



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

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TITLE	1.1KV PAIRED CONTROL CABLE	SIGN					
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		GROUP	TBEM	W.O. No			
CUSTOMER	HPCL						
CONSULTANT	EIL						
PROJECTS	66KV GIS OF CCPP FOR VRMP, Vishakhapattanam						

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SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 1.1kV Paired Control Cables. This section covers the specific technical requirements of the cables.

In case of any conflict between the technical details mentioned in this section and the remaining sections of this document, then Section-1 shall prevail and is to be considered as binding requirement.

1.1 The equipment is required for the following Project.

Name of Customer : HPCL

Name of Consultant : EIL

Name of the Project : 66kV GIS of CCPP for VRMP, Vishakhapattanam

Refer Section – 2 : Equipment Specification.

Section – 3 : Project Details and General Specifications.

Section – 4: Standard Technical Data Sheet.(Not applicable)

Section – 5 : Checklist

2.0 SPECIFIC TECHNICAL PARTICULARS

- The data sheet of LT paired control cable is attached as annexure to Section-1.
- The cables shall be supplied in non-returnable steel drums.
- The cable length shall be 1200m per drum.
- Tolerance of +/- 3% shall be permissible for each drum. Overall tolerance on each size of cable shall be limited +/-2%.

3.0 BILL OF QUANTITY:

The cable type, size and length requirement shall be as per tables below. However, overall contract value may vary by +/-30%.

3.1 XLPE insulated 1.1kV Paired Control Cables:

S. No.	Description	Unit	Length
1.	4P x 2.5 sq mm XLPE/ Cu Control Cable	m	25200
2.	12P x 2.5 sq mm XLPE/ Cu Control Cable	m	7200

4.0 TESTS:

- All cables to be supplied of type tested quality. Cables shall conform to type tests including additional type tests as per clause 5.0 and Annexure-B of Section II of technical specification and shall be subject to routine & acceptance tests in accordance with requirements stipulated under respective sections. Any other test as per manufacturers standard quality plan (MQP) approved by Customer is deemed to be included.

The type, acceptance and routine tests may be witnessed by purchaser/ purchaser's representative.

- b) The bidder should have valid test reports of test for resistance to ultra violet radiation and test for accelerated water absorption test on insulation as per technical specification at recognized NABL approved testing laboratory. The test certificates should not be older than one year.
In case valid test reports (not older than one year) are not available, the tests shall be conducted at any recognized test laboratory or in house testing laboratory before despatch clearance of cables without any price or delivery implication to BHEL. Sampling for this test shall be done randomly once for each order provided outer sheath remains the same.
- c) The prices for conducting all tests (routine, type, acceptance and special tests) are deemed to be included in respective cable prices.

5.0 TECHNICAL QUALIFYING REQUIREMENT:

A) FOR 1.1KV CONTROL CABLE :

The manufacturers, whose XLPE Cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 50 Kms of 1.1 KV grade XLPE insulated Control cables as on the date of technical bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 19C x 2.5 Sq.mm or higher size as on the date of bid opening.

6.0 DEVIATIONS:

The offer of bidder shall be as per technical specification. No deviation from the same will be accepted. NIL deviation sheet should be signed and attached with offer.

ANNEXURE - A

S.No.	Descriptions (Pair x sqmm)		4P x 2.5	10P x 2.5	12P x 2.5
	ITEM CODE				
1	Name Of Manufacturer				
2	Aplicable Standard				
3	Voltage Grade		650V / 1100V		
4	CONDUCTOR				
a)	Material		Electrolytic Grade Annealed Tinned Copper Conductor as per IS: 8130		
b)	Size	Sqmm	2.5	2.5	2.5
c)	No. of Strands		7	7	7
d)	Dia. of each strand(Before Stranding)	mm	0.67	0.67	0.67
5	INSULATION				
a)	Material		Extruded, XLPE compound for Non-IS cables		
b)	Thickness	mm	0.9 (Min.)	0.9 (Min.)	0.9 (Min.)
c)	Color		Pair: black and white	Pair: black and white	Pair: black and white
6	Min. no. of twists		13 twists/meter		
7	PAIR SCREENING		Applicable		
a)	Material		Aluminium Mylar tape		
b)	Thickness		0.05 mm		
c)	Drain Wire Size		0.5 Sq.mm.(7/0.30 mm ATC)		
d)	Min.Coverage & Min.Overlap(%)		25% / 100%		
8	CABLE BUNDLING		Applicable for Multi Pairs		
a)	Binding Material		Polyester Tape		
b)	No. Of Twists/Mtr		2 to 4 twists per meter		
c)	Tape thickness		0.025 mm		
d)	Communication Pair				
i)	Conductor materials		Stranded Annealed Tinned Copper Conductor as per IS:8130		
ii)	Size (mm ²)		0.5 mm ² ((7x0.3 mm)		
iii)	Insulation materials		XLPE as per IS-7098-I		
iv)	Insulation thickness (mm)		0.4 (Min)		
v)	Color of cores		Colour of cores Green-Red		
9	Overall Screening		Applicable		
a)	Material		Aluminium Mylar tape		
b)	Thickness (Min)		0.075 mm		
c)	Drain Wire Material		Stranded Annealed Tinned Copper Conductor as per IS:8130		
d)	Drain Wire Size		0.5 Sq.mm.(7/0.30 mm ATC)		
e)	Min.Coverage & Min.Overlap(%)		25% / 100%		
10	INNER SHEATH				
a)	Material		Extruded FRLS PVC ST-2		
b)	Thickness (Min.)	mm	0.3	0.3	0.3
c)	Approx. Dia. Of cable Over In. Sh.	mm	18.9	28.5	30.2
d)	Rip Cord		Provided		
e)	Colour		Black		
11	ARMOURING				
a)	Material		Galvanised Steel Flat Strip as per IS:7098 (P-1)1988		
b)	Size Of Armour	mm	4 x 0.8	4 x 0.8	4 x 0.8
c)	Approx. Dia. Over Armour	mm	20.5	30.1	31.8
12	OUTER SHEATH				
a)	Material		Extruded FRLS PVC ST-2 (with antiodent & termite)		
b)	Thickness (Min.)	mm	1.4	1.56	1.56
c)	Overall Dia.		24.4	34.1	35.2

S.No.	Descriptions (Pair x sqmm)		4P x 2.5	40P x 2.5	12P x 2.5
	ITEM CODE				
d)	O.D Tolerance	mm	+/-2	+/-2	+/-2
e)	Colour		Black	Black	Black
13	ELECTRICAL CHARACTERISTICS				
	Inductance Between Conductor at 1000 Hz mH/Km	mH/Km	1	1	1
	Capacitance Between Conductor at 1000 Hz Micro F/Km(Max.)		0.2	0.2	0.2
	Capacitance Between Core & Screen @1KHz MicroF/Km (Max)		0.4	0.4	0.4
	L/R Ratio max.(Micro H/Ohm)		60	60	60
	Max. Drain Wire + shield Resistance		30 OHMS/KM(MAX.)		
	Max. D.C Resistance at 20 Deg.C	Ohm/Km	7.71	7.71	7.71
	Insulation Resistance		1000 MQ/Km		
	Electorstatic Noise Rejection Ratio		76 db or better		
14	Colour Identification		Pair: black and white		
			Pairs/Triad shall be identified by printing pair numbers by black indelible ink on the white core at interval not more than 250 mm. Conductor insulation shall be black and white for each Pair		
15	Cable length/Drum with Tolerance	Mtrs			
16	Marking on Cables				
17	FRLS Properties				
a.	Oxygen Index at room temperature		30% min.As Per ASTM-D-2863		
b.	Temperature Index		Min. 250 deg.c.ASTM-D-2863		
c)	Smoke Density Rating		Max 60% as per ASTM-D-2843		
d)	Acid Gas Generation		20% as per IEC 754-1		
e.	Flammability test		As per IEEE 383/ IEC – 332.3, Part 3, Category-A.		
18	Sequential Marking		To Be Provided at every one meter		

मध्यम एवं उच्च वोल्टेज
केबल एवं असेसरीज
के लिए विनिर्देश

**SPECIFICATION
FOR
MEDIUM AND HIGH VOLTAGE
CABLES & ACCESSORIES**

8	20/01/17	REVISED AND ISSUED AS STANDARD SPECIFICATION	RG	MKS	BRB	RN
7	01/04/16	REVISED AND ISSUED AS STANDARD SPECIFICATION	RG	MKS	BRB	RN
6	11/04/11	REVISED AND ISSUED AS STANDARD SPECIFICATION	PS	ANPS	UAP	DM
5	20/04/09	REVISED AND ISSUED AS STANDARD SPECIFICATION	PB	UAP	JMS	ND
4	15/03/04	REVISED AND ISSUED AS STANDARD SPECIFICATION	RKM	AAN	VPS	SKG
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

ASTM	:	American Society for Testing and Materials
BIS	:	Bureau of Indian Standards
BS	:	British Standard
CEA	:	Central Electricity Authority
DGMS	:	Director General of Mines and Safety
EPR	:	Ethylene Propylene Rubber
FR	:	Flame Retardant
FRLS	:	Flame Retardant Low Smoke
FS	:	Fire Survival
HR PVC	:	Heat Resistant Polyvinyl Chloride
ICEA	:	Insulated Cable Engineers Association
IEC	:	International Electro technical Commission
IS	:	Indian Standards
NEMA	:	National Electrical Manufacturers Association
PVC	:	Polyvinyl Chloride
UV	:	Ultra Violet
XLPE	:	Cross linked Polyethylene

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Ms. N.P. Guha (Projects)

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1.0 SCOPE

This specification along with data sheets covers requirements for design, manufacture, testing at works and supply of Fire survival Medium voltage cables and Flame Retardant Low Smoke Medium & High Voltage cables and cable jointing / terminating accessories for medium and high voltage systems.

2.0 STANDARDS

2.1 The cables and cables jointing & terminating accessories shall comply with the latest edition of the following standards as applicable:

IS: 209	:	Specification for zinc.
IS: 1554	:	PVC insulated (heavy duty) electric cables.
IS: 3961(Pt-2)	:	Recommended current ratings for cables: Part - 2 PVC Insulated and PVC sheathed heavy-duty cables.
IS: 3975	:	Mild steel wires, strips and tapes for armouring of cables.
IS: 5831	:	PVC insulation and sheath of electric cables.
IS: 6380	:	Specification for elastomeric insulation and sheath of electric cables.
IS: 7098	:	Cross-linked polyethylene insulated PVC sheathed cables.
IS: 8130	:	Conductors for insulated electric cables and flexible cords.
IS: 10418	:	Drums for electric cables.
IS: 10462 (Pt-1)	:	Fictitious calculation method for determination of dimensions of protective coverings of cables: Part - I Electrometric and thermo-plastic insulated cables.
IS: 10810	:	Methods of test for cables: - Part 41: Mass of zinc coating on steel armour - Part 58: Oxygen index test - Part-61: Flame retardant test - Part-62: Fire resistance test for bunched cables. - Part-63: Measurement of Smoke density of Electric cables under fire conditions
IS: 13573	:	Joints and terminations for polymeric cables for working voltages from 6.6kV up to and including 33kV.
IEC: 60331-21:	:	Tests for electric cables under fire conditions circuit integrity – Procedures and requirements - Cables of rated voltage up and including 0.6/1.0kV.
IEC: 60332-1	:	Test of the fire behaviour on single core or single cable (flame retardancy)
IEC: 60332-3	:	Tests of the fire behaviour on bunched cables (reduced flame propagation)
IEC: 61034	:	Measurement of smoke density of cables burning under defined condition
NEMA-WC70	:	Standard for non shielded power cables rated 2000V or less for the distribution of electrical energy.
NEMA-WC53	:	Standard test methods for extruded dielectric power, control, instrumentation and portable cables for test.
ASTM-G-154	:	Standard practice for operating fluorescent light apparatus for UV exposure of non metallic materials.
ASTM-D-2863	:	Measurement of minimum oxygen concentration to support candle like combustion of plastics
BS: 7846	:	Electric cables- 600/1000V armoured fire resistant cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire.

- 2.2 The cables and accessories shall also conform to the provisions of CEA Regulations and other statutory regulations, as applicable.
- 2.3 In case of any conflict between requirements specified in various applicable documents for the project, the most stringent one shall prevail. However, Owner's decision in this regard will be final and binding.

3.0 GENERAL CONSTRUCTION

- 3.1 The cables shall be suitable for laying in trays, trenches, duets, and conduits and for underground-buried installation with uncontrolled backfill and possibility of flooding by water and chemicals.
- 3.2 Outer sheath of all cables shall be black in colour and the minimum value of oxygen index shall be 29% at $27 \pm 2^\circ \text{C}$. In addition suitable chemicals shall be added into the PVC compound of the outer sheath to protect the cable against rodent and termite attack. However, for earthing cables; colour of outer sheath shall be green.
- 3.3 All cables covered in this specification shall be Flame Retardant Low Smoke (FRLS) or Fire Survival (FS). The outer sheath of FRLS cables shall possess flame propagation properties meeting requirements as per IS-10810 (Part-62) category AF. FRLS cable shall be identified by indenting, embossing or printing the appropriate legend i.e. 'FRLS, Category - C2' throughout the cable length. FRLS properties shall be as per IS:10810 Part 61 & 62, IEC-60332 Part 1 & Part 3, IEEE-383, IEC-61034, IEC-60754 Part 1, ASTM-D-2863.
- 3.4 Sequential marking of the length of the cable in metres shall be provided on the outer sheath at every one metre. The embossing/engraving shall be legible and indelible.
- 3.5 The overall diameter of the cables shall be strictly as per the values declared by the manufacturer in the technical information subject to a maximum tolerance of $\pm 2 \text{ mm}$ up to overall diameter of 60mm and $\pm 3 \text{ mm}$ for beyond 60mm.
- 3.6 PVC/ Rubber end caps shall be supplied free of cost for each drum with a minimum of eight per thousand metre length. In addition, ends of the cables shall be properly sealed with caps to avoid ingress of water during transportation and storage.
- 3.7 The joints in armour wire/strips shall be made by brazing or welding and any surface irregularities shall be removed. A joint in any wire/strip shall be at least 300mm. from the nearest joint in any wire/strip in the complete cable.
- 3.8 The cables meant to be used in mining area under the jurisdiction of DGMS shall satisfy the following
- (a) "DGMS CERTIFIED" to be embossed at outer sheath at regular interval.
 - (b) Cables to be used in Mines shall have copper conductor only.
 - (c) The resistance of armour shall not exceed that of the conductor as specified in IS-8130 by more than 33%. To satisfy this, substitution of galvanised steel wire/strip in armouring by the required number of tinned copper wires/strips is permissible.
 - (d) For mining cables, the size and type of armour shall be such that the combined conductance of armour shall be equivalent to 75 percent of the conductance of the largest conductor of the cable.

3.9 Medium Voltage Cables

- 3.9.1 All power/control cables for use on medium voltage systems shall be heavy-duty type, 650/1100V grade with aluminium/ copper conductor, PVC/XLPE (as mentioned in datasheet / Material requisition) insulated, inner-sheathed, armoured/ unarmoured and overall PVC sheathed. XLPE insulated cables shall meet the requirement specified in IS-7098 (Part-1).
- 3.9.2 The conductors shall be solid for conductor of nominal area up to and including 6mm² and stranded beyond 6mm². Conductors of nominal area less than 16 mm² shall be circular only. Conductors of nominal area 16 mm² and above may be circular or shaped as per IS 8130. Cables with reduced neutral conductor shall have sizes as per Table 1 of IS 1554 (Part-1).
- 3.9.3 The core insulation shall be with PVC/XLPE compound applied over the conductor by extrusion. PVC compound shall conform to the requirements of type 'C' compound as per IS: 5831. The thickness of insulation and the tolerance on thickness of insulation shall be as per Table 2 of IS: 1554 (Part-1). Control cables having 6 cores and above shall be identified with prominent and indelible Arabic numerals on the outer surface of the insulation. Colour of the numbers shall contrast with the colour of insulation with a spacing of maximum 50 mm between two consecutive numbers. Colour coding for cables up to 5 cores shall be as per Indian standard.
- 3.9.4 The inner sheath shall be applied over the laid-up cores by extrusion and shall be of PVC conforming to the requirements of Type ST-2 PVC compound as per IS: 5831. The minimum thickness of inner sheath shall be as per Table-4 of IS: 1554 (Part-1). Single core cables shall have no inner sheath.
- 3.9.5 All cables shall be provided with armour except those specifically specified as unarmoured. For single core cables intended for use on AC system, the armouring shall be of non-magnetic material. For multicore cables, the armour shall be by single round galvanised steel wires where the calculated diameter below armouring does not exceed 13 mm and by galvanised steel strips where this dimension is greater than 13 mm. Requirement and methods of tests for armour material and uniformity of galvanisation shall be considered as per IS - 3975 and IS - 10810 (Part 41). The dimensions of armour shall be considered as per method (b) of IS - 1554 (Part -1). For single core cables, the armour shall be with H4 grade hard drawn aluminium round wire of 2.5 mm diameter.
- 3.9.6 The outer sheath for the cables shall be applied by extrusion and shall be formulated for lower smoke and shall be of PVC compound conforming to the requirements of type ST-2 compound as per IS: 5831. The minimum and average thickness of outer sheath for unarmoured cables and minimum thickness of outer sheath for armoured cables shall be as per Table-7 of IS: 1554 (Part -1).
- 3.9.7 If heat resisting PVC cables are specified in the data sheet, it shall be possible to continuously operate the cable at a maximum conductor temperature of 85°C under full load condition and 160°C under short-circuit condition.
- 3.9.8 For XLPE insulated cables, it shall be possible to continuously operate the cable at a maximum conductor temperature of 90°C under full load condition and 250°C under short-circuit condition.
- 3.9.9 The fire survival cables shall meet the following additional requirements :
- The insulation shall be of EPR or equivalent material with glass mica tape below or above insulation.
 - The cables shall meet requirement of circuit integrity test for a minimum period of 3 hours at maximum temperature of 950° C.

3.10 High Voltage Cables

- 3.10.1 Power cables from 3.3kV and up to and including 33kV systems shall be Aluminium/ Copper conductor, XLPE insulated, sheathed, armoured/ unarmoured and overall PVC sheathed.
- 3.10.2 The conductors shall be stranded and compacted circular for all cables.
- 3.10.3 All cables rated 3.8/ 6.6kV and above shall be provided with both conductor screening and insulation screening. The conductors shall be provided with non-metallic extruded semi conducting screen.
- 3.10.4 The core insulation shall be with cross linked polyethylene insulating compound dry cured, applied by extrusion. It shall be free from voids and shall withstand all mechanical and thermal stresses under steady state and transient operating conditions. It shall conform to the properties given in Table-1 of IS: 7098 (Part -2).
- 3.10.5 The insulation screen shall consist of non-metallic extruded semi-conducting compound in combination with a non-magnetic metallic copper screen. The copper screen for all the three cores together shall be capable of carrying the single line to ground fault current value and the duration specified in the data sheet. For single core cable, copper screen provided shall be capable of carrying the single line to ground fault current value and the duration specified in the data sheet.
- 3.10.6 The conductor screen, XLPE insulation and insulation screen shall all be extruded in one operation by 'Triple Extrusion' process to ensure perfect bonding between the layers. The core identification shall be by coloured strips or by printed numerals.
- 3.10.7 The inner sheath shall be applied over the laid up cores by extrusion and shall conform to the requirements of type ST 2 compound of IS: 5831. The extruded inner sheath shall be of uniform thickness. In case of single core cables, there shall be extruded inner sheath between insulation metallic screen and armouring.
- 3.10.8 All cables shall be provided with armour except those specifically specified as unarmoured. For single core cables intended for use on AC system, the armouring shall be of non-magnetic material. For multicore cables, the armour shall be by galvanised steel strips. Requirement and methods of tests for armour material and uniformity of galvanisation shall be as per IS - 3975 and IS -10810 (Part 41). The dimensions of armour shall be as per method (b) of IS - 7098 (Part -2). For single core cables, the armour shall be with H4 grade hard drawn aluminium round wire of 2.5 mm diameter.
- 3.10.9 The outer sheath of the cables shall be applied by extrusion over the armouring and shall be of PVC compound conforming to the requirements of Type ST 2 compound of IS: 5831. The minimum and average thickness of outer sheath for unarmoured cables and minimum thickness of outer sheath for armoured cables shall be as per IS: 7098 (Part-2).
- 3.10.10 The thickness of the insulation, inner sheath shall be governed by values given in Table-4 and Table-5 of IS: 7098 (Part -2).

4.0 CABLE ACCESSORIES

- 4.1 The termination and straight through jointing kits for use on the systems shall be suitable for the type of cables offered as per this specification and shall meet requirements of IS 13573.
- 4.2 The accessories shall be supplied in kit form. Each component of the kit shall carry the manufacturer's mark of origin.

4.3 The kit shall include all stress grading, insulating and sealing materials apart from conductor fittings and consumable items. An installation instruction sheet shall also be included in each kit.

4.4 The contents of the accessories kit including all consumable shall be suitable for storage without deterioration at a temperature of 45° C, with shelf life extending to more than 5 years.

4.5 Terminating Kits

The terminating kits shall be suitable for termination of the cables to an indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer/ motor. For outdoor terminations, weather shields/ sealing ends and any other accessories required shall also form part of the kit. The terminating kits shall be from one of the makes/ types mentioned in the data sheet.

4.6 Jointing Kits

The straight through jointing kits shall be suitable for installation on overhead trays, concrete lined trenches, and ducts and for underground burial with uncontrolled backfill and possibility of flooding by water and chemicals. These shall have protection against any mechanical damage and suitably designed to be protected against rodent and termite attack. The inner sheath similar to that provided for cables shall be provided as part of straight through joint. The jointing kits shall be from one of the makes/ types mentioned in the data sheet.

5.0 INSPECTION, TESTING AND ACCEPTANCE

The cables shall be tested and inspected at the manufacturer's works. Manufacturer shall furnish all necessary information concerning the raw material supply to EIL/ Owner's inspectors. The inspector shall have free access to the manufacturer's works for the purpose of inspecting the process of manufacture in all its stages and will have the power to reject any material, which appears to be of unsuitable description or of unsatisfactory quality. For HV cables, the vendor shall give at least 2 weeks advance notice to the purchaser, regarding the date of testing to enable purchaser's representative to witness the tests.

5.1 Cables

5.1.1 After completion of manufacture of cables and prior to despatch, the cables shall be subjected to type, routine, acceptance and special tests as detailed below. The test reports for all cables shall be got approved from the Engineer before despatch of the cables.

5.1.2 All routine tests, acceptance tests, type tests and additional type tests for improved fire performance shall be carried out as listed in IS: 1554 (Part-1) and IS: 7098 (Part-2) on PVC and XLPE insulated cables respectively.

5.1.3 The test requirements for PVC insulation and sheath of cables shall be as per latest revision of IS: 5831.

5.1.4 Test for Resistance to Ultra Violet Radiation: This test shall be carried out as per ASTM-G-53 or ASTM-G-154 on outer sheath. The retention value of tensile strength and ultimate elongation after the test shall be minimum 60 % of tensile strength and ultimate elongation before the test. Test certificates with respect to this test (not older than one year) from recognised testing laboratory to be furnished for review by EIL before despatch clearance of cables. In case test certificates are not available, test is to be conducted by vendor at his own cost in any recognised test laboratory or in house testing laboratory, before despatch clearance

of cables. Sampling for this test is to be done randomly once for each order, provided outer sheath remains same.

5.1.5 Acceptance tests as per IS-1554 (Part-1) and IS-7098 (Part-2) and the following special tests to be performed on the cables as per sampling plan for all cables. However these tests are required to be witnessed by EIL/ Owner for HV cables.

- a. Accelerated water absorption test for insulation as per NEMA-WC-70. (For PVC insulated cables) and as per NEMA-WC-53 (for XLPE/ EPR insulated cables). Test certificates with respect to this test (not older than one year) from recognised testing laboratory to be furnished for review by EIL before despatch clearance of cables. In case test certificates are not available, test is to be conducted by vendor at his own cost in any recognized test laboratory or in house testing laboratory, before despatch clearance of cables. Sampling for this test is to be done randomly once for each order, provided type of insulation remains same.
- b. Dielectric Retention Test: The dielectric strength of the cable insulation tested in accordance with NEMA-WC-70 at $75 \pm 1^\circ \text{C}$ shall not be less than 50 % of the original dielectric strength. (For PVC insulated cables). Test certificates with respect to this test (not older than one year) from recognised testing laboratory to be furnished for review by EIL before despatch clearance of cables. In case test certificates are not available, test is to be conducted by vendor at his own cost in any recognized test laboratory or in house testing laboratory, before despatch clearance of cables. Sampling for this test is to be done randomly and once for each order.
- c. Oxygen Index Test: The test shall be carried out as per IS-10810 (Part 58). Sampling to be done for every offered lot/size as per sampling plan.
- d. Flammability Test: The test shall be carried out on finished cable as per IS-10810 (Part 61 & 62). Sampling for these tests is to be done randomly once for each order, provided outer sheath remains same. The acceptance criteria for tests conducted shall be as under:

Part-61-The cable meets the requirement if there is no visible damage on the test specimen within 300 mm from its upper end

Part-62-The maximum extent of the charred portion measured on the test sample should not have reached a height exceeding 2.5 m above the bottom edge of the burner at the front of the ladder.

- e. Test for rodent and termite repulsion property shall be done by analysing the property by chemical method.

5.1.6 Following tests shall be carried out to prove FRLS property of the cable.

- a. Critical oxygen index as per ASTM-D-2863 i.e. Determination of % of oxygen required for combustion at room temperature of FRLS sheath which shall remain as 29%(min.)
- b. Temperature index as per ASTM-D-2863 i.e. to determine at what temperature normal oxygen content of 29% in air will support combustion of FRLS sheath which shall remain as 250°C .
- c. Halogen acid gas emission as per IEC-60754 Part 1 i.e. to determine the % of release of hydrochloric acid gas from the FRLS sheath under fire which shall be 20% (max.)

- d. Smoke Density Test shall be as per ASTM D - 2843 and Smoke Density Rating of FRLS Sheath shall be 60% (max.).

5.1.7 The test for circuit integrity for fire survival cables shall be carried out as per IEC-60331 (Part-21).

5.2 Cable Accessories

Type tests should have been carried out to prove the general qualities and design of a given type of termination/ jointing system as per IS-13573. The type test certificates from independent testing laboratory shall be submitted before despatch.

6.0 PACKING AND DESPATCH

6.1 Cables shall be despatched in non-returnable steel drums of suitable barrel diameter, securely packed, with the take-off end fully protected against mechanical damage. Ferrous parts used shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.

6.2 On the flange of the drum, necessary information such as project title, manufacturer's name, type, size, voltage grade of cable, length of cable in metres, drum no., cable code, BIS certification mark, gross weight etc. shall be printed. An arrow shall be printed on the drum with suitable instructions to show the direction of rotation of the drum.

6.3 Cables shall be supplied in drum lengths as follows:

6.3.1 MV Cables

- Multicore Power cables upto 6 mm ²	:	1000 m
- Multicore Power cables from 10 mm ² up to 500 mm ²	:	500 m
- Single Core Power cables upto 630 mm ²	:	1000 m
- Control cables upto 61 cores	:	1000 m

6.3.2 HV Power Cables Upto 11kV Grade

- Three Core cables upto 400 mm ²	:	500 m
- Single Core cables upto 400 mm ²	:	1000 m
- Single Core cables above 400 mm ² and upto 1000 mm ²	:	750 m

6.3.3 HV Power Cables Above 11kV Grade and upto 33kV Grade

- Three Core cables upto 300 mm ² grade	:	350 m
- Single Core cables upto 400 mm ²	:	1000 m
- Single Core cables above 400 mm ² and upto 1000 mm ²	:	500 m

However exact drum lengths shall be finalised during order execution. A tolerance of $\pm 3\%$ shall be permissible for each drum. However overall tolerance on each size of cable shall be limited to $\pm 2\%$.

SECTION-2 : ANNEXURE-A .

Project	Project Management Consultancy (PMC) Services for execution of VRMP	Client	HPCL
Unit	CAPTIVE POWER PLANT (CPP)	Location	VIZAG
		Job No.	B016
		Unit No.	606

PURCHASER'S DATA

A. Site Conditions	
1. Maximum Ambient Temperature	°C 45
2. Minimum Ambient Temperature	°C 12.5
3. Design Ambient Temperature	°C 45
4. Relative Humidity	% 95
5. Altitude Above MSL	mm < 5.56
6. Environment	Humid & highly corrosive
B. Technical particulars	
1. System Voltage	
Nominal	
Highest	
Voltage grade	As per EDB
2. Frequency	Hz 50 +/- 3 %
3. Conductor material	
HV Power cable	Copper & Aluminium
MV Power cable	Copper & Aluminium
MV control cable	Copper
4. Installation under DGMS jurisdiction (See Note)	No
5. Applicable spec.	6-51-0051
6. Insulation	XLPE
7. PVC compound type	ST-2
8. Type of conductor	
9. Conductor class	Class-1/2 for fixed installation
10. Types of cable	Flame retardant low smoke
11. Armour	
Type	
Size of armour	
12. Type of drum	Steel

MANUFACTURER'S DATA

A. Technical particulars	
1. Name of manufacturer	
2. MR/PR item no.	
3. Cable type/ code	
4. Conductor material	
5. Conductor semiconducting screen (HV cables)	
Material	
Thickness	mm
6. Insulation	
Type of compound	
Thickness	mm
7. Insulation semiconducting screen (HV cables)	
Material	

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Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

Project	Project Management Consultancy (PMC) Services for execution of VRMP			Client	HPCL
Unit	CAPTIVE POWER PLANT(CPP)	Location	VIZAG	Job No.	B016
				Unit No.	606
	Thickness		mm		
8.	Copper tape				
	Thickness		mm		
9.	inner sheath				
	Type of compound				
	Thickness		mm		
10.	Nominal dia under armour		mm		
11.	Calculated dia under armour		mm		
12.	Armour				
	Material				
	Type				
	Size				
13.	Nominal dia under outersheath		mm		
14.	Calculated dia under outersheath		mm		
15.	Outersheath				
	Type of compound				
	Thickness		mm		
16.	Nominal outer dia of cable		mm		
17.	Tolerance on outer dia		%		
18.	Weight of cable per km		kg		
19.	Maximum drum length		mtr.		
20.	Maximum DC resistance of conductor at 20 °C				
21.	AC resistance at 90 °C				
22.	Reactance of cable at 50 Hz				
23.	Capacitance of cable				
24.	Zero sequence impedance of cable				
25.	Capacitive charging current per km				

Notes

- 1 E- Earthed system
UE -Un Earthed system
- 2 Where the installation falls under the jurisdiction of Directorate General of Mines Safety, cables shall comply
- 3 Single line to ground earth fault current for sizing of insulation screen for HV cables shall be considered as follows:
11kV (UE) grade cable : 1250A for 1 sec
- 4 All control cables to PLC/DCS from substation, field, control room panels shall be individually shielded & overall shielded with twisted pair.

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SECTION - 2

Annexure -B

Inspection and Testing Requirements.

(A)	Type Tests	:	Remarks
1	Type tests shall be as per IS-7098-I part-1;	:	
2	Test for resistance to Ultra violet radiation as per ASTM-G-53 or ASTM-G-154 on outer sheath.	:	Earlier test report review. If test report is older than one year, test shall be conducted in recognized test lab or in house testing lab without price or delivery implication.
(B)	<u>Routine Tests</u> Vendor shall carry out these tests during various stages of manufacturing.		
3.0	Insulation and sheaths: All tests as per IS-5831 shall be conducted as part of routine tests, except for insulation resistance, voltage and spark test	:	
3.1	Insulation resistance, voltage and spark test shall be as per BS-5308 part-2	:	
3.2	Armour test as per IS -3975	:	
3.3	Conductor resistance test as per IS 8130.		
3.4	Electrical test including cable capacitance (core-core) and (core-screen).	:	
3.5	Spark test as per BS 5308 Part 2.	:	
(C)	<u>Acceptance Tests</u>		
3.6	Insulation resistance as per BS 5308 Part 2.	:	The sampling plan is as per IS-7098-I.
3.7	High Voltage test as per BS 5308 Part 2.	:	
3.8	Conductor resistance test as per IS 8130.	:	
3.9	Inductance between 2 adjacent cores at 1 kHz frequency.	:	
3.10	Mutual capacitance between 2 adjacent cores and core - screen at 1 kHz frequency.	:	
3.11	L/ R ratio at 1 kHz frequency.	:	
3.12	Drain wire resistance as per IS 8130.	:	
3.13	Continuity test.	:	
3.14	Oxygen & temp. Index test as per ASTM - D 2863	:	
3.15	Acid gas generation test as per IEC - 754. (For FRLS)	:	
3.16	Smoke density test as per ASTM -D 2843. (For FRLS)	:	
3.17	Flame Retardant test as per IEEE 383/ IEC - 332.3, Part 3, Category-A.	:	
3.18	Dimensional checks overall diameter, under armour and over armour diameter. Overall diameter shall be within ± 2 mm over offered value.	:	
3.19	Checks for uniformity of galvanization of armour wire as per IS-2633.	:	
3.20	Checks for armour wire size as per IS-7098, part-1.	:	
3.21	Armour test as per IS-3975.	:	
3.22	Electrostatic noise rejection test, type wise for each lot.	:	
3.23	Accelerated water absorption test for Insulation as per NEMA-WC-53	:	Earlier test report review. If older than one year, test shall be conducted in recognized test lab or in house testing lab without price or delivery implication.
3.24	Flammability test as per IS-10810 (Part 61 & 62)	:	

Section 3: Project Details and General technical requirements for all equipment under the Project

The Break-up for section is as follows,

1. Project Details and Documental Requirements
2. Engineering Design Basis-Electrical
3. Specification for Documentation Requirements from Contractors
4. Methodology of Drawing & Document Review Procedure

Section 3: Project Details and General technical requirements for all equipment under the Project

1.1 PROJECT DETAILS

Sl. No.	Description	Specific Details
1.	Project Information	
i.	Customer	Hindustan Petroleum Corporation Limited (HPCL)
ii.	Project Management Consultant (PMC)	Engineers India Limited (EIL)
iii.	Projects	Captive Power Plant (CPP) package of M/S Hindustan Petroleum Corporation Limited, Visakh Refinery, Vishakhapatnam (Andhra Pradesh), India
iv.	Project locations	Visakh Airport: 12 Kms Visakh Sea port: 10 Kms BHEL HPVP: 8 Kms Hyderabad: 630 Kms Chennai: 800 Kms
v.	Transport facilities	Visakh Airport: 12 Kms Visakh Sea port: 10 Kms
2.	Site Conditions	Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.
i.	Maximum Ambient air temp. (max.)	45°C
ii.	Minimum Ambient air temp. (max.) °C	12.5°C
iii.	Design ambient temperature	45°C
iv.	Relative Humidity	95 %
v.	Environment	Humid & highly corrosive
vi.	Altitude above MSL	<5.56M
vii.		
3.	Auxiliary Supply	Details are as follows.
	Normal Voltage Variation	Frequency Phase/Wire Neutral Connection
	415 Volts	50+3% to -5% ¼ wire Solidly earthed
	230 Volts	50+3% to -5% ½ Solidly earthed
	110 Volts DC	DC 2 wire Isolated 2 wire system

Note:
Combined variation of voltage and frequency shall be limited to ±10%

1.2 INSPECTION, TESTING AND INSPECTION CERTIFICATE

Inspection testing shall be done as per customer specification and inspection plan mentioned elsewhere in the specification.

1.3 DOCUMENTATION

1.3.1 DRAWINGS AND INSTRUCTION MANUALS

A. Drawings to be furnished by the bidder after Award of Contract
The Bidder shall submit a 'drawing list' within 15 days from the effective date of Contract. Drawings/documents for 'approval' shall be submitted in (7) copies and shall be commented or approved within four (4) weeks after submitting. In case the approval or comment of drawings/documents by the BHEL/OWNER/PMC is delayed beyond a period of four (4) weeks after submitting, drawings/documents shall be deemed as approved.

In case acceptance, one set of drawings/documents shall be returned marked 'approved'.

In case of comments the following procedure shall apply

In case the drawings/document are accepted in principle, but minor modifications are required, the drawings/documents should be marked 'approved with comments' and the required modifications shall be spelt out detailed in the covering letter and/or clearly marked in the drawings. Fabrication / construction shall proceed, considering the comments. The corrected drawings/documents shall be submitted after incorporating comments.

In case of disagreement with the drawings/documents, these shall be marked 'returned for correction' and the reasons should be spelt out detailed in the covering letter. The drawings/documents shall be corrected and resubmitted for approval by return.

The drawings shall show sufficient overall dimensions, clearances etc., required for assembling and dismantling, and space requirement of all apparatus to enable the BHEL/OWNER/PMC to determine the design and layout at the installation.

After the completion of the erection work, the Bidder shall furnish fifteen (15) sets of the completion drawings and Ten (10) CD with Auto Cad 2011 or later version drawings in 2D and 3D marked 'as built' shall be submitted.

B. Operation and Maintenance Instruction Manuals

The Bidder shall furnish subsequent to completion of despatch twelve (12) sets of approved O&M instruction manuals. These manuals shall be properly bound in book form and contain all information, description of equipment, diagrams etc. necessary to enable the BHEL/OWNER/PMC to operate and maintain the complete equipment. Drawings with 'as built' status shall be added after commissioning. Reduced scale drawings/diagrams must be fully legible.

The title block of drawings shall contain the following information incorporated in all contract drawings

1.3.2 TITLE BLOCK

Title block for project shall be as follows.

Customer	Hindustan Petroleum Corporation Limited (HPCL)
Consultant:	Engineers India Limited (EIL)
Main Contractor	Bharat Heavy Electricals Limited (BHEL)
Project	Captive Power Plant (CPP) package of M/S Hindustan Petroleum Corporation Limited, Visakh Refinery, Vishakhapatnam (Andhra Pradesh), India

1.3.3 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

- 1) Drawings in 2D and 3D format.
- 2) Guaranteed Technical Particulars
- 3) Type Test Reports
- 4) Manufacturing Quality Plan
- 5) Any other drawings/documents as per Master Drawing List

1.3.4 DOCUMENTATION SCHEDULE AT CONTRACT STAGE

No. of Copies	A: For Approval
5	Copies of GA drawings (2d and 3D) with projects details, dimension, equipment weight, fixing details, tolerances and terminal details etc.
5	Copies of type test reports
5	Copies of shipping list detailing the description & quantities of all items being dispatched separately, with shipping weights, number of cases and dimensions
5	Copies of manufacturing and field quality plan
5	Copies of installation, operation & Maintenance manual
6	B : After Approval and For Information/Distribution.
6	Copies of All drawings
6	Bound sets containing all drawings/manuals, type and routine test reports etc. along with sub-vendor's test reports for all bought out assemblies/components/parts including internal wiring diagrams and exploded diagrams of assemblies/ parts, shall be furnished.
10	Copies of installation, Operation & Maintenance manual
12	C: On Completion of Entire works
10	Bound sets of installation, Operation & Maintenance manual and all as built drawings
10	Set of Computer CD-ROMs (with unbreakable CD Covers) containing all as-built drawings in Auto-Cad version 2008 or later with 2D and 3D drawings, Instruction Manual and GTP.

1.4 STANDARDS AND CODES OF PRACTICE

All equipment, systems and works covered under these specifications shall be in accordance

with all the applicable statutes, regulations, codes and standards specified as well as all such standards, statutes, regulations and safety codes applicable in the locality where the equipment will be installed. Bidder may familiarize themselves with all such requirements. Complete design including pressure parts, piping, valves and fittings shall meet or exceed all the latest requirements of the Indian Boiler Regulations (IBR), latest Indian Standards /ASME codes, latest codes and standards as applicable. Any Indian/International standards shall be followed for any imported equipment. For plant layout aspects and area classification requirements OISD standards shall be followed

The design, construction and testing of all equipment, facilities, components and systems shall be in accordance with relevant standards and codes issued by Bureau of Indian Standards (BIS) and/or reputed international standards and codes as on the date of Award of Contract. A non-exhaustive list of reputed international standards follows for reference.

- a) American National Standards Institute (ANSI)
- b) American Petroleum Institute (API)
- c) American Society of Mechanical Engineers (ASME)
- d) American Society of Testing and Materials (ASTM)
- e) American Water Works Association (AWWA)
- f) American Welding Society (AWS)
- g) British Standards (BS)
- h) Cooling Technology Institute (CTI)
- i) Deutsches Institut für Normung (DIN), Germany
- j) Gosstandart of Russia (GOST) standards
- k) Heat Exchange Institute (HEI), USA
- l) Hydraulic Institute Standards (HIS), USA
- m) International Electro-technical Commission (IEC)
- n) Institute of Electrical and Electronics Engineers (IEEE)
- o) International Organisation for Standardisation (ISO)
- p) Japanese Industrial Standards (JIS)
- q) National Electric Code (NEC), USA
- r) National Electrical Manufacturers Association (NEMA), USA
- s) Central Electricity Authority (Construction of Electrical Plants and Electric Lines) Regulations, Notification, 20th August 2010 and to those referred therein
- t) National Fire Protection Association (NFPA), USA
- u) Occupational Safety and Health Administration (OSHA)
- v) Tubular Exchanger Manufacturers Association (TEMA), USA
- w) VDE association for Electrical, Electronic and Information Technologies (VDE), Germany
- x) OISD

Other international Standards, equivalent or superior to the above Standards can also be adopted. However, in the event of any conflict between the requirements of the international standards or codes and the requirements of the BIS standards or codes, the latter shall govern unless specified elsewhere in the specifications. Any Indian/International standards shall be followed for imported equipment.

The Plants and Electric Lines (within the plant) shall also be designed to comply with the requirements stipulated in.

- a) Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.
- b) Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007
- c) Central Electricity Authority (Measures relating to Safety and Electricity Supply), Regulations as and when these are notified by the Authority.
- d) Central Electricity Authority (Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electric Lines) Regulations as and when these are notified by the Authority.
- e) Central Electricity Authority (Grid Standards) Regulations as and when these are notified by the Authority.
- f) Central Electricity Authority (Construction of Electrical Plants and Electric Lines) Regulations, Notification, 20th August 2010 and to those referred therein
- g) Indian Electricity Grid Code issued by Central Electricity Regulatory Commission (CERC) and
- h) Applicable State Grid Code issued by appropriate Regulatory Commission.

All material and equipment supplied and all work carried out as well as calculation sheets, drawings, quality and class of equipment, methods of inspection, constructional peculiarities of equipment and parts and acceptances of partial plants, as far as these are beyond the special requirements of the specifications, shall comply in every respect with the technical codes of the above listed codes and Standards.

It shall be the responsibility of the bidder to take all approvals required and get the HRSG registered under the IBR. In all other cases where IBR does not govern, IS/ASME, Japanese, American, British, German or other international standards established to be equivalent or superior to IS/ASME shall be acceptable with the approval of the Owner/Owner's representative at the time of detailed engineering.

Where there are no standards or regulations, or the standard is not sufficient to meet the need of design and supply, for such items relating to the power plant, the bidder shall carry out the design, manufacture, supply and installation on the basis of good engineering practice.

During the period of Contract execution, if any standards change, the bidder shall be responsible to notify the Owner/Owner's representative and provide the basis for the prospect that it would not cause the lowering of quality, performance and service life of the power plant due to alteration of the standard and the latest standards shall be followed by the bidder.

Further requirements about applicable standards and codes are specified in the detailed technical specifications.

1.5 SPECIAL TOOLS, TACKLES AND EQUIPMENT

One set of special tools and tackles required unit for the operation, maintenance, inspection and repair of the individual main equipment and auxiliary equipment shall be supplied by the bidder in sufficient quantity to equip the shift personnel, maintenance personnel and workshop craftsman for commissioning, testing, calibration, modification and maintenance of

the unit. List of such special tools, tackles and equipment shall be submitted in the EPC bid. Special tools and tackles excludes conventional ones and those locally available normally (not those requiring a drawing and considered as those made to order).

The special tools and equipment for maintenance and repair shall be delivered by the bidder in lockable steel boxes and they shall be marked in an approved manner for identification purposes and a corresponding tool chart shall be supplied with the steel boxes.

The following tools and appliances shall be supplied under this Contract for use by the Owner/Owner's representative.

- two sets of special tools and gauges required for the maintenance of the Plant
- one set of special lifting and handling tackles / appliances required for the maintenance of the Plant.

The tools, tackles and appliances supplied in general, shall not be used for erection purposes by the bidder and shall be handed over in brand new condition. Damaged tools, tackles, and appliances shall be replaced before handing over. The exception to this is the special lifting gear which may be used provided that when it is handed over to the Owner/Owner's representative it has not been subjected to more than normal wear and is still fully suitable for its intended use. Each set of tools, gauges and appliances under category (a) above shall be suitably arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the layout of the plant and equipment in question. If the weight of any box and its contents should be such that it cannot conveniently be carried, it shall be supported on steerable rubber-tyred wheels. Each cabinet and box shall be painted, fitted with a lock and clearly marked in white letters with the name of the item of equipment for which the tools and appliances contained are intended.

Suitable storage racks shall be provided for all portable lifting tackle supplied under this contract. Suitable lifting lugs, ears or ring bolts, or tapped holes for lifting rings shall be provided on all equipment items where the weight exceeds 15 kg.

All lifting tackle shall be stamped with a unique identification number and safe working load. A test certificate from an approved Authority shall be supplied for each item of lifting tackle. The bidder shall provide a schedule of all lifting tackle and tools and appliances being supplied, for the approval of the Owner/Owner's representative.

The bidder shall provide all runway beams, trolleys, lifting blocks, special slings necessary for the safe and efficient handling and maintenance of the works. Particular attention shall be paid to handling of equipment located at higher elevations safety valves

The tools and appliances with the appropriate storage racks, cabinets and boxes shall be handed over to the Owner/Owner's representative at the time of Taking Over of the complete Plant. Since the Contract includes supervision of site erection, any special tools or appliances required solely for erection shall be provided by the bidder for his own use and shall remain the property of the bidder.

Control and Instrumentation: Software with associated hardware required to access instruments or control systems to be provided

Section 1: Scope, Technical Requirements and Quantities

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1.6 PAINTING, INSULATION AND ANTI DEWING

Anti-corrosive coatings and painting shall be carried out as a pre-treatment to all equipment and parts. The paint system used should coordinate with the painted objects and surrounding conditions of project.

In multi-layer painting system, different painting layers should be selected to make the painting coordinate. If multi-layer painting system is used, various painting layers should have distinct colours so that the later layer can be distinguished from the former one.

After the equipment or apparatus finished preliminary or full painting, it can be supplied to field. After the installation is finished, ground coat must be painted. Entire painting procedure should be supplied in order to repair the injuries of painting coat after the equipment is delivered to field.

Colour strip indication system should be used for pipes. These strips should be painted on the joint of pipes, entrance, valves of pipe. This pipe without outside protection layer should be marked by some colour in whole length.

The principal colour of field equipment should be determined by Owner/Owner's representative and bidder during execution stage. For Electrical equipment, paint shade shall be as mentioned in the equipment Specification.

Further requirements with regard to painting, insulation, and anti-dewing are specified in the relevant sections in the detailed technical specifications. The specified requirements shall be applied to the whole equipment and facilities of the Contract. Insulation specification for MPP supplied equipment shall be as mentioned in detailed technical specification.

1.7 CONSUMABLES

1.7.1 Lubricants and greases

All lubricants proposed for the Plant operation shall be suitable for all operating and environmental conditions that will be met on site. All oils and greases shall where possible be readily available in India. The number of oils and greases shall be kept to a minimum to the extent feasible. For each type and grade of lubricant recommended the bidder shall list at least three equivalent lubricants manufactured by alternative companies. This will be in line with that suggested by OEM and outcome will be informed to the Owner/Owner's representative.

In case of imported oils, lubricants and other consumables, the bidder shall indicate the indigenous equivalents to enable the Owner/Owner's representative to arrange subsequent fills. Preference should be given to indigenous oils and lubricants during first filling itself. Short shelf life items if any may be supplied in a phased manner keeping in view of their actual use.

The bidder shall supply the first fill lubricants and greases, and also shall provide at the Completion Certificate sufficient lubricants and greases necessary for the efficient operation and maintenance of the Plant at full load 24 hours per day for a period as mentioned in the relevant portion of Commercial Specification.

Section 1: Scope, Technical Requirements and Quantities

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1.0 SCOPE

This electrical design basis defines the design requirements agreed by owner/clients in addition to "EIL standard design philosophy for electrical facilities no. 6-51-0099 Rev No 6". In case of any conflict between statutory requirements, this design basis and standard design philosophy, the most stringent requirement shall govern.

This electrical design basis is applicable for New process units (CDU/VDU, RUF, Isomerisation Unit, full conversion HCU), Auxiliary units (Hydrogen generation, Sulfur block, SWS-I, SWS-II, ARU, SR LPG Treater, FG ATU & Fuel gas PSA and existing revamp units (NHT, CCR, DHOT, PRIME-G, & PRU), CPP, Offsites & Utilities, etc.

2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

2.1 ABBREVIATIONS

Code	Description
@	To be decided during detail engineering
NA	Not Applicable
#	To be decided/data to be provided by Client
AC	Alternating Current
ACB	Air Circuit Breaker
ASB	Auxiliary Service Board
CBCT	Core Balance Current Transformer
CEA	Central Electricity Authority
CT	Current Transformer
DC	Direct Current
DCP	Data Concentrator Panel
DG	Diesel Generator
DGMS	Director General Mines Safety
DOL	Direct On Line
EHV	Extra High Voltage
ELCB	Earth Leakage Circuit Breaker
EPC	Emergency Power Control Center
EPGCC	Emergency Power cum Motor Control Center
FRLS	Flame Retardant Low Smoke
GI	Galvanised Iron
GTG	Gas Turbine Generator
HMI	Human Machine Interface
HSR	High Availability Seamless Redundancy
HV	High Voltage
IEC	International Electro-Technical Commission
LDB	Lighting Distribution Board
LV	Low Voltage
MCC	Motor Control Centre
MCCB	Moulded Case Circuit Breaker
MOV	Motor Operated Valve
MV	Medium Voltage
NGR	Neutral Grounding Resistor
OLTC	On Load Tap Changer
PCC	Power Control Centre
PESO	Petroleum & Explosive Safety Organisation
PLC	Programmable Logic Control
PMCC	Power Cum Motor Control Centre

Code	Description
PRP	Parallel Redundancy Protocol
PT	Potential Transformer
PTB	Physikalisch-Technische Bundesanstalt
PVC	Polyvinyl Chloride
RCC	Reinforced Concrete
RSTP	Rapid Spanning Tree Protocol
SFU	Switch Fuse Unit
SPN	Single Phase & Neutral
STG	Steam Turbine Generator
TP	Three Phase
TPN	Three Phase & Neutral
UPS	Uninterrupted Power Supply
VFD	Variable Frequency Drive
XLPE	Cross Link Poly Ethylene

2.2 CODES & STANDARDS / PUBLICATIONS

The main codes and standards, considered as minimum requirements, as applicable, are as follows :

S.No.	Description	Standards / Codes	Edition
1	Code of practice for the fire safety of buildings - Electrical Installations	IS-1646	Latest
2	Code of practice for selection, installation and maintenance of automatic fire detection and alarm system.	IS-2189	Latest
3	Code of practice for the protection against lightning	IS/IEC-62305	Latest
4	Code of practice for fire safety of industrial buildings - Electrical generating and distributing stations	IS-3034	Latest
5	Code of practice for Earthing.	IS-3043	Latest
6	Code of practice for interior illumination	IS-3846	Latest
7	Application guide for insulation Coordination.	IS-3716	Latest
9	Guide for safety procedures and practices in electrical work	IS-5216	Latest
10	Guide for selection of electrical equipment for hazardous areas.	IS-5571	Latest
11	Classification of hazardous areas (other than mines) having flammable gases and vapours for electrical installations.	IS-5572	Latest
12	Code of practice for Industrial Lighting	IS-6665	Latest
13	Guide for Control of undesirable static electricity.	IS-7689	Latest
14	Guide for improvement of power factor - consumer's installations.	IS-7762	Latest

S.No.	Description	Standards / Codes	Edition
15	Application guide for on load tap changers	IS-8478	Latest
16	Reference ambient temperature for electrical equipment	IS-9676	Latest
17	Code of practice for selection, installation and maintenance of transformer.	IS-10028	Latest
18	Code of practice for selection, installation and maintenance for switchgear and control gear.	IS-10118	Latest
19	Application guide for Power Transformer.	IS-10561	Latest
20	Voltage bands for electrical installations including preferred voltages and frequencies.	IS-12360	Latest
21	Guide for short circuit calculations in three phase AC systems.	IS-13234	Latest
22	Code of practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres.	IS-13408(Part-1)	Latest
23	Guide to the use of electrical apparatus for potentially explosive atmospheres in the presence of combustible dusts	IS-15142	Latest
24	National Electrical Code (NEC) - BIS Publication	SP-30	Latest
25	Recommended practices on static electricity	OISD-STD-110	Latest
26	Classification of Area for electrical installation at Hydrocarbon Processing and handling facilities	OISD STD-113	Latest
27	Inspection and safe practices during electrical installation	OISD-STD-147	Latest
28	Design aspects for safety in electrical systems	OISD STD-149	Latest
29	Fire Protection System for Electrical Installations	OISD STD 173	Latest
30	Lightning Protection	OISD STD-180	Latest
31	Electrical apparatus for explosive gas atmospheres - General requirements.	IS/IEC 60079-0	Latest
32	Equipment protection flameproof enclosures 'd'	IS/IEC 60079-1	Latest
33	Electrical apparatus for explosive gas atmospheres - Intrinsic safety	IS 5780/IEC 60079-11	Latest
34	Electrical apparatus for explosive gas atmospheres increased safety type 'e'	IS-6381/IEC 60079-7	Latest

S.No.	Description	Standards / Codes	Edition
35	Classification of flammable gases or vapours with air with air according to their maximum experimental safe gaps and minimum igniting currents	IS 9570/IEC 60079-12	Latest
36	Electrical apparatus for explosive gas atmosphere -Part-15 Construction, test and marking of type of protection "n" electrical apparatus	IS/IEC 60079-15	Latest
37	Material characteristics for gas and vapour classification- Test methods and data	IS/IEC 60079-20-1	Latest
38	Energy efficient induction motors- Three phase squirrel cage	IS-12615	Latest
39	Outdoor distribution transformers of ratings upto and including 100 KVA, for use on systems with nominal voltages upto and including 11 KV.	IS-11180	Latest

3.0 GENERAL / DESIGN CONSIDERATIONS

S.No.	Project Philosophy
1	LV - Low Voltage. The voltage which does not normally exceeds 250 V.
2	MV - Medium Voltage. The voltage which normally exceeds 250 V and does not exceeds 650 V.
3	HV - High Voltage. The voltage which normally exceeds 650 V but does not exceed 33 kV.
4	EHV - Extra High Voltage. The voltage which exceeds 33 kV under normal condition.
5	Canopy shall be provided for all outdoor equipments except transformers, Capacitor Banks & control gear boxes of non-integral lighting fixtures. However, Roof slab for all transformers, Capacitor banks and removable type shed for Generator transformers & Tie transformers shall be provided.

4.0 SPECIFIC DESIGN REQUIREMENTS

S.No.	Project Philosophy
1	MCC incomer shall be electrically operated air circuit breaker in place of load break switch
2	Minimum 4 nos., 400A 415V, TPN load break switch shall be provided in each process units for Annual shut down and maintenance. Each load break switch shall consists of 1 no. 400A heavy duty switch and outgoing switch fuse feeders as per the following (a) 2 Nos. 100A, TPN (b) 2 Nos. 63A, TPN (c) 2 Nos. 32A, TPN (d) 2 nos. 32A, SPN
3	For spare philosophy of outgoing feeders in EHV/HV/MV switchboards, AC distribution board (UPS system) & DC distribution board (DC system), etc., refer relevant clauses of "EIL standard design philosophy for electrical facilities no. 6-51-0099 Rev.No. 6"

5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

5.1 SITE CONDITIONS

S.No.	Description	Selected Option	Available Options
1	Equipment design temperature (IS-9676)	45 DEG C	a)40 DEG C b)45 DEG C c)50 DEG C d)Any other
2	Relative humidity	Refer Gen. Civil Design basis	
3	Soil Resistivity	As per soil investigation report. Min. value shall be considered as 20 ohm-m	
4	Minimum temperature, for battery sizing	10 DEG C	a)10 DEG C b)20 DEG C c)Any other
5	Altitude above mean sea level	5.56 m	a)Less than 1000m above MSL b)Any Other
6	Maximum temp	45 DEG C	a)40 DEG C b)45 DEG C c)50 DEG C d)Any other
7	Minimum temp	12.5 DEG C	
8	Sismic Zone	As per IS-1893 (Also Refer Structural Design Basis)	

5.2 POWER SOURCE DETAILS

S.No.	Description	Selected Option	Available Options
1	Power System	Mixture of Independent and existing system	a)Independent system b)Existing system
2	Grid Supply	Grid and CPP in Parallel	a)Yes b)No (Below Clause is not applicable)
2.1	Name of sub station	@	
2.2	Number of feeders	@	
2.3	Length of feeder	@	
2.4	Type /size of conductor/ cable size	@ _ sqmm	
2.5	Voltage	@ kV ± %	
2.6	Frequency	@ Hz ± %	
2.7	Maximum fault level	@ kA, sec.	
2.7.1	3 Phase fault	@ kA, sec.	
2.7.2	1 Phase fault	@ kA, sec.	
2.7.3	X/R Ratio	@	
2.8	Minimum fault level	@ kA, sec.	
2.9	Design fault level	@ kA	
2.10	Basic Insulation Level	@ kV	
2.11	System neutral Earthing	@	

S.No.	Description	Selected Option	Available Options
2.12	Minimum power factor	0.9	a)0.9 b)0.95 c)Any other
2.13	Parallel operation of inverters	Momentary Parallel	a)YES b)NO c)Any other
2.14	PLCC requirement	NA	a)YES b)NO
3	CPP and its configuration		a)YES b)NO
3.1	Type of Generator	STG & GTG	a)STG b)GTG
3.1.1	Number of Generator	1 no. STG, 1 no. GTG	
3.1.2	Rating of Generator/Voltage/P1 of Generator	@ MW/ 11KV/ 0.8	
3.1.3	Requirement of Generator Circuit Breaker	NO	a)YES b)NO
3.2	Parallel operation with grid	YES	a)YES b)NO
3.3	Type of Neutral Earthing for Generators	Neutral Transformer	
3.4	Black Start DG Envisaged	NO	a)YES b)NO
4	Emergency generator	Centralised(REFER NOTE-1)	a)Centralised b)Distributed c)Any Other
4.1	Generator Voltage	6.6KV	a)6.6KV b)4.15V
4.2	Parallel operation with other sources	Momentary Paralleling	a)Momentary Paralleling b)Continuously Paralleling
4.3	Auto Starting	Yes	a)YES b)NO
4.4	Type of Generator	Emergency Diesel	a)Diesel b)Gas
5	Solar Power System	REQUIRED	a)Provided b)Not provided
5.1	Solar PV System	Provided	
5.2	Buildings on which power system is to be mounted	Substation, Administration building(if any), Car parking	
5.3	Technology	SPV -Crystalline	
5.4	Battery	NO	
5.5	Connectivity	Local Switchboard	
5.6	Monitoring System	Provided	a)Provided b)Not provided
5.7	Location of Inverter	Indoor	a)Outdoor b)Indoor

Note:
1. The rating of emergency DG set shall be finalized during detailed engineering. The emergency DG set for the plant shall cater to emergency loads of various units, utility and offsite areas. 2 nos. Emergency DG set shall be considered each rated for 50% of full load capacity.

5.3 POWER SUPPLY DISTRIBUTION SYSTEM

5.3.1 VOLTAGE AND FREQUENCY VARIATION

S.No.	Description	Selected Option	Available Options
1	AC System		
1.1	Voltage	+ 10%	
1.2	Frequency	± 3%	
2	DC System		
2.1	Electrical protection and control system	+ 10%	
2.2	DC critical Lighting system		
2.3	Instrumentation Power Supplies	Refer Design Basis	

Note:

1. Refer section 5.6.10 of this document for design voltage/frequency variation for motors.

5.3.2 UTILISATION VOLTAGE

S.No.	Description	Selected Option	Available Options
1	Primary EHV/HV distribution voltage	220kV/500kV/3.3kV	a)33kV b)66kV c)Any other
2	Secondary HV distribution voltage	11kV/6.6kV (for new units/areas) 6.6kV (for revamp units)	a)11kV b)6.6kV c)3.3kV
3	Primary EHV/HV distribution system neutral Earthing	Solidly Earthed (for 220kV, 66kV, 33kV)	a)Solidly Earthed b)NGR c)Unearthed
4	Secondary HV distribution system Neutral Earthing	NGR	
5	HV motor voltage for DOL	6.6kV (For motors rating > 160kW)	
6	MV motor voltage	415 V AC (except VFD motor) (For motors rating 0.18<=kW<=160)	
7	AC Motors	240V AC (except MOVs) (For motors rating < 0.18kW)	
8	DC Motor	As per equipment supplier std.	
9	Motor operated valves	415V AC, TPN	
10	Battery chargers power supply	415V AC, TPN	
11	UPS System incoming power supply	415V AC, TPN	
12	AC Lighting/Power Panels	415V AC, TPN	
13	Auxiliary Boards incoming power supply	415V AC, TPN	
14	Welding Receptacles	415V AC, TPN	

5.3 POWER SUPPLY DISTRIBUTION SYSTEM

5.3.1 VOLTAGE AND FREQUENCY VARIATION

S.No.	Description	Selected Option	Available Options
1	AC System		
1.1	Voltage	± 10%	
1.2	Frequency	± 3%	
2	DC System		
2.1	Electrical protection and Control system	± 10%	
2.2	DC critical Lighting system	± 10%	
2.3	Instrumentation Power Supplies	Refer Design Basis	

Note:
1. Refer section 5.6.10 of this document for design voltage/frequency variation for motors.

5.3.2 UTILISATION VOLTAGE

S.No.	Description	Selected Option	Available Options
1	Primary EHV/HV distribution voltage	220kV/66kV/33kV	a)33kV b)66kV c)Any other
2	Secondary HV distribution voltage	11kV/6.6kV (for new units/areas); 6.6kV (for revamp units)	a)11kV b)6.6kV c)3.3kV d)Any Other
3	Primary EHV/HV distribution system neutral Earthing	Solidly Earthed (for 220kV, 86kV, 33kV)	a)Solidly Earthed b)NGR c)Unearthed
4	Secondary HV distribution system Neutral Earthing	NGR	
5	HV motor voltage for DOL	6.8kV (For motors rating > 160kW)	
6	MV motor voltage	415 V AC (except VFD motor) (For motors rating 0.18<=kW<=160)	
7	AC Motors	240V AC (except MOVs) (For motors rating < 0.18kW)	
8	DC Motor	As per equipment supplier std.	
9	Motor operated valves	415V AC, TPN	
10	Battery chargers incoming power supply	415V AC, TPN	
11	UPS System incoming power supply	415V AC, TPN	
12	AC Lighting/Power Panels	415V AC, TPN	
13	Auxiliary Boards incoming power supply	415V AC, TPN	
14	Welding Receptacles	415V AC, TPN	

S.No.	Description	Selected Option	Available Options
15	Bulk loads like Process Heaters etc	415V AC, TPN	
16	Normal Lighting/Emergency Lighting	240V AC, SPN	
17	LAN UPS	240V AC, SPN	

NOTES:

1) Electrical heaters shall be designed with 415V elements connected in delta

5.3.3 UTILISATION VOLTAGE FOR CRITICAL SUPPLIES

S.No.	Description	Selected Option	Available Options
1	Switchgear control power supply	110 V DC	a)220V DC b)110V DC
2	Critical lighting power supply	220 V DC	a)220V DC b)110V DC
3	Input power supply for Plant communication system	110V AC UPS	a)240V AC SPN (With Dedicated battery back up) b)110V AC UPS
4	Input power supply Fire alarm system power supply	240V AC SPN (With Dedicated battery backup)	
5	Power supply for electrical annunciation panel	Not Applicable	a)220V DC b)110V DC
6	Normal Instrumentation power supply	Refer Instrumentation design basis	
7	Critical Instrumentation power supply	Refer Instrumentation design basis	
8	Instrumentation Shut-down system power supply	Refer Instrumentation design basis	

NOTES:

1) Auxiliary supply of all critical systems such as VFD control supply and DAVR control supply shall be provided from Battery charger/DC system.

5.3.4 OPERATING PHILOSOPHY

S.No.	Description	Selected Option	Available Options
1	Auto/Manual transfer at primary distribution bus with momentary paralleling	YES	a)YES b)NO
2	Auto/Manual transfer at secondary distribution bus with momentary paralleling	Yes	a)YES b)NO
3	Auto /Manual transfer at MV with momentary paralleling		
3.1	At PCC/EPC/EP/MCC Level	Yes	manual momentary paralleling of incoming MCC shall be provided through 25 relay

S.No.	Description	Selected Option	Available Options
3.2	At MCC/ASB/DB Level	YES (for MCC process area only)	a) YES b) NO
4	Continuous Parallel operation of Incomers	YES	a) YES b) NO
4.1	Primary EHV/HV voltage	NO	a) YES b) NO
4.2	Secondary HV voltage	NO	a) YES b) NO
4.3	PCC/PMCC	NO	a) YES b) NO
5	Power Factor Correction	Required	a) 6.6kV bus b) 4.15kV c) Both 6.6kV & 4.15kV d) Any other
5.1	Power factor improvement capacitors- location	11kV bus (for new units/areas)	
5.2	Minimum P.F. to be maintained at Transformer Primary	0.95	
5.3	Monitoring at Transformer Primary	Yes	a) YES b) NO
6	Load shedding	Yes	a) YES b) NO
6.1	Voltage level for Load Shedding	Up to PCC/PMCC Incomers & Bus-coupler only (Part of ECS System)	a) 33kV b) 11kV c) 6.6kV d) 4.15kV e) Any Other

5.4 CONTROL-PROTECTION - METERING

5.4.1 CONTROL PHILOSOPHY

S.No.	Description	Selected Option	Available Options
1	Location of Relays for Generator	Separate relay & control panel	
2	Location of Relays for Outdoor Switchyard	Separate relay & control panel	
3	Location of Protection relays for EHV/HV switchgear		
3.1	Primary voltage EHV/HV switch gear	On Switchgear for 33kV, Separate relay & Control panel for 66kV, 220kV	a) On switchgear b) Separate relay and control panel
3.2	Secondary Voltage HV switchgear	On switchgear	a) On switchgear b) Separate relay and control panel
4	EHV/HV Switchgear control		
4.1	Generator	Separate relay and control panel, SCAP	
4.2	Outdoor Switchyard	Separate relay and control panel	
4.3	Primary voltage EHV/HV switch gear	Separate relay & control panel	a) On switchgear b) Separate relay and control panel

S.No.	Description	Voltage	Selected Option	Available Options
4.4	Secondary switchgear	HV	On switchgear, selected switchgears	a) On switchgear b) Separate relay and control panel c) ECS
5	Numerical Protection/Monitoring system for			
5.1	EHV system		YES	a) YES b) NO
5.2	HV Switchboard		YES	a) YES b) NO
5.3	PMCC/PMCC		YES	a) YES b) NO
5.4	MCC		YES (Incomer & Bus-coupler with non-communicable relays)	a) YES b) NO
6	Control and logic through numerical relays		YES	a) YES b) NO
7	Hardwired synchronization control panel-SCAP		YES	a) YES b) NO
7.1	Synchronizing trolley		YES	a) YES b) NO
7.2	Type of Panel		Mosaic	a) Mosaic b) Simplex
7.3	Extent of Coverage on SCAP		New GTG, new STG, new CPP auxiliary transformers, HV switchboard, MV switchboard, existing GTG-03 to 06, existing 11kV & 33kV CPP bus, existing 132kV Switchgear, new CPP substations & all new Substations of VRMP	
8	Type of annunciation panel		Part of SCAP	a) HMI b) Part of SCAP
9	Load shedding panel		Part of ECS	a) Part of ECS b) Separate PLC c) Hardwired
10	Method of motor starting		DOL/ Soft Starter upto 2 MW (Note-2)	
10.1	HV Motors		Note-2 (Above 2 MW)	a) Auto transformer b) Soft starter c) VFD d) Dedicated transformer 2 MW and above
10.2	HV Motors			
10.3	MV Motors		DOL up to motor 160 kW rating	
11	Starting MVA limitation conditions for Motors			
11.1	HV Motors		Up to 1 MW 550% inclusive of + tolerance rating >1MW - to be decided during detailed engineering (Note-3)	
11.2	MV Motors		600%	

- Notes.
1. Provision of laptop connectivity to the data concentrator shall be provided for unmanned sub-station.
 2. V/F controlled soft starter shall be considered for starting large HV motors if essential/unavoidable as per system design requirement/equipment design limitation.
 3. Starting current for motors shall be further reduced from 500% as per motor start up study.

5.4.2 POWER ISOLATION FOR TRANSFORMERS LOCATED REMOTELY AWAY FROM HV SUBSTATION

S.No.	Description	Selected Option	Available Options
1	Push button in transformer bay for tripping remote breaker	NO, Push button (Break glass type with hammer) shall trip the local isolator breaker.	a) YES b) NO
2	Local power isolating device	Yes	a) YES b) NO
3	Type	Breaker in panel	
4	Protection relay required	Yes	

5.4.3 RELAY PROTECTION SYSTEM

5.4.3.1 PROTECTION DEVICES FOR POWER DISTRIBUTION SYSTEM

Protection devices for power distribution system shall be as indicated below -
 (YES - Applicable)
 (Figure inside bracket refers to note below)

S.No.	Relay Description	Relay No.	HV Transformer Feeder - Sec. Winding Volt > 3.3kv	HV Transformer Feeder - Sec. Winding Volt < 0.433kv	HV Motor Feeder	Outgoing Breaker - HV Plant Feeder	Outgoing Breaker - MV Feeder - PCC/PMCC	Incomer - EHV/HV MV PCC/PMCC
1	IDMTL over-current relay	51	YES	YES	-	YES	YES	YES
2	IDMTL earth-fault relay	51N	YES(4)	NO	-	YES	YES	YES
3	51G backup (Earthed fault relay)	51G(11)	YES(23)	YES(23)	-	-	-	-
4	Motor protection relay with (50, 50N, 46, 49, 50L/R, 86, 95)	99	-	-	YES(3)	-	YES(3)	-
5	Instantaneous restricted earth-fault relay (Earthed side)	64R(11)	YES	YES, for rated 2.5MVA & more	-	-	-	-
6	Instantaneous over-current relay	50	YES	YES	-	-	-	-
7	Instantaneous earth-fault relay	50N	YES(2)	YES	-	-	-	-
8	Differential protection relay	87	YES(5)	-	YES(6)	-	-	-

S.No.	Relay Description	Relay No.	HV Transformer Feeder - Sec. Winding	HV Transformer Feeder - Sec. Winding Volt<0.433kv	HV Motor Feeder	Outgoing Breaker	Outgoing Breaker - HV Plant Feeder	Outgoing Breaker - MV PCC/PMCC	Incomer - EHV/HV	Incomer - MV PCC/PMCC
9	High speed tripping relay	86(20)	YES	YES	YES	YES	YES	YES	YES	YES
10	trip circuit supervision relay	95(20)	YES	YES	YES	YES	YES	YES	YES	YES
11	Transformer auxiliary relay	63	YES	YES	-	-	-	-	-	-
12	Under-voltage relay with timer	27/2	-	-	Note(14)	-	-	-	YES(9)	YES(9)
13	Check synchronisation relay	25	-	-	-	-	-	-	YES(10)	YES(10)

5.4.3.2 POWER GENERATION AND EXTERNAL POWER SUPPLY

Minimum protection relays for Synchronous generator (G/G/S/G), generator transformer Grid power supply incomer and Synchronous motors shall be as follows

(YES - Applicable)

S.No.	Relay Description	NEMA Code	Generator	Generator Transformer	EHV Incomer	EHV Transformer	Syn. Motor
1	Distance protection	25					
2	Synchronous check	27					
3	Under voltage with timer	32					
4	Reverse power	37					
5	Low power flow	40					
6	Loss of excitation	46					
7	Negative sequence	50					
8	Over current	50N					
9	Earth fault relay						

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S.No.	Relay Description	NEMA Code	Generator	Generator Transformer	EHV Incomer	EHV Transformer	Syn. Motor
10	Over current	51					
11	Voltage restrained Earth Fault back up	51V					
12	Earth Fault back up	51G					
13	Over current E/F	51N					
14	Over voltage with timer	59					
15	VT failure	60					
16	Auxiliary relay for transformer	63TX					
17	Restricted Earth Fault	64R					
18	Stator back up earth fault	64G					
19	Generator Rotor Earth fault	64R					
20	Directional O/C	67					
21	Directional E/F	67N					
22	Under frequency/dft	81					
23	Tripping relay	86					
24	Gen differential	87G					
25	Gen and transformer differential	87GT					
26	Transformer differential	87T					
27	Feeder differential	87F					
28	Bus bar differential	87B/87CH					
29	trip circuit supervision	95					

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S.No.	Relay Description	NEMA Code	Generator	Transformer	EHV Incomer	EHV Transformer	Syn. Motor
30	Dead bus charging relay	98					
31	Over fluxing relay	99					
32	Out of step	78					

5.4.3.3 RELAY PROTECTION PHILOSOPHY

S.No.	Project Philosophy
1	For air insulated HV switchboards, One set of 8/7B (Bus differential) relay and 95 B (Bus wire supervision) relays shall be provided for each bus section. The Bus wire supervision relay (95B) shall be provided for alarm and shall not lead to trip. Further, in case of HV switchboards with continuous parallel operation of incomers, One set of 87 and 67N (Directional IDMTL over current and earth fault) relays shall be provided for the incomers.
2	Instantaneous earth fault (50N) shall be provided only for transformer with delta primary.
3	MPR shall be provided for breaker fed motor feeders. However, for Contactor controlled motor feeders, the relay 50 shall not be provided in MPR.
4	Directional IDMTL earth fault (67N) shall be provided for transformer with star primary.
5	For transformers rated 5 MVA and above.
6	For motors rated 1500 kW and above, excluding VFD fed motors.
7	For critical/long feeders and plant feeders connected to main power generation and distribution bus. A plant feeder implies outgoing feeders from one switchboard to another switchboard of same voltage level.
8	Trip circuit supervision relay 95 shall be provided as part of the numerical relay for HV/ MV feeders wherever numerical relays are provided.
9	Wherever auto-transfer feature is provided
10	For switchgear where continuous or momentary paralleling of incomers is envisaged, check synchronising relay shall be provided.
11	51G and 64R relays for input transformer of VFD system shall be decided by VFD Manufacturer, CT's for REF 64R) and SEF (51G) shall be located at either side of the neutral tap point of transformer to prevent spurious tripping of transformers on 51G due to unbalanced current.
12	The bus tie feeders in HV switchboards shall be provided with 51, 51N, 59 (over voltage), 60 (Neutral displacement), 86 and 95 relays.
13	HV capacitor bank feeders shall be provided with 51, 51N, 59 (over voltage), 60 (Neutral displacement), 86 and 95 relays.

S.No.	Project Philosophy
14	The following feeders shall be provided with timers for delayed tripping on bus under voltage while the under voltage relay shall be common for the bus a. HV and MV capacitor feeders b. HV and MV breaker controlled motor feeders c. Contactor controlled motor feeders with DC control supply. Numerical relays where ever provided for motor and capacitor feeders shall use in built under voltage relay and timer for delayed tripping on bus under voltage.
15	One no. DC supply supervision relay (80) shall be provided for each incoming DC supply to the switchboard
16	One set of bus differential relays (87B) and bus wire supervision relay (95 B) for each bus section shall be provided for HV switchboards connected directly to generation buses
17	In case of numerical relays, all relays shall be comprehensive units including all protection, metering and control.
18	Under voltage and over voltage function along with associated timer shall be part of the numerical relays.
19	Auto changeover logic between incomers and bus coupler shall be built in the numerical relay
20	Tripping relays (86) & Trip Circuit supervision relay (95) shall be part of numerical relay.
21	2 Nos. of 86 relays shall be considered for HV and MV breaker fed motors for ease of differentiation between process & electric trip in the numerical relay. Built-in logic to be provided in relay for process/electrical trip with LED latched condition. Process trip in the numerical relay should be auto reset but LED should be latched.
22	Breaker control switch shall be hardwired type
23	Stand by earth fault relay 51G shall be provided for all transformers.
24	Restricted earth fault relay 64R shall be provided in the incomer of switchboard fed from transformer of rating ≥ 2.5 MVA and secondary winding is star connected.
25	Relay 51V voltage controlled over current relay shall be provided on specific requirement considering the rating of the outgoing feeders with respect to the incomer rating. Generally this relay shall be provided wherever CT primary current of outgoing feeders is exceeding 40% of the CT primary current of the incomer.
26	415V DG set shall be provided with protection but not limited to 51V, 51G, 40, 46, 86, 95, 80, 64R etc for generator rated above 500KVA and Generator rated less than 500KVA shall have 51V, 51G, 40, 46, 86, 95, 80 unless otherwise agreed with the owner.
27	All master trip relay (66) shall be part of numerical relay. No electromechanical type relay shall be provided
29	Relay 87 and 64R shall be separate numerical relay. Hence shall not be part of main comprehensive numerical relay CT for 87 and 64R can be clubbed, as two core of single CT.
30	Stabilizing resistors shall be provided in residual earth fault connections for all motors & transformers even in case of Numerical relays to prevent any spurious tripping during starting.

5.4.4 METERING

- Notes:
1. MVA meter in EHV external power supply incomers shall include maximum demand indication also.
 2. Separate MW, MVAR, MVA and MVAH meters shall be provided for EHV external power supply incomers only.
 3. Separate 3 nos. voltmeter and 3 nos. ammeter shall be provided for EHV external power supply incomers.
 4. All metering shall be provided through numerical relay in case switchboard are having numerical relay.
 5. One no CT with 1 secondary core shall be provided in Y phase of motor feeder in switchgear for remote metering on local control station.
 6. Field Ammeters are to be provided for motors >= 3.7 KW
 7. In LT panels, wherever metering is not available as part of Numerical relays, separate digital multifunction meter (MFM) shall be provided.

S.No.	Feeder Type	A	V	Hz	PF	MW	MWH	HM	MVAR	MVAH	MVA
17	MCC/ASB Incomer	YES	YES	-	-	-	-	-	-	-	-
18	MCCB/SFU Incomer	YES	-	-	-	-	YES(kWh)	-	-	-	-
19	LDB Incomer	YES	YES	-	-	-	YES(kWh)	-	-	-	-
20	DG Set-MV	YES	YES	YES	YES	YES(kW)	YES(kWh)	YES	-	-	-

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S.No.	Feeder Type	A	V	Hz	PF	MW	MWH	HM	MVAR	MVAH	MVA
1	Grd Incomers	-	-	-	-	-	-	-	-	-	-
2	Grd Bus Tie	-	-	-	-	-	-	-	-	-	-
3	Grd Transformer	YES	-	-	-	YES	-	-	-	-	-
4	Grd Bus P.T.	-	-	-	-	-	-	-	-	-	-
5	EHV/HV Incomer	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
6	EHV/HV Bus Tie	YES	-	-	-	-	-	-	-	-	-
7	EHV/HV Transformer	YES	-	-	-	-	-	-	-	-	-
8	EHV/HV Bus P.T.	-	YES	-	-	-	-	-	-	-	-
9	EHV/HV Plant Feeder	YES	-	-	-	-	-	-	-	-	-
10	EHV/HV Motor	YES	-	-	-	-	YES(kWh)	YES	-	-	-
11	EHV/HV Capacitor	YES	YES	-	-	-	-	-	-	-	-
12	PCC/PMCC Incomer	YES	YES	-	YES	-	YES(kWh)	-	-	-	-
13	PCC/PMCC Bus Tie	YES	-	-	-	-	-	-	-	-	-
14	PCC Bus P.T.	-	YES	-	-	-	-	-	-	-	-
15	ACB Outgoing (Non motor)	YES	-	-	-	-	YES(kWh)	-	-	-	-
16	MV Motor (>55kW)	YES	-	-	-	-	-	-	-	-	-

(Figure inside bracket refers to note below) (YES - Applicable)

The metering devices in EHV, HV and MV switchboards shall be as below
Type of metering : Multifunction digital meter / As part of the Numerical relay

5.4.4.1 METERING DEVICES IN EHV, HV AND MV SWITCHBOARDS.

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5.4.4.2 METERING FOR GENERATOR AND GENERATOR TRANSFORMER

S.No.	Meter	HV Generator	Generator transformer
1	Ammeter (3 nos.)	YES	YES
2	Voltmeter (3 nos.)	YES	YES
3	MW meter	YES	YES
4	MVAR meter	YES	
5	MVA meter	YES	
6	MWH meter	YES	YES
7	MVARH meter	YES	
8	Power factor	YES	YES
9	Frequency meter	YES	

5.5 SUBSTATION DESIGN

5.5.1 SUBSTATION AUTOMATION SYSTEM

S.No.	Description	Automation	Selected Option	Available Options
1	Substation System (SAS)		Required	
2	Communication protocol for relay network	IEC 61850 (Note-1)		a) IEC 61850 b) open protocol
3	System architecture	IEC 61850 HSR (Note-1)		a) IEC 61850 RSTP b) IEC 61850 PRP c) IEC 61850 HSR d) Redundant architecture for other open protocols
4	Data concentrator for SAS		common for HV & MV	a) not required b) common for HV & MV c) separate for HV & MV
5	Communication with other devices			
5.1	Communication with ECS		YES (with load shedding cum logic control panel)	
5.1.1	Protocol for communication with ECS		IEC 61850	a) IEC 61850 b) Modbus
5.2	Communication with DCS		Part of data concentrator	a) part of concentrator b) part of ECS RTU
5.2.1	Protocol for communication with DCS		MODBUS TCP/IP protocol	a) part of concentrator b) part of ECS RTU
5.3	Communication with VFD & UPS		Part of data concentrator	a) part of concentrator b) part of ECS RTU
5.3.1	Protocol for communication with VFD & UPS		MODBUS TCP/IP protocol	a) part of concentrator b) part of ECS RTU
6	HMI for SAS		2 operator engineering workstation with redundant servers as applicable	a) not required b) operator cum engineering workstation c) 1 operator & 1 engineering workstation

S.No.	Description	Selected Option	Available Options
7	Laptop	Separate for HV & MV for each substation	a) not required b) common for HV & MV for each substation c) separate for HV & MV for each substation
8	Local storage of data	part of HMI	a) not required (part of ECS) b) part of HMI c) part of concentrator d) data
9	Relay parameterization	SAS HMI	a) SAS HMI b) ECS HMI

Note:

- 1) Communication protocol & system architecture mentioned above is applicable for new system/units/areas only. For revamp units/areas, the communication protocol of existing system shall be followed

5.5.2 EHV SWITCHYARD

S.No.	Description	Selected Option	Available Options
1	Type	NOTE-1	
2	Type of bus	NOTE-1	a) String bus b) Tubular bus
3	Structure for outdoor	NOTE-1	a) Galvanised b) Painted c) Not applicable
4	Bus material	NOTE-1	a) Aluminium b) Copper

NOTES:

- 1) EHV SWITCHYARD is not applicable. In case it is found essential at later date, the same shall be further discussed and suitable options shall be decided during detail engineering.

5.5.3 SUBSTATION FEATURES

S.No.	Description	EHV	HV	MV	MCC/Elec. Room
1	Elevated with trays in cable cellar	YES	YES	YES	NO
2	Raised with internal trenches	NO	NO	NO	YES
3	All top cable entry with trays below ceiling	NO	NO	NO	NO
4	Pressurisation against ingress of dust	NO	YES (NOTE-2)	YES (NOTE-2)	NO
5	Air-conditioned room for operator	YES	YES	YES	YES
6	Roof slab for Power transformer	NO (NOTE-3)	YES (NOTE-3)	YES (NOTE-3)	NO

S.No.	Description	EHV	HV	MV	MCC/Elec. Room
6.2	Distribution transformer	NA	YES (NOTE-3)	YES (NOTE-3)	NA
7	Air conditioning of switchgear hall	YES	YES (NOTE-2)	YES (NOTE-2)	NA
8	EOT crane in sub-station	NO (NOTE-5)	NO (NOTE-5)	NO (NOTE-5)	NA

Column HV is defined below

1. Substation having full fledged HV Switchboard having incoming, bus coupler & outgoing feeder.
2. All new Unit Substations and Interconnecting Substations under VRMP shall be provided with HVAC system with chemical filters. However, other new Substations shall be provided with pressurization system against ingress of dust.
3. Roof slab for all transformers shall be provided except for Generator transformers & Tie transformers. However, removable type shed shall be provided for Generator transformers & Tie transformers.
4. Each substation shall be provided with a toilet, maintenance/store room for workmen to keep their tools and operator room (based on space availability), etc
5. Lift to be provided with adequate capacity for substations having higher than 2 floors.
6. The clear height of bottom most cable tray running across the width of the substation cellar shall be at 1.8m from FFL to enable smooth movement of personnel inside the cellar room.
7. Substations shall have provision of access control & CCTV (Refer instrumentation design basis for technical design data & specifications of access control & CCTV system).

5.5.4 SPECIFIC EQUIPMENT LOCATIONS

S.No	Description	Selected Option	Available Options
1	Batteries in substation and control Rooms	Separate room	
2	Battery charger in substation	Air conditioned room	a) Air conditioned room b) Non air conditioned room
3	Battery charger in control room	Air conditioned room	a) Air conditioned room b) Non air conditioned room
4	Variable speed drive panels	Air-conditioned room in substation	a) Air-conditioned room in substation b) SRR
5	Thyristor controlled panels	Air-conditioned room in substation	a) Air-conditioned room in substation b) SRR
6	UPS System	Air conditioned room in control room	
7	Lead-Acid and Nickel-Cadmium	Separate room	a) Separate room b) Common room
8	Location of VRLA battery	Air conditioned room	
9	Annunciation panel	Part of HMI	
10	Energy saver panel with Lighting transformers	NA	
11	GIS Hall	Air conditioned	a) Air Conditioned b) Pressurised

1. Battery room shall be preferably located in corner side at cable cellar level/switchgear floor level of the substation building

2. Battery charger for instrumentation if applicable, shall be placed in air-conditioned UPS room in control room.
3. Electrical equipment installed in battery room such as exhaust fan, lighting fixtures, receptacles shall be of flameproof and certified for gas group II-C classified locations. Heat detectors installed in battery room shall be of intrinsically safe type

5.6 EQUIPMENT DESIGN

5.6.1 EHV DESIGN

5.6.1.1 EHV OUTDOOR SWITCHYARD

S.No.	Description	Selected Option	Available Options
1	Bus bar system	Double	a) Single b) Double
2	Circuit breaker type	SF6	
3	Isolator type	During detail engineering	a) Pantograph b) Semi Pantograph c) Centre rotating d) Centre break

5.6.1.2 EHV SWITCHBOARD

S.No.	Description	Selected Option	Available Options
1	Execution	Fixed Type	
2	Type of Switchgear	Gas Insulated	
3	Busbar	Double	a) Double b) Single
4	Circuit Breaker Type	SF6	

5.6.2 HV SWITCHBOARD

S.No.	Description	Selected Option	Available Options
1	Execution	Drawout for AIS, Fixed for GIS	a) Drawout b) Fixed
2	Type of switchgear	Air insulated for 11kV, 6.6kV & 3.3kV, Gas insulated for 33kV	a) Air insulated b) Gas insulated
3	Bus bar	Single bus for AIS & GIS	a) Single bus b) Double bus
4	Circuit breaker type	VCB/SF6	a) SF6 b) VCB
5	Motor Control	Breaker	a) Breaker b) Vacuum contactor

NOTES

- 1) All HV Switchboard shall be LOTO compliant
- 2) In HT Switchboards, the thermo-graphic window shall be provided to check cable termination
3. HV switchboards (6.6kV & 11kV) shall be provided with earthing trucks for cable side and/or busbar side earthing

5.6.3 CURRENT TRANSFORMER (CT)/POTENTIAL TRANSFORMER (PT)

S.No.	Description	Selected Option	Available Options
1	CT Secondary		
1.1	General Protection	1A	
1.2	Special protection (87, 64R, 51G etc)	1A	
1.3	Metering	1A for conventional and remote metering	
2	PT Secondary	110V AC	

Note :-

- 1.) CT for metering shall be separate from the protection CT and no interposing CT shall be provided in the protection CT secondary circuit for metering purpose.

5.6.4 TRANSFORMERS (POWER/DISTRIBUTION)

S.No.	Transformer	Voltage Ratio	Vector Group	Tap Changer	Cooling
1	Power transformer	# During Detail engineering	Dyn1	OLTC	ONAN/ONAF
2	Dedicated (e.g. for VFD)	As Req.		Off-circuit	AN
3	Distribution Transformer (<= 2500 KVA)		Dyn 11	Off-circuit	ONAN

Note

- 1) Provision of Oil Soak Pit & Oil Collection Pit for transformers shall be as follows:
 - a) Oil quantity <= 2000L: Not Required
 - b) 2000L < Oil Quantity <= 9000L: Soak Pit
 - c) Oil Quantity > 9000L: Soak Pit + Collection Pit
- 2) Fire fighting system (Nitrogen injection fire protection system) shall be provided for transformers having oil greater than 2000 Liters.

5.6.5 MV SWITCHBOARD

S.No.	Description	Selected Option	Available Options
1	PCC / PMCC		
1.1	Breaker panels	Drawout Single front	
1.2	Contactor feeders	Drawout Single front	a) Drawout Single Front b) Drawout Double front c) Fixed Single front
2	MCC	Drawout Single front	a) Drawout Single Front b) Drawout Double front c) Fixed Single front
3	ASB	Drawout Single front	a) Drawout Single Front b) Drawout Double front c) Fixed Single front
4	LOB	Drawout Single front	a) Drawout Single Front b) Drawout Double front c) Fixed Single front

S.No.	Description	Selected Option	Available Options
5	Motors		Single front for critical applications and utilities
5.1	PMCC	Above 55 kW Up to 160 kW	
5.2	MCC	Up to 55 kW	
6	Type of switchboard for small package (AC system, Pressurisation system, Bagging plant etc)	Compartmentalised Fixed type Draw-out type for HVAC System	a) Compartmentalised Fixed type b) Non Compartmentalised Fixed type

Notes:

- 1) 4-pole ACBs for PCC/PMCC incomer & bus coupler having direct/ immediate connection with distribution transformer shall be provided.
- 2) All MV Switchboard shall be LOTO compliant.
- 3) All super critical application motors shall be provided with double contactors in DOL feeder. HPCL shall identify and furnish the list of motors for super critical applications during detail engineering.

5.6.6 MEDIUM VOLTAGE MOTOR STARTER TYPE

S.No.	Description	Selected Option	Available Options
1	Contactor and switch fuse with overload relay	NA	
2	Contactor, switch fuse and overload relay with CBCT for earth fault protection	NA	
3	Contactor and switch fuse with motor protection relay	NA	
4	Air circuit breaker with motor protection relay	Above 55kW up to 160KW (Note-1)	
5	Contactor and MCCB with overload relay	Upto 55kW (Note-1 & 2)	
6	Contactor, MCCB and overload relay with CBCT for earth fault protection	Not Applicable	

NOTES:

- 1) Motor protection relay (numerical type) shall be provided with communication facility.
- 2) All LT motor upto 55kW shall be provided with motor protection relay (numerical type) with earth fault protection.

5.6.7 MEDIUM VOLTAGE OUTGOING FEEDER TYPE

S.No.	Description	Selected Option	Available Options
1	Switch fuse	NA	
2	Switch fuse with Contactor and CBCT for earth fault protection	NA	
3	MCCB with Contactor and CBCT for earth fault protection	above 100A and up to 400A (with O/C & S/C protection)(Note-1)	a) A and up to A b) Not Applicable

S.No.	Description	Selected Option	Available Options
4	MCCB	Upto 100A (with O/C, S/C & E/F protection) (Note-1)	a) A and up to A b) Not Applicable

NOTES:

- MCCB shall be provided with shunt trip coil.
- R-C Circuit across power contactor and low burden auxiliary contactor for receiving start/stop command from field shall be provided in all DOL starter feeders.
- MCCB feeders feeding to VFD shall be provided with under voltage protection.
- ELCB with 30mA rating shall be provided for all power points, receptacles, plant lighting system, heat tracing system etc. for human safety.

5.6.8 MOTOR CONTROLS (AS PER PROCESS PACKAGE & OPERATING PHILOSOPHY)

S.No.	Description	Selected Option	Available Options
1	Auto/Off/Manual switch	Control room	a) Near motor b) Switchgear c) Control room
2	Local/Off/Remote switch	Near Motor	a) Near motor b) Switchgear c) Control room
3	Process Interlock	PLC/DCS/Switchgear (Note-1)	a) PLC b) Switchgear c) Control room
4	Reacceleration equipment	Switchgear	a) PLC b) Switchgear

Note :-

- To be made available at Switchgear as per instrumentation philosophy.

5.6.9 CONTROL SUPPLY VOLTAGE

S.No.	Description	Selected Option	Available Options
1	Breaker control	110V DC	a) 220V DC b) 110V DC
2	Breaker spring charging	110V DC	a) 240V AC b) 220V DC c) 110V DC
3	Contactors feeder	110V DC / 240V AC (for remotely located MCCs)	a) 24V DC b) 220V DC c) 110V DC d) 240V AC
4	Control supply for earth fault relay in contactor feeder (Note 1)	110V DC	a) 24V DC b) 220V DC c) 110V DC d) 240V AC
5	Control supply for contactor motor starter	Control Transformer (one for each bus section) for remotely located MCCs	a) Control Transformer P-N of Respective Feeder b) Tapping P-N of Respective Feeder c) Control Transformer in individual DOL Starter
6	Control transformer for each feeder	NO	a) YES b) NO c) Not Applicable

- Notes:
- DC control supply to MCC is applicable for main sub-station where DC power supply is available.

5.6.10 MOTORS

S.No.	Motors	High voltage	415 volts
1	Enclosure		
1.1	Indoor	IP55	IP55
1.2	Outdoor	IP55	IP55
2	Insulation class	F (Temp. Rise limited to B)	F (Temp. Rise limited to B)
3	Anti-condensation heater	Yes	Yes (FRP type)
4	Additional canopy (outdoor motors)	Yes (FRP type)	Yes (FRP type)
5	Design voltage variation	±10%	±10%
6	Design frequency variation	±3%	±3%
7	Combined voltage / frequency variation (Design)	±10%	Any combination of above

- Motors for MOV actuator shall have F class of insulation with temperature rise limited to class-B.

5.6.11 UPS SYSTEM

S.No.	Description	Selected Option	Available Options
1	Redundancy	100%	a) 50% b) 100%
2	Type of redundancy	Parallel redundant	a) Parallel redundant b) Hot standby
3	Back-up time	30 minutes	a) 30 minutes b) 60 minutes c) 120 minutes
4	Bypass transfer control	Auto	a) Auto b) Manual
5	Separate fault diagnostic unit (Note 1)	YES	a) YES b) NO
6	Battery type	Ni-Cd (2x50%)	a) Lead acid b) Ni-Cd c) VRLA (in configuration)
7	Type of UPS	IGBT	a) IGBT b) Transistorised
8	UPS Output Supply	Single Phase	a) Single Phase b) Triple Phase
9	UPS Output Voltage	110V AC (Final voltage shall be as per Instrumentation Design Basis)	

NOTES:

- IP based in built Fault Diagnostic Unit (FDU) is required.

2. UPS for data communication system, CFAP of FA system and sub-station HMI and small package units shall be non redundant with bypass type with VRLA battery.

5.6.12 COMMUNICATION SYSTEM

S.No.	Description	Selected Option	Available Options
1	Plant Communication System	Yes	a) YES b) NO
2	Telephone System	Yes (Note-1 & 2)	a) YES b) NO
3	Telephone system and plant Communication system	Separate (Note-1, 3 & 4)	c) Separate a) Separate b) Integrated
4	Interface of Communication system	Yes	a) YES b) NO
4.1	With fire alarm system	Yes	a) YES b) NO
4.2	With telephone system	Yes	a) YES b) NO

Notes:-

- 1) New system for new units and Expansion of existing system for NHT/CCR/DHDT/ PRIME-G/PRU unit
- 2) Dedicated battery is not envisaged for plant communication system. 110 V AC UPS supply shall be given to Plant communication exchange.
- 3) Flameproof telephones are to be provided in all classified areas.
- 4) No. of intercom and external P&T lines to be furnished by client.

5.6.13 FIRE DETECTION AND ALARM SYSTEM

S.No.	Description	Selected Option	Available Options
1	Type	Analogous addressable (Note-1)	a) Conventional b) Analogous addressable
2	Name of buildings to be provided with Detectors	Control room, sub-station, SRR, other buildings as required.	
3	Detection System	Break Glass, Multi sensor detectors (for heat & smoke detection), linear beam detectors.	
4	Type of manual call point	Without call back facility	a) With call back facility b) Without call back facility
5	Qty of Siren and location	@ To be decided during detail engineering.	
6	Power supply for Siren	415V AC	a) 415V AC b) 110V AC UPS c) 48V DC
7	Siren range	5 Km (Diametrically)	
8	Response indicator for rooms and concealed area for Addressable Fire alarm system	YES	a) YES b) NO c) Not Applicable

NOTES:

- 1) New system for new units and Expansion of existing system for NHT/CCR/DHDT/ PRIME-

G/PRU unit to be considered.
2) Fire siren hooter & flashlight to be provided inside control room and major buildings.

5.6.14 DC SYSTEM

S.No.	Description	Selected Option	Available Options
1	Battery type		
1.1	Switchgear Protection Control and critical lighting	Ni-Cd	a) Lead acid b) Ni-Cd c) VRLA
1.2	Instrumentation System	As per Design Basis	a) Lead acid b) Ni-Cd c) VRLA
1.3	Diesel Engine Starting	Lead Acid	
1.4	DC Motors	As per equipment supplier recommendations	a) Lead acid b) Ni-Cd c) VRLA
1.5	Fire alarm system	VRLA	
1.6	Telephone system	VRLA	
1.7	End Cell Voltage		
1.7.1	Lead Acid Battery	1.85 VOLT	
1.7.2	VRLA Battery	1.75 VOLT	
1.7.3	Ni-Cd Battery	1.0 VOLT	
2	Battery backup time		
2.1	Switchgear Protection and Control	120 minutes	a) 30 minutes b) 60 minutes c) 120 minutes
2.2	DC Critical lighting	120 minutes	a) 30 minutes b) 60 minutes c) 120 minutes
2.3	Instrumentation	As per Inst. Design basis	a) 30 minutes b) 60 minutes c) 120 minutes
2.4	Diesel Engine Starting	10 starts (FW pumps) & 6 starts (others)	
2.5	DC Motors	As per equipment manufacturer's recommendation	
3	Battery Configuration	2X50%	a) 2X50% b) 1X100%

5.6.15 VARIABLE FREQUENCY DRIVE

S.No.	Description	Selected Option	Available Options
1	By pass feature required	Yes (Note-1)	a) YES b) NO
2	VFD rated output voltage		
2.1	MV Inverter	i) Motor kW rating less than 315kW at 415V ii) More than 315kW & up to 700kW at voltage upto 890V	

S.No.	Description	Selected Option	Available Options
2.2	HV Inverter	Motor rating more than 700kW	

Notes:

1. Bypass for VFD shall be provided as a standard practice unless not recommended from Process or driven equipment operation point of view.

5.6.16 CABLE SIZES

The power and control cables shall have the following minimum cross sectional areas:

S.No.	Description	Selected Option	Available Options
1	Medium voltage cable	Upto 10 Sq mm - Copper, Greater than and equal to 25 Sq mm - Aluminium	a) Above 16 sqmm (Aluminium) b) 2.5 sqmm to 16 sqmm (Copper)
2	Control cables	2.5 sqmm (Copper) Overall shielded (Note-5)	
3	Lighting	2.5 Sq mm (Copper) for street lighting	4
4	Communication system	6P*0.9 mm dia. (Copper) (Note-7)	
5	Telephone System	0.63 mm dia. (Copper)	
6	Fire alarm system	1.5 sqmm (Copper)- twisted pair (Note-7)	

Notes:

1. For lighting inside the building, minimum 1.5 sqmm copper conductor, PVC Insulated FRLS wires shall be used in conduit system (for circuit and point wiring), with proper colour coding.
2. Cable sizes are indicative only and these shall be finalised as per the recommendations of the equipment manufacturer.
3. Special cable type and size shall be decided on specific requirement.
4. The outgoing cables of UPS & DC system shall be 3-core copper cables.
5. Control cable & FA cables shall be twisted pair overall shielded type.
6. Outer PVC sheath of all cables shall be flame retardant type. Cables shall have low smoke properties i.e. FRLS type with 60% (Max) smoke density.
7. Cable sizes are indicative only and these shall be finalised as per the recommendations of the equipment manufacturer.

5.7 CABLING SYSTEM

5.7.1 CABLE DETAILS

S.No.	Design Criteria	EHV	HV	415 volts
1	Loads located beyond 1 km	1C cable	1C / 3C cable	1C / 3.5C cable
2	Loads located 200-1000 m	1C cable	1C / 3C cable	1C / 3.5C cable

S.No.	Design Criteria	EHV	HV	415 volts
3	Loads located upto 200 m	1C cable	1C / 3C Cable	1C / 3.5C Cable
4	Loads beyond 1000A rating & located near the transformer	NA	Busduct	Busduct / 1C cable
5	Recommended limiting size of multi-core cable (sqmm)	630 (1C Cable)	300 (3C Cable) & 630 (1C Cable)	300 (3C Cable) & 630 (1C Cable)
6	Short circuit withstand time (sec)	1 Incoming from transformer-1.0 2 Plant feeder-0.6 3 Transformer feeder-0.2	1 Incoming from transformer-1.0 2 Plant feeder-0.6 3 Transformer feeder-0.2	NA
7	Insulation voltage grade	220kV(Earthed), 66kV (Earthed)	33kV (Earthed), 11kV (Unearthed), 6.6kV(Unearthed), 3.3kV(Unearthed)	Earthed
8	Type of cable insulation	XLPE	XLPE	XLPE
9	Fire survival (Resistant) cable for Fire proof MOV	NA	NA	Yes
10	Power Cable for Motors/MOV	NA	3 core	3 core
11	Cable Conductor	Copper	Copper / Aluminium	Refer Sr no 1 of CI 5.6.16
12	Power & Earthing cable	Armoured	Armoured	Armoured

NOTES:

1. Copper cables shall be used for termination to all Electrical heaters.
2. All power cables for Electrical heat tracing and lighting loads shall be 4-Core of suitable size.

5.7.2 CABLE LAYING PHILOSOPHY

S.No.	Description	Selected Option	Available Options
1	Process area	RCC trench with sand filling	a)Overhead cable tray b)RCC trench
2	Offsite paved area	Above Ground cable tray on sleeper /Overhead rack /RCC trench as per site requirement	a)Above Ground cable tray on sleeper b)Overhead rack c)RCC trench
3	Offsite unpaved area	Above Ground cable tray (on sleeper) /Overhead rack /directly buried as per site requirement	a)Above Ground cable tray b)Directly buried

S.No.	Description	Selected Option	Available Options
4	Type of cable trays	Galvanized prefabricated	a) Galvanized prefabricated. b) Site fabricated and painted c) FRP type
5	Road Crossings for underground cables	PVC Pipes embedded in concrete/ERC/ Cable culvert/ RCC Hume pipes	a) PVC Pipes b) Cable culvert
6	Road Crossings for Above ground cables	Overhead cable bridge / pipe rack	a) Overhead cable bridge b) Culvert

- 1.) Plant communication, fire alarm and telephone cables shall be laid in instrumentation overhead cable duct / instrumentation trenches as far possible. In case these are not available Cable shall be laid in buried cable trenches along berm of the roads.
- 2.) Walkways shall be provided on either side of cable tray (with ladders at regular intervals) to facilitate movement of people while pulling cable.
- 3.) No cable Trays/ racks will be provided in RCC lined trenches.
- 4.) RCC cable trenches shall be filled with river sand/manufactured sand.
- 5.) Street lighting cables shall not be laid along with fire alarm, communication and telephone cables. These cables shall be laid in separate buried cable trench in road berm.
- 6.) The single core cables shall be laid in trefoil formation except for short run of cables within substations. Single core cables pertaining to 3-phase circuits shall be laid together & separated from multi-core cables as per requirements specified in IS-1255.
- 7.) Underground Road crossings shall be provided using Cable culverts where ever large number of cables cross the roads. At road crossings where few cables cross the roads, Electrical road crossings(ERC) using 150mm PVC/RCC pipes may be provided. The ERC shall have minimum 40% spare pipes. The pipes shall be embedded in concrete. Minimum 2 nos. 150mm pipes shall be provided at any road crossing.
- 8.) In case of vehicular traffic over the RCC cable trench, the same shall be of heavy duty construction suitable for vehicular movement.

5.8 EARTHING SYSTEM

S.No.	Description	Selected Option	Available Options
1	Earth electrode	GI pipe (Note-1)	
2	Main earth loop material	GI strip	
3	Substation earth loop	GI strip	
4	EHV switchyard earth grid	Not Applicable	

Note:

1. For instrumentation earth, copper electrode to be provided.

5.9 LIGHTING SYSTEM

5.9.1 SUPPLY SYSTEM

S.No.	Description	Selected Option	Available Options
1	Centralised with Lighting distribution board-LDB	Yes	a) YES b) NO
2	LDB at each substation	Yes	a) YES b) NC
3	Lighting transformer required	Yes	a) YES b) NO

S.No.	Description	Selected Option	Available Options
4	100% Standby transformer for normal lighting system	Yes	a) YES b) NO
5	100% Standby transformer for emergency lighting system	YES	a) YES b) NO
6	Lighting transformer voltage ratio	415V/415V	a) 415V/415V

5.9.2 CONTROL PHILOSOPHY

S.No.	Description	Selected Option	Available Options
1	Outdoor yard	Auto through timer	a) Auto b) Manual c) Centralised d) Local
2	Street lighting	Auto through timer	a) Auto b) Manual c) Centralised d) Local
3	Outdoor process area	Auto through timer	a) Auto b) Manual c) Centralised d) Local
4	Process building	Manual	a) Auto b) Manual c) Centralised d) Local
5	Auto control	Synchronous timer	a) Synchronous timer b) Photocell c) ECS
6	Lamp type for outdoor general lighting	(1). Process Area: LED (2). Offsite Hazardous Area: LED (3). Offsite Safe Area: LED (4). Street Lighting: LED (5). High Mast: HPSV/SON-T	
7	Lamp wattage for outdoor lighting (Normal)		
8	Lamp type for emergency AC lighting	LED (for building Lighting)	a) CFL b) LED
9	ELCB at Incoming of Lighting / Power Panels	NO (ELCB shall be provided in Outgoing of LDB/ASB)	a) YES b) NO
10	Switch ON/OFF push button at substation entry	Yes	a) YES b) NO

Note:

1. LED Lighting fixtures shall be provided for all building normal & emergency lighting.
@ To be decided during detail engineering

5.9.3 AC EMERGENCY LIGHTING

S.No.	Description	Selected Option	Available Options
1	Name of process plants	ALL new & revamp units under VRMP scope	
2	Name of buildings	Substation, Control room, Fire Water Pump House, Admin Building, Lab, Workshop, DG Shed, Canteen, Warehouse (Office Area and other locations as per OISD)	
3	Power supply source	Diesel generator	

5.9.4 DC CRITICAL LIGHTING FOR ESCAPE

S.No.	Description	Selected Option	Available Options
1	Name of process units	ALL new & revamp units under VRMP scope	
2	Name of building	Substation, control room, SRR, Administration building/office, FWP, Fire Station, DG Shed, Compressor House and other locations as per OISD	
3	Power supply	220V DC	a) 220V DC b) 110V DC
4	DC lighting for remote buildings	Lighting fixture with built in battery	

5.9.5 WIRING TYPE

S.No.	Description	Selected Option	Available Options
1	Process plant / Building / Shed	Armoured cable	
2	Large service building	Armoured cable	
3	Buildings with false ceiling	Black enamelled Surface conduit above false ceiling/ PVC concealed conduit below false ceiling	a) Surface conduit above false ceiling b) Cables
4	Substation (Switchgear Room)	METSEC channel/Black enamelled Surface conduit above false ceiling/ PVC concealed conduit below false ceiling	a) METSEC channel b) Concealed conduit
5	Substation (Cable Cellar)	Armoured cable	a) Surface Conduit b) Armoured cable
6	Other buildings in safe area	Black enamelled Surface conduit above false ceiling/ PVC concealed conduit below false ceiling	

5.9.6 SPECIFIC LIGHTING REQUIREMENTS

S.No.	Description	Selected Option	Available Options
1	Aviation lighting	Yes (Clustered lamps) (Note-1)	a) YES b) NO

S.No.	Description	Selected Option	Available Options
2	Security lighting for peripheral road boundary wall	Yes	
3	Type of control gear for HPMV/HPSV lamps	Separate	a) Separate b) Integral
4	Control gear box location	Accessible level	
5	Type of high mast flood light	30 meters Telescopic tubular	a) 30 meters Telescopic tubular b) Lattice structural mast

NOTES:

- 1) Xenon flash light for aviation lighting to be provided for Chimneys and heater stacks at the top most level instead of Clustered LED light.
- 2) Illumination level in Control room buildings shall be minimum 400 Lux

5.10 ELECTRIC HEAT TRACING SYSTEM

S.No.	Description	Selected Option	Available Options
1	System Design Basis approach	Product classification/ as per process recommendation	a) Product Classification b) System approach

5.11 ELECTRICAL EQUIPMENT FOR HAZARDOUS AREAS

The electrical equipment for hazardous areas shall be selected as per IS-5571 and petroleum rules & Gas group shall be selected based on the hazardous area classification. The minimum requirement is summarised below

S.No.	Equipment	Zone-1	Zone-2
1	MV Motors	Ex-de	Ex-e/Ex-de (Note-2 & 2.11)
2	HV Motors	Ex-de / Ex-p (Refer note-2.8)	Ex-e/Ex-de/Ex-p (Note-2.9, 2.10 & 2.11)
3	Push Button Station	Ex-de	Ex-de
4	Motor Starters	Ex-de	Ex-de
5	Plug & Socket	Ex-de	Ex-de
6	Welding Receptacle	Ex-de	Ex-de
7	Lighting fitting	Ex-de	Ex-nR
8	Control Gear Box	Ex-de	Ex-de
9	Junction Boxes	Ex-de	Ex-de/Ex-n
10	Transformer Unit	Ex-de	Ex-de
11	Plug & Socket	Ex-de	Ex-de
12	Break Glass Unit (Fire Alarm System)	Ex-dig	Ex-de
13	Lighting Panel/Power Panel	Ex-da	Ex-de
14	Transformers	Hermetically sealed with surface temperature not exceeding 200 DEG C	Hermetically sealed with surface temperature not exceeding 200 DEG C

For additional Hazardous Area requirements, refer notes below -

5.11.1 NOTES

S.No.	Notes
1	The electrical equipment for hazardous areas shall generally be suitable for gas group IIB and temp classification T3 as applicable to the selected type of explosion protection. In case of hydrogen or hydrocarbon mixtures having more than 30% hydrogen, the gas group to be considered shall be IIC.
2	As additional safety features, the following requirements for electrical equipment shall be followed.
2.1	All electric motors for agitators/mixers and metering pumps handling flammable material shall be flameproof type irrespective of the area being classified as zone 2 or zone 1.
2.2	All electric motors for vertical sump pumps handling flammable material shall be flameproof type. (Ex-de)
2.3	Irrespective of the area classification (whether zone 1 or zone 2), all lighting fixtures within the storage areas shall be flameproof type. (Ex-de)
2.4	Irrespective of the area classification (whether zone 1 or zone 2), all motors and lighting fittings within the pump house/pump station/compressed house associated with offsite tank farm and within the loading/unloading gantries shall be of flameproof type. (Ex-de)
2.5	All emergency/critical lighting fixtures and associated junction boxes in hazardous areas (whether zone-1 and zone-2) shall be flameproof type. (Ex-de)
2.6	Even though fired heaters in process units are not considered for area classification, all electrical equipments associated with fired heaters in process units shall as a minimum be suitable for installation in Zone-2 area.
2.7	Building such as Compressor sheds inside the process area shall be designed to allow adequate ventilation to allow area classification as Zone-2. Lighting equipment, EOT crane etc. in the shed shall be flameproof type. All other electrical equipment shall be suitable for Zone-1 or Zone-2 area depending on extent of hazard.
2.8	All motors for hazardous area Zone-1 shall preferably be Ex-de type. Pressurised motors may be provided in exceptional cases, when Ex-de motors are not available. Pressurised motors shall be provided with facility to trip motor in case of failure or pressurisation.
2.9	Ex-e motors shall be used unless any other type is specified by process licensor, except for following cases: (i) H-V motors in Zone-2 area for centrifugal compressors shall be Ex-de type (ii) Ex-de motors shall be used in zone-2 areas having frequent start-stop requirements such as EOT cranes, elevators, MOV actuators, etc.
2.10	For zone-2 areas, motors with rating above 100kW having average starting frequency of more than 1 per week, Ex-de or Ex-p motors shall be used.
2.11	Ex-p motors shall be used for higher rated motors where Ex-de / Ex-e motors are not available.
3	Statutory Approval 1. Statutory Authority for Electrical Installation: State Electrical Inspectorate/CEA 2. Statutory authority for hazardous area: DGMS/For mining area PESO For area other than mines

5.12 ELECTRICAL CONTROL SYSTEM-ECS

S.No.	Description	Selected Option	Available Options
1	Extent of coverage	Up to PCC/PMCC level	
1.1	No of substations	@	
1.2	Monitoring		
1.2.1	EHV/HV switchboard	YES	a)YES b)NO

S.No.	Description	Selected Option	Available Options
1.2.2	415V switchboard (I/C, B/C & outgoing breaker feeders)	YES	a)YES b)NO
1.2.3	Emergency OG set	YES	a)YES b)NO
1.3	Control		
1.3.1	EHV/HV switchboard	YES	a)YES b)NO
1.3.2	415V switchboard (I/C, B/C & outgoing breaker feeders)	YES	a)YES b)NO
1.3.3	Emergency DG set	NO	a)YES b)NO
2	Base ECS functionalities		
2.1	Breaker control in CPP & Switchyard	YES	
2.2	Breaker control in other substations	YES	
2.3	Area lighting	YES	
2.4	Electrical plant data acquisition and display	YES	a)YES b)NO
2.5	Routine log report generation and energy balance report	YES	a)YES b)NO
2.6	Detection and reporting of alarms	YES	a)YES b)NO
2.7	Sequence of event recording	YES	a)YES b)NO
3	Advanced functionalities		
3.1	Load shedding including maximum demand limit control	YES	a)YES b)NO
3.2	Synchronization	YES	a)YES b)NO
3.3	Capacitor feeder control for power factor improvement	YES	a)YES b)NO
3.4	Active & Reactive power control	YES	a)YES b)NO
3.5	Frequency & load control of all generators except DG	YES	a)YES b)NO
3.6	Excitation control of synchronous motors	YES	a)YES b)NO
3.7	Grid transformer OLTC control	@	a)YES b)NO
4	Communication with other systems	Communication with DCS system for exchange of data. Interface with data concentrator	

6.0 SPARE PARTS

6.1 MANDATORY SPARES

Mandatory spares shall be procured along with the main equipment. Such spares for each equipment shall be as per the below table. These spares include only those spares, which

are critical for equipment

S.No.	Part Description	Description
1	Generator (one set of spare for each Generator)	one set (each type & make)
1.1	Generator relay	One each type
1.2	DVR - all control card	Quantity is per transformer
2	Power Transformer (one set of spare for each power transformer)	one set
2.1	Gasket	2 Nos of each rating & type
2.2	Gauge glass	6 Nos.
3	Gas Insulated Switchgear	6 Nos.
3.1	Portable gas filling equipment/SF6 gas cart	6 Nos.
3.2	Handle for disconnector switch drive	6 Nos.
3.3	Handle for earthing switch drive	6 Nos.
3.4	Pre selection key for three position switch	12 Nos.
3.5	Power cable termination kit	1 Nos.
3.6	Tripping coil (Per Switchgear)	1 Nos.
3.7	Closing coil (Per Switchgear)	6 Nos.
3.8	Capacitive type voltage detectors	10 Nos. each rating and type
3.9	Control fuses (Per switchboard)	1 Nos. of each type
3.10	Network switches	Quantity is per switchboard
4	33 kV Switchgear (one set of spare for each switchgear)	1 No. of each Rating/Type
4.1	Closing coil	1 No. of each Rating/Type
4.2	Shunt trip coil	10 Nos. each rating & type
4.3	control fuses(all type & rating)	Quantity is per switchboard
5	11 kV & 6.6 Switchgear (one set of spare for each switchgear)	1 No. of each Rating/Type
5.1	Closing coil	1 No. of each Rating/Type
5.2	Shunt trip coil	10 Nos. each rating & type
5.3	control fuses(all type & rating)	Quantity is per switchboard
6	415 V MCC/MECC/EPCC or MV Switchboard	1 No. of each Rating/Type
6.1	Closing coil	1 No. of each Rating/Type
6.2	Shunt trip coil	1 No. of each Rating/Type
6.3	control fuses(all type & rating)	10 Nos. each rating & type
7	Variable Frequency Drive (one set of spare for each VFD)	Quantity is per VFD
7.1	Transistors/IGBT	One No of each rating & type
7.2	Control cards	One No of each type
7.3	Power supply cards	One No of each rating & type
7.4	Power & control fuses	20 % or one no (min) of each rating & type, whichever is more
8	Data concentrator panel/HMI (one set of spare for each)	One No of each type
8.1	All cards such as input & output cards, power supply cards, processor cards etc	10 Nos of each rating & type
8.2	All control fuse	10 Nos of each rating & type
9	UPS (one set of spare for each UPS system)	One No of each rating & type
9.1	Power transistors/IGBT	One No of each type
9.2	Power supply cards	One No of each type
9.3	operating console card	One No of each type

S.No.	Part Description	Description
9.4	All fuses	10 nos. of each rating & type
10	DC System (one set of spare for each DC System)	10 nos. of each rating & type
10.1	All fuse	1 no. of each rating & type
10.2	All cards such as input & output cards, power supply cards, processor cards etc	1 no. of each rating & type
10.3	Thyristors	10 nos. of each rating & type
10.4	fuse link	Two nos.
10.5	Blocker Diode	10 nos. of each rating & type
11	Synchronous motors (one set of spare for each rating & type)	one each
11.1	Fuses	10 nos. of each rating & type
11.2	Bearing (DE & NDE) (as applicable)	one set of spare for each rating & type
12	HV induction motors (one set of spare for each rating & type)	one each
12.1	Bearing (DE & NDE)	one no.
12.2	Terminal studs/bushing assembly	one set of spare for each rating & type
13	MV induction motors 37 kW & above (one set of spare for each rating & type)	one no. of each type
13.1	Bearing set (DE & NDE)	one set each
13.2	Terminal/ bushing	1 no. of each type
14	Telephone exchange	1 no. of each type
14.1	All line cards, Processing cards, power supply cards	one no. of each type
15	Fire alarm system	10 nos. of each rating & type
15.1	All cards	20 nos.
15.2	Fuses	5 % of total installed capacity of each type
15.3	Terminal blocks	10 %
15.4	Fire detectors	10 %
15.5	Glass for Break Glass Boxes/ Manual call point	one no. of each type
16	Paging system / Plant Communication System	10 nos. of each rating & type
16.1	All cards	10% of each type
16.2	All fuses	10% of each type
16.3	Field call stations	one no. of each type
17	Thyristor control panel for heaters	one no. of each type
17.1	Rectifier control module (Control card fully assembled)	one no. of each type
17.2	Power supply card	5 Nos. of each type
18	ECS	1 nos. of each type
18.1	Interposing relays (As applicable)	1 no. of each type
18.2	Power supply & control cards	1 no. of each type
19	Numerical relays	1 no. of each type

1. The word "TYPE" means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable.
2. Wherever % age is identified, Contractor shall supply next rounded figure.
3. The terminology used under "Part Description" is the commonly used name of the part and may vary from manufacturer to manufacturer.
4. Mandatory spares as indicated above do not cover commissioning spares
5. Mandatory spares as indicated above do not cover two year O&M spares
6. Mandatory spares shall be applicable for electrical items of motors / sub-packages as per

mandatory spares philosophy specified elsewhere in the bid document.

6.2 COMMISSIONING SPARES

Commissioning Spare Parts shall be procured along with the main equipment as per equipment manufacturer's recommendations. The list of such recommended spares shall be obtained along with the offer.

6.3 RECOMMENDED SPARE FOR NORMAL OPERATION & MAINTENANCE

Quotation for two-years spares for normal operation and maintenance (over and above mandatory spares) along with unit price shall be obtained with the proposal for Client to order the same separately.

6.4 SPECIAL TOOLS AND TACKLES

Required Special Tools and Tackles shall be procured along with the main equipment as per equipment manufacturer's recommendations. The list of such recommended special tools/tackles shall be obtained along with the offer.

7.0 VENDOR DATA REQUIREMENT

Vendor Data Requirement as indicated in the respective equipment Material Requirements shall be followed

METHODOLOGY OF DRAWING & DOCUMENT REVIEW PROCEDURE

CAPTIVE POWER PLANT PACKAGE

TENDER NO. B016-606-02-43-PG-T-7810

PROJECT	: VISAKH REFINERY MODERNISATION PROJECT
UNIT No.	: 606
OWNER	: M/s HPCL, VISAKHAPATNAM
LOCATION	: VISAKHAPATNAM, INDIA
PMC	: M/s ENGINEERS INDIA LIMITED
EIL JOB No.	: B016

A	24 Oct 2017	ISSUED FOR TENDER	SD	NP	KVI
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

1.0 GENERAL

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10.0	Other Document Requirements

This chapter details out the type of drawings and documents to be generated by the CONTRACTOR at different stages of the Project.

The CONTRACTOR must recognize that efficient handling of drawings and documents prepared by him under the contract is the key to the timely completion of the plant.

The CONTRACTOR shall ensure that all drawings and documents to be submitted by him to the Owner and/or PMC shall be of professional quality and conforming to the contractual requirements.

The CONTRACTOR shall institute a formal drawing control system, which will be documented and submitted to the Owner/ PMC for review or approval.

Compliance to the requirements as spelt in this document on drawings and documents is mandatory and is non-negotiable.

The drawings/ documents as generated by the CONTRACTOR at various stages of the Project will be in the category of

- (i) Review
- (ii) Information/ Records

The listing of drawings and documents required for submission under different categories is enclosed elsewhere in the Bid. However, submission of drawings/ documents under different categorization will in no way relieve the CONTRACTOR of his responsibility to conform drawings/ documents specification to contractual requirements.

Computer aided design and drafting only shall be used, manual drafting is not permitted. Bidders shall commit in their Offer the extent (discipline-wise) to which Computer Aided Design (CAD) shall be used.

The CONTRACTOR / sub-vendors etc shall only use standard, approved and well-established PC based computer programs/ software packages available in the market. CONTRACTOR shall bring out the list of all such packages in the Offer, for each discipline. Minimum requirements of the software to be used for engineering and documentations are specified in the tender document needs to be complied by the CONTRACTOR. Additional software if required to be utilized by the Bidders along with the offer in the execution of the project shall needs to be indicated by the Bidders along with the offer in the Format provided with this document. CONTRACTOR are required to execute complete project in the software as specified or suggested by the Contractor in the offer and deviation against that will not be entertained by OWNER/PMC during project execution. In case it is felt that there is a requirement of any change with respect to software during execution, same shall be permitted only after approval of OWNER/PMC.

DOCUMENTS to be submitted by CONTRACTOR for review to the Owner/ PMC are to be uploaded through PMC Web portal along with hardcopies. Two (2) complete sets (A4 & A3) and four (4) Complete set for Document size above A3 of the Document/ Drawing are to be submitted in hard copies along with all input/output data, soft file of these documents in native also needs to be submitted by CONTRACTOR. Each CAD document should specify the

name of the software package used and it shall be ensured that the CO is operable on any PC system.

NO Manual Drafted Calculations and documents are permitted.

The CONTRACTOR shall vet all documents, including documents of his sub-vendors before submission to the Owner/ PMC for review. Contractor shall duly stamp & sign the hardcopies of documents submitted by him as proof of his vetting. Document received without contractor's vetting will be returned without review / approval. Also, the CONTRACTOR will not only rectify any inaccuracies / mistakes found during review but the CONTRACTOR shall remain liable for bearing charges towards efforts spent by Owner / PMC for discussing the same. Delay owing to these shall be to the account of CONTRACTOR.

Review of the drawings/ documents by the Owner/ PMC would be only limited to the review of compatibility with basic designs and concepts. The review by the Owner/ PMC shall not be construed by the CONTRACTOR as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and drawings.

Only AUTOCAD release 2011 as minimum or later versions shall be used for drawings, data sheets and all graphic works. For all text related documents, MS Word 2011 as minimum only shall be used.

CONTRACTOR shall furnish 3D modeling of plant with dynamic walk-through facility to check any interference, requirement of safety, operation and maintenance for getting approval from Owner/ PMC. Contractor shall demonstrate their capability through walk-through of one of such 3D models developed by them. CONTRACTOR shall carry out the 3 D Modelling in accordance to the specification provided in the tender document.

Such modelling could be done through an agency approved, which has proven track record for 3D modelling of packages of similar complexities.

Drawings shall be prepared on the DRAWING FORMAT as provided to successful bidder. Excepting the Title block of (A0, and A1 sizes) drawings which shall be bi-lingual (English and Hindi) all notes, markings and dimensioning on the drawings shall be in English.

All the dimensions shall be in metric units.

Subsequent submissions of reviewed (commented) Drawings/ Documents by the CONTRACTOR shall be along with a document-wise compliance report, with separate listing of compliance/ status for each of the comments. If required comments given by the Owner/ PMC shall be discussed and finalized within agreed schedule.

The schedule of submission of Drawings/ Documents shall be in accordance with Project plans only. The detailed list of documents/ documents proposed to be submitted for the Owner/ PMC review (for different categories) shall be prepared by the CONTRACTOR for review of Owner/ PMC. This activity is to be completed within **one month of placement of the order.**

Sequence of submission of all drawings and documents is essential for proper review of documents and timely completion of the Project and is to be strictly adhered to. In case sequence is not maintained, Owner/ PMC will not review the documents submitted and responsibility of timely execution of Package shall be to CONTRACTOR's accounts.

The CONTRACTOR shall maintain latest record of drawings & document status and make regular issue of drawing/ documents index (*discipline wise*), on *fortnightly/ monthly basis, as agreed, with copies to PMC Site, HO and Owner* indicating schedule date of submission, submission date of various revisions and date of review with code.

2.0 Category of Documents and Cycle Time

The handling of documents by Owner/PMC/CONTRACTOR shall be as follows:

2.1 Owner's/ PMC's Review

A detailed document list clearly identifying the class of review to be performed against each document shall be developed. Following classes of review shall be followed for all the documents engineered by the CONTRACTOR:

Review

The documents shall be reviewed by OWNER/PMC with respect to specifications guidelines and details provided in the Tender package. Upon review of the documents approval review codes will be indicated the documents based on the compliance to tender requirements. Code-1/Code-2/Code-3 will be accorded to such documents.

Information/Records

The CONTRACTOR shall submit documents for Owner's/ PMC information/ records and proceed with the work. Inadequacies/ inaccuracies noticed at any stage of the Project on such documents/ drawings shall be brought to the attention/ notice of the CONTRACTOR for corrections and incorporation in works. These corrections, as made by the Contractor, shall be to the Contractor's account and would not have any cost or time impact to the Owner.

The documents falling under review category shall in general, except for drawings requiring multi-disciplinary review, be returned with comments within 10 working days.

Documents submitted without meeting pre-requisite requirements will be returned without review.

The period of ten working days shall be reckoned from the date of receiving the documents at Owner/PMC Review centre. Receiving date shall be considered as date entered by PMC.

However, documents where multi-disciplinary activity is involved, the CONTRACTOR shall visit Owner / PMC design office for discussion for expeditious review of documents, after submission of these for Owner/ PMC review.

In absence of visit of CONTRACTOR'S engineering team at Owner's/ PMC office

review time shall be 15 working days.

The information/ records category documents/ drawings shall be retained for records only.

2.2 CONTRACTOR'S REVIEW

The following cycle time shall be adopted for the incorporation of comments by CONTRACTOR

- Review of comments by CONTRACTOR. 7 days
- Owner/EIL/CONTRACTOR discussion on comments, if required: 7 days
- Incorporation of comments in drawings and resubmission. 7 days

CONTRACTOR shall revert on unacceptable comment, if any, within 10 days from the date of release of documents by Owner/PMC in absence of any rebuttal by CONTRACTOR, all comments will be deemed as acceptable to CONTRACTOR.

3.0 Review of Bid Evaluation Report

1.2.1 The CONTRACTOR shall ensure that all equipments are ordered on vendors who are capable of supplying the equipments and meet all specifications.

1.2.2 CONTRACTOR shall submit a comprehensive bid evaluation report and recommendation for procurement of major equipment to OWNER/PMC prior to award of purchase order.

The report shall incorporate, but is not limited to:

- Names and addresses of the companies invited to quote or bid.
- Recommended supplier.
- Reason for selection.
- Evaluation of Vendor quality system.
- Scheduled award date.
- Quoted delivery date.
- Reason(s) for rejecting unsuccessful bidders whether it is technical, commercial, delivery, etc.

1.2.3 Review of Purchase Requisition

CONTRACTOR shall forward Purchase Requisition (Technical Part) for items as mentioned in the VDR, together with attached documentation, without pricing details, to OWNER/PMC for review. Such review by OWNER / PMC shall not relieve CONTRACTOR of any of his obligations under the Contract.

All subsequent changes to purchase requisition following review of the original shall be subject to prior APPROVAL. Where requisitions specify a

particular make or brand of equipment to be used followed by the statement "or PURCHASER approved equal", any such "equal" proposed by the suppliers shall be submitted for APPROVAL of OWNER/PMC.

4.0 Control and Monitoring of documents review and submission

Owner's review

A document logging system shall be established within PMC through Web Portal (Electronics Data Management System) to monitor the review cycle. This log shall be updated on real time basis.

In case review requires more than stipulated cycle time for any document, CONTRACTOR shall be informed for the same.

Submissions

- PMC is using electronic document management system for document workflows and storage.
- All vendor documents shall be submitted and reviewed through web portal. To facilitate document exchange with the vendors a separate vendor portal for the successful bidder will be provided at the time of award.
- Discipline wise Document Control Index (DCI) based on VDR in Tender will be created by vendor through the vendor portal in the format available in the portal.
- DCI shall be submitted and will be approved by PMC. All document submission on the vendor portal shall be against the approved DCI only.
- During the course of engineering any unscheduled documents if required to be submitted shall be as approved by EIL.
- Drawing schedule shall indicate the following as minimum:
 - Schedule/Actual submission to Owner/ PMC
 - Category of submission
 - Receipt of comments from Owner/PMC
 - Category of return status from Owner/PMC
 - Issue date for Construction

Detailed listing of documents (discipline-wise) that are scheduled to be submitted or resubmitted incorporating Owner / PMC's comments, shall be provided by CONTRACTOR in the weekly meetings. Contractor may ensure that drawings / documents are submitted as per the agreed schedule only. Bunching of documents / out of sequence submissions and consequential delay of documents and approval there of shall be exclusively attributable to CONTRACTOR.

Details regarding PMC Web portal shall be furnished to Successful bidder.

Documents to Boiler Regulation authorities shall be submitted on getting the documents reviewed by Owner / PMC. To any other agencies, documents shall be submitted under intimation to Owner/ PMC.

5.0 As-Built Drawings

As built drawings and documents will have to be generated within one month of completion of activities on respective items of work.

CONTRACTOR shall furnish electronic files of all the drawings under their scope to Owner / PMC certified as "As Built Issue." These documents also need to be submitted through PMS web Portal.

Upon completion of identifiable units or components of the fabrication, construction and installation phase of the project, the CONTRACTOR will complete all the related plans to the "as built" stage including all Vendor drawings and furnish Owner/ PMC with the following:

- a) 6 complete sets of full size prints of the drawings and 4 sets of reduced size prints.
- b) 6 complete bound sets of Manufacturer's specifications including design calculations
- c) As Built drawings generated specifically for this job in electronic media (AutoCAD 2011 or above).
- d) All vendor drawings & documents either in AutoCAD or in scanned images stored in electronic media.
- e) All operating & maintenance instructions in electronic media or in scanned images converted in electronic media.
- f) 6 complete sets in hard binders of the Manufacturer's data book including certified prints and data for all items including test reports. Data Book shall be complete with index as tag numbers associated with Manufacturer's data shown. Equipment data shall include as a minimum requirement the principal and description of operation, drawings and dimensions, spare parts lists and un-priced purchase orders and bill of materials.
- g) 6 bound copies each of the Spare Parts data book and the Lubricants inventory schedule.
- h) The CONTRACTOR'S and Owner's representatives at the site shall sign 6 complete sets of field records.
- i) Original approvals and related drawings and documents from the statutory authority.
- j) Copies of correspondence with the statutory authorities.

6.0 Pre-Requisites Needed from Contractor

- 1.6.1 At the kick-off meeting, the CONTRACTOR must submit discipline wise list of documents and drawings index in the specified format.
- 1.6.2 The Drawing Index (discipline wise) shall include description of drawings/ documents, category of drawings, scheduled date of submission, actual date of submission, review code received with dates. This shall be updated fortnightly / monthly, as agreed by CONTRACTOR and copies issued to PMC site and H.O. as well as Owner. Drawings submitted before finalization of drawing index shall be rejected.
- 1.6.3 CONTRACTOR shall separately submit list of drawings/documents involving multi-disciplinary reviews, considering the PMC departmental activities furnished in the contract during the kick off meeting itself. They are also highlighted in the discipline-wise document list.
- 1.6.4 Critical and typical drawings/documents having impact on schedule and quality should only be identified for such timely reviews. This shall be adopted after receipt of drawings/documents indexes from the CONTRACTOR at the kick-off meeting with mutual understanding of the CONTRACTOR/concerned specialists/Owner.
- 1.6.5 All requirements specified in the Bid Package/contract is with the intent of providing a safe, user-friendly plant conforming to all applicable codes, standards, regulations, etc.
- It is CONTRACTOR'S responsibility to comply with the bid package. To monitor the same, Owner/PMC shall select a few critical documents/drawings for review and leave the rest as Information/Record Category.
- Any deviation on such Information/Record category drawings/documents and on review category drawings observed later or in execution at site during site visit/technical review by Owner/PMC shall be taken seriously. Contractor shall rectify the same at his own cost and time.
- 1.6.6 CONTRACTOR shall plan submission progressively so that no bunching takes place in any discipline.
- 1.6.7 Review period shall be reckoned from the "Date of Receipt" of documents/drawings at PMC Office to the "Date of Receiving" the reviewed documents by the CONTRACTOR at PMC Review Center. CONTRACTOR shall monitor submission and receipt.
- 1.6.8 Documents/drawings received prior to holiday/week end shall be accounted as received on the following working day and the review period committed shall include only working days.
- 1.6.9 Quality of drawings / documents is essence for a timely review. If major comments / deviations to the agreed design basis are noticed, the drawing shall be rejected in Code-3. (CONTRACTOR cannot proceed with construction with Code-3 approval/review)

any impact of time and cost to Owner.	
1.6.18 CONTRACTOR shall submit designs drawings for review only after the corresponding GA/Equipment data sheets etc. have been co-ordinated in his office and reviewed by Owner/PMC engineers at least in Code 2. Such Owner/PMC reviewed drawings shall be furnished along with drawings/designs for timely review	
1.6.19 CONTRACTOR shall open an engineering office in India for speedy document submission and to help faster review of the drawings & documents.	
7.0 Approved for Construction Drawings	
Drawings approved / reviewed under Code 2 & Code 1 required for execution at site shall be arranged by CONTRACTOR to PMC (RCM), CONTRACTOR'S RCM and HPCL-Visakhapatnam (site).	
- "Approved for Construction" stamped / sticker drawings shall be issued by CONTRACTOR for execution.	
- "Approved for Construction" stamp / sticker separately on the reviewed print and not on the Title block.	
- Without changing Revision Number, CONTRACTOR to arrange adequate number of prints of documents and drawings to CONTRACTOR'S RCM, 2 copies to PMC RCM and one copy to HPCL-Visakhapatnam (site) with transmittal.	
- Copies of only reviewed or final documents like design calculations, design basis etc. shall be sent to PMC site for records.	
- Copy of such transmittal shall be sent to PMC (HO) & HPCL for records.	
8.0 Activity Sequence for Drawing Approval	
CONTRACTOR shall establish an electronic mail system compatible with that of Owner/PMC for document/data transfer.	
The drawings requiring Owner/PMC's review shall be uploaded on Web Portal of PMC and E-mail intimation, regarding uploading to be forwarded to Owner / PMC.	
CONTRACTOR shall establish a local office having facility of telephone, fax and electronic mail system for receiving documents and drawings from outstation.	
On uploading the drawings/documents through Web Portal, CONTRACTOR shall send and Email Intimation for the same to Owner/PMC. However, hard copies in numbers as mentioned in section 1.0 of this document, shall be sent by CONTRACTOR to Owner/PMC by courier or by hand delivery.	
After review, Owner/PMC shall send back the drawings/ documents through Web Portal with Email intimation to CONTRACTORS.	

1.6.10 Sequence of submission of drawings is essential for proper review of documents and timely completion of the project and the same is to be adhered to. In case sequence is not maintained, the documents submitted shall not be approved / reviewed by Owner/PMC and the responsibility of timely execution of the plant shall remain to CONTRACTOR'S accounts.	
1.6.11 Piping/instrument & other engineering drawings/documents shall be issued only after the corresponding P&IDs & Process documents coming under approval / review category are first approved/ reviewed by the concerned department in code-2 as a minimum.	
1.6.12 In principle, CONTRACTOR is not expected to revise drawings/ documents already reviewed in Code-1.	
a) If it is of utmost necessity to revise or add some minor details in Code-1 drawings, CONTRACTOR shall highlight such revisions by marking "CLOUD" to such additions/alterations. CONTRACTOR is also needed to provide a "BLOCK" in the drawing indicating reasons of such changes and to insert another "Review Block". PMC shall put relevant code for such revisions only "Code marking given by PMC on such revisions shall not change the category of drawing.	
b) Any major change in Code-1 drawing shall call for preparation of new drawing.	
1.6.13 Based on the confidence gained on CONTRACTOR'S quality of drawings/ documents already submitted, "Review" Category drawings could be retained as Information/Records and vice versa at the discretion of Owner/PMC. This however, does not change the category of drawings.	
1.6.14 Once a document is already reviewed in Code-2, subsequent submission due to non- incorporation of comments shall not be accounted for any contractual commitment of approval/review period from PMC. CONTRACTOR is expected to comply with PMC's comments in the next revision after Code-2 and is required to submit a compliance report accordingly.	
1.6.15 Deviation permit, submitted for seeking deviation, shall be separately identified and shall not be considered as a document for timely approval/review.	
1.6.16 When PMC deploys engineers at the CONTRACTOR'S work centre following shall be satisfied:	
- Review's limited to identify long delivery/schedule critical items only	
- Readiness of documents/drawings shall be ensured by the CONTRACTOR.	
- Presence of lead engineers of all disciplines of the CONTRACTOR.	
1.6.17 If Owner / PMC highlights any necessary rectifications required in the construction at the time of Technical Review/Audit, construction executed based on Reviewed drawings not complying with Bid requirement, CONTRACTOR shall rectify without	

It shall be the responsibility of CONTRACTOR'S representative to transmit the drawings/documents to their design office/vendor works.

CONTRACTOR shall also establish electronic system at site to receive all drawings and documents with all printing and scanning facilities

The reviewed drawings shall be transmitted to site by CONTRACTOR.

Necessary printing / plotting and distribution of documents and drawings to RCM (CONTRACTOR), RCM (PMC) and HPCL-Visakhapatnam (site) is the responsibility of CONTRACTOR.

9.0 Requirement of Project Document Handover

As a part of Overall Project document Handover OWNER/PMC intends to use integrated documentation & Handing over system with a focus on engineering information integrity for final handover. For the specific purpose and specific requirements of document integration & Handing over it is required that CONTRACTOR to utilize the latest generation software, utilize the formats, templates, numbering system as specified, in this tender document without any deviation. Further details like additional formats, templates if required shall be provided to the successful bidders. For the requirement of Final Documentation in the integrated & Smart platform OWNER/PMC shall be engaging a agency and Project document integration shall be carried out the other. However for carrying out the activities related to document integrations by others certain activities are required to be performed by the the CONTRACTOR during execution of the project is covered in this part of the document

9.1 Proposed Software's for detailed engineering to be utilized by the CONTRACTOR

Sr. No.	Deliverable List	Software
1	Project Scheduling	Primavera
2	3D Design	PDS/PDMS/SP-3D
3	P&ID	Smart P&ID's or Equivalent
4	Power Plant Configuration	GATE Cycle or Equivalent
5	Process Simulation	Hysys or equivalent
6	Heat Exchangers	HTRI or equivalent
7	Electrical System Configuration	ETAP

Sr. No.	Deliverable List	Software
8	Instrumentation	Smart Plant Instrumentation(SPI-INTTools)
9	Datasheets & Line list	In house tools with compatible output in PDF/ Excel
10	Documentation Handling	eDMS or Equivalent (For centralization of documents with vendor, client and consultant interface)
11	Vessels, Columns	PVELITE
12	Piping Stress Analysis	CESEAR-II
13	Structural Analysis	STAAD PRO
14	Finite Element Analysis(if Required)	ANSYS and Equivalent
15	All Text Data	MS Word in Words
16	All Spread Sheet work	MS Excel in Windows
17	Final Drawings	In PDF as well as in Original Format

9.2 Contractor's Responsibility With Respect To Document Handover for Document Integration and Document Handover

For ensuring integration & smart Document handover LSTK contractor to ensure following during execution of the project till final document handover.

1. CONTRACTOR should strictly comply to the project standards, specifications and templates issued by OWNER/PMC. Any standard documents equivalent to those referred too herein shall not be substituted without written approval from OWNER/PMC. Approval of equivalent standard documents will not, in any way release/relieve responsibility from the CONTRACTOR to meet the best practices and/or requirement of the standard Engineering Documents referred herein, in the event of conflict.
2. Where differences and/or conflicting issues occur, the requirements released by OWNER/PMC shall overrule unless otherwise advised. However major conflicts shall be

reported in writing to the OWNER/PMC for the project along with the engaged third party for information management for the resolution of the conflict. Owner/EIL will reserve the right of final approval/rejection on the differences/conflicts. Any such deviations will be recorded for the documentation clearance at the time of stage review (30%, 60%, 90% and 100% of engineering completion)

3. Quality assurance will be a part of completion for the stage review (30%, 60%, 90% and 100%). Non-adherence to data quality standards may impact the milestone completion and further to the release of the milestone payments of the CONTRACTOR.

4. During execution of the project, CONTRACTOR is required to deputize their persons either at OWNER/PMC office and/or at Third party office for document handling at various stages of the document integration, checking for correctness, validation and correction of document if found not validated during process of integration.

5. During Execution of the Project it is expected that the detailed engineering documents shall be submitted as generated using following software as minimum

Sr. No.	Deliverable List	Software
1	Project Scheduling	Primavera
2	3D Design	PDS/PDMS/SP-3D
3	P&ID	Smart P&ID's or Equivalent
4	Drawings	AutoCAD
5	Electrical System Configuration	ETAP
6	Instrumentation	Smart Plant Instrumentation(SPI-INTools)
7	Datasheets & Line list	In house tools with compatible output in PDF/ Excel
8	Piping Stress Analysis	CESEAR-II
9	All Text Data	MS Word in Words
10	All Spread Sheet work	MS Excel in Windows
11	Final Drawings	In PDF as well as in Original Format

6. CONTRACTOR to make sure that their Sub Contractor or Sub vendors shall also be comply with the requirement of the Integrated and smart documentation as outlined above.

7. As a part of proposal Contractors are required to provide extent of data / Drawing/ document volume which are expected during project execution

10. OTHER DOCUMENT REQUIREMENTS

1. Operating Manuals- CONTRACTOR & PACKAGE SUPPLIER shall prepare a detailed operating manual Process unit as part of Documentation. OWNER/PMC shall review the documents for the completeness and compliance to PSM compliant Operating Manual requirement. Format PSM-GL-4.1 and 4.2 are attached

2. CONTRACTOR shall also develop supervisory operating manual including concise SOP (pocket booklets) for the assigned units

FORMAT TO BE FILLED IN BY CONTRACTOR FOR DOCUMENTATION
 (To be filled in by Contractor and needs to be submitted along with the bids)

Sr. No.	Deliverable List	Software	Data Volume in Numbers, Size
1	Project Scheduling		
2	3D Design		
3	P&ID		
4	Power Plant Configuration		
5	Process Simulation		
6	Heat Exchangers		
7	Electrical System Configuration		
8	Instrumentation		
9	Datasheets & Line list		
10	Documentation Handling		
11	Vessels, Columns		
12	Piping Stress Analysis		
13	Structural Analysis		
14	Finite Element Analysis (if Required)		
15	All Text Data		
16	All Spread Sheet work		
17	Final Drawings		

ठेकेदारों से प्रलेखन
 अपेक्षाओं हेतु विनिर्देश

SPECIFICATION FOR DOCUMENTATION REQUIREMENTS FROM CONTRACTORS

1	12.03.15	General Revision	OMS Standards Committee	OMS Standards Committee	MPJ	SC
0	04.06.03	Issued as Standard Specification	OMS Standards Committee	OMS Standards Committee	SCT	NO
Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Converter	Standards Bureau Chairman
					Approved by	

Formal No. 8-00-0001-F1 Rev 0

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Abbreviations:

DCI	-	Document Control Index
eDMS	-	Electronic Document Management System
FOA	-	Fax of Acceptance
HOD	-	Head of Division / Department
IC	-	Inspection Certificate
IRN	-	Inspection Release Note
ITP	-	Inspection and Test Plan
LOA	-	Letter of Acceptance
MOU	-	Memorandum of Understanding
QMS	-	Quality Management System
URL	-	Universal Resource Locator

QMS Standards Committee

Convenor: Mr. M.P. Jain

Members: Mr. A.K. Chaudhary (Insp.)
Mr. S.K. Kaul (C&P)
Mr. R.K. Trivedi (Engrg.)
Mr. Ravindra Kumar (Const.)
Mr. Tilak Raj (Projects)
Mr. Vinod Kumar (CQA)

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2.0	DEFINITIONS	4
3.0	REFERENCE DOCUMENTS	4
4.0	DOCUMENTATION REQUIREMENTS	4

Attachments

Format for completeness of Final Documentation | Format No. 3-78-0004

1.0 SCOPE

This specification establishes the Documentation Requirements from Contractors

All documents/data against the Tender / Contract shall be developed and submitted to EIL/Owner by the contractor for review / records, in line with this specification.

2.0 DEFINITIONS

2.1 Contractor

For the purpose of this specification, the word "CONTRACTOR" means the person(s), firm, company or organization who is under the process of being contracted by EIL / Owner for delivery of some products and services. The word is considered synonymous to bidder, supplier or vendor.

2.2 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

3.0 REFERENCE DOCUMENTS

6-78-0001 Specification for Quality Management System Requirements from Bidders

4.0 DOCUMENTATION REQUIREMENTS

4.1 Documents/Data to be submitted by the Contractor

4.1.1 The contractor shall submit the documents and data against the Tender/Contract as per the list specified in respective Tender/Contract.

4.1.2 Review of the contractor drawings by EIL would be only to review the compatibility with basic designs and concepts and in no way absolve the contractor of his responsibility/contractual obligation to comply with Tender/Contract requirements, applicable codes, specifications and statutory rules/regulations. Any error/deficiency noticed during any stage of manufacturing/execution/installation shall be promptly corrected by the contractor without any extra cost or time, whether or not comments on the same were received from EIL during the drawing review stage.

4.1.3 Unless otherwise specified, submission of documents for Review/Records shall commence as follows from the date of Fax of Intent / Letter of Intent/ Fax of Acceptance (FOA)/ Letter of Acceptance (LOA):

QMS - 1 week
Drawing/Document Control Index - 2 weeks
Other Documents/Drawings - As per approved Drawing/Document Control Index/Schedule

4.1.4 Documents as specified in Tender/Contract are minimum requirements. Contractor shall submit any other document/data required for completion of the job as per EIL/Owner instructions.

4.2 Style and Formatting

4.2.1 All Documents shall be in ENGLISH language and in M.K.S System of units.

4.2.2 Before submitting the drawings and documents, contractor shall ensure that the following information are properly entered in each drawing:

Tender Number
Name of Equipment / Package
Equipment / Package Tag No.
Name of Project
Owner
Main Contractor (if work is sub-contracted)
Drawing / Document Title
Drawing / Document No.
Drawing / Document Revision No. and Date

4.3 Review and Approval of Documents by Contractor

4.3.1 The Drawing/Documents shall be reviewed, checked, approved and duly signed/stamped by contractor before submission. Revision number shall be changed during submission of the revised contractor documents and all revisions shall be highlighted by clouds. Whenever the contractor require any sub-contractor drawings to be reviewed by EIL, the same shall be submitted by the contractor after duly reviewed, approved and stamped by the contractor. Direct submission of sub-contractor's drawings without contractor's approval shall not be entertained.

4.4 Document Category

4.4.1 Review Category

Following review codes shall be used for review of contractor Drawings/Documents:

Review Code 1	-	No comments. Proceed with manufacture/ fabrication/ Construction as per the document.
Review Code 2	-	Proceed with manufacture/ fabrication/ Construction as per commented document. Revised document required
Review Code 3	-	Document does not conform to basic requirements as marked. Resubmit for review
R	-	Document is retained for Records. Proceed with manufacture/ fabrication
V	-	Void

4.5 Methodology for Submission of Documents to EIL/Owner

4.5.1 Document Control Index (DCI)

Contractor shall create and submit Document Control Index (DCI) for review based on PO/PR/MR along with schedule date of submission of each drawing/document on EIL eDMS. The DCI shall be specific with regard to drawing/document no. and the exact title. Proper sequencing of the drawings/documents should be ensured in schedule date of submission.

4.5.2 Submission of Drawings/Documents

Drawings/documents and data shall be uploaded on the EIL eDMS Portal. The detail guidelines for uploading documents on EIL eDMS Portal are available on following URL
<http://edocx.eil.co.in/vportal>

4.5.3 Statutory Approvals

Wherever approval by any statutory body is required to be taken by Contractor, the Contractor shall submit copy of approval by the authority to EIL.

4.5.4 Details of Contact Persons of Contractor

After placement of order contractor shall assign a Project Manager for that order. The details are to be filled online through the portal. The details include e-mail address, mailing address, telephone nos., fax nos. and name of Project Manager. All the system generated emails pertaining to that order shall be sent to the assigned Project Manager.

4.5.5 Schedule and Progress Reporting

Contractor shall submit monthly progress report and updated procurement, engineering and manufacturing status (schedule vs. actual) every month. First report shall be submitted within 2 weeks from FOALOA. In case of exigencies, EIL/Owner can ask for report submission as required on weekly/fortnightly/adhoc basis depending upon supply status and contractor shall furnish such reports promptly without any price implication. Format for progress report shall be submitted by the contractor during kick off meeting or within one week of receiving FOALOA, whichever is earlier.

4.5.6 Quality Assurance Plan/Inspection and Test Plan

Inspection and test plans attached if any, to the tender are generic and indicative only. Immediately after receipt of the order, contractor shall submit within one week of receiving FOALOA, job specific ITPs based on the indicative ITPs. Further, contractor shall also submit Quality Assurance Plan for project activities in the scope of contract, starting from manufacturing to handing over/ commissioning, these plans shall cover/identify the activities, relevant procedure, if any, code of conformance, resources for performance and checking/monitoring, approval requirements and authority, records to be generated and audit scope by EIL/Owner.

For EPCC/LSTK/Package contracts, the contractor shall prepare a list of items/equipments and their inspection categorization plans for all items included in the scope of supply immediately after receipt of order and obtain approval for the same from EIL. The items shall be categorized into different categories depending upon their criticality for the scope of inspection of TPIA and/or EIL.

4.5.7 Inspection Release Note (IRN)/ Inspection Certificate (IC)

Contractor shall ensure that all documents viz. documents reviewed, manufacturer's test certificate etc., mentioned in Inspection Release Note (IRN), issued by EIL/third party against the materials supplied by contractor, are sent to EIL along with the IRN. IRN/ IC shall be issued by EIL. Inspector/ third party inspection agency only after all the drawings/documents as per DCI are submitted and are accepted under review code-1 & code R. Material/Equipments dispatch from contractor's/sub vendor's works shall not commence till above condition is met.

Note: Non fulfilling above requirement shall result into appropriate penalty or withholding of payment as per conditions of Tender/Contract.

4.6 Final Documentation

4.6.1 As built Drawings

Shop/ Site changes made by contractor after approval of drawings under 'Code 1' by EIL and deviations granted through online system, if any, shall be marked in hard copies of drawings which shall then be stamped 'As-built' by the contractor. These 'As-built' drawings shall be reviewed and stamped by EIL Inspector/ Site engineer/TPIA also. Format for completeness of final documents (Format No. 3-78-0004) is attached with this specification. Contractor shall prepare scanned images files of all marked - up 'As - built' drawings. Simultaneously contractor shall incorporate the shop/site changes in the native soft files of the drawings also.

4.6.2 As built Final Documents

As built final documents shall be submitted as listed in Tender/Contract.

4.6.3 Packing/Presentation of Final Documents

Final Documents shall be legible photocopies in A4, A3 size only. Drawings will be inserted in plastic pockets (both sides transparent, sheet thickness minimum 0.1 mm) with an extra strip of 12 mm wide for punching so that drawings are well placed.

Final Documentation shall be bound in hard board plastic folder(s) of size 265 mm x 315 mm (10 1/2 inch x 12 1/2 inch) and shall not be more than 75 mm thick. It may be of several volumes and each volume shall have a volume number, index of volumes and index of contents of that particular volume. Where numbers of volumes are more, 90mm thickness can be used. Each volume shall have top PVC sheet of minimum 0.15 mm thick duly fixed and pressed on folder cover and will have 2 lever clips. In case of imported items documents, 4 lever clip shall also be accepted. All four corners of folders shall be properly metal clamped. Indexing of contents with page numbering must be incorporated by contractor. Spiral/Spico bound documents shall not be acceptable. As mentioned above, books should be in hard board plastic folders with sheets punched and having 2/4 lever clips arrangement.

Each volume shall contain on cover a title block indicating Tender No., name of project, name of customer, package equipment tag no. & name (if applicable). Each volume will have hard front cover and a reinforced spine to fit thickness of book. These spines will also have the title printed on them. Title shall include also volume number (say 11 of 15) etc.

4.6.4 Submission of Soft copies

Contractor shall submit to EIL, the scanned images files as well as the native files of drawings/documents, along with proper index.

In addition to hard copies, contractor shall submit electronic file (CD-ROM) covering soft copies of all the final drawings and documents, all text documents prepared on computer, scanned images of all important documents (not available as soft files), all relevant catalogues, manuals available as soft files (editable copies of drawings/text documents, while for catalogues/manuals/proprietary information and data PDF files can be furnished).

All the above documents shall also be uploaded on the EIL eDMS portal.

4.6.5 Completeness of Final Documentation

Contractor shall get the completeness of final documentation verified by EIL/TPIA and attach the Format for Completeness of Final Documentation (Format No. 3-78-0004) duly signed by EIL or TPIA as applicable to the document folder.

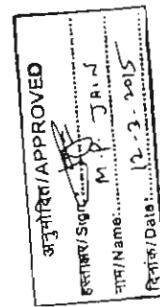
COMPLETENESS OF FINAL DOCUMENTATION

Name of Supplier/Contractor :
 Customer :
 Project :
 EIL's Job No :
 Purchase Order No./ Contract No. :
 Purchase Requisition No./ Tender No :
 Name of the Work/ Equipment :
 Tag. No. :
 Supplier's/ Contractor's Works Order No. :
 Rev. No. :

Certified that the Engineering Documents/ Manufacturing & Test Certificates submitted by the supplier are complete in accordance with the Vendor Data Requirements of Purchase Requisition.

Signature	Signature
Date	Date
Name	Name
Designation	Designation
Department	Department

Supplier/Contractor _____ EIL/TPIA _____



SECTION-5

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

BHEL ENQUIRY. NO:

BIDDER OFFER REFERENCE:

A)

(1) S.No.	(2) Parameters	(3) Data	(4) Yes / No	(5) Remarks in case reply in Col (4) is <i>NO</i>
1.	Technical offer complies with Cable details given in Section-1 Annexure-A of technical specification.	Complied.	Yes	
2.	NIL Technical Deviation sheet	NIL technical deviation sheet attached.	Yes	
3.	Cable Drum	Non –returnable Steel drums as per clause 6.0 of Section II	Yes	
4.	Cable End Caps	PVC/ Rubber end caps shall be supplied free of cost for each drum with a minimum of eight per thousand metre length.	Yes	
5	All routine test , acceptance test , type test and additional tests for improved fire performance shall be carried out as listed in IS 7098 and Inspection and testing requirements Annexure B. For Accelerated water absorption test If test report of test conducted in less than one year is not available then same shall be conducted in any recognized test laboratory or in house test laboratory without any price or delivery implication to BHEL.		Yes	
6	Compliance to requirements mentioned in clause 5.14 of Section II - Test for resistance to ultra violet radiation. If test report of test conducted in less than one year is not available then same shall be conducted in any recognized test laboratory or in house test laboratory without any price or delivery implication to BHEL.		Yes	
7	Compliance to Acceptance tests as per clause 5.15 of Section –II		Yes	
8	Compliance to Clause 5.16 of Section II to prove FRLS property of cable.		Yes	
9	Chemicals added to outer sheath to protect from rodent, vermin and termite attack	Yes	Yes	

B) ROUTINE, TYPE, ACCEPTANCE, SPECIAL AND ADDITIONAL TESTS

All Tests to be performed as per clause 5.0 & Annexure B of section-2 of technical specification.

(YES)

C)

(1) S.No.	(2) Description	(3) Confirmation of Supplier
1.	Bidder to confirm that at all drawings / data sheets/QP/ valid type tests reports/ all relevant information shall be submitted to BHEL for organizing approval of ultimate customer.	

Date:

Signature of the authorized representative of Bidder

Company Seal

SCHEDULE OF TECHNICAL DEVIATION

ENQUIRY NO.

The following are the deviations/ variations exception from the Technical Specifications:

SL.NO.	CLAUSE NO. OF GENERAL TERMS AND CONDITIONS	STATEMENT OF DEVIATION
1		

In case, this schedule is not submitted, it will be presumed that the equipment /material to be supplied under this contract is deemed to be in compliance with the Technical Specifications,

If there is NIL deviation,even then the format to be filled as NIL DEVIATION.

Note : 1. Continuation Sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

2 Deviation mentioned in this schedule shall only be considered.

**This Format is to be submitted in original duly signed by bidder.
Reproduction of the same in any sort is not acceptable.**

Place:
Date :

Signature of the authorised representative of

Bidder's name :.....
Designation:.....