



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

SPECIFICATION FOR ELECTRICAL MOTORS



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

CONTENTS

Sl. No. Description

1.0	SCOPE
2.0	CODES AND STANDARDS
3.0	ENVIRONMENTAL CONDITIONS
4.0	TECHNICAL DATA
5.0	GENERAL REQUIREMENTS
6.0	MEDIUM VOLTAGE MOTORS
7.0	LOW VOLTAGE MOTORS
8.0	PAINTING
9.0	INSTALLATION
10.0	TESTS
11.0	DOCUMENTATION
12.0	SHIPPING
13.0	SPARE PARTS AND SPECIAL TOOLS



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

1.0 SCOPE

The intent of this specification is to define the requirements of Electrical Motor for medium and low voltage. Tenderer's scope of work includes design, manufacture, testing, packing and delivery to site and testing & commissioning of electrical motor as per this specification. Unless specified in material requisition motor shall be suitable for Zone-0 Groups IIA & IIB as per IS 2148, IS 5572.

2.0 CODES AND STANDARDS

The design, manufacturing, construction, installation, test and commissioning of electrical motors shall be in accordance with the following codes and standards, at least. The latest revision of the publication referred to shall apply.

IEC 60034 Rotating electrical machines

IEC 60038 IEC standard voltages

IEC 60072 Dimensions and output series for rotating electrical machines

IEC 60085 Thermal evaluation and classification of electrical insulation

IEC 60529 Degrees of protection provided by enclosures (IP Code)

ISO 15 Rolling bearings - Radial bearings - Boundary dimensions, general plan

ISO 281 Rolling bearings - Dynamic load ratings and rating life

2.1 Wherever the requirements in this specification are in conflict with any of the above standards, the requirements under this specification shall be binding.

2.2 In case of imported equipments standards of the country of origin shall be applicable if these standards are equivalent or stringent than the applicable standards as mentioned.

2.3 The equipment shall also confirm to the provisions of Electricity rules of the country and other statutory regulations currently in force in the country.

2.4 In case of any contradiction between various referred standards/ specifications and statutory regulations the following order of priority shall govern.

i) Schedule of rates

ii) Design Basis

iii) Scope of Work/ Job specification

iv) Date Sheet



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

v) Standard specification

vi) Codes and standards

As far as the power supply authority (PEC) and permits of other authorities require additional codes and standards, respectively impose additional requirements, these are also part of the contract.

Equipment meeting with the requirement of any other authoritative standards, which ensure equal or better quality than the standard mentioned above shall also be acceptable. If the equipment offered by the bidders conforms to any other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. Four copies of such standards with authentic English Translations shall be furnished alongwith the offer.

2.5 Latest Applicable Standards of

i) Bureau of Indian Standard

ii) British Standard Institute

iii) American Standard Institute

iv) International Electro Technical Commission

3.0 ENVIRONMENTAL CONDITIONS

The electrical motors shall be designed and constructed for continuous operation at full load under the climatic and environmental conditions as described in the specification "Design Basis Electrical".

4.0 TECHNICAL DATA

The technical data of the electrical motors as per the technical specifications and scope of the work. The Contractor has to guarantee the fulfillment of these requirements.

5.0 GENERAL REQUIREMENTS

5.1 Selection of Motors

In general it shall be the responsibility of the driven equipment manufacturer to select and co-ordinate the required motor type. This includes the co-ordination of the performance data (motor speed, shaft power and direction of rotation) as also the mechanical construction and coupling requirements. The motors shall be designed as squirrel cage motor and shall be of industrial type. If not specified otherwise the actual power output of the motors must be selected to meet the maximum required shaft power of the driven equipment, multiplied by a factor of 1.2 for motors up to 250 kW and 1.15 for motors above 250 kW and using the next larger standard motor size. Motors shall be entirely suitable for outdoor installation without any additional protection. Lifting lugs and drain hole for condensation shall be provided on all motors.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

The motors shall be suitable to deliver rated power continuously at

- $\pm 10\%$ nominal voltage and rated frequency,
- Nominal voltage and $\pm 5\%$ of rated frequency,
- $\pm 10\%$ combined variation of nominal voltage and frequency, with frequency variation $\pm 5\%$.

The type of MV motors (fixed or variable speed) has to be specified. In case variable speed motors are selected, speed control mode of operation need to be detailed.

5.2 Components and Equipment

The Contractor has to take care that all components and equipment are selected considering easy maintenance, simple and quick diagnosis and long maintenance intervals. All components and equipment shall be designed for continuous duty at rated load and under the given climatic conditions. Standard industrial high performance systems and components of supplier's standard lists shall be used as far as possible. Components and equipment of same kind and type shall be selected for equivalent functions. The interchangeability must be guaranteed.

5.3 Duty

The motors shall be designed for continuous running duty, S1 according to IEC, at the specified conditions. Motors connected to electric / electronic speed control or start-up equipment such as frequency converters or start-up transformers have to be selected / matched to the special requirement of such duty.

5.4 Dimensions

All motors of the same size shall be interchangeable. The motor dimensions shall be in accordance with IEC 60072.

5.5 Noise Requirements

The sound pressure level of electrical motors shall not exceed 85 dB (A) @ 1 m under no load conditions.

5.6 Tagging

All components, equipment and installations shall receive the respective tagging plates, labels, etc., which have to be of extremely durable material resistant against the environmental conditions.

For further requirements, reference is made to specification "Design Basis Electrical".

5.7 Units and Scales

The metric system on basis of SI-units shall be used for all scales and indications.

6.0 MEDIUM VOLTAGE MOTORS



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

6.1 Motor Start and Torque Requirements

The motors shall be designed for direct on-line starting at full load, the starting current shall not exceed 5.5 times the rated current.

The motors shall not break out if during normal operation the voltage at the motor terminals remains 0.8 UN, but the operation at 0.8 UN shall be limited to 10 seconds. The motors shall be designed to allow 4 starts successively from cold (max. ambient temperature) or 3 starts successively from hot service temperature without tripping of any protection device.

6.2 Insulation / Winding Protection

The motors shall have tropicalized insulation. The motors shall be designed for class F insulation, thermal utilization of the motors shall be for class B only. The Motors shall be designed for operation in isolated neutral or unearthed systems. Therefore the level of insulation required shall be suitable for this condition. The stator winding shall be insulated by high quality modern synthetic resin insulation system based on mica-glass tape. After insertion of the coils into the stator core the whole winding shall be vacuum impregnated with epoxy resin, free from any solvent.

The allowable impulse-stress-voltage for the insulation system shall meet the requirements of IEC 60034 part 15.

The motors shall be designed for re-acceleration against 100% residual field at phase opposition. In each stator winding phase at least two (2) Pt 100 temperature elements (4-wire system) shall be imbedded at the hottest place and wired to the auxiliary terminal box. The motors shall be equipped with surge arrestors, which are to be installed in the motor stator connection terminal box. The surge arrestor design must match to the actual network configuration, the used circuit breakers and the connected cable arrangement. If technically recommended additional surge arrestors shall be installed at the switchgear side for cable protection during vacuum circuit breaker switching.

6.3 Method of Cooling

The motor cooling shall be according to the scope of the work, either air cooled or with air/water heat exchanger. If the motor cooling will be performed via an air/water heat exchanger, the water outlet of the heat exchanger shall be equipped with a thermostat or an equivalent device for control of water temperature and flow.

6.4 Current Transformers for Differential Protection

For all motors with a rating at 2000 KW or above a differential relay for winding protection shall be provided and installed in the associated switchgear. In that case the star-point connection shall be brought out separately to terminals box and three current transformers at motor end shall be provided, one for each winding between line and neutral side at motor. The differential current transformers shall be designed to class 5P10 or class X to BS with a rating matched to the protection system. The CTs shall be provided by the motor supplier and accommodated in



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

the star-point terminal box. The current transformers for the motors and as well the current transformers for installation inside of MV switchgear shall be delivered by the motor manufacturer. The current transformers for motors must be installed prior to workshop tests. The current transformers for the MV switchgear shall be handed over to switchgear manufacturer before workshop tests of the respective switchgear.

6.5 Bearings

The motors shall be fitted with ball or rolling contact bearings, supplied with life time grease. Grease regulator and nipples, as also surplus grease discharge openings shall be provided if required. For larger motors, self-cooled sleeve bearings are acceptable, too. Sleeve bearings shall be equipped with an oil ring lubrication, the bearing housings shall have an oil level indication. External lube oil systems shall only be used, if necessary and shall be combined with the lube oil system of driven equipment. Temperature monitoring with Pt 100 temperature elements (4-wire) is required for the bearings.

6.6 Terminal Boxes

A stator connection terminal box shall be provided and fitted with terminals, including surge arrestors and cable glands for the connection of the actual number and type of cables. Dimension of cable glands shall be as per requirement. Pressure relief flaps shall be foreseen.

Auxiliary terminal boxes with terminals and cable glands for current transformers, instrumentation and anti-condensation heater connection shall be foreseen. Surge arrestors shall be installed for all monitoring instrument circuits.

6.7 Anti Condensation Heater

The motors shall be equipped in general with electrical anti condensation heaters, to be switched on if the motor circuit breaker is off. The voltage level for the anti-condensation heater shall be 1 x 230 V AC, 50 Hz.

7.0 LOW VOLTAGE MOTORS

7.1 Motor Start and Torque Requirements

The motors shall be designed for direct on-line starting at full load. For motors of 132 kW shaft power and above, the starting current shall not exceed 5.5 times the rated current. The motors shall not break out if during normal operation the voltage at the motor terminals remains greater than 0.8 UN, but the operation at 0.8 UN shall be limited to 10 seconds. The motors shall be designed to allow 4 starts successively from cold (max. ambient temperature) or 3 starts successively from hot service temperature without tripping of any protection device.

7.2 Insulation / Winding Protection

The motors shall have tropicalized insulation. The motors shall be designed for class F insulation, thermal utilization of the motors shall be for class B only. The stator winding shall be insulated by high quality modern synthetic resin insulation system based on mica-glass tape.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

After insertion of the coils into the stator core the whole winding shall be vacuum impregnated with epoxy resin, free from any solvent.

The motors shall be designed for re-acceleration against 100% residual field at phase opposition. Motors of a rated power of 90 kW and above shall be equipped with winding protection by means of embedded positive temperature coefficient thermistors. Two thermistors per phase (one set service – one set spare) shall be provided and wired to the auxiliary terminal box.

7.3 Method of Cooling

Motors shall be totally enclosed and fan cooled by ambient air, equivalent to cooling code IC0141 or IC0151 according to IEC 60034 part 6.

7.4 Bearings

The motors shall be fitted with ball or rolling contact bearings, supplied with life time grease. Grease regulator and nipples, as also surplus grease discharge openings shall be provided if required. Self-cooled sleeve bearings are acceptable, too. Sleeve bearings shall be equipped with an oil ring lubrication, the bearing housings shall have an oil level indication. External lube oil systems for LV motors will not be accepted.

7.5 Terminal Boxes

Terminal boxes shall be provided and fitted with terminals and cable glands for the connection of the actual number and type of cables. Dimension of cable glands as per requirement. If required, auxiliary terminal boxes with terminals and cable glands for instrumentation and anti-condensation heater connection shall be foreseen. All terminal boxes shall be IP55 enclosure type.

7.6 Anti Condensation Heater

Motors with 90 kW rated power and above shall be equipped in general with electrical anti-condensation heaters, to be switched on if the motor circuit breaker is off.

The voltage level for the anti-condensation heater shall be 1 x 230 V AC, 60 Hz.

8.0 PAINTING

The painting shall be as per the approved manufacturer standard at least consisting of:

- One coat of two-component epoxy zinc chromate rust-inhibiting primer,
- One intermediate coat of two-component epoxy primer,
- Two top coatings for two-component resin, colour as per the approved colour code schedule.

Total thickness of dry protective paint coating shall be at least 120 μm . All paint coatings shall be resistant against temperature conditions up to 140 $^{\circ}\text{C}$ and intermittently up to 180 $^{\circ}\text{C}$.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

Damages, caused by transport, installation, cabling or commissioning shall be repaired in a way, that the original quality is restored. An additional painting at location of installation is not allowed.

9.0 INSTALLATION

Installation and alignment shall be carried out in accordance with the instructions and recommendations of the manufacturer and with due regard to the requirements of the driven machine.

10.0 TESTS

10.1 Workshop Tests

All motors shall be tested completely and detailed in manufacturer's workshop. All tests required by the codes and standards as well as all manufactures tests have to be performed. The test program for the work shop test has to be submitted prior to start of the tests in accordance with the Project Procedure Manual. All motors shall be subjected to at least the 'abbreviated' tests in accordance with the applicable standard test procedures. Complete tests on motors up to 90 kW will not normally be required if evidence of type tests on identical machines is produced at the time of quotation. For machines of 90 kW and above it will be acceptable that 'complete' tests are made on only one of several identical machines with 'abbreviated' tests on the remaining machines. The following tests shall be performed, at least:

a) Abbreviated tests ('routine' tests)

- Measurement of no-load losses at rated voltage and frequency
- Measurement to allow calculation of locked rotor current and torque
- High voltage tests plus insulation resistance test
- Inspection (at no-load) of bearings and mechanical operation of motor
- Vibration
- High voltage and continuity tests on built-in temperature detectors
- Bearing insulation integrity (if applicable)
- Complete test ('full' tests)
- Measurement of winding resistance (cold and hot)
- Measurement of no-load losses at rated voltage and frequency
- Measurement to allow calculation of locked rotor current and torque
- Full load heat run



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

- High voltage test after heat run and insulation resistance before and after heat run
- Inspection (at full load) of bearings and mechanical operation of motor
- Measurement of slip at full load
- Measurement to allow calculation of pull-out torque
- Measurement to allow calculation of starting torque
- Measurement to allow calculation of efficiency at full, three quarter and half load
- Measurement to allow calculation of power factor at full, three quarter and half load
- Vibration
- Noise
- High voltage and continuity tests on built-in temperature detectors, together with tests to demonstrate satisfactory operation and compliance with stated characteristics
- Bearing insulation integrity (if applicable)

Detailed test protocols of all tests performed have to be submitted prior to installation. Type test certificates for LV motors will be acceptable, if the same type and rating of motor is covered.

10.2 Site Tests

The site tests shall include the following steps:

- Pre-installation testing,
- Pre-commissioning (including “Loop Testing”),
- Commissioning and test on completion,
- Test runs,
- Performance tests.

The aim of the tests is to ensure and prove the proper function of the complete scope.

11.0 DOCUMENTATION

Complete documentation shall be provided for the design, manufacturing, testing, commissioning, start-up, operation, maintenance and repair of the motors and its components. All documents shall be in English language.

The documentation of motors shall include the following documents and drawings (minimum requirements):



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

- a) Layout drawings
- b) Wiring diagrams
- c) Termination drawings
- d) Technical data sheets
- e) Calculations, protocols, certificates
- f) Spare parts list
- g) Performance curves
- h) Operation and maintenance manual
- i) Reports of tests and commissioning with protocols.

The documents listed above shall be handed over for approval. Special attention has to be given to the fact, that documentation must be submitted with sufficient time allocated for approval prior to manufacturing / assembly. Documentation has to be prepared in accordance with the relevant ISO standards or in the absence of relevant details in those standards the DIN standards shall apply.

The final documentation shall be delivered on paper in sufficient number and with exception of the signed protocols in electronic form, too. The type of the electronic files shall be agreed with the Client.

12.0 SHIPPING

All equipment, material and spare parts shall be sufficient packaged and shall be shipped as a common delivery. The material, especially loose parts and spare parts shall be clearly labelled according to the designation. Motors shall be coupled with the respective work machine before shipping.

13.0 SPARE PARTS AND SPECIAL TOOLS

The Contractor shall deliver all spare parts, which are necessary for commissioning and two years operation time (see "General Description of Project and Works"). Spare parts shall be available until ten years after commissioning. The following special tools shall be supplied:

One digital HV Insulation resistance testing kit (Megger) with PI measuring facility
Four digital LV Insulation resistance testing kit (Megger)



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

GENERAL TECHNICAL SPECIFICATION

01. High voltage squirrel cage induction motors

Sl. No.	Parameters	Description
1.0	Standard	IPSS 1-03-018/IS 325
2.0	Constructional Features	
i).	Frame size & rating	As per IS 325
ii)	Stator Frame	Fabricated Steel / High grade cast Iron
iii)	Stator Core	Laminated sheets of high grade low loss silicon steel
iv)	Motor body	Grey iron casting as per IS:210-1978
v)	Casing Feet	Integral with the motor frame
vi)	Body Design	Prevent breakage or other failures due to vibrations normally encountered in heavy industries
vii)	Protection for Motor & Bearing	IP – 55 as per IS 4691-1985.
viii)	Shaft	Forged Steel shaft
ix)	Bearings (below 1000kW)	Anti-friction Bearing with Regreasing facility & with grease quantity controllers
	Bearings (1000kW & above)	- Pedestal type sleeve bearing with forced oil lubrication. (Arrangements to be incorporated to prevent lubricating oil from reaching the windings). - Bearing temperature, lubricating oil temperature and pressure to be measured and monitored.
x)	Vibration monitor	Shall be provided at the DE end of motor bearing
xi)	Pedestals insulation	Against circulating shaft currents
xii)	Hazardous Area safety design	NA / as specified
xiii)	Indication of direction of rotation	By Arrow blocks on non-driving end
xiv)	RTD & BTD (PT100 type)	- All motors shall be provided with Bearing (DE & NDE) temperature detectors and 6 nos. stator winding temperature detectors, RTDs for monitoring alarm and trip conditions. RTD's shall



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

		<p>be of PT100 type (duplex).</p> <ul style="list-style-type: none"> - Analog input cards shall be provided in PLC for online monitoring of bearing (DE & NDE) and winding temperature of HT motors above 1000 KW. - For HT motors, temperature of each RTD (for winding / bearing) shall be wired to PLC system and limit value contacts for alarm and tripping shall be generated in the PLC along with the display of all parameters of the motor including the winding and bearing temperature.
xv)	Vibration monitoring	<ul style="list-style-type: none"> - Vibration monitoring (online) shall be provided at the DE end of motor bearing for motors of ratings 1000 kW and above and it should be connected to PLC for online monitoring
xvi)	Paint shade	<ul style="list-style-type: none"> - Light grey , shade no. 631 as per IS 5
3.0	Terminal box	
i)	Protection	IP - 55
ii)	Type	Phase segregated
iii)	Location	<ul style="list-style-type: none"> - RHS viewed from DE / On top - 01 nos. each on opposite sides of motor in case of Differential Protection (or not) / Neutral TB opposite to main TB
iv)	Winding star point	<ul style="list-style-type: none"> - Winding star point shall be kept outside in the motor for more than 1000 KW HT motor and other important HT motor. - In case no differential protection is required, star point of the winding may be formed inside the neutral terminal box to be provided on one side of the motor. The phase segregated terminal box shall be placed on other side of the motor.
v)	Suitability	<ul style="list-style-type: none"> - Termination of XLPE cables with heat shrinkable cable end seals. - Each terminal box to have two inlets to accommodate any parallel cables as required.
vi)	Reversible	To suit cable entry from Top / Bottom
vii)	Earthing stud	Inside TB for protective earth conductor termination
viii)	No. of terminal boxes	Separate for Space heaters, RTDs / BTDs , Vibration monitor etc
ix)	Fault withstand (Min.)	Rated Short circuit level of the system voltage for 0.25 sec
4.0	Cooling	TEFC / CACA / CACW



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

		CACW system shall be complete with temperature and pressure monitoring devices.
5.0	Quality of operation	
i)	Vibration intensity	Limited to 37.5 micron peak to peak.
ii)	Noise level	Continuous noise level should not exceed 85 db A at a distance of 1.0 m from the motor body as per IS: 12065-1987.
iii)	Balancing	Dynamically balanced with full key on shaft end and fan
6.0	Electrical design	
i).	Efficiency High	efficiency design of 96% at Full load
ii).	Starting	DOL
iii)	Min Voltage for Start & Run	85 % of rated voltage at terminal
iv)	Starting Torque	As specified in application
v)	Starting current	$\leq 600\%$ Rated current
vi)	Duty	S1
vii)	Starts permissible	3 successive start from cold condition OR 2 successive start from hot condition.
viii)	Starts / hour	3 equally spread in normal Voltage, Frequency & Load
ix)	Max speed permissible	150 % rated for 2 minutes
x)	Differential protection	Required for 1000 kW & above
xi)	Insulation	Class F & confirming to IEC 34 - 15/1990
xii)	Insulation Material	Cast resin rich / VPI
xiii)	Minimum Permissible temperature rise	Limited to class 'B' (120 deg absolute)
xiv)	Space Heater	Required & automatically off during RUN
xv)	No. of Poles	4 (or as mentioned specifically)
xvi)	Locked rotor current withstand time	5 sec longer than starting time under rated load condition.
xvii)	Surge protection	As specified
xviii)	Operational design	Suitable to VCB / SF6 Breaker
xix)	Motor winding and inter turn insulation, connections and leads:	Shall be fully insulated using mica insulation. For such motors surge absorbers (with non-linear resistance) shall be provided within 10 to 15 meters from the motor terminals to limit the over voltages. OR In case mica is not provided in motor insulation, both surge capacitors and surge absorbers (with non-linear resistance) shall be provided within 10 to 15 mtrs from the motor terminals to limit the over voltages and rate of rise of voltage.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

--	--	--

02. Synchronous Motors

2.0	Constructional Features	
i).	Frame size & rating	As per IS 325
ii)	Stator Frame	Fabricated Steel / High grade cast Iron
iii)	Stator Core	Laminated sheets of high grade low loss silicon steel
iv)	Motor body	Grey iron casting as per IS:210-1978
v)	Casing Feet	Integral with the motor frame
vi)	Body Design	Prevent breakage or other failures due to vibrations normally encountered in heavy industries
vii)	Protection for Motor & Bearing	IP – 55 as per IS 4691-1985.
viii)	Shaft	Forged Steel shaft
ix)	Bearings (below 1000kW)	Anti-friction Bearing with Regreasing facility & with grease quantity controllers
	Bearings (1000kW & above)	- Pedestal type sleeve bearing with forced oil lubrication. (Arrangements to be incorporated to prevent lubricating oil from reaching the windings) - Bearing temperature, lubricating oil temperature and pressure to be measured and monitored.
x)	Vibration monitor	Shall be provided at the DE end of motor bearing
xi)	Pedestals insulation	Against circulating shaft currents



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

SPECIFICATION FOR LV & MV CABLE



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

CONTENTS

Sl. No.	Description
1.0	SCOPE
2.0	CODES AND STANDARDS
3.0	ENVIRONMENTAL CONDITIONS
4.0	DESIGN REQUIREMENTS
5.0	CABLE SPECIFICATIONS
6.0	GENERAL REQUIREMENTS
7.0	CABLE DRUMS
8.0	TRANSPORTATION AND UNLOADING
9.0	DRAWING AND DOCUMENTS
10.0	INSPECTION



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

1.0 SCOPE

This specification is intended to detail the selection criteria of MV power and control cables besides covering general requirements, testing at manufacturer's works, packing, transportation and receipt at site.

2.0 CODES & STANDARDS

The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specifications, codes of practice of Indian Standards Institution, approved drawings and instructions of Engineer-in-Charge or his authorized representative issued from time to time. In case of any conflict between the standards, the instruction of Engineer-in-Charge shall be binding.

The cables shall comply in design, material, testing and performance to the following codes and standards. The latest revision of the publication referred to shall apply.

IS-209: Specification for zinc.

IS-1554: PVC insulated (heavy duty) electric cables.

IS-3961 (Part-2): Recommended current ratings for cables; PVC insulated and PVC sheathed heavy duty cables.

IS-3975: Mild steel wires, straps and tapes for armouring of cables.

IS-5831: PVC insulation and sheath of electric cables.

IS-7098: Cross-linked poly ethylene insulated PVC sheathed cables.

IS-8130: Conductors for insulated electric cables and flexible cords.

IS-10418: Drum for electric cables.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

IS-10810 (Pt-41): Method of test for cables; mass of zinc coating on steel armour.

IS-10810 (Pt-58): Method of test for cables; Oxygen Index test.

IS-10810 (Pt-61): Method of test for cables; Flame Retardant test. IS-10810 (Pt-62): Method of test for cables; Flame Retardant test for bunched cables.

IS-13573: Joints and terminations for polymeric cables for working voltages from 6.6 KV & including 33KV; performance requirements & type tests.

IEC-323-3: Tests on cables under fire conditions.

IEC-502: Extruded solid dielectric insulated power cables for rated voltages from 1KV upto 30 KV.

IEC-540 & IEC540 A: Test methods for insulation & sheaths of electric cables cords.

ASTM-D2863: Standard method of test for flammability of plastics using oxygen index method.

IEC 60028: International standard of resistance for copper

IEC 60502: Power cables with extruded insulation and their accessories for rated voltages from 1 kV up to 30 kV

IEC 61034: Measurement of smoke density of cables burning under defined conditions

IEC 60502: Power cables with extruded insulation and their accessories for rated voltages from 1 kV up to 30 kV

The cables and accessories shall conform to the provisions of Indian Electricity Rules and other statutory regulations as applicable.

2.1 Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.

2.2 In case any contradiction between various referred standards/specification and statutory regulation etc the following order of priority shall be given –

- i) Schedule of rates
- ii) Design Basis
- iii) Scope of work/Job specification
- v) Standard specification
- vi) Codes & standard

3.0 ENVIRONMENTAL CONDITIONS



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

The cables shall be designed and calculated for continuous operation at full load under the climatic and environmental conditions as described in the “Design Basis”.

4.0 DESIGN REQUIREMENTS

The cross section of all power cables shall be determined in accordance with the current demand of the linked power consumer, the maximum permissible voltage drop, the operating temperature, thermal short-circuit capacity, maximum cable loop impedance for earth faults and laying conditions.

Cable cross-sections shall be determined using the manufacturer’s published data and the respective reduction factors according to installation conditions. The current-carrying capacities of power cables shall be calculated according to the type of operation, the conditions of installation and the ambient condition. The reduction factor shall be related to the following parameters:

- Ambient or ground temperature
- Exposure to solar rays
- Ground thermal resistivity
- Grouping/spacing

The maximum voltage drop is limited to the values given in specification “Design Basis”. The values for voltage drops are referred to the nominal voltage of the system. The maximum permissible continuous conductor temperature for power cables, depending on insulation material, shall be:

- PVC insulated cables 70 °C
- XLPE insulated cables 90 °C

The colours of the cores shall be in accordance with the IEC regulations.

5.0 CABLES SPECIFICATION

5.1 Power Cables for Medium Voltage up to 11kV.

Power cables for 3.3 KV, 6.6 KV and 11 KV systems shall be single core OR three core, U/UE as per SOR with the following construction (from inwards to outwards):

1. Screened Stranded Aluminium/copper Conductor as per SOR.
2. Conductor screening (with non-metallic semi conducting tape or by extrusion of semiconducting compound)
3. XLPE insulation by extrusion
4. Insulation screening (Extruded semi Conducting layer followed by copper tape)



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

5. Core with suitable filler material (For three core cables)
6. PVC inner sheath ST2 by extrusion or wrapping
7. Galvanized flat steel strip armour/Round wire Armour (For three core cables)
8. Hard drawn Aluminium Round wire armour (For single core cables)
9. Outer sheath of cable will be FRLS PVC, ST2 type by extrusion

The minimum cross section of medium voltage cables shall be 70 mm². If cross sections larger than 240 mm² are required, in general two or more parallel cables shall be provided. For cables above 240 mm² single core cables shall be used only. The maximum conductor size shall be 400 mm². In general the bending radius during installation shall be within acceptable limits as specified by cable manufacturer.

Power cables for medium voltage shall be designed in accordance to IEC 60502.

Minimum value of oxygen index shall be 29% (min) as per ASTM-D-2863

5.2 Power Cables for Low Voltage

Low voltage cables (1100 V Grade) shall be multi – core with the following construction (from inward to outwards):

1. 1100 Volts grade
2. Aluminium/copper stranded conductor (Stranded Annealed Copper Conductor up to 16 mm² & Stranded Aluminium Conductor from 25 mm² and above)
3. XLPE/PVC insulation as per SOR
4. PVC inner sheath by Extrusion
5. Galvanized flat steel strip armour/Round wire Armour
6. Overall PVC outer sheathed by extrusion

For secondary circuits, building installations, outdoor lighting and sockets etc PVC insulation for the conductor may be used. If cross-sections larger than 240 mm² per phase are required, general two or more parallel cables shall be provided. The minimum cross section of low voltage power cables shall be 2.5 mm². Power cables for low voltage shall meet the requirements of IEC 60502. Direct buried cable shall be armoured cables. Unarmoured cables shall also be used wherever required.

Minimum value of oxygen index shall be 29 % (min) as per ASTM-D-2863.

Flame propagation properties shall meet the requirement as per IEC-332(part 3)

5.3 CONTROL CABLES



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

Control cables shall be 1100 Volt Grade, 2.5 mm² copper conductor PVC insulated type A by extrusion, extruded inner PVC sheathed ST2, single wire armoured with an overall PVC ST2 sheath, as per IS: 1554 Part-I. Unarmoured cables shall be used wherever required.

Cores shall be identified as per IS: 1554 (Part-1) for the cables up to five (5) cores and for cables with more than five (5) cores the identification of cores shall be done by printing on all cores as per clause 10.3 of IS 1554 (Part-1).

6.0 GENERAL REQUIREMENT

The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installations.

They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions. The XLPE /PVC insulated L.T. power cables shall withstand without damage a 3 phase fault current for 1 second as specified in “Design Basis” **at rated conductor temperature (70° C for PVC insulated cables and 90°C for XLPE insulated cables).**

The XLPE insulated cables shall be capable of withstanding a conductor temperature of 250°C during a short circuit without any damage. The PVC insulated cables shall be capable of withstanding a conductor temperature of 160°C during a short circuit.

The Aluminium/Copper wires used for manufacturing the cables shall be true circular in shape before stranding and shall be uniformly good quality, free from defects.

Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of all cables.

The fillers and inner sheath shall be of non-hygroscopic, fire retardant material, shall be softer than insulation and outer sheath shall be suitable for the operating temperature of the cable.

When armouring is specified for single core cables, the same shall consist of aluminium wires/strips.

7.0 CABLE DRUMS

7.1 Cables shall be supplied in returnable wooden or steel drums of heavy construction. Wooden drum shall be properly seasoned sound and free from defects. Wood preservative shall be applied to the entire drum.

7.2 Standard lengths for each size of power and control cables shall be 500/1000 meters. The cable length per drum shall be subject to a tolerance of plus or minus 5% of the standard drum length. The owner shall have the option of rejecting cable drums with shorter lengths. However if shorter length of cable (Not standard as specified) is required shall be provided by the contractor in drums.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

Maximum, One (1) number nonstandard length of cable size(s) may be supplied in drums for completion of project.

7.3 A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.

7.4 Each drum shall carry the manufacturer's name, the purchaser's name, address and contract number and type, size and length of the cable, net and gross weight stenciled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

7.5 Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.

8.0 TRANSPORTATION AND UNLOADING

All cables shall be shipped and transported on cable drums of adequate size. Drums shall be lifted by means of a crane or by means of a loading ramp. Throwing and dropping down of cable drums shall be strictly avoided. In order to prevent drums moving during transportation, these must be securely wedged to prevent movement. Before unloading it is necessary to verify that the drum is received in proper condition. The directional arrow of the drums has to be observed during rolling. Empty cable drums have to be stored on a suitable central store place. Retransport to the cable manufacturer of returnable drums is the Contractor's responsibility.

9.0 DRAWINGS AND DOCUMENTS

Following minimum information shall be furnished with bid:

- a) Data sheet for cables
- b) Type Test Reports of cables

The following drawings (in three sets) shall be submitted for approval/review within 3 weeks of award of contract.

- a) Data sheet for cables
- b) Type Test Reports of cables

10.0 INSPECTION

Inspection and testing of equipment shall be carried out by the owner/ consultant at the works of the contractor on final product to ensure conformity of the same with the acceptable criteria of technical specification, approval draws and reference national/ international standards.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

The contractor shall submit Quality Assurance Plan (QAP) for respective equipments within 3 weeks of award of contract.

QAP shall be prepared and furnished by the contractor in Employer Form No. 11.20(4.4) F-10 along with their internal in process quality checks.

Routine test and type test certificate shall be furnished for review.

Acceptance test shall be witnessed by owner/consultant.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

SPECIFICATION FOR EARTHING AND LIGHTNING PROTECTION

CONTENTS

Sl. No.	Description
1.0	SCOPE
2.0	STANDARDS
3.0	EARTHING SYSTEM
4.0	EARTHING CONDUCTOR



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

5.0	DESIGN REQUIRMENTS
6.0	EARTHING NETWORK
7.0	INSTALLATION OF EARTH ELECTRODE
8.0	CONNECTION
9.0	TESTING
10.0	LIGHTING PROTECTION
11.0	LIGHTING PROTECTION
12.0	COLLECTORS
13.0	TESTING OF LIGHTING PROTECTION SYSTEM
14.0	DOCUMENTATION

1.0 SCOPE

The intent of this specification is to define the requirements for the supply, installation, testing, and commissioning of the complete Earthing & lightning protection System.

2.0 STANDARDS

The work shall be carried out in the best workmanlike manner in conformity with this specification, the relevant specifications/codes of practice of Indian Standard Institution,



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

approved drawings and instructions of the Engineer-in-Charge or his authorized representative issued from time to time. In case of any conflict between the standards, the instructions of Engineer-in-Charge shall be binding.

IEC 60364 Electrical installations of buildings

IEC 61024 Protection of structures against lightning

IEC 61312 Protection against lightning electromagnetic impulse

IS 2309 Protection of building and allied structure against lightning

IS 3043 Code of practice for earthing

2.1 Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.

2.2 In case any contradiction between various referred standards/specification and statutory regulation etc the following order of priority shall be govern –

- i) Schedule of rates
- ii) Design Basis
- iii) Scope of work/Job specification
- v) Standard specification
- vi) Codes & standard

3.0 TAGGING/MARKING

All components, equipment and installations shall receive the respective tagging plates, labels etc, which have to be of extremely durable material resistant against the environmental conditions. For further requirements, reference is made to the specification “Design Basis-Electrical”.

Contractor shall provide structure MS plate at each earth pit for indication of followings –

- a) Year of installation of earth pit
- b) Earth pit number
- c) Resistance of pit (Individual & with grid)
- d) Next due date

4.0 EARTHING SYSTEM

General



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

The stations shall be equipped with an equipotentially meshed grounding network. All exposed conductive parts or elements of the station systems will be connected to this network. The earthing systems of the various stations are part of the protection systems for electrical power supply, instrumentation, control and supervisory system. The earthing system consists of the main grounding grid, the grounding rods, the building foundation grounding and the equipment grounding.

Supply of all other erection/consumable required to complete the installation shall be the responsibility of the contractor. All hardware used for earthing shall be hot dip galvanized.

Any other items not specifically mentioned here but necessary for completeness of job shall be in the scope of contractor & shall be supplied by contractor without any extra cost.

For stations, which are to be extended, the existing earthing system shall be considered. The layout of new earthing system shall match to the existing installations. The new and the existing grounding network must be interconnected at two (2) locations, at least.

The grounding network system will be installed in different locations have different soil characteristics according to the location of the stations. Before design and installation of the grounding network the actual soil conditions in the station areas must be determined by adequate soil resistance measurements by the contractor & submit for review & approval.

Station earthing should have low earth resistance, low touch & step potential.

5.0 EARTHING CONDUCTOR

The main grid conductor shall be hot dip galvanized G.I. Flat or PVC insulated copper conductor. Size & type of conductor shall be as marked on the drawings. Thickness of hot dip galvanizing shall not be less than 75 microns.

6.0 DESIGN REQUIREMENTS

6.1 The earth resistance of the overall interconnected station grounding network shall not exceed 1 Ω .

6.2 All exposed metal part such as HT/LT switchgear, DP/FP structure, distribution board, metal clad switchgear enclosure, lamp brackets, lamp holder, plug sockets, lighting poles, junction boxes, high mast etc shall be properly earthed by connecting these to the earth electrode by means of GI wire/Flat or PVC insulated Cu conductor of approved size to pass the fault current safely to earth in case of any fault.

6.3 For the UPS, the SCADA and telecommunication systems with their equipment a separate grounding network with sufficient cross-section to avoid interference shall be installed. This grounding network shall be connected to the common station grounding network on one (1) separable and indicated connection point, within the electrical building or equipment container/enclosure.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

6.4 Before design and installation of the grounding network the actual soil conditions in the station areas must be determined by adequate soil resistance measurements.

6.5 The required conductor spacing, the total length of the grounding grid and the required grounding material cross-section shall be calculated under consideration of the maximum earth fault current, to maintain touch and step voltages within reasonable limits. The impedance of the fault current path and protective devices shall be chosen that the faulted circuit will be disconnected from the supply within the required time. A respective grounding calculation with report shall be performed for each station and is to be submitted to the Employer for approval.

6.6 Multiple connections of grounding conductors shall only be carried out above ground. For these connections the respective grounding bars are to be installed. Extensions of single grounding conductors can be permitted below ground under use of compression connectors or welding connections, with repair painting and coating of the connection point.

6.7 All connections of conductors on equipment shall be performed with pressure type lugs or connectors and threaded bolts, screws, spring-washers and washers. Special care must be taken to avoid the arising of a chemical element. Connections between bare copper and iron parts must be protected in a special manner and shall only be executed on above-ground connection points (grounding bars) or inside of pits.

7.0 EARTHING NETWORK

7.1 The earthing installation shall be done in accordance with the earthing drawings and the standard drawings of reference attached with this document. The entire earthing system shall fully comply with the Indian Electricity Act and Rules. The contractor shall carry out any changes desired by the Electrical Inspector or the owner, in order to make the installation conform to the Indian Electricity Rules at no extra cost. The exact location on the equipment shall be determined in field, in consultation with the Engineer-in-Charge or his authorized representative. Any changes in the methods, routing, size of conductors etc shall be subject to approval of the Owner/ Engineer-in-Charge before execution.

7.2 Excavation and refilling of earth, necessary for laying underground earth bus loops shall be the responsibility of the contractor.

7.3 The main earth grid shall be laid at a depth of minimum 700 mm below grade level. Wherever RCC cable trenches are available, the earth lead shall be laid in the trenches and shall be firmly cleared to the walls of concrete lined trenches. The earthing strip shall be protected against mechanical damage.

7.4 Interconnected earth pits for watering

All earth pits of grounding system shall be interconnected by GI Pipe with valve for provision of watering all pits simultaneously. The tapping for water shall be terminated to nearby source of water as per drawing.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

7.5 A common grounding system network (Main earthing grid) will be made underground by using 50 mm x 6 mm GI earthing strip connected to earth electrodes in loop-in & loop-out system and connecting the electrical equipment to network. In RCC cable trench one number earth strip of size 50 x 6 mm shall be run throughout the length of the trench.

7.6 Earthing system around each building shall be laid at distance approximately 1.5 meter from the building & at a depth of approximately 0.8m. The ring shall be bonded at intervals to the building steel structure, reinforcement of building columns & pipes wherever they are crossing. The earth ring shall further be connected to deep earthing electrodes to achieve a combined earth resistance of less than one ohm as specified earlier.

7.7 In process unit areas, the earthing cable shall be run along cable trays wherever specified in the layout drawings. The earthing cable shall be suitably cleated and electrically bonded to the cable tray at regular intervals.

7.8 Joints and tapping in the main earth loop shall be made in such a way that reliable and good electrical connections are permanently ensured. All joints below ground shall be welded and suitably protected by giving two coats of bitumen and covering with Hessian tape. All joints above ground shall be by means of connectors/ lugs as far as practicable. Tee connectors shall be used for tapping, earth leads from the main earth loop wherever it is installed above ground. Earthing plates shall be provided for earthing of two or more equipment at a place from earth grid. Where aluminium cable risers are to be connected to the underground GI earth bus, the aluminium cable riser shall be taken to the nearest earth pit and terminated through a bolted joint. If this is not practicable, then G.I. risers shall be brought above grade and a bolted joint shall be made between this GI riser and the aluminium cable termination. This G.I. Riser shall be protected applying two coats of bituminous paint/bitumen on the exposed portion.

7.9 Conduits in which cables have been installed shall be effectively bonded and earthed. Cable armours shall be earthed at both ends.

8.0 INSTALLATION OF EARTH ELECTRODES

8.1 Earth pipe electrodes shall be installed at locations shown in the earthing layout drawings & earth electrode shall be in accordance with the standard drawings, specification and IS: 3043.

8.2 All earth electrodes shall preferably be driven to sufficient depth to reach permanently moist soil. Electrodes shall preferably be situated in a soil which has a fine texture and which is packed by watering and ramming as tightly as possible. Wherever practicable, the soil shall be dug up, all lumps broken and stones removed from the immediate vicinity of the electrodes.

8.3 All earth electrodes shall be tested for earth resistance by means of standard earth test meter. The tests shall take place in dry months. If necessary, a number of electrodes shall be connected in parallel to reduce the earth resistance, shall be in the scope of contractor. The distance between two electrodes shall not be less than twice the length of electrode.

8.4 The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

8.5 Tentative no of earth pits shown in drawing are only for reference to the contractor. The exact location and number of earth electrodes required at each location shall be determined in the field in consultation with the owner/Engineer-in- Charge, depending on the soil strata and resistivity, to meet the ohmic values prescribed in clause 6.1. The contractor shall design the earthing system accordingly & submit for review & approval.

8.6 Earth Electrodes shall be located avoiding interference with road, building foundation, column etc. Individual earth electrode shall be provided for each lightning arrestor and lightning mast. The electrodes shall be so placed that all lightning protective earths may be brought to earth electrode by a short and straight a path as possible to minimize surge impedance.

8.7 The disconnect facility shall be provided for the individual earth pits to check their earth resistance periodically. All the earth electrodes shall be suitably numbered and this should be indicated in as built drawings.

9.0 CONNECTION

9.1 All electrical equipment is to be doubly earthed by connecting two points on equipment to a main earthing ring. The earthing ring will be connected via links to several earth electrodes. The earth grid formed shall be a closed loop as shown in the drawing with earth electrodes connected to the grid with double strip connection. The cable armour will be earthed through the cable glands.

9.2 In hazardous areas all major process equipments shall be connected to the earthing ring by means of anti- loosening connections and all pipelines will be bonded and earthed on entering the battery limit of the process area.

9.3 The following shall be earthed.

1. Transformer neutrals & body
2. Double Pole & Four Pole structures
3. CT/PT neutrals
4. Neutral Grounding Resistors
5. Lightning Arrestors
6. All switchgear and their earth buses, bus duct
7. Motor Frames
8. UPS, Telecommunication system, RTU's, Control panels & other instruments etc.
9. Non-current carrying metallic parts of electrical equipment such as switchgear, switch racks, panel boards, motor control centres, lighting, power and instrument panels, push button stations, cable trays, pipes, conduits, terminal boxes, etc.
10. All fences, gates/enclosures, housing electrical equipment



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

11. All steel structures, rails etc. including bonding between sections
12. Shield Wire
13. Structural steel and Columns
14. Loading racks
15. Lighting Mast, poles etc
16. Tanks and vessels containing flammable materials.
17. Rotating parts of the agitators, pumps etc. through spring loaded brushes of suitable grade.
18. Earth continuity conductor shall be provided for flanges.

Conductor size for connection to various equipments shall be as indicated on Earthing Layout Drawings.

9.4 Two distinct conductors directly connected to independent earth electrodes, which in turn shall be connected to the earth and earth system. The earth connection shall be properly made. A small flexible aluminium cable loops to bridge the top cover of the transformer and the tank shall be provided to avoid earth fault current passing through fastening bolts when there is a Lightning surge, high voltage surge or failure of the bushings.

9.5 Each Lightning Arrestor shall be connected to a separate electrode located as close as possible to it and within the fenced area for each set of arrestors. The two nos. electrodes for each set of arrestors shall be spaced about 5 meters apart so that they are all within the enclosing fence. Each of these electrodes shall be connected to the main earth grid.

9.6 The shield wire shall be connected with the main grid solidly and not through supporting steel structures.

9.7 All paint, scale and enamel shall be removed from the contact surface before the earthing connections are made.

9.8 All earthing connections for equipment earthing shall be preferably from the earth plate mounted above ground. In case of G.I. Earth Loop all underground "T" connections shall be of the same size as main loop however in case of PVC insulated aluminium conductor loops underground joints shall be completely avoided. Connections to motors from earth plate or main loop conductor brought above ground shall not be less than following:

Equipments

Earthing Conductor size

Main earth Bus/Power transformer

As Calculated

Grid & equipment such as:

50 x 6 mm GI Flat

PMCC/MCC, Silent D. G. Set



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

HT switch board panel, DP/FP structure

EHV & HV substation

As Calculated

PDB/ MLDB/LDB

25 x 5 mm GI Flat

Switch Socket DB, UPSDB etc

GI octagonal Pole/Street light pole/

25 x 5 mm GI Flat

Flood light/High mast pole

Motors up to 2.2kW

6mm² stranded GI wire

Motors 3.7kW to 11kW

16mm² stranded GI wire

Motors 15kW to 45kW

25mmx3mm GI strip

Motors 55kW to 90kW

25mmx3mm GI strip

Motors 110kW & above

40mmx6mm GI strip

FLP – WP lights/control station

6 sq. mm solid GI Wire

Product pipe line

16 sq mm flexible copper wires

Mechanical equipment / Vessels,

50 x 6 mm GI Flat

Tanks, Pipe/cable racks, structure, fencing

RTU, Telecom, UPS

25 x 5 mm copper

Field Instruments/Lighting fixture/ 2.5 sq mm PVC Cu Wire

Power Socket/Switch socket

Jumper for flanges

50 x 2 mm Copper Strip

Anchor bolts or fixing bolts shall not be used for earthing connection.

9.9 All hardware used for earthing installations shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections of equipment.

9.10 Lighting fixtures shall be earthed through the extra core provided in the lighting cable for this purpose.

10.0 TESTING OF EARTHING SYSTEM

Earthing systems/connections shall be tested as follows:

10.1 Resistance of individual electrodes shall be measured after disconnecting it from the grid.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

10.2 Earthing resistance of the grid shall be measured after connecting all the electrodes to the grid. The resistance between any point on the metallic earth grid and the general mass of earth shall not exceed 1 ohm.

10.3 The resistance to earth shall be measured at the following:

- 1) At each electrical system earth or system neutral earth.
- 2) At each earth provided for structure lightning protections.
- 3) At one point on each earthing system used to earth electrical equipment enclosure.
- 4) At one point on each earthing system used to earth wiring system enclosures such as metal conduits and cable sheaths or armour.
- 5) Each fencing shall be earthed as per construction drawings. Measurement shall be made before connection is made between the ground and the object to be grounded.

11.0 LIGHTNING PROTECTION

All buildings and plant structures vulnerable to lightning strokes owing to their height or exposed situation shall be protected against atmospheric flash-overs and lightning strokes in such a manner as to eliminate any danger to the personnel employed therein.

The installation shall confirm to IS: 2309 as amended up to date.

11.1 Lightning protection system shall generally comprise lightning finials (air terminals or collector rods), roof conductors or collector lines, down conductors, test links, and earth electrodes. The number, types, materials and sizes shall be in accordance with the standard drawings, construction drawings etc issued to contractor.

11.2 Air terminals shall be mounted on top of buildings or structure as required. All air terminals shall be inter-connected with roof conductors, pipes, hand rails or any other metallic projection above the roofs shall also be bonded to the roof conductors.

11.3 Down conductors from air terminals or from roof conductors shall be routed as directly as possible to the test links on earth buses, with minimum bends.

11.4 All provisions regarding connections of conductors for equipment earthing system shall also apply to lightning protection system.

11.5 In corrosive atmospheres, plumbing metal for corrosion protection shall cover lightning finials or air terminals.

11.6 The layout and design of lightning protection systems for building extensions or new buildings and structures provided within existing station areas shall match the existing design.

11.7 All connections between the different parts of lightning protection systems and the connections to the earthing system must be performed in a manner such that the arising of chemical elements will be avoided.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

12.0 COLLECTORS

Collectors shall be determined in accordance with the IS:2309. Collectors may comprise a combination of the following components:

- Collector lines/Parapet conductors
- Collector rods

12.1 Natural Components of Collectors

Metal cladding, metal roof structures, metal components of roof Structures, gutters and railings may be considered as natural components of collectors.

The requirements of the standards, such as the following, have to be considered:

- Parts must be permanently conductively connected, Protective coatings or insulation between metal parts shall be electrically bridged.

12.2 Mesh Type Collectors lines/Parapet conductors

Buildings shall be provided with mesh-type collector lines. The collectors have to be configured in a way such that no point of the roof is at a distance of more than 5 m from a collector.

The maximum permitted mesh size is as follows:

- Buildings with telecommunication or control rooms 10 x 10 m
- Other buildings 10 x 20 m

Protruding roof superstructures, such as ladders, chimney stacks, pipes, antenna mounting brackets, etc. and other metallic parts of buildings which are located near the roof (e.g. louvers of ventilation openings) must be directly connected to the collector lines.

12.3 Collector Rods

Collector rods shall be used for roof superstructures featuring mechanically or electrically operated equipment, such as ventilators and non-conductive parts projecting from the mesh plane by 0.3 m. The angle of protection and a certain minimum distance have to be observed.

Outdoor electrical facilities for HVAC or other purposes not located in the protective area of earthed structures, installations or buildings, including exposed electrical equipment shall be protected by collectors.

Buildings with sheet metal roofs where the thickness of the sheet is smaller as the required value, the collector mesh must be equipped with collector rods of sufficient quantity and length to avoid lightning strokes in the sheet metal.

12.4 Down Conductors



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

Down conductors shall be selected in a manner such that there are several parallel current paths between the collector and the earthing system. The length of each down conductor is to be kept as short as possible.

Steel structures and steel columns of buildings may be used as down conductor, if the minimum sizes according to the standards are guaranteed. In each case the connections with the earthing system and collectors respectively must be visible and removable.

Starting from the corners of the structure involved, conductors should be distributed around the exterior as evenly as possible. They must be configured in such a way as to constitute the direct continuation of the collector. The minimum distance between conductors and doors, windows and other apertures must be 0.5 m.

If not already connected with the collectors or with the internal potential equalization, larger metal parts mounted in/on the building outer walls (e.g. frames of doors, ventilation louvers) shall be terminated on the down conductors. The number of down conductors and the minimum distance between the conductors is given as follows:

a) Buildings containing telecommunication and control systems

- Minimum number of conductors: 4
- Maximum distance between conductors: 10 m

b) Other buildings

- Minimum number of conductors: 2
- Maximum distance between conductors: 20 m

All down conductors which are connected to the earthing system must be provided with an accessible isolating point for measuring purposes. For termination the grounding bars of grounding loops shall be used, preferably. No conductors are required for outdoor metal structures of adequate size.

12.5 Inadmissibly Short Distances

Inadmissibly short distances between the lightning protection system and metal installations or electrical equipment shall be prevented. In the event of potential hazard due to flash-over or disruptive discharge caused by lightning, appropriate measures shall be taken.

Admissible distances between lightning protection systems and metal installations, electrical wiring and equipment shall be determined in compliance with the relevant Indian & International standards. This also applies to the use of special roof-mounted collectors.

13.0 TESTS OF LIGHTNING PROTECTION SYSTEM

After erection of the earthing and lightning protection system all installations shall be tested in accordance with applicable regulations



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

The following tests shall be carried out, at least:

- Measures against corrosion protection and arising of chemical elements,
- Check of all connections,
- Measurements of earthing system resistance,
- Measurements of lightning protection system conductivity,
- Check of mechanical details,
- Compliance with specifications.

The aim of the tests is to ensure the proper function of the complete scope. The measuring results and the locations of the measuring points have to be indicated in respective drawings as a basis for future measurements.

14.0 DOCUMENTATION

Complete documentation shall be provided for the design, construction, testing, maintenance and repair of the earthing and lightning protection systems and their components.

The documentation shall be in English language.

The following drawings/documents shall be submitted for approval within 3 weeks of award of contract.

- a) Soil resistivity report
- b) Technical data sheets
- c) Complete Earthing design calculations
- d) Lightning protection design calculations
- e) Earthing grid layouts
- f) Construction drawings
- g) Spare parts list
- h) Operation and maintenance manuals
- i) Test reports

The documents listed above shall be handed over for approval. Special attention has to be given to the fact, that documentation must be submitted with sufficient time allocated for approval prior to manufacturing / assembly. The documentation has to be prepared in accordance with the relevant ISO standards. The final documentation shall be delivered on



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

paper in sufficient number and with exception of the signed protocols in electronic form, also. The type of the electronic files and the number of copies shall be agreed with the Client.

After commissioning & testing of earthing system contractor shall submit the following document to Employer for As-Built status in hard copy (5 set) plus one soft copy.

- a) Soil resistivity report
- b) As built earthing grid layouts & earth electrode installations
- c) Construction drawings



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

SPECIFICATION FOR CABLE LAYING



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

CONTENTS

Sl. No.	Description
1.0	SCOPE
2.0	STANDARDS
3.0	GENERAL REQUIRMENT
4.0	CABLE SPECIFICATIONS
5.0	MISCELLANEOUS MATERIALS SPECIFICATIONS
6.0	CABLE LAYING
7.0	TERMINATION
8.0	TESTING
9.0	DOCUMENTATION



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

1.0 SCOPE

The intent of this standard specification gives recommendation & Board Guideline for selection, transportation, laying, jointing, termination, testing and commissioning of the cabling system. Up to 33kV.

2.0 STANDARDS

The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specifications, codes of practice of Indian Standards Institution, approved drawings and instructions of Engineer-in-Charge or his authorized representative issued from time to time. In case of any conflict between the standards, the instruction of Engineer-in-Charge shall be binding.

In general the equipment covered by this specification shall, unless otherwise specified, be in line with the requirement of any of the latest applicable standards of

- a) Bureau of Indian Standards
- b) British Standard Institution
- c) American Standard Institution
- d) International Electro Technical Commission

2.2 Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.

2.3 In case any contradiction between various referred standards/specification and statutory regulation etc the following order of priority shall be govern –

- i) Schedule of rates
- ii) Design Basis
- iii) Scope of work/Job specification
- v) Standard specification
- vi) Codes & standard

3.0 GENERAL REQUIREMENTS

3.1 ENVIRONMENTAL CONDITIONS

The cables shall be laid for continuous operation at full load under the climatic and environmental conditions as described in the specification “Design Basis Electrical”.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

3.2 COMPONENTS AND EQUIPMENT

a) The Contractor has to take care that all components, equipment & cable routes are selected considering easy maintenance, simple and quick diagnosis and long maintenance intervals. All components and equipment shall be designed for continuous duty at rated load and under the given climatic conditions. Standard industrial high performance systems and components shall be used as far as possible. Components and equipment of same kind and type shall be selected for equivalent functions. The interchangeability must be guaranteed.

3.3 TAGGING

All components, equipment, cable route and installations shall receive the respective tagging plates, labels, etc which have to be of extremely durable material resistant against the environmental conditions.

4.0 CABLE SPECIFICATIONS

Refer Specification for LV & MV Cable- Specification No. MEC/TS/05/E9/073A

5.0 MISCELLANEOUS MATERIALS SPECIFICATIONS

5.1 Connectors

Cable terminations shall be made with Aluminium/tinned copper crimped type solder less lugs of approved make for all Aluminium/Cu conductors cables and stud type terminals and shall be as per IS: 8309.

5.2 Cable Identification

Cable tags shall be of 2 mm thick, 20 mm wide aluminium strap of suitable length to contain cable number, equipment no etc.

5.3 Ferrules

Ferrules shall be of approved type size to suit core size mentioned and shall be employed to designate the various cores of control cable by the terminal numbers to which the cores are connected for ease in identification and maintenance. Ferruling shall be done at both end of cables.

5.4 Cable Glands

Cable glands shall be nickel-plated Brass double compression type of approved/ reputed make. Glands for classified hazardous areas shall be certified by CMRI and approved by CCE, Nagpur.

5.5 Cable trays

This shall be either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron trays as specified elsewhere. Prefabricated hot dip galvanized sheet steel cable trays shall be used for maximum support span of 2000 mm unless design is approved for larger span. For



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

requirements of larger than 750 mm width two trays shall be run side by side. Cable trays shall be suitable for a cable weight of 50 kg/meter running length of tray. Minimum thickness of sheet steel/galvanizing shall be 2mm/86 microns respectively.

Cable trays fabricated from standard rolled sections shall use 50x50x6 /ISMC 100 Sections for runners for supporting spans limited to 2000 mm/more than 2000 mm respectively. Cross support shall be 30 x 6 mm flat/ 25x25x6 angle for width upto 500 mm/ more than 500 mm respectively.

Vertical supports for both the above type of trays shall be fabricated out of ISMC 100 and horizontal supports with 75 x 50 x 6 angle iron/ ISMC 75 as approved by Engineer-in-Charge.

If unit rate is not included in schedule of rates, then cable trays if required, shall be fabricated and installed at site as per ton rate for electrical structural supports etc.

6.0 CABLE LAYING

6.1 Cable network shall include power, control, lighting and communication/signal cables, which shall be laid in trenches, cable trays or conduits as detailed in the relevant drawings and cable schedules. Erection of cable trays as required shall be checked after erection and marked in as built drawings. Cable routing given on the layout drawings shall be checked in the field to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc and minor adjustments shall be done to suit the field conditions wherever deemed necessary without any extra cost.

6.2 High voltage, medium voltage and other control cables shall be separated from each other by adequate spacing or running through independent pipes, trenches or cables trays, as applicable as per IS 1255.

All communication/signal cables (telephones, P.A.S, Instrument) RTD Cables shall run on instrument trays/ducts/trenches. Wherever these are not available, cables shall be taken in a separate trench with a minimum clearance of 300 mm away from electrical trench as per IS 1255 & direction of Engineer-in-Charge. Communication cables shall cross power cables at right angles.

Clearance –The desired Minimum clearance are as follows

Power Cable to Power Cable	- Clearance is not necessary. However, there would be some clearance so that, the current carrying capacity become better.
Power cable to control cable	- 0.2m
Power cable to communication/	- 0.3m
Signal cable	
Power cable to Gas/Water Main	- 0.3m



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

Inductive influence/interference on signal/control/communication cable should be checked.

The Power cable should not be laid above the Communication Cable. While laying of power cables the likely interference to existing communication/signal cable should be avoided by referring to and coordinating to appropriate authority.

6.3 All cable routes shall be carefully measured and cables cut to the required lengths, leaving sufficient lengths for the final connection of the cable to the terminal of the equipment. The various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. The quantity indicated in the cable schedule is only approximate. The contractor shall ascertain the exact requirement of cable for a particular feeder by measuring at site and avoiding interference with structure, foundation, pipelines or any other works.

Before the start of cable laying, cable drum schedule shall be prepared by contractor and get that approved by Engineer-in-Charge to minimize/avoid straight through joints required. Contractor shall work out the actual number of straight through joints required.

6.4 Cables as far as possible shall be laid in complete, uncut lengths from one termination to the other.

6.5 Cables shall be neatly arranged in the trenches/trays in such a manner so that cross-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trenches/trays shall be the responsibility of the Contractor. Cable routing between lined cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 45° to the trench wall. In case of larger diameter cables, i.e., 50 mm and above, adequately sized pipe with larger bend radius shall be provided for ease of drawing of cable or for replacement. In places where it is not possible, a smaller trench may be provided if approved by Engineer-in-Charge.

6.6 All cables shall be identified close to their termination point by cable numbers as per cable schedule. Cable numbers will be punched on aluminium straps (2 mm thick) securely fastened to the cable and wrapped around it. Alternatively cable tags shall be circular in construction to which cable numbers can be conveniently punched.

Each underground cable shall be provided with identity tags of lead securely fastened every 30 m of its underground length & at turning of power cable with at least one tag at each end before the cable enters or leave the ground. In unpaved areas, cable trenches shall be identified by means of markers as per standard drawing. These posts shall be placed at location of changes in the direction of cables (turnings & crossings) and at intervals of not more than 30 M and at cable joint locations.

6.7 All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all XLPE/PVC insulated cables shall be taped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

6.8 RCC cable trenches with removable covers as shown on the drawings will be provided by the Owner. Cables shall be laid in 3 or 4 tiers in these trenches as indicated on the sectional drawings. Concrete cable trenches shall be filled with sand where specified to avoid accumulation of hazardous gases, RCC covers of trenches in process area shall be effectively sealed to avoid ingress of chemicals etc. Removal of concrete covers for purpose of cable laying and reinstalling them in their proper positions after the cables are laid shall be done by the electrical Contractor at no extra cost.

6.9 Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cables leaving trenches shall be coiled and provided with a protective pipe or cover, until such times the final termination to the equipment is connected. Minimum bending radii of cable shall be as specified in IS: 1255.

6.10 Directly buried cables shall be laid underground in excavated cable trenches where specified in layout drawings. Trenches shall be of sufficient depth and width for accommodation of all cables correctly spaced and arranged with a view of heat dissipation and economy of design.

Desired Minimum depth of laying from ground surface to top of cable is as follows

High voltage cables, 3.3kV to 11kV Rating : 0.9m

High voltage cables, 22kV to 33kV Rating : 1.05m

Low voltage & control cable : 0.75m

Cables at Road Crossing : 1.00m

Cables at railway crossing (Measured from : 1.00m

Bottom of sleepers to top of pipe)

The depth and the width of the trench shall vary depending upon the number of layers of cables.

Cables shall be laid in trenches at depth as shown in the drawing with protective GI earth conductor (runs along the cable). Before cables are placed, the trenches bottom shall be filled with a layer of sand. This sand shall be leveled and cables laid over it. These cables shall be covered with 150 mm of sand on top of the largest diameter cable and sand shall be lightly pressed. A protective covering of 75 mm thick second class red bricks shall then be laid flat. The remainder of the trench shall then be back-filled with soil, rammed and leveled.

6.11 As each row of cables is laid in place and before covering with sand every cable shall be given an insulation test in the presence of Engineer-in-Charge / Owner. Any cable, which proves defective, shall be replaced before the next groups of cables are laid.

All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/ lined trench.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

6.12 Where cables rise from trenches to motor, control station, lighting panels etc., they shall be taken in G.I. Pipes for mechanical protection upto a minimum of 300 mm above grade or as shown in the standard drawings.

Cable ends shall be carefully pulled through the conduits, to prevent damage to the cable. Where required, approved cable lubricant shall be used for this purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacturer. Following grade of the pipe fill shall be used for sizing the pipe size:

- a) 1 cable in pipe - 53% full
- b) 2 cables in pipe - 31% full
- c) 3 or more cables - 43% full
- d) Multiple cables - 40% full

After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/ 'PUTTI' for sealing purpose. The cost for the same shall be deemed to have been included in the installation of G.I. Pipe and no separate payment shall be allowed.

6.13 Where cables pass through foundation walls or other underground structures, the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical contractor shall determine their location and obtain approval of the Engineer-in-Charge before cutting is done.

6.14 At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends.

6.15 Drum number of each cable from which it is taken shall be recorded against the cable number in the cable schedule.

6.16 Cables installed above ground shall be run in trays, exposed on walls, ceilings or structures and shall be run parallel or at right angles to beams, walls or columns.

Cables shall be so routed that they will not be subjected to heat from adjacent hot piping or vessels.

6.17 Individual cables or small groups which run along structures/walls etc. will be clamped by means of 10 SWG GI saddles on 25x6 mm saddle bars. The cost of saddle and saddle bars shall be deemed to have been included in the installation of cables and no separate payment shall be made on this account. Alternatively small group of cables can be taken through 100 mm slotted channel/ISMC 100.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

They shall be rightly supported on structural steel and masonry, individual or in groups as required, if drilling of steel must be resorted to, approval must be secured and steel must be drilled where the minimum weakening of the structure will result.

Cables shall be supported so as to prevent unsightly sagging. In general distance between supports shall be approximately 300 mm for cables upto 25 mm diameter and maximum 450 mm for cables larger than 25 mm diameter.

6.18 All G.I. Pipes shall be laid as per layout drawings and site requirements. Before fabrication of various profiles of pipe by hydraulically operated bending machine (which is to be arranged by the contractor), all the burrs from the pipes shall be removed. GI Pipes with bends shall be buried in soil/concrete in such way that the bends shall be totally concealed. For G.I. Pipes buried in soil, bitumen coating shall be applied on the buried lengths. Installation of G.I. Pipes shall be undertaken well before paving is completed and necessary co-ordination with paving agency shall be the responsibility of Electrical Contractor. The open ends of pipes shall be suitably plugged with G.I. Plugs after they are laid in final position. G.I. Plugs shall be supplied by the Contractor at no extra cost.

6.19 Cable laid on supporting angle in cable trenches, structures, columns and vertical run of cable trays shall be suitably clamped by means of G.I. Saddles/Clamps, whereas cable in horizontal run of cable trays shall be tied by means of nylon cords.

6.20 Supporting steel shall be painted before laying of cables. The painting shall be done with one coat of red lead paint and two coats of approved bituminous aluminium paint unless otherwise specified.

7.0 TERMINATION

7.1 All PVC cables upto 1.1 KV grade shall be terminated at the equipments by means of double compression type cable glands. They shall have a screwed nipple with conduit electrical threads and check nut.

All Cable entries shall be through bottom only and top entry terminations are made only after getting approval of Engineer-in-Charge.

7.2 Power cables wherever colour coding is not available shall be identified with red, yellow and blue PVC tapes. Where copper to aluminum connections are made, necessary bimetallic washers shall be used for trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/Control panels and Control Switches.

7.3 In case of control cables, all cables shall be identified at both ends by their terminal numbers by means of PVC ferrules or self-sticking cable markers. Wire numbers shall be as per schematic/ wiring /inter- connection diagram. Bidders shall have the samples of PVC ferrules/cable markers approved before starting the work. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

7.4 Where threaded cable gland is screwed into threaded opening of different size, suitable galvanized threaded reducing bushing shall be used of approved type, at no extra cost. All switchgear and control panels shall have un-drilled gland plate.

Contractor shall drill holes for fixing glands wherever necessary at no extra cost. Gland plate shall be of non-magnetic material/aluminium sheet in case of single core cables.

7.5 The cable shall be taken through glands inside the panels or any other electrical equipment such as motors. The individual cores shall then be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Only control cables of single strand and lighting cables may be directly terminated on to the terminals.

In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom close fit hole should be drilled in the bottom plate for all the cables in one line, then bottom plate should be split in two parts along the center line of holes. After installation of bottom plate and cables it should be sealed with cold setting compound. Cables shall be clamped over the open armouring to connect it to earth bus.

7.6 Cable leads shall be terminated at the equipment terminals, by means of crimped type solder less connectors.

Crimping shall be done by hand crimping hydraulically operated tool and conducting jelly shall be applied on the conductor. Insulation of the leads should be removed immediately before the crimping. Conductor surface shall be cleaned and shall not be left open.

7.7 Cable accessories for H.V. Systems

7.7.1 The 11, 6.6 and 3.3 KV cables terminations joints shall be done by skilled and experienced jointers duly approved by the Engineer-in-Charge. Termination including supplying of jointing kit shall be in the scope of contractor unless specified otherwise.

7.7.2 The termination and straight through joint kit for use on high voltage system shall be suitable for the type of cables or the type of cables issued by owner for installation. Supply of termination kit shall be in the scope of contractor. The materials required for termination and straight through joints shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fitting and consumables items. An installation instruction shall be included in each sheet.

7.7.3 The termination kits shall be suitable for termination of the cables to indoor switchgear/panels or outdoor weatherproof cable box or outdoor transformer & motors or Double/Four pole structure. The terminating kits shall preferably be of the following types:

a) Heat-shrinkable power cable termination/joint kit of M/s. Raychem or equivalent.

For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

7.7.4 The straight through jointing kits shall be suitable for underground-buried installation with uncontrolled backfill and possibility of flooding by water. The jointing kit shall be one of the following types.

a) Heat-shrinkable sleeve type of M/s. Raychem or equivalent.

7.7.5 Makes of kits other than those specified above may be considered, provided the Contractor furnishes type test certificates, along with the offer for approval of the same.

7.7.6 Type tests are to be carried out at manufacturer's works to prove the general qualities and design of a given type of termination/jointing system. The type tests shall include the following tests conforming to the latest IEC 502.2, 466 and VDE 0278 specifications. The type test certificates shall be submitted by the Contractor along with the offer for indicating the jointing system considered.

a. A.C. Voltage withstand dry test for 1 minute

b. Partial discharge test - Discharge magnitude shall be less than 20 p.c.

c. Impulse voltage withstand test with 10 impulses of each polarity.

d. A.C. high voltage test following load cycling test with conductor temperature at 95°C.

e. Thermal short circuit test of 250°C for 1 second.

f. DC Voltage withstand test for 30 minutes.

g. Humidity test.

h. Dynamic short circuit test.

i. Salt fog test

j. Impact test

8.0 TESTING

8.1 Before energizing, the insulation resistance of every circuit shall be measured from phase to phase and from phase to ground.

8.2 Where splices or termination are required in circuits rated above 600 volts, measure insulation resistance of each length of cable before splicing and or/ terminating. Repeat measurement after splices and/or terminations are completed.

8.3 Measure the insulation resistance of directly buried cable circuits before cable trenches are back-filled. Repeat measurement after back- filling.

Rating of IR tester for cables of different voltage rating as follows-

Cable Voltage grade

IR Tester Voltage Rating



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

1.1kV	500V
3.3kV	1000V
6.6kV	1000V
11kV	1000V

8.4 Cables after jointing & termination are subjected to DC high voltage test. The recommended values of test voltage are given below.

Uo/U	Test Voltage Between		Duration (Min.)
	Any conductor and metallic Sheath/ Screen /Armour	Conductor to Conductor (For Unscreened Cable)	
0.65/1.1	3	3	
1.9/3.3	5	9	
3.3/3.3	9	9	
3.8/6.6	10.5	18	15
6.6/6.6	18	18	
6.35/11	18	30	
11/11	30	30	

8.5 All cables shall be tested as per standard test Performa available with site engineer.

8.6 Cable schedule and layout drawings must be marked for AS BUILT conditions during the installation work and shall be approved by Site Engineer.

9.0 DOCUMENTATION

After commissioning & testing of all power & control cables, contractor shall submit the following document to Employer for As-Built status in hard copy (5 set) plus one soft copy.

- Complete commissioning report of cables
- Drawing showing Cable rout of all laid cables in trenches/trays including respective cable numbers.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

SPECIFICATION FOR VCB CABLE



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

CONTENTS

S.No	Description
------	-------------

- | | |
|------|-------------------------------|
| 1.0 | INTRODUCTION |
| 2.0 | GENERAL REQUIREMENTS |
| 3.0 | AUXILIARY WIRING AND TERMINAL |
| 4.0 | CONTROL AND INDICATION |
| 5.0 | EARTHING CONNECTION |
| 6.0 | SPACE HEATER |
| 7.0 | NAME PLATE |
| 8.0 | PAINTING |
| 9.0 | DEAWINGS |
| 10.0 | TESTS AND ACCEPTANCE |
| 11.0 | PACKING AND TRANSPORT |



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

1.0 INTRODUCTION

The intent of this standard specification is to define the general requirements for design, manufacture, assembly and testing at manufacturer's works, packing, transportation and receipt at site with all materials and accessories of VCB Panel.

2.0 GENERAL REQUIREMENTS

The VCB shall be three-pole with stored energy, spring charged operating mechanism, re-strike free operation suitable for very low value of chopping currents under all duty conditions. Metal oxide gap-less surge arresters shall be provided with pressure relieving vents and mechanical indication for the arrester failure. Parts of the breaker requiring inspection, maintenance or replacement shall be easily accessible. Circuit breakers shall be fully withdrawable type and interrupting medium shall be vacuum. The breaker operating duty shall be O-0.3 sec-CO-3minCO unless otherwise agreed. VCB shall be fitted in withdrawable trolley, which can be set in the following positions: -

Plugged in.

Withdrawn, in test.

Withdrawn, fully isolated.

In test position, auxiliary circuits are connected, but power contacts are disconnected.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

VCB shall be motor operated spring charged, manual independent closing and shunt trip mechanism. Breakers shall be trip free and shall have anti-pumping device. The shunt trip coil, closing coil and spring charging motor shall be suitable for DC control supply. A maintenance free battery of suitable rating along with battery charging unit shall be part of the VCB panel. Alternatively, VCB panel shall be provided with a built in adequately rated power pack for the complete DC control supply. Details shall be furnished for Employer approval.

The trip coil shall operate satisfactorily at 50% to 110% of rated voltage while closing coil and spring charging motor shall operate between 80% & 110% of rated voltage.

Continuous rated current shall be 630A and Short circuit rating, Impulse and 1 min PF withstand voltages shall be as per scope of the work

A readily identifiable mechanical emergency trip device as well as provision for manual charging of springs through cubicle door shall be provided, which shall cut-off the electrical circuit of spring charging motor on insertion of the operating lever.

A visual ON/OFF indication and spring charged indication shall be provided positively coupled to the operating mechanism and visible from front with the cubicle door closed. Spring charged/discharged indications and operation counter also shall be provided.

VCB shall have 8 NO + 8 NC auxiliary contacts for purchaser's use. Advance and retard contacts shall be provided if required. All auxiliary contacts shall be wired to the terminal block. Auxiliary contacts and limit switches shall be in dust tight enclosures.

Voltage Transformers (PT) and current transformers (CT) shall be part of the VCB panel. Current transformers shall generally conform to IS: 2705. The voltage transformers shall generally conform to IS: 3156.

Separate cores shall be used for metering and protection. CT's shall have 1A secondary, air insulated, plain ring type encapsulated in thermal setting resin with bar primary mounted in a separate chamber. The PT's shall be 3 phase star/star type fully insulated with neutral points brought out, protected by HRC fuses on H.T. & L.T. side by MCB for isolation.

The VCB panel shall be metal clad (2 mm CRCA sheet), self-standing cubicle, dust & vermin proof in IP43 weatherproof enclosure. A lockable-hinged lift-off type front door shall be provided. All control switches, indicating lamps, instruments, protection and auxiliary relays shall be flush-mounted on the wing panel of L.T. compartment on the front side.

Compression type brass cable glands with gland plates for HT cables and for control cables, tinned heavy-duty copper lugs shall be envisaged.

Protective relays shall be provided as per Single Line Diagram like Inst. Over current, IDMT Over current relay, Inst. Earth fault relay, Restricted Earth fault relay, Relay for transformer fault protection (winding, oil temperature, buch-holz, oil level etc.). Master trip, Trip circuit supervision relay and Auxiliary relays as per circuit requirement shall also be provided. Protection relays shall be clearly labeled and shall not be sensitive to vibration, shocks or transients. Multiple



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

function elements, such as tripping and alarm duties, shall have separate operating contacts for each function and shall be brought out to separate terminals.

CT's for over current protection shall have appropriate VA rating and accuracy to energize relays, without causing damage to the relays, cover the range of short circuit currents that can arise. Trip circuits shall be automatically broken and CT secondary circuits shorted when a relay is withdrawn from the case.

All protective relays shall be back connected, draw out type, suitable for flush mounting and fitted with dust tight covers. Alternatively, 'plug in' type of relays will also be acceptable. All protection relays shall be Microprocessor based relays. However make and model shall be subject to approval from the owner/purchaser.

All relays shall preferably be mounted in front of the panel unless otherwise specified. Protective relays shall have hand reset facilities and clear operating indication, e.g. flags for mechanical type relays or light emitting diodes for static type relays. Anti-fungus treatment shall be provided for all relays.

Numerical relays covering the transformer faults with proper ranges and operational indications can also be considered as an alternative.

All relays in tripping circuits shall have mechanically operated flag indicators, which can be reset without opening the relay case. All tripping relays shall be lockout type with hand reset contacts and shall be suitable to operate on the specified D.C. voltage. These relays shall have self-coil cut-off contacts and shall be provided with hand reset operation indicators. Tripping relays will be acceptable in non-draw out cases. The number of contacts shall be as shown on the approved schematic drawings.

Indicating instruments shall be 96 x 96mm size, class 1.0 accuracy, taut band type. Integrating meters shall conform to IS 722, class 2.0, cyclometer register and integration period of 15 min. for maximum demand, 5-digit type.

VCB operating Trip-neutral-close switch shall be of pistol grip type, spring return to neutral and lockable in that position. All control switches shall be rotary, back connected type having a cam operated contact mechanism, and phosphor bronze contacts shall be used on the control

switches. Unless otherwise stated, circuit breaker control switches shall be 3-position spring return to 'neutral' from both 'ON' and 'OFF' positions.. Ammeter selector switches shall have 'make before break feature' on its contacts. The ammeter and voltmeter selector switches shall generally have four positions.

Indicating lamps shall be LED type and supplied complete with the necessary current limiting resistor duly tested for its rating. Lamps shall be provided with translucent lamp covers to diffuse light.

Space heaters with thermostat control shall be provided.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

Operating height of all push buttons, switches, lamps, meters, relays etc shall not exceed 1800 mm.

An exclusive Emergency Push Button (to be located in the Depot manager's room & transformer yard) to trip the VCB shall be wired up in the control circuit.

Solid-state Alarm annunciator for Transformer faults and trip indicators shall form part of VCB Panel.

Auxiliary relays/contactors shall generally be used for interlocking and multiplying contacts. Auxiliary contacts shall be capable of carrying the maximum estimated current.

Selection, sizing and suitability of all components shall be the vendor's responsibility and the vendor shall include all equipment required for safe and satisfactory operation, even if not specifically mentioned.

Only major relays, meters and controls are indicated in the SLD/scheme drawings. Any auxiliary relays, timers, switches etc. as required while developing the control schematic and required for safe operation, even if these are not specifically included shall be supplied without price implication.

All relays, metering and control components shall be mounted on the panel front only.

Components requiring inspection or adjustment shall be accessible from floor level.

The vendor shall be solely responsible for coordinating the relay characteristics with suppliers for the proper selection of all CT's.

The vendor shall prepare a proposal for the settings of the protection relays. The final setting of the relays shall be agreed between the vendor and the Purchaser.

The VCB Panel components viz. Circuit breaker, main horizontal & vertical bus bars, bus bar joints, bus bar supports etc. shall be designed to withstand the maximum expected short circuit level for a minimum time of 3 sec.

Vendor shall indicate the space requirement for the VCB Panel along with the bid (required for designing the electrical room layout).

All mounted equipment shall have "identification" tags of self - sticking PVC tape at the rear.

All terminals shall be shrouded with plastic covers to prevent accidental contact.

Thermal design of the bus bars shall be based on installation of the switchgear in poorly ventilated conditions. The cooling air volume shall take in to account only the bus enclosure.

Cable supporting facility shall be provided in cable alay for power and control cables.

The earth busbar size shall be 50 x 12 mm copper or equivalent.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

All power and control cables shall be terminated by purchaser through double compression nickel-plated brass cable glands. However, supplier shall supply lugs and cable glands.

Test of the complete panel shall be carried out at site in presence of manufacturer's specialist, once the external cable connections have been completed.

Vendor shall also provide minimum following potential free normally open contacts for remote annunciation.

Tripped on fault.

Under voltage trip

Trip circuit unhealthy

DC control supply failure

PT secondary MCB off.

The vendor shall supply appropriate base frames to provide a substantial foundation for the VCB Panel installation, together with necessary holding down bolts, nuts & washers, rails, etc.

The VCB Panel shall be totally enclosed and vermin-proof. If necessary, louvered openings with wire mesh shall be provided for natural ventilation. Wire mesh for bus bar compartments shall be such as to protect against objects of 1 mm and above. The enclosure shall have complete protection against live parts and internal moving parts.

Suitable neoprene gaskets shall be provided in all openings, covers and doors. Unless otherwise specified, the minimum protection class for the enclosure shall be IP 43.

Each unit of the switchgear shall have necessary internal sheet metal barriers to form separate compartments for bus bars, instruments and relays, cable connections, etc. Suitable arc propagation barrier shall be provided in the bus bar compartment at every junction between two adjacent cubicles. Independent pressure release flaps shall be provided for all HV compartments, viz. Bus bar, cable and breaker compartments. Terminal strips for outgoing control cable connection should be accessible to facilitate working and testing of breaker in test/service condition and while the panel is energized.

It shall be possible to extend the panels/bus bars at both the ends.

In the VCB Panel, the draw out carriage shall have three positions: "Service", "Test" and "Draw out". Automatic safety shutters shall be provided to ensure the inaccessibility of all live parts after the breaker is drawn out. It shall not be possible to draw out the carriage with the circuit breaker closed. The breaker feeder trolley shall remain inside the cubicle even in the "Test" position. There shall be a distinct overall door for the breaker compartment and it should be lockable. Necessary interlocks to prevent faulty operations shall be provided.

Switchgear shall be designed and constructed to facilitate inspection, cleaning, repair and maintenance and to ensure absolute safety during operation, inspection and maintenance.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

All hardware shall be corrosion resistant. All joints and connections of the panel members shall be made by zinc-passivated, or cadmium-plated, high quality steel bolts, nuts and washers, secured against loosening.

Suitable eye bolts/provision for the lifting of the panel shall be provided.

Checking and removal of components shall be possible without disturbing adjacent equipment. All equipment shall be easily accessible.

BUSBARS

Bus bars and connections shall be made of electrolytic Aluminum / Copper and shall be and shall be sleeved by using heat-shrinkable PVC sleeves of suitable voltage grade.

Bus bars shall be of same cross sectional area throughout the length of the switchgear, and shall be sized to carry continuously the current specified in the single line diagrams

For the phase identification, bus bars shall be marked with Red, Yellow and Blue colour.

Bus bars and connections shall be adequately sized, braced and supported to withstand the mechanical forces and thermal effects resulting from the switchgear rated short circuit current and carry certification from a recognized testing authority.

The incoming and outgoing power connection shall be through XLPE cables. Suitable termination arrangement shall be provided for number and size of cables as indicated in the single line diagrams. Ample space for connection for these cables shall be provided at the rear of the switchboard. A removable expanded metal barrier shall be provided in the cable compartment, in order to avoid accidental contact in the cable compartment, while carrying out inspection by opening the back cover. Unless otherwise specified, the power cable shall enter the switchboard from the bottom.

The switchboard shall be supplied complete with supports for clamping outgoing and incoming cables. The headroom available between cable gland plate and terminal lug shall not be less than 600 mm for switchgear.

A set of earthing plugs shall be provided for earthing the bus bars or circuit cables through circuit breaker.

Provision is also made for earthing through circuit breaker truck by means of separate earthing contacts.

3.0 AUXILIARY WIRING AND TERMINAL

Inside the cubicles, the wiring for control, signaling, protection and instrument circuits shall be done with coloured PVC insulated conductors. The insulation grade shall be 1.1 kV. The Wiring shall preferably be enclosed in plastic channels or neatly bunched together. Wiring between HV breakers or cable compartments to relay and metering compartments shall be routed through flexible conduits.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

10% spare terminals shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block to ensure that not more than one outgoing wire is connected

Terminal strips shall preferably be separated from power circuits by metal barriers or enclosures. All spare contacts of auxiliary relays, timers, etc. shall be wired up to the terminals.

Each wire shall be identified at both ends by correctly sized PVC ferrules. Shorting links shall be provided for all CT terminals.

For CT circuits 2.5 Sqmm copper conductor shall be used. Other control wiring can be with 1.5 mm² copper conductors. Unused CT secondary terminals shall be short-circuited. All terminals shall be shrouded with plastic covers to prevent accidental contact.

External control cables shall enter the switchgear from the bottom. Tinned-copper cable lugs and requisite cable glands for these cables are also included in the scope of supply of the switchboard. The cable glands shall be of nickel-plated brass, single-compression type and shall be suitable for control cable sizes as mentioned in the approved drawings. Supporting facilities shall be provided for clamping of the control cables. All external control cabling will be carried out with 2.5 Sq.mm Cu conductors. The vendor shall provide suitable terminals and cable lugs accordingly in the panel.

4.0 CONTROL AND INDICATION

Breaker tripping and closing devices shall be suitable for D.C. voltage as specified. The power supply distribution for a switchboard shall be arranged as follows:

One D.C. feeder shall be provided from battery. (Refer Battery and charger specifications)

One separate 240 V AC supply shall be provided for feeding space heaters, etc.

One power pack is also be provided to convert 11KV to 110V DC.

Serial port shall be provided for modbus communication. All signals shall be available for PLC/SCADA/Automation purpose.

Breaker positions, ON/OFF/Spring charged/Test position/ Service position shall be indicated mechanically. Following indications shall also be provided on the front of panel.

- | | | |
|----|----------------------|--------------|
| a) | Breaker 'ON' | :Red Lamp |
| b) | Breaker 'OFF' | :Green Lamp |
| c) | Breaker 'Auto Trip' | : Amber Lamp |
| d) | Trip circuit healthy | :White Lamp |
| e) | DC supply fail | :Blue Lamp |
| f) | Spring fully charged | :Amber Lamp |



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

5.0 EARTHING CONNECTION

All metallic non-current carrying parts of the switchgear shall be bonded together and connected to the switchgear earth bus bar.

All doors shall be bonded to the main structure by means of a flexible copper connection arranged so that it cannot be trapped as the door is opened or closed.

All with drawable parts shall be effectively earthed until they are completely withdrawn with all power and control connections disconnected.

Provision shall be made, adjacent to cable termination, for earthing of the cable screen and Armouring to the earth bus bar.

An earthing bus bar suitable for switchboard rating shall be provided along the full length of the switchboard. Provision shall be made to connect earth bus bar to the plant-earthing grid at two ends.

Each earthing point shall be identified with suitable marking.

6.0 SPACE HEATER

The cubicle shall be provided with space heaters to prevent moisture condensation. The space heater shall be controlled through a thermostat with an adjustable setting and a manually operated switch.

7.0 NAME PLATES

A nameplate with the switchgear designation shall be fixed at the top of the panel. Nameplates shall be provided for each equipment (lamps, PB, switches, relays, auxiliary contactors, etc.). All mounted equipment shall have identification tags of self-sticking PVC tapes at the rear also. Special warning plates shall be provided on all removable covers or doors giving access to high voltage cable or bus bars. Engraved nameplates shall preferably be of 3-ply (Black-White-Black) lamicold sheets or anodized aluminum. Black engraved Perspex sheet nameplates will also be acceptable. Nameplates shall be fastened by 'screws' and not by adhesives.

8.0 PAINTING

All metal surfaces shall be thoroughly cleaned and de-greased to removed mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under-surface shall be prepared by applying a coat of phosphate paint, and a coat of yellow zinc chromate primer. The under-surface shall be made free from all imperfections before undertaking the finishing coat.

After preparation of the under-surface, the switchboard shall be spray painted with two coats of epoxy-based final paint. The colour shade of final paint shall be shade 631 (Light Grey) as per



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

IS: 5, unless otherwise specified. Spray-painted finished panels shall be dried in stoving ovens in dust-free atmosphere.

All unpainted steel parts shall be cadmium plated suitable treated to prevent rust corrosion. If these parts are moving elements, then these shall be greased.

9.0 DRAWINGS

The following drawings shall be submitted for approval as per agreed schedule.

- a) Single-line diagrams
- b) general arrangement drawings
- c) flooring and mounting detail drawings
- d) schematic diagrams
- e) bill of material with all component details
- f) Wiring diagram

Employer concurrence of schematic drawings is required before the manufacturer proceeds with the cubicle wiring. Review of the manufacturer's drawings shall not relieve the manufacturer of his responsibility for supplying equipment conforming with the relevant specifications and standards, or for any mistakes, errors or omissions in manufacturer's drawings.

ACCESSORIES

Lift truck

Foot operated hydraulic device that docks with the switchgear. It has wheels.

Test Jumper

To enable the breaker to be electrically operated using controls in the switchgear, or electrically charged after manual operation of the breaker in a switchgear aisle.

Ground and Test Device

A G & T device is a drawout assembly compatible with circuit breaker compartments. "Dummy Breaker" is a no load disconnect device similar to a drawout circuit breaker, but without an operating mechanism, control or interrupts. It provides a three phase short circuit current path between upper and lower terminals, and usually serves to isolate entire switchgear line ups or specific loads for maintenance work. Dummy device do not have load interrupting capability , and must be kirk key interlocked with the switchgear power source to prevent racking when primary circuit are energized.

10.0 TESTS AND ACCEPTANCE

Tests shall be carried out at manufacturer's works under his care and expense.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

The manufacturer shall submit a QAP inline with the format enclosed for approval of Employer. All tests and documents of inspection documents shall be done based on this.

All routine tests as specified by the applicable standard code shall be conducted. Type test certificates for the switchgear panel and circuit breaker from a recognized testing organization shall be furnished with the bids. The vendor shall also submit a list of guaranteed technical particulars with the bids.

In addition, specific tests shall be conducted to check mechanical and electrical operation/wiring etc. and switchboard wiring conforming to the specification and approved schematic drawings.

All routine tests on breakers shall be conducted as per relevant standards.

Above tests shall be provisionally conducted at manufacturer's works by providing temporary connection to switchgear units in order to simulate the actual conditions.

Tests shall be finally performed at site, in presence of the manufacturer's specialist, once the external cable connections have been completed.

Tests, which will be witnessed by Purchaser/ Employer representatives shall be as follows:

- a) A visual check shall be carried out. This shall cover measurement of overall dimensions, locations, number and type of devices, terminal boxes, location and connection of terminals, etc.
- b) Manual and electrical operation of switching device/Relays shall be checked under the worst conditions of auxiliary supply voltage.
- c) Dry insulation test with power frequency voltage shall be conducted for the main and auxiliary circuits.
- d) Insulation resistance of the main and auxiliary circuits shall be checked.
- e) Operation check shall be carried out for every control function as per the approved schematic diagrams by manually simulating fault conditions and operation of control switches/relays etc.
- f) Relays shall be tested with secondary injection test equipment.
- g) For bought out equipment, test reports of tests carried out at the manufacturer's works shall be submitted. Normally, all routine tests as specified in the relevant standards shall be conducted at his works.

11.0 PACKING AND TRANSPORT

The switchboard shall be shipped to site packed in wooden crates. They shall be wrapped with polythene sheets before being placed in crates to prevent damage to the finish. Crates shall have skid bottoms for handling.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

SPECIFICATION



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

FOR POWER & LIGHTING DISTRIBUTION BOARD

CONTENTS

SL.NO	Description
1.0	INTENT
2.0	CODES AND STANDARDS
3.0	ENVIORNAMENTAL CONDITIONS
4.0	GENERAL REQUIREMENTS
5.0	PAINTING
6.0	TROPICAL PROTECTION
7.0	PACKING & DESPATCH



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

8.0 DRAWINGS AND DOCUMENTS

9.0 INSPECTION AND TESTED

1.0 INTENT

This specification defines the design, construction, testing and supply of LT Small Power Distribution Board suitable for installation in classified hazardous locations in Refineries/ Petrochemical plants. Unless specified in material requisition all fixtures shall be suitable for Hazardous area specified in Design basis/Scope of work.

2.0 CODES AND STANDARDS

The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specifications, codes of practice of Indian Standards Institution, approved drawings and instructions of Engineer-in-Charge or his authorized representative issued from time to time. In case of any conflict between the standards, the instruction of Engineer-in-Charge shall be binding.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

The switchboards shall comply in design, material, testing and performance to the following codes and standards. The latest revision of the publication referred to shall apply.

- IS: 722 - Specification for AC Electricity Meters
- IS: 1248/ IEC 60051 - Specification for direct acting indicating analogue electrical measuring instruments and their accessories.
- IS: 8623 - Specification for low voltage switchgear and control gear assemblies
- IS: 10118 - Code of practice for Selection, installation & maintenance switchgear & control gear & control gear
- IS: 1554 - PVC insulated (heavy-duty) electric cables
- IS: 2551 - Danger boards.
- IS: 3043 - Earthing
- IS: 3618 - Phosphate treatment of iron and steel for protection against corrosion
- IS: 3722 - Letters and Symbols used in electrical technology.
- IS: 8197 - Terminal markings—Electrical measuring instruments.
- IS: 13703 - HRC cartridge fuse links
- IS: 13947/ IEC 60439 IEC 60947 - Specification for low voltage switchgear & control gear & assemblies
- IEC 60529 - Degrees of protection provided by enclosures (IP-Code)
- IEC 60664 - Insulation co-ordination for equipment within low voltage systems

2.1 Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.

2.2 In case any contradiction between various referred standards/specification and statutory regulation etc the following order of priority shall be govern -

- i) Schedule of rates
- ii) Design Basis
- iii) Scope of work/Job specification
- v) Standard specification
- vi) Codes & standard



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

3.0 ENVIRONMENTAL CONDITIONS

The low voltage switchboards shall be designed and constructed for continuous operation at full load under the climatic and environmental conditions as described in the specification "Design Basis-Electrical".

Main switchgears and main distribution boards shall be installed inside without air conditioned electrical buildings or rooms.

The installation of switchboards may be at outdoor locations as required, if any.

4.0 GENERAL REQUIREMENTS

The low voltage switchgears shall be industrial type, metal-enclosed, factory assembled, type tested.

4.1 Component & equipments

The Contractor has to take care that all components and equipment are selected considering easy maintenance, simple and quick diagnosis and long maintenance intervals. All components and equipment shall be designed for continuous duty at rated load and under the given climatic conditions. Standard industrial high performance systems and components of supplier's standard lists shall be used as far as possible. Components and equipment of same kind and type shall be selected for equivalent functions. The interchangeability must be guaranteed.

4.2 Tagging

All components, equipment and installations shall receive the respective tagging plates, labels etc, which have to be of extremely durable material resistant against the environmental conditions. Tagging plates or labels on fronts of enclosures shall be fixed with screws. For further requirements, reference is made to specification "Design BasisElectrical".

4.3 Constructional Features

a) Power Distribution board-

i) Power Distribution boards shall be single/ double front, non-draw out/draw out type, floor/surface mounted, as specified in Bill of Quantities/SOR, Appropriate lifting facilities shall be provided. Overall height of panel shall not exceed 2500 mm and minimum operating height shall not be lower than 300mm & higher than 1800mm.

ii) The minimum thickness of steel shall be 2mm for load bearing members, 1.6 mm for non load bearing members & 3 mm for base channel. The doors & covers shall be fabricated from cold rolled sheet steel.

iii) All doors & removable covers shall be provided with non-deteriorating neoprene gaskets. Gasket & The door hinges shall be concealed type with pad locking arrangement.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

iv) The structure, including doors, insulators and panels, shall be capable of withstanding the internal pressure created by faults within the structure (equal to the maximum fault-current rating) without danger to the operating personnel. Structures shall be self-ventilating.

v) Each PDB panel have horizontal bus-bar chamber running on top with module units (multi tiers) in centre having vertical bus-bar chamber & cable alley on either side.

vi) Door of modules shall be so interlocked that it is not possible to open the door when MCCB/SFU in closed position.

vii) Interlocks, covers, etc shall be provided to prevent incorrect or unsafe operation, and to prevent access to live parts. Mechanical interlock shall be provided between two incomers and bus coupler switches.

viii) Power Distribution boards shall be designed and constructed to facilitate easy inspection, cleaning, repair and maintenance and to ensure absolute safety during operation, inspection and maintenance. Similar parts and components shall be interchangeable.

ix) The overall Power distribution board enclosure shall have a degree of protection IP-52 as per IS: 13947 to make it dust & vermin proof.

x) Any equipped spares shall be arranged such that they can be connected without deenergising the complete distribution board.

xi) It shall be possible to operated individual circuit switches and replace fuses (where used) without de-energizing the complete distribution board.

xii) Cable entry for all I/C & O/G cables shall be from the bottom of the PDB through removable Gland Plates of 2mm Thick.

xiii) LED (Cluster type) indicating lamps shall be used for incoming supply.

xiv) Inscription plate with inscription for all feeders shall be provided.

xv) Single line diagram to be pasted inside the door.

b) Lighting Distribution board-

i) Lighting Distribution boards shall be single front operated, wall mounted, cubicle, non compartmentalized type. Where appropriate, lifting facilities shall be provided. Overall height of panel shall not exceed 2500 mm and minimum operating height shall not be lower than 300mm & higher than 1800mm.

ii) The minimum thickness of steel shall be 2mm for load bearing members, 1.6 mm for non load bearing members & 3 mm for base channel. The doors & covers shall be fabricated from cold rolled sheet steel.

iii) All doors & removable covers shall be provided with non-deteriorating neoprene gaskets. Gasket. The door hinges shall be concealed type with pad locking arrangement.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

- iv) The structure, including doors and panels, shall be capable of withstanding the internal pressure created by faults within the structure (equal to the maximum fault-current rating) without danger to the operating personnel. Structures shall be self-ventilating.
- v) Concealed mechanical lock shall be provided for safety of LDB.
- vi) Lighting Distribution boards shall be designed and constructed to facilitate easy inspection, cleaning, repair and maintenance and to ensure absolute safety during operation, inspection and maintenance. Similar parts and components shall be interchangeable.
- vii) The overall lighting distribution board enclosure shall have a degree of protection IP-52 as per IS: 13947 to make it dust & vermin proof.
- viii) Cable entry for all I/C & O/G cables shall be from the bottom of the LDB through removable Gland Plates of 2mm Thick.
- ix) The door hinges shall be concealed type.
- x) Any equipped spares shall be arranged such that they can be connected without deenergising the complete distribution board.
- xi) It shall be possible to operated individual circuit switches and replace fuses (where used) without de-energizing the complete distribution board.
- xii) LED (Cluster Type) indicating lamps shall be used for incoming supply.

4.4 Busbar & connections

- i) The bus bars shall be selected according to the electrical requirements and shall be of electrolytic copper or high-conductivity aluminium alloy grade E91E as per IS: 5082.
- ii) Bus-bar size shall be sized to carry rated continuous current under the temperature specified elsewhere without exceeding the temperature 90°C. Bus-bars shall be of the same cross sectional area throughout the length of the distribution board.
- iii) Bus-bar shall also be designed to withstand the system fault current for 1 sec as specified in design basis with out exceeding the temperature 200°C for AL & 250°C for Cu. The minimum acceptable size of bus bar shall be 250 Sq mm (Aluminum).
- iv) Contractor shall submit the size calculation of bus-bar for review/approval.
- v) Bus-bars (Vertical & Horizontal) shall be insulated with color coded Heat shrinkable PVC sleeves as per IS: 5578. Horizontal bus bar running at top of the panel shall have separate inspection covers (screwed type).
- vi) Bus-bars shall be marked to indicate the phase color, which shall be red, yellow, blue and neutral bus shall be marked with black colour.
- vii) An earth bus-bar (continuous PE conductor) with earthing studs shall be provided along the full length of the distribution board, throughout its length.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

viii) Bus-bars supports and connections shall be sized, braced and supported to withstand the mechanical forces and thermal effects resulting from the short circuit current & shall equally supported on insulators.

ix) Bus bar supports shall be of SMC/epoxy based insulator.

x) PDB & LDB shall be provided with two earthing terminal for earthing with earthing bolt, nuts & washers, enable to connect with earth grid.

4.5 Clearance, creepage distance & insulation level

The clearance & creepage shall not be the lesser than the values specified below-

Phase to Phase - 26mm

Phase to earth - 19mm

Minimum creepage distance - 28mm

Rated insulation voltage 660V

One-minute power frequency withstands voltage: 2.5 kV for power circuits and 2 kV for control circuits.

4.6 Moulded Case Circuit Breaker

i) MCCB shall confirm to IS: 13947 & shall have rupturing capacity as specified in SOR for non-draw out / draw out type modules as applicable.

ii) MCCB shall be of AC23 duty, quick make & quick break type & trip free mechanism as per IS 13947. MCCB shall be provided with necessary alarm & auxiliary contacts.

iii) Rating and number of poles for the switch shall be as mentioned in feeder list/single line diagram.

iv) The thermal & short circuit tripping device shall be adjustable type.

v) Interlocking to prevent the compartment door being opened unless the isolator/MCCB is in the open position.

vi) Distribution board shall be provided with current transformers, earth fault and over current relay, contactors (mechanically and electrically interlocked, if required) as per SLD.

vii) Distribution board incomers shall have power monitoring meter and indication lamps for metering and indication purpose as shown in SLD for PDB/MLDB/MOVDB etc.

viii) MCCB tripping characteristics curves shall be submitted along with offer & MCCB shall be type tested (contractor shall submit the type test reports/certificates along with offer)

4.7 Miniature Circuit Breaker



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

MCB shall confirm to IS: 13032 & 8828 & shall have breaking capacity of 10kA. The overload & short circuit device shall be provided in heat resistance housing.

Short circuit time curve/tripping curves shall be submitted along with offer.

4.8 Switch and Fuse combination units

- i) Sheet steel enclosed heavy duty Switch fuse unit as per SOR.
- ii) Rating and number of poles for the switch shall be as mentioned in feeder list/single line diagram.
- iii) Padlocking facility in the 'off' position.
- iv) AC-23 duty as per IS: 13947 with Auxiliary contacts - 1 No & 1 NC
- v) Fault-make, load-break type, unless specified otherwise
- vi) Interlocking to prevent the compartment door being opened unless the isolator is in the open position.
- vii) Distribution board shall be provided with HRC fuses with fuse holder as per IS: 9224 and shall be suitable coordinated with load & fault current.

4.9 Earthing

- i) All metallic non-current carrying parts of the distribution board shall be bonded together and connected to the internal earth bus-bar.
- ii) All doors shall be bonded to the main structure by means of a flexible copper connection arranged so that it cannot be trapped as the door is opened or closed.
- iii) Provision shall be made, adjacent to the cable termination, for cable armour earthing.
- iv) Distribution boards shall be supplied with an external M10 brass earth stud complete with nuts, spring and plain washers. This stud is to be internally connected to the earth busbar

4.10 Secondary Wiring

- i) Secondary wiring shall be copper conductor PVC insulated 660/1000 volts grade.
- ii) Secondary wiring within the distribution board shall be securely held in position (either bunched or run in conduit/trunking).
- iii) Wiring identification shall be by numbered and/or lettered interlocking sleeve ferrules of insulating material adjacent to the terminals. They shall be indelibly marked and removal without disconnecting the wire from its terminal shall not be possible.
- iv) Flexible cables shall be used for connections on door mounted equipment. Wiring shall be bunched, wrapped in flexible conduit and be firmly clamped at both ends to prevent movement at terminations.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

- v) The minimum conductor size shall be 2.5 mm² cable sheath colour shall be consistent with the phase/neutral/earth circuit to which they are connected.
- vi) All wiring for external connections shall be brought out to individual terminals on a easily accessible terminal block.
- vii) Only one conductor shall be connected to each side of each terminal, additional linked terminals shall be provided where more connections are required.
- viii) All control wiring shall be neatly arranged & properly supported.

4.11 Cable Terminations

- i) All power & control cable shall enter to the distribution board from bottom unless otherwise specified. Cable terminating facilities and terminals shall be suitable for the specified cable type and conductor size. Contractor shall take consideration and provision on the equipment design for the use of cable with aluminium conductors.
- ii) Terminal blocks shall be arranged and positioned for easy access for carrying out external cable termination, testing, inspection and maintenance. There shall be clear space allowed between the terminal block and the cable entry for the spreading and termination of external conductors.
- iii) Terminal blocks shall be mounted in a single tier arrangement. 20% extra terminal shall be provided in terminal block.
- iv) Terminal block for control cable shall be pressure clip type & terminal block for power cables are bolted type. Minimum current rating of terminal block shall be 16 amp.
- v) The panel wiring shall be on one side of the terminal block only.
- vi) All terminal blocks shall be shrouded or provided with transparent covers.
- vii) Terminals for different voltages shall be separated by partition..
- viii) For power cable connection suitable marking shall be provided to the terminal block for identification of phases of cable.
- ix) An un-drilled gland-plate or entry panel of sufficient dimensions to terminate the specified cables shall be provided. Cable entry shall be from bottom unless specified.
- x) Positioning of cable terminations shall avoid obstruction of other cable terminations, removable covers, etc. and sufficient space shall be available for maintenance work and cable termination.
- xi) Cable clamping arrangement shall be provided to avoid undue strain on the cable termination.

4.12 Indication Lamp, Instrument & meters



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

Indication for the circuit conditions shall be as per drawing.

PDB & LDB shall have indication lamp for showing the availability of incoming power.

The colors of the lamp for various status of the circuit is shown below (Provided in all outgoing feeder's of PDB)-

- i) Red - Switch/MCCB/Contactor ON
- ii) Green - Switch/MCCB/Contactor OFF
- iii) Amber - For Trip Indication

All lamps shall be LED (Cluster Type).

Measuring Instruments

- i) The instrument shall be flush mounted to the door of distribution board.
- ii) 96x96 mm size, CL 1.5 analog ammeter & voltmeter shall be provided with ammeter & voltmeter selector switch in PBDs & LDBs.
- iii) One KW meter shall be provided in each PDB. Kw meter shall be 3 Ph 4 wire type & CT operated, the current coil shall be rated for 5A.
- iv) Multi function meter-

PDB shall be provided with multi function meter having follow specification-

The MFM (Multi function Meter) shall be microprocessor based Electronic type having load survey facility and RS 485 communication port with necessary software / hardware for connectivity to SCADA.

The multi function meter shall have the following minimum features

- Ammeter
- Voltmeter
- Frequency meter
- Power Factor meter
- KW meter
- KWH meter
- KVA meter
- KVAR meter
- 30 min or 15 min maximum demand meter
- Maximum Demand controller

4.13 Fuses



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

Fuses shall be non-deteriorating HRC cartridge link type as per IS: 9224 use for back up protection. 4.14 Anti-condensation Space Heaters

Thermostatically controlled heaters suitably rated to prevent condensation shall be provided within the distribution board.

The heater shall be supplied with a double pole isolator.

The heater terminals shall be clearly marked as to their use.

4.15 Name Plate

A main nameplate shall be affixed in a prominent position on the front of each distribution board giving the following information:

Manufacturers name.

Distribution board Tag Number and name.

System voltage, phase, wires and frequency

Year of manufacture

Danger Board

Characters shall be of 12 mm height.

Labels shall have black characters on a white background and be made of a non-corrodible material. Warning/Danger labels shall have black lettering on a yellow background.

Label shall be affixed by screws or rivets.

Each distribution board shall have fitted a circuit directory within a clear protective cover located on the inside of the outgoing circuit compartment door.

5.0 PAINTING

All sheet metal work shall undergo a process of Degreasing Pickling in acid cold rinsing & Phosphating Two primer coats of Epoxy based primer suitable for corrosive (seashore) atmosphere. Two finish coats of painting of RAL7032 or approved color shade and quality. The interior of panel shall have eggshell white paint.

6.0 TROPICAL PROTECTION

All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects & corrosion. Screens of corrosion resistant materials shall be furnished on all ventilating louvers to prevent the entrance of insects.

7.0 PACKING AND DISPATCH



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

Distribution boards shall be shipped to suit ease of handling for transportation and installation. Each shipping section shall be provided with location of lifting points clearly marked on shipping containers. Each shipping section shall have its weight clearly marked on the container.

Preparation for shipment shall protect the distribution board, auxiliary devices, accessories, etc. against corrosion, dampness, breakage or vibration injury during transportation and handling. The packing shall be completely suitable for long duration outdoor storage in areas with heavy rains/high ambient temperature.

Each shipping container shall be identified with the contents, purchase order number and item number.

Instructions shall be provided for reassemble of sections in the field.

8.0 DRAWINGS AND DOCUMENTS

8.1 The following documents shall be submitted along with the offer:

- a) List of two years operation and maintenance spare.
- b) Bus-Bar sizing calculation
- c) Type test certificates of Bought Out items
- d) Dimensional GA & foundation drawing of PDB/LDB indicating bus-bar arrangement, foundation details, gland plate location
- e) Component specification details
- f) Catalogues of bought out items like -relays, breakers etc

8.2 The following drawings/documents shall be submitted for approval within 3 weeks of award of contract.

- a) Dimensional GA & foundation drawing of PDB/LDB indicating bus-bar arrangement, foundation details, gland plate location
- b) Front view of PDB/LDB indicating component locations
- c) Single line schematic diagram indicating feeder details
- d) Control schemes of feeders
- e) Component specification details
- f) List of inscriptions
- g) Internal wiring diagrams
- h) Terminal plan and external connection diagrams



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

- i) Cross sectional drawings of cubicle indicating details of bus-bar chamber, cable chamber breaker chamber, LV chamber etc
- j) Operation and maintenance manuals
- k) Bus-Bar sizing calculations
- l) Catalogues of bought out items like -relays, breakers etc
- m) Bill of material

9.0 INSPECTION AND TESTING

Inspection and testing of equipment shall be carried out by the owner/ consultant at the works of the contractor on final product to ensure conformity of the same with the acceptable criteria of technical specification, approved drawings and national/ international standards.

The contractor shall submit Quality Assurance Plan (QAP) for respective equipments within three weeks of award of contract. Owner's representative shall be given minimum two weeks advance notice for witnessing the final testing.

QAP shall be prepared and furnished by the contractor in Employer Form No. 11.20(4.4) F-10 along with their internal in process quality checks.