Electrical and Electronic Engineers (IEEE)
- American Petroleum Institute (API)
- Electrical Inspector, Explosive Inspector & other local authority approvals

These refer in particular to:

- Execution of electrical installations
- Safety codes, related in particular to oil and gas industry.
- Electrical Equipment for above

1.3 REFERENCES

TABLE-1: FEED DEVELOPED DOCUMENTS

DOCUMENT NOS.	DESCRIPTION
Refer Electrical Package Master Document Index	FEED Package Document/Drawings

Since the subject project involves up gradation of existing facility and in order to maintain the consistency in equipment selection, ease of operation & maintenance, managing spares and so forth, existing project documents/design basis are indispensable for the applicability of this BOD. However, only cited references as discussed in following sections shall be applied.

2 SITE CONDITIONS (DESIGN BASE)

Electrical design shall be based on the following environmental conditions. All Electrical Equipment shall be rated and suitable to operate in ambient conditions given below if located in external areas.

Equipment within enclosed heated and air conditioned rooms shall be capable of operating at the extremes of temperature which may occur following power failure. These upper and lower extremes of temperature and time duration of such extremes shall be calculated during detailed design. It should be noted that regardless of final installed location, all equipment shall be able to withstand the extremes of all conditions during shipment, storage, and installation prior to commissioning and shall be protected accordingly.

TABLE-2: SITE ENVIRONMENTAL PARAMETERS

PARAMETERS	VALUE/UNIT
MAXIMUM AMBIENT TEMPERATURE	118 °F
MINIMUM AMBIENT TEMPERATURE	36 °F
WET BULB TEMPERATURE (DESIGN)	88 °F
MAXIMUM RELATIVE HUMIDITY	77%
MINIMUM RELATIVE HUMIDITY	20%

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DIRECTION OF PREVAILING WIND (ACROSS THE YEAR)	The prevailing wind directions are blowing from the North to the North-East
WIND VELOCITY (MAX. / NORMAL)	100mph Design velocity (mech. Design): 120mph Exposure factor C – flat open terrain, Importance factor 1.15 – essential facility
ELEVATION ABOVE MEAN SEA LEVEL (GPF)	21 m (69 ft.)
AIRBORNE DUST PARTICLES	Possible effect of airborne dust particles shall be considered when developing the design
SEISMIC ZONE	Zone 2A of Uniform Building Code- UBC-1997.
MAXIMUM DAILY RAINFALL	251mm (recorded over 24 hours)
MAXIMUM MONTHLY RAINFALL	286mm

3 AREA CLASSIFICATION

Areas needed for the Upgrade of the Facility shall be classified into hazardous area in accordance with the following:

- Explosive atmospheres (Classification of Areas-Gas Atmospheres) -IEC-60079-10
- Recommended Practice Classifications of Locations for Electrical Installations at Petroleum Facilities Classified as Class 1 Zone 0,1 and 2- API Std. RP 505

In area classified as hazardous the electrical equipment shall be installed shall be certified as per ATEX guidelines. Hazardous Area Classification drawing shall be produced for the areas, which shall be used as a basis for the selection of suitable electrical equipment.

As a minimum, the electrical material in hazardous area shall be suitable for gas group IIA and temperature class T4 and IIC T4 if installed in battery rooms.

All areas within scope of Facility Upgrade shall be classified as one of the following zones to define the design and installation requirements for electrical equipment and facilities:

- **Zone 0:** Area where an explosive gas atmosphere is present continuously or is present for long periods.
- **Zone 1:** Area where an explosive atmosphere is likely to occur in normal operation.
 - All electric motors shall be specified as being certified EExde, manufactured to IEC standards, and have an ingress protection rating given below. (EExe motors shall not be used).
 - All inherently non-sparking equipment, e.g. junction boxes and terminal boxes shall be a minimum of EExe.
 - All inherently sparking equipment, e.g. switchgear and local control stations, shall be EExd.
- **Zone 2:** Area where an explosive gas atmosphere is not likely to occur in normal operation, and if it occurs, will exist only for a short period.
 - Equipment certified for Zone 1 with the addition of Type N.

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- **Non-hazardous:** A location considered inherently non-hazardous due to its separation from hazardous locations.

The selection and installation of equipment for use in hazardous areas shall be carried out in accordance with IEC-60079.

Selection of electrical equipment and certification requirement necessary will be in accordance with the table 4.3.1 given in section 4.3 of 165-4-DER-008-0.

Electrical equipment which is required to remain energized following a F&G shutdown, shall be certified for Zone 1 use, regardless of whether installed in a hazardous or nonhazardous area. Typical examples would include battery-backed emergency lighting, emergency ventilation equipment and equipment to be confirmed further during detail design.

Equipment installed in outdoor, non-hazardous areas shall be of a standard industrial weatherproof type. Equipment installed in indoor non-hazardous areas, outside the process area e.g. within the switchgear room, control room shall also be an industrial type.

All equipment and materials installed in hazardous areas on the Facilities shall be certified by an internationally recognized certifying authority (e.g. BASEEFA, PT, INIEX, CENELEC, FM, UL etc. approved by ATEX) for use in the respective "Classified Area".

4 ELECTRICAL SYSTEM DESIGN CRITERIA

4.1 ENCLOSURE SELECTION

Equipment enclosures are used to isolate live parts, protect equipment from environmental conditions, and satisfy area classification requirements. They are provided on large groups of equipment, such as motor control centers and switchgear, as well as for individual circuit breakers, switches, and motor starters, motors, Local control stations, junction boxes. Equipment will generally comply with the following degrees of protection, in accordance with IEC 60529.

TABLE-3: ENCLOSURE SELECTION

EQUIPMENT APPLICATION	IP PROTECTION
Equipment located in indoor areas such as substations, control rooms, etc	IP42
Equipment located outdoors (excluding LV motors)	IP66
Low voltage motor enclosures	IP55
All motor terminal boxes	IP56
Electrical enclosures, with door(s) open, shrouding of live parts.	IP20



4.2 POWER DISTRIBUTION SYSTEM & EMERGENCY/ESSENTIAL GENERATION

THORA DEEP-03 GGS & TAY-03 GGS

Power supply for the aforementioned facilities shall be ensured through in-house power generation based on gas as well as diesel generator.

Each facility shall be provided with separate power generation comprising 02 nos. of GAS GENSETS and 01 no. of diesel generator (DG SET). In normal operation, only one (01) of GAS GENSET shall be in continuous operation while other GAS GENSET to be off line in order to meet plant operating & maintenance contingencies .i.e. due to unscheduled shutdown or facilitate maintenance activities.

Each GAS GENSET shall be sufficient in size to support facility peak demand (including 20% of design contingency and operating margin) and be able to start the induction motor of highest starting torque at any condition of loading without exceeding the permissible voltage and frequency variations. In addition to above, provision of parallel (active and reactive) sharing between GAS GENSETS shall also be provided. In case of unscheduled shutdown/tripping occur in anyone GAS GENSETS may cause other/ available GAS GENSET to be start automatically and cater the plant peak demand. Both Auto and Manual provision shall be provided in order to facilitate maintenance activities.

01 no. of DG SET shall also be provided to support facility average/continuous electrical demand with 20% of design contingency & operating margin and be able to start the induction motor of highest starting torque at any condition of loading without exceeding the permissible voltage and frequency variations.

Operation of Electric fire Water pump motor (herein after referred to FW Motor) at alternate source of supply/ Emergency DG SET shall not be required when back-up Diesel Engine driven fire pump is installed as per section 9.3.3 of NFPA-20. Since Electrical FW motor at TAY-003 GSS shall be supplemented with diesel engine driven fire pump, therefore, their loading (motor rating of approx. 110KW) should only be considered on GAS GENSET. However, the said requirement will further be finalized during detail engineering and if it is concluded/emerged that requirement of alternate electrical source of power is otherwise necessary then suitable load shedding scheme shall be provided in order to cut off all the non-essential loads during the operation of Electrical FW motor.

Additionally, the DG SET shall serve as the cold (black) start machine when indigenous gas supply is not available and be designed in such a way that when all the 2 nos. gas generators fail, the diesel generator will auto starts and auto close to the bus. When gas generator return, diesel generator will synchronize with the gas generator before its soft unload to the gas generator and will go for shutdown thereafter. Auto and Manual provision of synchronization of GAS GENSETS with DG sets or vice versa shall be provided.

All the relevant electrical system controls, electrical protection, synchronizing facilities and load management (load sharing and load shedding) system shall be incorporated in the panels provided by GENSET Vendor.

**KPD @ GPP**

As per OGDCL provided response, existing power generation (both normal and emergency) system available at Plant is suffice to cater the additional demand of the subject project load and MCC-5 (103-MCC-05) being energized from essential bus as well is therefore to be utilized for the said purpose. Power supply for new Compression facility shall be taken from existing MCC-5 (103-MCC-05) by utilizing one no. feeder from each side of existing Low Voltage Switchgear/MCC-5 (103-MCC-05) to avoid single power failure. Following are the details of Spare feeders/space available in 103-MCC-05:

- F-61, 400A spare feeder available in Bus-B
- 01 nos. of additional 400A, MCCB Type tested Withdrawable module to added in free space available in Bus-A.

Moreover, FEC compressor or engine auxiliaries i.e. lube oil heaters, pumps are field controlled, therefore, their starters/breakers shall be provided in field mounted distribution boards (DB's), and only single feeder shall be considered for each compressor's DB from the Plant new MCC/Switchgear.

TAY-03 @ GPP

Existing power generation system available at Plant is suffice to cater the additional demand of the aforesaid facility. Therefore, power supply for new Compression facility shall be taken from existing MCC-3 (102-MCC-03) by utilizing existing available Spare feeders.

New area lighting shall be powered from existing Power Distribution board (located in old early facility area).

4.3 LOW VOLTAGE SWITCHGEAR/MCC (400 V)

A new Dedicated LV Switchgear/MCC shall be provided for each facility, please refer single line diagram 0258-ELB-6600, 0258-ELB-6602 and 0258-ELB-6604.

Switchgear/MCC assemblies shall be completely enclosed, metal clad, self-supporting and suitable for floor, in multi-cubicle or multi-box type structures.

Switchgear and MCC shall be of the compartmented metal enclosed with internal Separation of Form 4b type per IEC 61439-1 and 2, fully draw out designed to minimize any risk of developing a short circuit or the propagation of a short circuit and to ensure personnel and operational safety during all operating conditions, inspections, maintenance, the connection of main control and auxiliary cables and the equipping and commissioning of spare panels while the switchgear/MCC is live and in operation.

The entire switchgear/MCC assembly shall be a type tested unit in accordance with IEC 61439-1 & 61439-2, proving that it has been fully short circuit tested and certified by an internationally recognized testing authority for the fault level specified.

The number of equipped spares shall be as per facility specific single Line Diagram and specification.

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The circuit breaker shall be fitted with manual and motor spring charging mechanism for closing.

Circuit breakers shall comply with IEC-60947 and be type tested.

With reference to IEC 60947-4-1, motor starters and contactors shall conform to the requirements of both uninterrupted duty and intermittent duty class 12 (12 operating cycles per hour), at rated operational current.

4.3.1 A.C. Mains Voltage Regulation

Equipment shall be specified to operate continuously at 90% to 110% of system voltage coincident with 98% to + 102% of system frequency. Voltage depressions to 80% of system voltage at equipment terminals during motor starting shall have no detrimental effect on equipment operation. Overvoltages of up to 120% of system voltage at equipment terminals as a result of AVR action shall have no detrimental effect on equipment operation. Power supplies to equipment shall be designed to provide a voltage at the equipment terminals, which satisfies that equipment's rating. The design of the supply system shall take into account the voltage regulation of both the power generation system and the power distribution system.

Distribution system cable sizing shall be designed such that the following voltage drops from the nominal voltage at the circuit full load current are not exceeded:

Generator to Switchgear incomer	1.0%
Switchgear feeder/Motor starter to Motor Starting	15.0%
Running	2.5%
Switchboard feeder to Distribution board	1.0%
Switchboard feeder to Welding outlet	2.5%
Distribution board feeder to Luminaire (circuit average)	2.0%
Distribution board feeder to 110V socket outlet	1.5%
Voltage Drop from UPS Distribution Board to ICS Equipment Panels	1.0%
Maximum Voltage Drop between ICS Equipment Panels and Field Devices	2.0%

NOTE:

- 1- Volt drop will not exceed 3.5% of system nominal voltage (400) at the consumer's terminals, when the consumer is drawing rated (nameplate) current.
- 2- Depending on relative distances between Main Switchgear, Distribution board, and load, the allowable volt drop splits may be varied, but total circuit volt drop will not exceed from the limits as stated above.



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4.4 AC UN-INTERRUPTIBLE POWER SUPPLY SYSTEM (UPS):

The AC un-interruptible power system shall be double conversion dual redundant with backup battery separately for each unit and shall have a maintenance bypass circuit.

UPS system will consist of 2 x 100% rated rectifiers and inverters, 2 x 100% rated static bypass switches, 2 x 100% rated battery banks (each rated for 60 mins), and an isolating transformer/bypass transformer. Two identical fully segregated 100 % rated UPS units operate in parallel/load sharing mode to energize a single distribution board to which the load circuits are connected.

Dual redundant control circuits shall be included to facilitate equal sharing of the load between the two units. The load sharing controls shall not be subject to common mode failure and any failure of the load sharing controls shall not result in the loss of vital power.

With the two units sharing the load, each unit shall effectively run at 50 % load. Failure or switching-off of any one inverter shall result in uninterrupted acceptance of the complete load by the other inverter and in the further transfer of the complete load to the bypass circuit in the event of subsequent failure or switching-off of the second inverter

Each unit shall have a static switch connected to the common bypass circuit.

Suitable protection shall be incorporated to safeguard against loss of synchronism during bypass supply deviations that could result in short circuiting of the UPS output.

The UPS systems will have dual incomers, one side to be fed from the 'normal' 400V Switchgear bus, and the other side, and mains bypass transformer, to be fed from the 'essential' 415V switchboard bus.

All UPS batteries will be sealed lead-acid type, housed in enclosed freestanding cabinets. Each battery bank will have a means of isolation which can be tripped by the ESD or F&G system, and which will also automatically isolate the battery bank at the end of discharge.

4.5 INDUCTION MOTORS

The following requirements shall be fulfilled for the new motors:

Motors will be outdoor used, industrial type, 3-phase squirrel cage induction motors in accordance with project specification, 0258-ELA-6510.

Motors shall be designed for suitable starting method and shall be continuously rated and suitable for continuous operation at full load rating under combined variation of both voltage and frequency, as above.

Starting method for LV motors shall be applicable as given below.

Up to < 11KW	Direct On-Line
≥ 11 < 55 KW	Star Delta
≥ 55KW	Soft Starting/Variable Frequency Drive



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NOTE: *“Requirement for VFD will be provided as determined by process operations/conditions.” However, VFD for Fire water pump motor shall be provided as illustrated in project single line diagram.*

For low voltage motors starting current shall not exceed 6 times the motor locked current.

All motors will at minimum have class F insulation with a temperature rise limited to class B.

The minimum degree of protection and area classification shall be in accordance with stated as above.

LV motors will have TEFC enclosures.

Motor 22 kW rated and above will have anti-condensation heaters.

Efficiencies of all the motors shall be minimum IE3 and p.f greater than 0.9

4.5.1 Motor Controls

The following requirements shall be fulfilled for the new motors controllers:

Generally, all the motors shall have facilities to control (On and Off) from MCC through push buttons available at the front of each motor starter and from local motor control station (LCS) mounted close to each motors. Selector switch should be available at the front of each motor starter for selection of motor control whether from MCC or field as stated above. Local control stations shall be provided with minimum of following provisions .i.e. Start push button, stop push button and stay-put lock off emergency stop push button.

4.6 CABLES

The following requirements shall be fulfilled for the new cables:

Cable size and installation criteria given in section 11.0 of 165-4-DER-008-0 shall be followed supplemented to:

All cables (Power and control) shall be of annealed stranded copper conductors, XLPE insulated, steel wire armoured and overall PVC sheathed. Armour for single core cables shall be of aluminum.

The most appropriate installation method for individual plant areas shall be selected on grounds of ensuring the lowest risk of failure/damage, longest life. However, as far as practicable, direct buried method shall be preferred.

Cable sizing shall be carried out generally in accordance with the requirements of the Institution of Electrical Engineers – Regulations for Electrical Installations (Latest Edition) and as detailed in the following paragraphs.

- Cable current carrying capacity shall be determined by applying the manufacturers published data making the necessary allowances for de-rating to account for the installation conditions. De-rating shall be applied for the following parameters:
 - a) Ambient or ground temperature



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- b) Exposure to solar radiation
 - c) Ground thermal resistivity
 - d) Depth of laying
 - e) Grouping/Spacing
 - f) Method of installation
-
- Cables shall be able to withstand the maximum short-circuit during the corresponding tripping time of protective device in case of short-circuit. The minimum conductor sizes suitable to withstand the applicable short circuit conditions are calculated based on maximum permissible conductor temperature. Clearing time of protective device (Manufacturer declared) and relay co-ordination study results/tripping curves shall be referred to calculate the tripping time of protective device.
 - 100% continuous duty except feeders to transformers that shall be sized to suit the transformers AF rating.
 - Soil temperature for cable sizing to be considered 35°C unless stated otherwise.

When the cable trench passes in the paved area such as process paved areas, the trench shall be backfilled by sand up to the bottom of the pave.

Cables installed below ground in unpaved areas shall be direct buried at a minimum depth of 750-mm and in paved areas shall be run in preformed concrete or brick-sided trenches. Trenches shall be filled with sand. Cable warning tape and tiles shall be installed for the direct buried cables. Project typical drawings to be referred for further details.

Cable trenches and cable trays/ladder racks shall be designed to allow for 25% spare capacity for future installations.

Cables shall be installed in concrete encased duct banks in the instances detailed below:

- At road crossings
- In load-bearing areas (e.g. access ramps to equipment shelters)
- At access points to buildings
- In other areas where access to excavate trenches will be restricted by plant equipment (e.g. under pipe racks at grade level).

Cables, crossing roads in general shall be installed in concrete encased PVC pipes. At least 20% spare pipes subject to a minimum of two, sealed at both ends, shall be installed for future requirements. Bell mouths shall be installed on ends of each pipe.

Cable trenches and cable trays/ladder racks shall be designed to allow for 25% spare capacity for future installations.

All cables from Switchgear/MCCs to motors/other devices shall be laid in single length without any joint except where length and size of cable exceeds maximum manufacturing capability, in which case CONTRACTOR shall seek COMPANY/CLIENT/OGDCL approval. Sufficient cable loop shall be provided near joint/termination for future use.

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Glands shall be selected to suit the type of cable and termination box/enclosure, and be of the appropriate type of protection, e.g., Ex'd', Ex'e'. However, for standardization purposes, and to reduce the risk of errors, the same "Ex" glands (of most stringent protection) shall be adopted for all process plant areas.

The routing and general arrangement of all cables i.e. power, instrumentation, control and communications should be planned concurrently with main pipe-racks and vehicle access-ways etc., to provide unimpeded direct routes wherever possible.

Cables for protection, controls, indications and alarms for a particular item of plant or circuit (e.g., generator, motor, and transformer) shall be dedicated to that item of plant or circuit.

This requirement does not apply to 4 mA - 20 mA transducer signals.

0258-ELA-6503, Specification for LV Power & Control Cable shall be referred for further details.

4.7 LIGHTING SYSTEM:

The categories of lighting to be installed on the each facility shall be as follows:

- Area lighting
- Flood lighting
- Walkway/access platform/tank/fence/Boundary area lighting
- Emergency lighting
- Switchgear/MCC room and other Buildings lighting

The number, positioning and distribution of luminaries shall provide a safe working environment for 24 hours plant operation. The emergency lighting design shall provide sufficient illumination to indicate safe escape routes for operating personnel from all plant areas, as well as providing illumination at essential control positions. Preference shall be given to energy efficient lights where ever possible. Emergency lighting backup should be at-least 30 mints inside new buildings and plant area and calculations must be performed as per DIALUX or similar.

Average illumination levels will be designed in accordance with the values given in table.

The design will allow for a maintenance level of 0.7. Illumination levels are at 1.0 metres above floor level.

TABLE-: ILLUMINATION LEVELS

AREA	LUX LEVEL
Process areas, pumps, valve stations, gauge panel.	100
Stairways, walkways, instrument stands.	50
At front of switchboards, local control panels, controller cabinets.	300
General lighting in switch room, instrument equipment room.	200

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Electrical Room, Instrumentation Cabinet Room and Central Control Room.	400
Outdoor tank areas.	20
Offices, first aid areas, reading areas.	500
Storerooms, warehouses.	75
Workshops	300
Roadways & Security (boundary wall) Lighting.	20
Essential lighting level - plant escape routes.	2
Emergency lighting level - Electrical Room, Instrumentation Cabinet Room and Central Control Room.	20

Where possible, maximum illumination levels will not be more than three times the minimum illumination level in any area, and sharp changes in illumination level will be avoided.

Types of luminaries shall be in accordance with the Doc. No. 0258-ELA-6505 "Specification for Lighting Material", however, following light fixtures/light fittings shall be used, are as follows:

- Luminaries in the more dense areas of the compression plant will generally be twin tube, two pin fluorescent types, having electronic ballasts.
- In open and laydown areas, floodlights will be utilized.
- In all hazardous areas, whether Zone 1 or Zone 2, fluorescent/HPS flood luminaries shall comply to IEC 60079, and shall be ATEX certified suitable for the classified areas.
- All floodlights will be located in non-hazardous or Zone 2 areas, but not in Zone 1 areas. All floodlights will therefore be certified suitable for Zone 2 operation at minimum.
- In non-hazardous areas, all luminaries except essential lighting will be non-certified.
- Essential light fittings will be Zone 1 certified fluorescent luminaries in all areas of the Plant, whether hazardous or non-hazardous.
- Fluorescent luminaries will operate at 230VAC. Floodlights will operate at 230VAC voltage, and any requirement to balance loads across the three-phase distribution system.

Power supply to luminaries shall be at 230V AC, 50Hz. Lighting sub-circuits shall be connected in a radial pattern and shall be provided with isolators arranged to switch phase and neutral at the distribution board. Isolators shall be pad lockable in the "OFF" position.

Flood, street and essential area and walkway lighting should be automatically switched by photoelectric incorporating a manual override.



Where emergency lighting luminaires are also used as normal lighting luminaires, they shall form a minimum of 30% of the total number of luminaires.

The use of junction boxes on lighting circuits shall be kept to the minimum necessitated by plant layout. Looping through luminaires, wherever possible, shall make circuit connections.

Flood/Fence lighting shall be provided by LED luminaires mounted on approx. 10 meters high poles at a nominal spacing around the plant which will provide the required level of illumination.

Calculations shall be prepared to demonstrate that the design will provide the required illumination levels. Contractor to submit lux calculation on DIALUX or similar.

Flood lighting fixture to be installed in Zone 2 shall be EEXeIIAT4 or EEXnRIIAT4 certified as per hazardous area application and must be ATEX approved.

Fluorescent luminaires to be installed in Zone 2 shall be EEXeIIAT4 or EEXnRIIAT4 certified as per hazardous area application and must be ATEX approved.

Skid lighting either SON discharge luminaires or fluorescent luminaires shall be EExd certified and must be ATEX approved.

4.7.1 Socket Outlet and Plugs

The following type of socket outlet shall be provided within the plant:

- Convenience socket outlet: 230 V, Phase + Neutral + Grounding
- Welding outlet : 400/230 V, 3P+N + Grounding

4.8 EARTHING AND LIGHTNING PROTECTION

A common earthing system shall be provided for electrical systems, lightning and static earthing, and shall be in accordance with relevant IEEE & IEC standards and Codes.

Every metallic structure/ skid, motors shall be earthed from two different ends.

Existing Earthing philosophy as described in Section # 14.0 of document # 165-4-DER-008, shall be followed supplemented to:

The earthing shall be provided to equipment/ enclosures etc. as described below.

- | | | |
|---|---|--------------------|
| – LV Switchgear/MCC: | = | 70 mm ² |
| – LV Motor below 22Kw: | = | 25 mm ² |
| – LV Motor above 90kW: | = | 70 mm ² |
| – Pole or Support: | = | 10 mm ² |
| – Lighting Distribution Board: | = | 25 mm ² |
| – Welding Receptacle (Industrial Socket): | = | 25 mm ² |
| – Local Control Station (LCS): | = | 16 mm ² |
| – Pump Shed Structures: | = | 25 mm ² |



Connection between earth electrode and earth cable shall be arranged in a pit with cover to allow maintenance and testing.

Earthing conductor shall be of soft drawn copper conductor with 600V grade green/yellow PVC insulation for electrical earth, and green PVC insulation for instrument clean earth. Earth grid interconnections shall be carried out with compression connectors or thermal welds and these

Earthing connection to equipment/structures shall be made with bolted connections. Foundation bolts shall not be used for earthing.

Earthing system will consist of the following:

- Electrical system earthing
- Equipment enclosure earthing
- Lightning protection
- Bonding for electrostatic discharge
- Instrumentation earthing

Underground earthing conductors shall be directly buried to a depth of at least 500 mm

Earth electrodes shall consist of a number of rod sections coupled together and driven vertically into the ground. The earth rods shall be tin plated copper.

The above earthing systems shall be interconnected with the existing main earthing network where applicable.

4.8.1 Instrumentation and Computer System Earthing

- Earthing system for instrumentation, shield of instrument cables, field control panels / UCP and computers shall be designed in accordance with the recommendations of the manufacturers.
- In case where the isolation from the other earthing systems is recommended by the manufacturer, the earthing system shall be isolated from the other earthing system. However, the study shall be made with the manufacturer on additional interconnections to earthing network at one or more points either directly or via transient earth clamps.

4.8.2 Lightning Protection

- Prior to design of lightning protection system a lightning protection assessment study shall be carried out by CONTRACTOR during detailed engineering which shall define the requirement and extent of lightning protection system. This study shall be carried out as per guidelines of BS EN/ IEC 62305-2 and API-545.

The Contractor shall design and install all necessary lightning protection equipment to the latest relevant IEC & API standards and codes/practices.



4.9 CATHODIC PROTECTION (CP)

The Cathodic protection system shall be engineered and designed for the equipment requires corrosion protection. The Contractor shall pre design survey, investigate, soil testing, design, supply and install Cathodic Protection (CP) of minimum following tanks and buried pipes.

- Raw Water and Fire Water storage tanks
- close drain and oily water lines

The Contractor shall be responsible to acquire all the existing cathodic protection details by visiting the facility before the bid submission.

All Cathodic protection work shall be carried out in accordance with Latest revision of NACE standards and to be based on impressed current method as given below:

Impressed Current CP system shall consist of following:

- Impressed current system based on conductive polymeric anodes (Anode flex) or equivalent for on-grade Storage tanks / buffer tank.
- Impressed current system external surface of underground piping based on appropriate closely distributed anode system and of galvanic anode system for short and medium pipes.

Design engineer nominated by the CONTRACTOR shall be minimum NACE CP Technologist or / I-corr Certified having at least 10 years' experience. The Design engineer should have experience of design engineering and installation of minimum of 10 tanks with polymeric anodes and 50km of piping work. Complete design documents, calculation, drawings, and BOQ's shall also be vetted form third party at CONTRACTOR's cost. The CONTRACTOR is required to mention at least 03 names of the reputable consultant/ consulting company in the bid. COMPANY shall have the right to choose any of the given name(s) or may also suggest a name at its own will.

Transformer rectifiers shall be oil immersed transformer with Selenium or SCR type rectifier rated 400 volts 3 phase, 50 Hz. Transformer rectifier shall outdoor use type and suitable for the area to be installed.

All the necessary steps as required in order to prevent the interfacing of Cathodic protection with other system (existing or new one) .i.e. grounding system, nearby foundations, shall be taken by contractor and it is his responsibility to ensure that true objective of CP system shall be fulfilled in all aspects without harming to nearby system/structure.

4.10 ELECTRICAL HEAT TRACING

Electrical heat tracing shall be provided in accordance with the requirement of process conditions and as per recommendations of equipment manufacturer.

Contractor shall Design, supply and install, Testing, pre-commissioning, commissioning and start-up of all equipment and material for the execution of the Electrical Heat Tracing system.

The design shall be based on the specific requirements stated on the process data specifications, drawings and isometrics. The Contractor is considered to be aware of all process data that may be



**SPECIFICATION FOR
ELECTRICAL BASIS OF DESIGN**

essential for the correct design of the trace heating system. The Manufacturer shall be involved in the design, or at least confirm that the design is sound; however, this does not relieve the Contractor of his responsibilities.

Trace heating shall be carried out using self-regulating tape. Where the requirements of the trace heating system are outside the limits of self-regulating tape constant wattage type shall be utilized. Other methods shall be selected with the agreement of the COMPANY. The design of the electrical trace heating system shall ensure any hotspots are within the temperature classification requirements of the area.