OGDCL PAKISTAN:
OIL & GAS DEVELOPMENT
COMPANY LIMITED

NASHPA COMPRESSION PROJECT (PHASE-II)

ISSUED FOR TENDER

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ENAR Petrotech Services (Pvt.) Limited , 7-B , Sector 7-A , Korangi Industrial Area , Karachi Pakistan

TITLE:

ELECTRICAL BASIS OF DESIGN

CONTRACT NO.
14-0193

DOCUMENT NO:
0193 – ELA – 6500 – 0

CLIENT : OIL & GAS DEVELOPMENT COMPANY LTD. (OGDCL)

PROJECT: NASHPA COMPRESSION PROJECT (PHASE-II)

ELECTRICAL BASIS OF DESIGN

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1 INTRODUCTION

The requirement mentioned herein describes the minimum requirements for the electrical design, installation, commissioning, equipment and materials for the **NASHPA Compression Facility** by EPCC.

1.1 GENERAL

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

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

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:

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

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
Volume **– II C**	FEED Package Document/Drawings

1.4 SITE CONDITIONS (DESIGN BASE)

Electrical design shall be based on the following environmental conditions:

Temperature:	Maximum	115 °F
	Minimum	35 °F
Humidity:	Maximum	70%
	Minimum	10%
Elevation		2700 Feet

1.5 AREA CLASSIFICATION

1.5.1 Area Classification

Area classification shall be in accordance with Area Classification Code for Petroleum Installation (API-505) and IEC 60097.

1.5.2 Zones

All areas within battery limit of the plant 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.
- Zone 2
  Area where an explosive gas atmosphere is not likely to occur in normal operation, if it occurs, will exist only for a short period.
- Natural Non-hazardous
  A location considered inherently non-hazardous due to its separation from hazardous locations.

1.5.3 Equipment Selection

- All electrical equipment to be used in classified areas shall be selected in accordance with API Std. RP 505 “Recommended Practice Classifications of Locations for Electrical Installations at Petroleum Facilities Classified as Class 1 Zone 0,1 and 2 and IEC 79 – 14 and approved by OGDCL/ Consultant.
- As a minimum, the electrical material in hazardous area shall be suitable for gas group IIA and temperature class T3 and IIC T3 if installed in battery rooms.
- Equipment used in classified area shall have minimum certification as laid down in Table-2.

Table-2: Hazardous Area Equipment Selection

Class	Zone	Equipment Description	Protection System	Remarks
1	0		Intrinsically safe EEx'ia'	Within Zone 0; where an explosive gas atmosphere is present continuously or is present for long periods, electrical Equipment shall not be installed.
	1	Induction Motors	Ex de	Vendor shall provide the international approved test certificates (ATEX, BASEEFA, IECEx, PTB, INIEX, BVS, LCIE, CERCHAR, CESI, LOM, KEMA, RIIS, UL, FM , CSA etc.) of offered equipment complying with relevant part of IEC-60079.
		Junction Box	Ex e	
		Lighting Fixture	Ex e	
	2	Induction Motors	Ex nA	
		Junction Box	Ex e	
		Lighting Fixture	Ex e Ex nA	
		Local Control Station	Ex e	
		Convenience/Welding Outlets	Ex e	
Non-hazardous			Non-certified, industrial design suitable for environmental conditions	

1.5.4 Enclosure Selction

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. 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)	IP65
Low voltage motor enclosures All motor terminal boxes	IP55 IP65

1.6 POWER DISTRIBUTION SYSTEM & EMERGENCY/ESSENTIAL GENERATION

1.6.1 Applicable Voltage Levels and Tolerances

- System voltage (3-phase, 4-wire) 400 V
- System voltage (1-phase, 3-wire) 230 V
- Frequency 50 Hz
- AC UPS (1 phase) 230Vac
- Motors (0.37kW and less) 230 Vac - 1 phase (Special condition)
- Motors (above 0.37 kW) 400 Vac - 3 phase
- Lighting system and outlets 230 Vac - 1 phase
- Small Power socket Outlets 400 / 230 Vac
- Instruments & Control 230V, 50 Hz, 1-phase from UPS

- Maximum supply voltage and frequency variations shall be as follows:

- Steady State voltage variation ±10% (AC Supplies)
- Frequency variation ±2%

I. Low Voltage Switchgear/MCC (400 V)

Switchgear/MCC assemblies shall be completely enclosed, metal clad, self-supporting and suitable for floor or back to back mounting, 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, 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 degree of protection as per IEC 60529 for any assembly shall be IP-42

The number of equipped spares shall be as per Single Line Diagram.

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.

All incoming breakers with bus tie breakers & motor starters shall be draw out type and suitable for main bus making and breaking on fault condition as per Table-4.

II. Voltage System

Table-4: Power Distribution System

Services	System Voltage (no-load voltage) (V)	Rated voltage (user voltage) (V)	Fault level (kA) (see note)	Phase/Wire	Earthing
Power Generation and Distribution system	400/230	400/230	120	3/4	Solid
AC system (UPS)	-	230	40	1/3	Solid

Note: The fault levels shown are preliminary & minimum which shall be further confirmed during detail engineering.

III. Allowable Voltage Drop

The electrical system shall be sized to assure that the following voltage drops will not be exceeded during normal operation and during transient (e.g. largest motor start up or reacceleration of group of motors).

The voltage drops shall be calculated on the worst operating conditions (i.e. with the system operating at minimum short circuit conditions).

The steady-state voltage drop of each circuit shall be calculated on the premise that the total load on the circuit is equal to the sum of the full load amperes of all connected utilization devices that will be in operation under normal conditions.

Voltages at consumer terminal (Motor, feeders etc.) must be maintained within the permissible limits defined in Table-5.

As a guide, maximum allowable voltage drops in cables, as a percentage of system nominal line to line voltage, at full load shall be as per Table-5.

Table-5: Permissible Volt Drop

System Distribution	Operating Condition	Criteria
400 V	Starting	For LV motors, the locked rotor current (LRA) during the starting of motor shall not be more than 15% at motor terminal.
400 V	Steady-state Operating	Volt drop will not exceed 4% of system nominal voltage at the consumer's terminals (motor), when the consumer is drawing rated (nameplate) current.
400 V	Steady-state Operating	Volt drop between the 400V Main Switchboard and the terminals of any Distribution Board will not exceed 2.5% of system nominal voltage. Volt drop between any Distribution Board and the final sub-circuit load will not exceed 2.5% of system nominal voltage when the load is drawing maximum demand current. NOTE: depending on relative distances between Main Swbd, Distribution board, and load, the allowable volt drop splits may be varied, but total circuit volt drop will not exceed 5%

IV. Motors

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 motors shall be applicable as given below.

Up to 37KW	Direct On-Line
>37< 100KW	Star Delta
>100KW	Variable Frequency Drive/ Soft Starting

All motors will be continuously rated, and all motors will be suitable for direct-on-line starting.

All motors will at minimum have class F insulation with a temperature rise limited to class B. The minimum degree of protection for motor enclosures will be IP55 to IEC60529 and for motor terminal boxes will be IP65.

LV motors will have TEFC enclosures.

Motor certification for operation in hazardous areas will be in accordance with Table 2.

Motor equal or greater than 55 kW rating will have anti-condensation heaters.

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

LV Motors shall comply with project documents specified in Table-1.

Motors to be installed in hazardous area shall be suitable for use in the Zone as per Table-2.

1.7 CABLE SIZING

The cable shall be sized based on the thermal limits in normal service conditions, and the maximum allowable voltage drops in the circuit.

The current carrying capacity (thermal limit) of cables in normal service condition shall take into account the de-rating factors (as applicable) for temperature, installation location, cable grouping, soil resistivity and touching factors etc.

The cables for main power distribution system shall be sized also to withstand without damage the maximum short circuit thermal stress for the full clearance time of the protective devices (i.e. fuses, or circuit breakers with protection relays). In case of LV cables protected by MCCB/MPCB, the LV cables shall be sized to withstand the maximum short circuit thermal stress at load end.

Cable current capacities shall be calculated for an ambient temperature if above ground or 35°C in case of underground cable.

The current rating of the circuit for cable sizing shall be as follows:

- The determined cable ampacity, taking into account the above factors, will not in any case exceed the ampacity figure calculated from IEC 60364-5-523 Current Carrying Capacities.

- The transformer primary and secondary cables shall be rated based on a current equal to the rated current of the transformer along with max. Current at any tap position.
- For switchgear/panel board feeder circuit without a transformer, cables shall have a current carrying capacity equal to the maximum demand of loads

connected to the switchgear/panel board with 10% surplus.

- The motor feeder cables shall be sized based on the 100% of motor nameplate rated current.
- All the remaining cables not mentioned above shall have a current carrying capacity equal to the maximum current demand of duration not shorter than one hour.

The following minimum cable sizes will be adhered to:

LV Power cables	2.5mm2
Control cables	1.5mm2
Lighting cables	2.5mm2

- Cable arrangement shall be in general so designed that the de-rating factor due to grouping of cables shall not be less than 0.7 for above-ground installation and 0.6 for underground installation.

  - Power & control cables shall comply with project documents specified in Table-1.

I. Cable Installation

Cables shall be installed either underground or above grade as follows:

Paved area	Brick walled trench
Unpaved area	Directly buried
Road crossing	In duct bank
Aboveground	Cable Tray Ladders

Underground Cable Installation:

For underground cable installation, directly buried system shall be employed as follows:

The cable burial depth shall be approx. 600mm between top surfaces of direct buried conductor & finished grade.

Multi-layer installation will be employed.

The bottom of trench shall be back filled with a minimum of 200 mm of clean sand. Each cable layer shall have 200 mm spaces between cable bottoms which shall be filled with clean sand.

Concrete tiles with a minimum thickness of 25 mm and PVC hazard tapes shall be installed over the top layer of sand to overhang the cables by a minimum of 75 mm and the rest of the trench shall be backfilled with soil free from the sharp edged or bigger stones.

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. Concrete protection tiles can be omitted and the pave on the trench shall be colored red to indicate the trench location.

The route markers of cable trenches in unpaved areas shall be provided at every changes in angle of the routing and at sites of road and pipe sleeper crossings.

The routing markers shall be made of concrete.

The following minimum spacing shall be maintained between power cables and analogue signal cables, if parallel runs cannot be avoided:

Table-6 Cable Separation

Power Wiring	Minimum Separation
230 V	300 mm
400 V	300 mm

Cross-over's that bring power and signal cables into close proximity shall be made at right angle.

Segregation between high and low voltage cables shall be made by spacing at least 300 mm in the underground installation.

Above Grade Cable Installation

Cables where required as per site shall be installed on ladder type tray of hot dipped galvanized steel. For branches from the cable tray or when cables are small number, cables shall be protected by perforated cable tray or steel conduit. Cable tray (ladder type) shall be designed to allow for 25% spare capacity.

The trays shall firmly be supported to preclude the sliding.

The cable shall not run close to parallel hot lines or large high temperature surfaces. Whenever practicable, 300 mm spacing shall be maintained.

Duct Bank System:

Duct bank system shall be used for road crossing. Duct bank shall be heavy duty PVC encased in concrete of at least 50 mm thickness.

The top of the concrete encasement shall be at least 600 mm below grade when the duct banks cross the road. Burial depth of duct bank may be reduced when duct bank is installed free from the heavy loads.

Multi-cables may be installed in one conduit provided that the current carrying capacity of cable remains within the allowable limit.

II. Types of cable

For 400V Cable Multi Core:

CU/Cross-linked polyethylene insulated (90°C)/polyvinyl chloride inner sheathed//galvanized steel wired armoured and heat resistant polyvinyl chloride outer sheathed cable.

For 400V Cable Single Core:

CU/Cross-linked polyethylene insulated (90°C)/polyvinyl chloride inner sheathed/Aluminum wired armoured and heat resistant polyvinyl chloride outer sheathed cable.

For 400V Control/Signal Cables:

CU/Cross-linked polyethylene insulated (90°C)/polyvinyl chloride inner sheathed//galvanized steel wired armoured and heat resistant polyvinyl chloride outer sheathed cable.

1.8 LIGHTING SYSTEM:

The following outlines the minimum requirements of the lighting system design:

- Lighting shall be supplied at single phase and neutral voltage and the lighting load shall be balanced across the phases.
- Lighting circuit for streets and other outdoor areas including perimeter lighting shall be photocell controlled with manual override.
- Lighting circuits shall be controlled by double pole switching device to isolate the neutral.
- Lighting installation including lighting boards (if required), lighting fixtures, and cabling shall be suitable for the hazardous area classification where they are installed.
- Lighting fixtures shall not be located directly over equipment with exposed moving parts
- All the lighting shall be LED type.
- In general, outdoor lighting shall be automatically controlled by photo-electric cell, incorporating a manual over-ride control.
- Loads connected in each branch circuit shall not exceed 80 % of the branch breaker rating.

I. Lighting Distribution (If Required)

- Lighting distribution boards for plant and building lighting shall be three phase, four wire, 400/230 V system. Branch circuits for lighting and non-lighting loads shall be provided with four or two pole connected to 3-phase or 1-phase

respectively.

- All the lighting distribution board circuits (power outlet as well as lightings) shall be protected through MCB/MCCB with earth leakage protection

II. Luminaire Types

- All the luminaries shall be LED type & suitable for environment as per Table-2.
- The accessories furnished with the LED luminaries shall be of suitable characteristics according to the lamps used.
- 45W LED type 2.5m pole mounting structure for process areas.
- 120W LED Flood type, 10m pole mounting for area lighting.

III. 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

IV. Illumination Levels

Average illumination levels will be designed in accordance with the values given in Table-7. The design will allow for a maintenance level of 0.7.

Table-7 Illumination Level

Process Area

Installation location	Illumination level (Lux)	Elevation	Remarks
General Process Units	50	Grade	
Outdoor pump rows	50	Floor	
Main operation platforms	20	Floor	
Ordinary platforms	30	Floor	
Stairways & platforms	30	Floor	
Compressor houses	200	Floor	

Offsite / Utility Area

Installation location	Illumination level (Lux)	Elevation	Remarks
Outdoor Pump Area	50	Grade	
Utility Area			
Outdoor pump area	50	Grade	
Pump shelter	150	Floor	

1.9 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 & API standards and Codes.

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

The earthing shall be provided to equipments/ 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.

Instrumentation and Computer System Earthing

- Earthing system for instrumentation, shield of instrument cables, 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.

Lightning Protection

- Prior to design of lightning protection system a lightning protection assessment study shall be carried out by EPC 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 EPC Contractor shall design and install all necessary lightning protection equipment to the latest relevant IEC & API standards and codes/practices.

1.10 CATHODIC PROTECTION

- A Cathodic protection system shall be Design, supply and install, Testing, pre-commissioning, commissioning by EPCC Contractor for corrosion protection against oily water sewerage & fire water network underground pipeline in new front end compressors (K-2001, K-2002, K-2003 & K-2004) area.
- The Cathodic protection shall be an impressed current system with auto control having provision of manual also.
- Transformer rectifiers shall be oil immersed transformer with Selenium or SCR type rectifier rated 400 volts 3 phase, 50 Hz. Transformer rectifier shall be installed in non hazardous area, and of weather proof, outdoor use type suitable for the area to be installed.
- Electric power to the transformer rectifier shall be supplied from emergency Switchgear/MCC.
- Cathodic protection equipment to be installed in hazardous area shall be suitable for the area where the equipment shall be installed.
- Objects of the cathodic protection system shall be insulated from the other structures and above ground pipes by insulation flanges, insulation sheet or equivalent in order to minimize the spilt current.

1.11 ELECTRICAL HEAT TRACING

- Electrical heat tracing shall be provided if warranted by detail engineering results.
- EPCC 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.
- Trace heating shall nominally 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. Heat tracing method shall be as per manufacturer recommendation subject to OGDCL / Consultant approval.
- The design of the electrical trace heating system shall ensure any hotspots are within the temperature classification requirements of the area.
- Power supplies shall be provided from switchgear/MCC placed in MCC room.
- Main supply feeder characteristics are 400Vac, whereas, onward supply feeder characteristics are 230Vac, single phase and neutral.

2 INTERNATIONAL CODES & STANDARDS

Codes and standards stated below are considered to be as minimum applicable standards and specifications.

International Electrotechnical Commission (IEC)

IEC 60034	Rotating Electrical Machines
IEC 60038	IEC Standard Voltages
IEC 61869	Instrument Transformers
IEC 60050	International Electro-technical Vocabulary
IEC 60051	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories
IEC 60502	Power cables with extruded insulation and their accessories for rated voltages from 1kV up to 30kV
IEC 60227	PVC insulated cables of rated voltages up to and including 450/750V
IEC 60072	Dimensions and Output Ratings for Rotating Electrical Machines
IEC 60073	Basic and Safety Principles for Man-Machine Interface, Marking and Identification
IEC 60079	Electrical Apparatus for Explosive Gas Areas
IEC 60085	Thermal Evaluation and Classification of Electrical Insulation
IEC 60255	Electrical relays

IEC 60269	Low Voltage Fuses
IEC 60317	Specifications for Particular Type of Winding Wires (formerly IEC 60182)
IEC 60417	Graphical Symbols for Use on Equipment
IEC 60439-4	Low Voltage Switchgear and Control Gear Assemblies - Part 4
IEC 60445	Identification of Equipment Terminals
IEC 60529	Classification of Degrees of Protection Provided by Enclosures
IEC 60617	Graphical Symbols for Diagrams
IEC 60898	Electrical Accessories - Circuit Breakers for Over-current Protection
IEC 60947	Low Voltage Switchgear and Control gear
IEC 60950	Information Technology Equipment-safety general requirement
IEC 61000	Electromagnetic Compatibility (EMC)
IEC 61150	Sealed Nickel Cadmium Rechargeable Batteries
IEC 61158	Digital data communications for measurement and control
IEC 60360,	Standard method of measurement of lamp cap temperature rise
IEC 60432-1	Incandescent lamps – Safety specifications – Part 1: Tungsten filament lamps for domestic and similar general lighting purposes
IEC 60598-1	Luminaries – Part 1: General requirements and tests
IEC 60695-2	Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods; Glow-wire apparatus and common test procedure
IEC 60695	Fire hazard testing – Part 2-11: Glowing/hot-wire Based test methods – Glow-wire flammability test method for end products
IEC 60695	Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods; Glow-wire flammability test method for materials
IEC 60909	Short circuit currents in three phase a.c. systems
IEC 60144	Degree of protection of enclosures of switchgear and control gear.
IEC 60364	Electrical Installations of Buildings

<u>International Organization For Standards (ISO)</u>

ISO 9000	Quality management and quality assurance standards
ISO 9001	Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation and

	Servicing
ISO 9003	Quality Systems - Model for Quality Assurance in Final Inspection and Test
ISO 9004	Quality Management and Quality System Elements - Guidelines
ISO 10441	Special Purpose Couplings for Petroleum, Chemical and Gas Industry Services -
ISO 14001	Environmental Management Systems
ISO 18001	Occupational Health and Safety Management Systems
NEQS	National Environmental Quality Standards (revised) –Pakistan
CIE 13.3	Method of measuring and specifying color rendering of light sources
CIE S 017/E,	International Lighting Vocabulary
IEEE Std. 80	IEEE Guide for Safety in AC Substation grounding.
IEEE Std. 142	Earthing

National Association of Corrosion Engineers (NACE)

NACE SP0607/ISO 15589:	Petroleum and natural gas industries – Cathodic Protection of pipeline transportation systems
NACE MR0175 / ISO 15156:	Petroleum and natural gas industries – Materials for use in H2S-containing environments in oil and gas.
NACE RP-0286:	Electrical Isolation of Cathodically Protected Pipelines
NACE SP0572:	Design, Installation, Operation, and Maintenance of Impressed Current Deep Anode Beds
NACE RP0169:	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE 10A196	Impressed Current Anodes for Underground Cathodic Protection Systems
NACE RP0193	External Cathodic Protection of On-Grade Metallic Storage Tank Bottoms
NACE TM0101	Measurement Techniques Related to Criteria for CP
NACE SP0575	Internal Cathodic Protection Systems in Oil Treating Vessels

National Fire Protection Association (NFPA)

NFPA 37	(Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
NFPA-70	National Electrical Code API RP 500& 505

	Recommended practice for classification of locations for electrical installation at petroleum facilities IEE Wiring Regulations

British Standards

BS 951	Earthing clamps
BS 2874	Nuts, bolts, washers, screws and rivets fixing for use on copper
BS 1433	Hard drawn bare copper conductor for earthing
BS-7430	Code of practice for protective earthing of electrical installations
BS 3676	switches for domestic and similar purposes.
BS 115	3 pin plugs, socket outlets and socket outlet adapter.