

**Nepal Electricity Authority**  
**Project Management Directorate**  
**Kohalpur-Nepalgunj 132 kV Transmission Line Project**

**Reply on Queries**

S.No.	Queries	NEA Reply			
1	Volume I				
	Section 3: Evaluation & Qualification Criteria				
	1. Clause 1.3.6.2: SUSTAINABLE PROCUREMENT: This clause states: "The following sustainable procurement technical requirements will be evaluated on a pass/fail basis. Failure to meet any of the following requirements will result in mandatory rejection of the bid".				
	It is not clear as to which technical requirements are being referred to here as there is nothing mentioned hereafter or In Section 6. This may be clarified.				
		If there is nothing mentioned in section 6, then no requirement needed thus will not be evaluated on a pass/fail basis under this clause			
2	Section 8: Special Conditions of Contract	<p>Please follow the clause 14.5.2 as a whole. It is written clearly that " Unless otherwise specifically declared in the contract documents, the prices bid by the Contractor and its suppliers and subcontractors shall include <i>business taxes and other taxes that may be levied in accordance with the laws and regulations in force or in effect in Nepal as of 28 days prior to the closing date for submission of tenders in the Employer's country on the Equipment, Plant, Materials and Supplies (permanent, temporary and consumables) acquired for the purpose of the Contract and on the services performed under the Contract</i> . Whatsoever provisions made in the Contract document shall not relieve the Contractor, its suppliers and subcontractors from their responsibility to pay income tax that may be levied in the Employer's country on profits made by the Contractor, its suppliers and subcontractors in respect of the Contract.</p>			
	1. Clause 14.5.2: TAXES & DUTIES IN NEPAL: This clause states: <i>Unless otherwise specifically declared in the contract documents, the prices bid by the Contractor and its suppliers and subcontractors shall include business taxes and other taxes that may be levied</i>				
	We enclose a notification from IRD Nepal as issued along with its English translation where it is notified that the paying Authority shall deduct 1.5% of the net workable value as Income tax. Kindly clarify the rates of other taxes that are to be included in the prices to be submitted by the bidder's. A specified rate will mean a uniform inclusion to be done by all bidders.				
	Volume II a				
	1. Clause- 2.2.2: REINFORCED CROSS ARM & LEG EXTENSION: This clause states that: <i>Reinforced Cross Arm &amp; Leg Extension may be used as per site condition but the Additional Galvanized Steel is not mentioned in BOQ.</i>				
We would request clarity in the methodology for claiming the quantity of Additional Galvanized Steel, and / or if there is need of Raised Chimney and / or RCC wall , then the methodology of claiming the extra item their quantity of excavation, formwork etc.	Please follow Section 7-GCC Clause no 39				
Volume III Transmission Line Portion					
a. Schedule 1(a) & 4(a): There is a discrepancy in quantities of towers as per these Schedule's which is brought out in the table below:					
	Type of Tower	Qty as per Schedule-1(a)	Qty as per Schedule-4(a)	Remark	NEA Reply
	QA	19	25	all type of soil classification of BOQ Item no. 5.1	This is to make the bidders quote price for all types of
	QB	8	12	all type of soil classification of BOQ Item no. 5.2	

	QC	5	9	all type of soil classification of BOQ Item no. 5.3	all types of foundations so that contractors will be paid on the basis of same quoted rate if any of the foundation type is faced during construction
	QD	5	8	all type of soil classification of BOQ Item no. 5.4	
	DD	2	2	all type of soil classification of BOQ Item no. 5.5	
	Total No. of Towers	39	56		
	Further the supply of hardware fittings mentioned for 36 towers only and supply of towers are mentioned for 39 towers. The above discrepancy may be reconciled and firm quantities may be conveyed.	Please quote the price as per the quantity mentioned. The quantity might be adjusted during contract agreement/execution			
	b. There is a discrepancy b/w Schedule 3A: Design Services and Schedule No. 4A: Installation and Other Services (Common for all) (e): Prototype Testing of Tower. Only 2 nos. of towers are mentioned in schedule 4 A (e), whereas in schedule 3A 4 nos. of tower are mentioned. We understand that both schedules should be identical with same type of tower. Kindly clarify.	As we have prototype tested already for QA and QD tower and only extension of +9 M for QB and QC type needs to be designed, please quote accordingly.			
	Volume II b				
	A. Chapter 1: Clause 2.1(p): SCOPE: It is stated that the scope covers: <i>11 kV Overhead line extension</i>				
	The commensurate BOQ was not found in the Price schedule and the scope may be clarified.	If you don't find commensurate BOQ in the price schedule, then no 11 kV overhead line extension needed			
B.	Chapter 1: Clause 3(a & b): SPECIFIC EXCLUSIONS: It is stated that : <i>The following items of work are specifically excluded from the scope of the specifications for all substations:</i>				
1	<i>Employer's quarters, site office and stores</i>				
	We find that the Staff quarters are listed in the price Schedule No. 4 B (a): Installation, Testing & Commissioning Services and Civil Works under 2.3.21.1 and the stores under 2.3.21.2. Kindly clarify the scope vis. the price schedule and the need of construction of Staff quarters and store. The construction of site office for employer which is not listed in the price schedule may also be clarified. In furtherance the items listed under item 2.3.35 (b) Side Entry Gate for Township (Staff Quarters) Buildings may also be clarified.	It clearly states that, " Employer will self-manage for quarters, site office and stores during construction phase and it is excluded from the contractor's scope".			
C.	Chapter 1: Clause 11 d: SPECIFIC REQUIREMENT: It is stated that: <i>The scope of work for supply, installation of approach optical fiber (as per requirement from JB to ODF box), Optical Line Termination Equipment, Digital Multiplexer, hardware accessories etc. at Kohalpur and Bhurigaon Substation and its integration work (at existing Kohalpur &amp; LDC Kathmandu) for onward transmission of Data and Voice communication upto LDC Kathmandu is included in the contract.</i>				
	The relevant addition of quantity for Kohalpur and Bhurigaon substations is not observed in the price Schedule No. 4 B (a): Installation, Testing & Commissioning Services and Civil Works item no. 1.19. Further in price Schedule No. 4 B (a): under item 1.19.4 we find a mention of Butawal substation. We would request that a network diagram along with clarifications on the total works for Augmentation and integration work related to Communication System may be provided with related amendments in the price schedule too.	Please quote as per bid price schedule. Integration of communication system shall be on 104 protocol. Please follow the network diagram attached herewith.			
D.	Chapter 9: CONTROL RELAY AND PROTECTION: The make of relays in the other end of transmission line terminating substation is not mentioned in the tender documents. The same may kindly be provided.	Is in process of replacement and upgradation .so the make cannot be confirmed at this moment.. However all the relays shall be on 61850 protocol.			
E.	Chapter 11: BATTERY AND BATTERY CHARGER:				
1	The size and type of both the types of batteries are mentioned but we could not find the rating of chargers (both for Boost and float mode) in the specific requirement. The load cycle is also not provided. The same may kindly be provided.	Please follow chapter 11, clause 1.2.11, capacity requirements and other relevant clauses for design purpose			

2	The voltage rating of the battery is mentioned as 110 V in the technical specification and in the price schedule whereas the same is mentioned as 220 V DC in the reference LT SLD drawing (Drg. Name: Standard SLD for AC/DC system for 400/220/132 kV S/S). We understand the voltage rating is 110 V DC. Kindly confirm.	Confirmed
F. Chapter 16: FIBER OPTIC BASED COMMUNICATION:		
1	Clause 2.3.1.1: It is mentioned in that the network diagram has been provided in the appendices but the same is missing in the annexure drawings. May kindly be provided.	Please find the network diagram attached in the mail.
2	The make of Telecommunication equipment for the other end of the Nepalgunj S/S is not mentioned in the Tender document. May kindly be provided.	Telecommunication Equipments are in process of replacement and upgradation .So the make cannot be confirmed at this moment. However, all TE should be on 104 protocol.
G. Chapter 19: CIVIL WORKS:		
1	Cl.2.3.3: The soil resistivity value has not been provided in the tender document. We would request that this data be made available for earthing design and quantity estimation.	It is under contractor's scope as per the price schedule no. 4B (a): Installation, testing and commissioning services and civil works, item no. 2.3.3. For your information, the soil is moist and is cultivable land type
2	Clause 2.0: The soil bearing capacity has not been provided in the tender document. We would request that this data be made available for equipment and building foundation design and estimation of quantity.	It is under contractor's scope as per the price schedule no. 4B (a): Installation, testing and commissioning services and civil works, item no. 2.3.2.
H.	Technical Schedules: We would request that a word format of the technical schedules may be provided for ease of filling the data.	This has been already sent
I.	Drawings: The Auto CAD format of the lay out may be provided so that the various critical dimensions can be measured and approximate quantities of items like fencing, cabling etc can be ascertained.	It is attached herewith the mail.
<b>Volume I:</b>		
J	<b>Query no. 1:</b> In Clause no 2.6 of section 3, it is mentioned that Form-EXP-3 shall be filled for sub-contractors or manufacturers, but Form-EXP-3 is for "Specific Experience in Managing Environmental, Health and Safety Aspects". This form is for the Bidder to submit and not for the sub-contractors or manufacturers. The same may be kindly clarified.	Please fill up EXP-7 for sub-contractors or manufacturers
K	<b>Query no. 2:</b> Section 3: We understand that the end user's certificate shall be notarized scanned copy of the original ones and therefore it cannot be on the original letterhead. Kindly confirm if this is acceptable.	Please submit the notarized photocopy of the original one
L	<b>Query no. 3:</b> In section 4 under Form EXP - 7: Subcontractors, one form is given to be filled up for each contract but the form given under this section is identical to the form Exp-1(Contracts of Similar Size and Nature) which shall be filled by the bidder. Kindly clarify if this form has to be filled for all the major manufacturers.	Please fill up the same as mentioned
<b>Volume IIB:</b>		
M	<b>Query no.4:</b> CHAPTER 1 -PROJECT SPECIFICATION REQUIREMENT : The BIL(basic insulation level) for 132 kV system is mentioned as 650 kv peak and One minute power frequency dry and wet withstand voltage(rms) is mentioned as 275 kV. CHAPTER 20-GENERAL TECHNICAL REQUIREMENT- TECHNICAL SCHEDULE: The requirement of above-mentioned parameters is mentioned as 750 kV peak and 325 kV rms. We have assumed the BIL as 750 kV peak and PF voltage as 325 kV rms. kindly confirm that our assumed parameters are correct.	Please follow Project Specific Requirement
N	<b>Query no.5:</b> CHAPTER 20-GENERAL TECHNICAL REQUIREMENT- TECHNICAL SCHEDULE: In page no. 9, the percentage impedance on maximum MVA base and in ONAF cooling for the 24MVA transformer is mentioned as 8. CHAPTER-03-GENERAL TECHNICAL REQUIREMENT-POWER TRANSFORMER: The percentage impedance for 24 MVA transformer is mentioned as greater than 11 % Kindly clarify which one to be adhered.	Please follow chapter 03: TECHNICAL REQUIREMENT - POWER TRANSFORMER
O	<b>Query no.6:</b> While visiting the site, the NEA representative showed the tap off point for only one circuit. The tap off point is around 2-3 km away from Kohalpur substation and was informed by the representative that one of the double circuits coming from Kohalpur S/s in not in charged condition now and the same shall be travelling to Nepalgunj S/s as one of the incoming lines. We would like to know from where the other three circuits shall be connected?	Both the circuits will be tapped off from the same point.



Project	Design, Supply, Installation, Testing and Commissioning of Transmission Line from Kohalpur to Nepalgunj (Janaki Rural Municipality) and and Associated 132/33/11 kV Air Insulated Substation (AIS) at Bakaspur, Janaki Rural Municipality, Banke District (Package A-3)				
Sl. No.	Query Type	Tender Document reference Clause no / Page no	Clarification by Bidder	Response by NEA	Remarks
<b>132/33/11KV Substation at Bakaspur (New Substation)</b>					
1	Power Transformer Specification	Specification Cl. No. 3.6.2.7	We understand Price schedule BOQ for transformer Line item no. 1.1.1.1 & 1.1.1.2 are not included with following requirement. Kindly confirm. a) Online Gases and moisture monitoring system, b) Online drying system c) Fiber optic sensor Box etc.	If they are not mentioned separately in BOQ, and are applicable during detail design, they may be required otherwise not.	
2	Power Transformer Specification	Specification Cl. No. 3.6.2.7	Kindly Share the specification & No. of Gas monitoring in case Online Gases and moisture monitoring system is required	Please refer addendum-I, chapter 17 (Annexure D)	
3	Power Transformer	General	Kindly Specify the Maximum Load Loss, No Load Loss & Cooler Losses for 132/33kV & 33/11kV Power Transformer same is not reflecting is specification	They should be submitted by the bidder only.	
4	Power Transformer Specification	BPS BOQ Line item no. 1.1.1.1 & 1.1.1.2	BOQ decryption provided with tank mounted for LA for LV side of 51/63MVA 132/33kV & 20/24 MVA 33/11kV Transformer , Kindly clarify whether to consider tank mounted LA on LV side or separate LA shall be considered.	Please consider tank mounted LA on LV side	
5	Power Transformer	Scope of work Volume II-B- Cl. No. 2.1	Power Transformer rating specified in scope of work / Technical schedule as 40/51.5/63 MVA ONAN/ONAF1/ONAF2 for 132/33kV However as per BPS Transformer rating is 51/63 MVA, ONAN/ONAF. Kindly clarify the correct requirement for Power Transformer	Please consider the rating as 40/51.5/63 MVA	
6	Substation Name	General	We understand Substation name Bakaspur village & Nepalganj is same , kindly clarify	They are same	
7	Substation Altitude Level	General	Kindly Clarify the Substation altitude level	Please refer chapter 1, Project Specific Requirement, clause 4.1. Metereological data	
8	Plot Layout	Tender Layout	Kindly Share Plot Layout Plan with Coordinates & dimension	please find the kmz and ACAD file attached herewith.	
9	Dead End Tower	Plot Layout	Please arrange to mark the Dead end tower on "Construction Plan Layout (Bakasapur SS)" to locate take of gantry and prepare layout for estimation.	It is under the contractor's scope	
10	Scope of work	Tender SLD / Scope of work Vollum II-B- Cl. No. 2.1	Description provided in scope of work as 132 kV bays, 4 nos. for LILO of 132kV Kohalpur-Nepalgunj D/C Lines, However as per tender SLD Line names are different for two nos line bays i.e. Bhurigaun-I & 2, kindly clarify all four line are going to same s/s or different	2 nos. of 132 kV bays receive the lines coming from Kohalpur side and they go out from the substation towards Bhurigaon.	
11	123kV Line Name	Tender SLD / Scope of work volume II-B- Cl. No. 2.1	If both 132kV Lines are going to two different s/s in that case kindly share line lengths	Please refer the SLD attached herewith.	
12	Power Transformer	volume II-B- Cl. No. 2.1	Power Trfo rating specified in scope of work / Technical schedule as 40/51.5/63 MVA ONAN/ONAF1/ONAF2 for 132/33kV However as per BPS Transformar rating is 51/63 MVA, ONAN/ONAF. Kindly clarify the correct requirement for Power Transformer	Same as 5	

Project	Design, Supply, Installation, Testing and Commissioning of Transmission Line from Kohalpur to Nepalgunj (Janaki Rural Municipality) and and Associated 132/33/11 kV Air Insulated Substation (AIS) at Bakaspur, Janaki Rural Municipality, Banke District (Package A-3)				
Sl. No.	Query Type	Tender Document reference Clause no / Page no	Clarification by Bidder	Response by NEA	Remarks
13	Scope of work	Tender SLD	In Tender SLD Provision for Two Future 132kV Line Bays is shown, Kindly clarify is Bus Extension for Future bays need to consider in present scope of work or not	They are not under present scope but space should be considered during design for future works	
14	Scope of work	Tender SLD / Scope of work volume II-B- Cl. No. 2.1 (A)	In Scope of work 33kV I/c Bays 2 No. for 132/33kV 51.5/60MVA Power Transformers is missing, however reflecting in tender SLD & BPS, hence we are considering Total 10 Bays in present scope of work along with Two. No.s station Trfo Bay & One Bus sectionalizer. Kindly confirm	Please refer price schedule	
15	Scope of work	Tender SLD	We understand there are no any Future bays for 33kV s/s in present scope of work & No provision of bus for future bay extension in present scope	Confirmed	
16	Scope of work	Scope of work volume II-B- Cl. No. 2.2 (A)-(c)	Kindly clarify the scope of work for Extension of 11kV overhead line distribution supply. We understand Our scope is supply of 11kV switchgear further distribution not in our scope scope of work	Please refer price schedule	
17	Scope of work	SAS System Price schedule Sr. no. 1.8.1	SAS system mentioned for 132kV is for 7 Bays as per Present scope. We understand Future bays SAS is not included in present scope of work, kindly clarify	Confirmed	
18	Control & Replay Panel Protection	volume II-B- Cl. No. 1.6	All Protection relay shall be of Numerical Type Kindly confirm	Confirmed	
19	Control & Replay Panel Protection	volume II-B- Cl. No. 1.8	For All Voltage simplex type C&R panel is acceptable or not, Kindly confirm'	They will be considered during detail design & engineering	
20	Control & Replay Panel Protection	volume II-B- Cl. No. 18	Kindly Clarify whether requirement of Relay shall be PRP type or Non PRP Type	They will be considered during detail design & engineering	
21	Control & Replay Panel Protection	volume II-B- Cl. No. 26	Kindly Clarify Required Bus Bar Protection scheme is centralized or decentralized	They will be considered during detail design & engineering	
22	Battery Charger Rating	Chapter 11 - Battery & Battery Charger	We understand for 110V & 48V Battery End Cell Voltage is 1.75 V. kindly confirm	Please follow the specification (chapter 11, vol II B)	
23	Conductor configuration for 132kV & 33kV Switchyard	General	Busbar shall be design for following condition as specified in Section- 14 Cl. No. 1.2 (a) We have considered 132kV & 33kV Main busbar 2000A - Considered 3" IPS Al. Tube 75mm 132kV & 33 kV Branch Bus Bar 800A Considered Twin ACSR Cardinal conductor & 2.5" IPS Al. tube 63mm	Please follow volume II B, chapter 17, clause 4.4, Technical Parameters	
24	Illumination System	General	We understand DC Light shall be considered only for Control Room in switchyard. Kindly confirm.	They will be considered during detail design & engineering	

Project	Design, Supply, Installation, Testing and Commissioning of Transmission Line from Kohalpur to Nepalgunj (Janaki Rural Municipality) and and Associated 132/33/11 kV Air Insulated Substation (AIS) at Bakaspur, Janaki Rural Municipality, Banke District (Package A-3)				
Sl. No.	Query Type	Tender Document reference Clause no / Page no	Clarification by Bidder	Response by NEA	Remarks
25	Outdoor Lighting	General	We presume that following are covered under outdoor lighting 1. 132KV bay area / yard 2. 33KV bay area/ Yard 3. 11KV bay area / Yard 4. Street light from Main gate entry to all inside road 5. Peripheral area across substation boundary wall. Other than above, no area/outdoor yard lighting is envisaged under present scope. Please confirm.	They will be considered during detail design & engineering	
26	Outdoor Lighting	General	We understand if Outdoor Peripheral area is covered by Fixture on LM or Tower in that case no sperate Light pole is required, Kindly confirm	They will be considered during detail design & engineering	
27	DG Set Location	General	We presume that DG set will be located at outdoor on PCC/RCC floor without any shade. Please confirm.	They will be considered during detail design & engineering	
28	Type Test of Transformer	General	We presume Type Test report & Dynamic Short Circuit (DSC) report to be submitted for Transformer conducted on similar design voltage level & rating or higher design voltage level & higher rating transformer and same shall be acceptable if conducted within valid period as specified in contract. Please confirm.	Please refer amendment-I	
29	Type Test	General	We understand Only type test report to be submitted which was conducted within valid time period as specified in contract document. Further we understand Type tests on any equipment's are not allowed to Conduct during detail engineering stage/execution stage. Please confirm.	Please refer section 19, clause 1.4.3	
30	Earthing	General	Earth Mat to be provide only for fence area i.e. 132KV bay area/yard, 33KV bay area/yard & 11KV bay area/yard as indicated in tender layout "Construction Plan Layout (Khungri SS)". Earth mat will not be provide rest of the area inside substation boundary. Please confirm.	Confirmed	
31	Discrepancy in Grounding system material	Earthing Price schedule Sr. no. 1.8.1	Price Schedule line item specified with "Earthing system of substation with Copper conductors, copper clad steel Earth Rod with necessary connectors/connections, risers etc. complete in all respect as per technical Specification and approved drawing." However as per technical data sheet 1.10.1 of Chapter 20 Earthing material specified with MS & GS material, Kindly clarify the requirement	Please refer chapter 17, clause 7 Grounding system of the volume II B carefully	
32	Station Supply, LV Switchgear (As per Technical specification)	Price schedule Sr. no. 1.10	Following specification are not included in the tender. Please arrange to provide the same 1. 400V AC Main Control Panel 2. 400V AC Distribution Board 3. 400V AC Main Lighting Distribution Board 4. 400V AC Emergency distribution Board 5. 110V DCDB 6. 48V DCDB	Please follow addendum-I chapter 8C : LT Switchgears	
33	Tender LT SLD	Price schedule Sr. no. 1.10	Tender LT SLD shared scheme is not matching with the Present scope requirement. Kindly share Project specifica LT SLD	They will be considered during detail design & engineering	

Project	Design, Supply, Installation, Testing and Commissioning of Transmission Line from Kohalpur to Nepalgunj (Janaki Rural Municipality) and and Associated 132/33/11 kV Air Insulated Substation (AIS) at Bakaspur, Janaki Rural Municipality, Banke District (Package A-3)				
Sl. No.	Query Type	Tender Document reference Clause no / Page no	Clarification by Bidder	Response by NEA	Remarks
34	Main Lighting Distribution Board (MLDB) & ELDB	General	No lighting transformer (...KVA, 415/415V) is envisaged in the MLDB & ELDB. Please confirm.	Please follow bid document	
35	Fire Detection & Alarm System	Price schedule Sr. no. 1.13.4 & 1.13.5	Following specification are not included in the tender. Please arrange to provide the same 1. Smoke detection system in Control Room cum administrative Building 3. Fire detection and Alarm System in Control Room cum administrative Building	Please find addendum-I	
36	Fire Protection System as per technical Specification	Price schedule Sr. no. 1.20	Following specification are not included in the tender. Please arrange to provide the same 1. Pumping arrangement for HVW system & hydrant system complete with all piping, valves, fittings etc. inside pump house. 2. Hydrant system, complete U/G piping and accessories etc. outside the Pump House for all transformers and equipment. 3. HVW spray system, Hydrant system and complete U/G & O/G piping and accessories etc. out side the pump house for :63 MVA, 132/33 kV & 24 MVA, 33/11 kV	Please find addendum-I, chapter 24	
37	DG Set	Price schedule Sr. no. 1.17.1	As per BOQ DG set description is "50 KVA Silent type Diesel Generator (400/230, 50 Hz) with control panel & AMF panel as per technical specification for firefighting system." We presume that it will be 433V (i.e 3 Phase) DG set instead of 230V (1 phase) . Please confirm.	Please follow bid document	
38	HT fuse 200KVA Aux trafo Connection	General	As per SLD there are 33KV fuse before 30KV LA in 200KVA Aux trafo feeder. But same are not available in the BOQ line item. Please check & confirm its requirement.	Please follow bid price schedule	
39	Cable Trench Size	General	We understood Cable trench Typical drawing provide along with technical specification is only for reference, we can modify Trench size & No. of Trays as per actual requirement, Kindly confirm	They will be considered during detail design & engineering	
40		General	Change in ownership in contractor's organization . 1. In contractor's organization it is not defined what if any contractor anticipate change in ownership such as merger, de-merger or acquisition . 2. What if the contract may be assigned by Contractor after approval of Employer to another entity where the promoter / promoter group consist of the same persons, and the same persons who control parent organisation control the transferee entity. 3. In a scenario contemplated in terms of Paragraph (2) above, please confirm if the contract may be assigned automatically by Contractor or if there are any other requirements for such assignment.	Employer has not anticipated such changes in the contractor's organisation	



S.N.	Power Transformer	Technical Data Sheet	Clause	Description	Bidder Clarify	NEA Reply
1	DS+CB	132kV DS +132kV CB	Page 204 1.13 Windings	It is required that Lightning Impulse withstand Voltage (LI): a) HV-winding, kV 650 b) LV-winding, kV 170 One Minute Power Frequency withstand Voltage (AC)(KV) a) HV-winding, kV 275 b) LV-winding, kV 70	According to IEC standard, the insulation level of 132kV transformer should be: a) HV-winding, kV 650 b) LV-winding, kV 170 One Minute Power Frequency withstand Voltage (AC)(KV) a) HV-winding, kV 275 b) LV-winding, kV 70	Please read as a) HV-winding, kV 650 b) LV-winding, kV 170 One Minute Power Frequency withstand Voltage (AC)(KV) a) HV-winding, kV 275 b) LV-winding, kV 70
2	DS+CB	132kV DS +132kV CB	Page 5 20. Insulation level	It is required that Impulse withstand(kV Crest): a) HV-winding, kV 750 b) LV-winding, kV 250 Power frequency withstand voltage (1 min. rms) a) HV-winding, kV 325 b) LV-winding, kV 95	a) HV-winding, kV 275 b) LV-winding, kV 70 Please confirm which one is correct?	a) HV-winding, kV 275 b) LV-winding, kV 70
3	DS+CB	33kV DS +33kV CB	Page 18 - 8. Insulation level and Page 13 - 9. Insulation level	It is required that Impulse withstand voltage: 750 kV Power frequency withstand voltage (1 min. rms) : 325 kV	According to IEC standard, the insulation level of 132kV CB and DS should be: Impulse withstand voltage 650 kV One Minute Power Frequency withstand Voltage (AC)(kV) : 275 kV Please Confirm	Please read as: Impulse withstand voltage 650 kV One Minute Power Frequency withstand Voltage (AC)(kV) : 275 kV
4	DS	33kV DS	Page 19 22. Insulator and Page 15 - 31. Porcelain insulator	Creepage distance in air is 4650mm	According to IEC, Very Heavy pollution class is 145*31=4495(mm) Please Confirm	Please consider roughness factor also
5	CB	33kV CB	Page 22 - 8. Insulation level and Page 17 - 9. Insulation level	It is required that Impulse withstand voltage: 250 kV Power frequency withstand voltage (1 min. rms) : 95 kV	According to IEC standard, the insulation level of 33kV CB and DS should be: Impulse withstand voltage 185 kV One Minute Power Frequency withstand Voltage (AC)(KV) : 80 kV Please Confirm	Please read as: Impulse withstand voltage 185 kV One Minute Power Frequency withstand Voltage (AC)(KV) : 80 kV
6	CT+CVT	+ 132kV CT +132kV CVT	Page 23 22. Insulator	Creepage distance in air is 1300mm	According to IEC, Very Heavy pollution class is 40.5*31=1255.5(mm) Please Confirm	Please follow the bidding document
7	Comercial	Section 9: Contract Forms	Page 16 16. First pole to clear factor	The requirement for this parameter is 1.3	According to IEC, for Indirect effective grounding system is 1.5 Please Confirm	please follow the bidding document
8.0	Comercial	Section 9: Contract Forms	Page 25 - 8. Insulation level and Page 27 - 6. Insulation level	It is required that Impulse withstand voltage: 750 kV Power frequency withstand voltage (1 min. rms) : 325 kV	According to IEC standard, the insulation level should be: Impulse withstand voltage 650 kV One Minute Power Frequency withstand Voltage (AC)(KV) : 275 kV Please Confirm	Please read as : Impulse withstand voltage as 650 kV and one minute power frequency withsatand voltage (AC) (KV) : 275 kV
9.0	Comercial	Section 9: Contract Forms	3.1 Effective Date	With regard to Effective Date	the bidder request handover of site by Owner shall also be a condition together with a, b, c conditions specified in the Contract.	please follow the bidding document
10.0	Comercial	Section 9: Contract Forms	1.1 Contract Documents	With regard to Contract Documents	the bidder request that the contract documents shall include all amendments and clarifications.	please follow the bidding document
11.0	Comercial	Section 8 - Special Conditions of Contract	Appendix 1: Terms and Procedures of Payment	With regard to Payment Schedule No. 1,2,4,	the bidder request 15% as advance payment and 5% upon completion certificate.	please follow the bidding document
12.0	Comercial	Section 7: General Conditions of Contract	Appendix 1: Terms and Procedures of Payment	With regard to Interest for Payment Delay,	the bidder request that the interest for period of delay shall be at the rate published by Nepal Rastra Bank (NRB) if the payment delay is more than 2 months.	please follow the bidding document
13.0	Comercial	Section 8 - Special Conditions of Contract	13. Securities:	With regard to Performance Security	the bidder request that the performance security shall be reduced to 5% on the date of the Operational Acceptance.	please follow the bidding document
14.0	Relay and Protection	Technical Specification	37. Force Majeure	With regard to Force Majeure,	the bidder request cost compensation if case new epidemic infectious diseases occur.	please follow the bidding document
15.0	Earthing	Technical Specification	45. Disputes and Arbitration	With regard to Arbitration Rules,	the bidder request that the international arbitration shall be conducted in accordance with the rules of Singapore International Arbitration Centre SIAC Rules.	please follow the bidding document

16.0	Transformer	Technical Specification	Technical Specification	Please Provide the Relay and protection brand of substation which will have communication with envisaged 132/33/11kV New substation at Bakaspur village, Janaki Rural Municipality-5 of Banke district	Please Provide the Relay and protection brand of substation which will have communication with envisaged 132/33/11kV New substation at Bakaspur village, Janaki Rural Municipality-5 of Banke district.	Please visit the site to assess the make
17.0			Volumell-B of III Chapter 20 General Requirement-Technical Technical Schedule 1.10 Technical Particular for Substation grounding system	The copper earthing system is envisaged as its mentioned in BOQ of 132KV AIS Substion Earthing system,but the mild steel & GI Flat are needed as the Technical Schedule 1.10 technical particular for substation grounding system - Chapter 20 General requirement - Volume IIB	We envisage that both of the mild steel &GI Flat earthing and copper system can be accepted during the detail design stage after submission of detail design proposal , kindly confirm.	Please follow chapter 17, clause 7: Grounding conductors of volume II B
18.0			Volumell-B of III Chapter 3 General Requirement-General technical requirement	The 11% impedance is envisaged for 33/11kV 20/24MVA Power Transformer in Volumell-B of III Chapter 3 General Requirement-General technical requirement,but 8% impedance is mentioned in the technical schedule	We envisage that both of the impedance value can be accepted during the detail design stage after submission of detail design proposal , kindly confirm.	Please follow chapter 3: Power transformers, clause 6: Technical Parameters of volume IIB

# Addendum-I



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# CHAPTER 4: LT SWITCHGEAR

## 1.1. CONSTRUCTIONAL DETAILS OF SWITCHBOARDS AND DISTRIBUTION BOARDS

- 1.1.1. All boards shall be of metal enclosed, indoor floor mounted, compartmentalised double front construction and freestanding type.
- 1.1.2. All board frames, shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. Gland plate shall be cold rolled sheet steel having thickness not less than 3 mm in all cases. However, in case of termination of single core power cables, gland plate shall be of non-magnetic material of at least 4mm thickness.
- 1.1.3. All panel edges and cover/door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members.
- 1.1.4. The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cut-outs shall be true in shape and devoid of sharp edges.
- 1.1.5. All boards shall be of dust and vermin proof construction and shall be provided with a degree of protection of IP: 52, for category I enclosure as per IEC 60947 (Part-1). However, the busbar chambers having a degree of protection of IP: 42, in accordance with IEC 60947 (Part-1), are also acceptable where continuous busbar rating exceeds 1000 Amp. Provision shall be made in all draw out Air Circuit Breaker compartments for providing IP: 52 degree of protection, when Circuit breaker trolley, has been removed. Panels with lighting transformers shall have IP 31 degree of protection in accordance with IEC 60947 (Part-1). Door frame of panels, meters, relays, Breaker cut-outs shall be provided with neoprene rubber gaskets generally conforming to IEC/International Standards.
- 1.1.6. Provision of louvers on boards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous busbar rating exceeds 1000 Amps. Panels with lighting transformers in lighting distribution boards shall have louvers.
- 1.1.7. All boards shall be of uniform height not exceeding 2450 mm.
- 1.1.8. Boards shall be easily extendible on both sides, by the addition of the vertical sections after removing the end covers of bus bar chambers.
- 1.1.9. Boards shall be supplied with base frames made of structural steel sections, alongwith all necessary mounting hardware required for welding the base frames to the insert plates.



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- 1.1.10. a) All boards shall be of double front construction and shall have :
- (i) A completely enclosed busbar compartment for running horizontal busbars and vertical busbars. Busbar chambers shall be completely enclosed with metallic portions. Bolted covers shall be provided for access to horizontal and Vertical busbars for repair and maintenance, which shall be feasible without disturbing feeder compartment. Vertical bus bar chambers shall be accessible from front as well as back side of the panel and shall be of at least 350 mm width. One set of vertical busbars shall be used in between two adjacent sections for switchgear connections. In case of ACB feeders, the panel shall have single front without any vertical busbar chamber, however vertical busbars associated with ACBs shall be located in rear side and shall be additionally covered with metallic perforated/transparent acrylic or polyvinyl bolted sheets to avoid direct access after opening rear door of chamber.
  - (ii) Completely enclosed switchgear compartment(s) one for each circuit for housing circuit breaker or MCCB or motor starter.
  - (iii) A distinct compartment or alley for power and control cables on each side of panel. Cable alley compartment shall have a through metallic partition for segregating cables on both sides. Cable alley door shall preferably be hinged. Cable alley shall have no exposed live parts. Any live terminals shall be fully shrouded/insulated from safety aspects. However, it shall be of atleast 350mm width.
  - (iv) A compartment for relays and other control devices associated with a circuit breaker.
- b) Lighting transformers shall be supplied in separate and distinct panel completely assembled for incoming cable connection from bottom and outgoing connection through busbar with adjacent associated lighting distribution board. Lighting transformers shall have provision of base channel with rollers for taking in and out from the panel in case of maintenance after disconnecting incoming and outgoing connections. Provision of single phase fans at least two (2) numbers of suitable ratings shall be made in the panel for ventilation. These fans shall run in sequential mode at suitable time interval to be controlled by thermostat and timer. The offered design of panel should be such that in no case, temperature rise of lighting transformers shall exceed the permissible limits for the class of insulation of lighting transformer.
- 1.1.11. Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. Each shipping section shall have full metal sheets at both ends for transport and storage.
- 1.1.12. All equipments associated with a single circuit except MCB circuits shall be housed in a separate compartment of the vertical section. The Compartment shall be sheet steel enclosed on all sides with the withdrawal units in position or removed. The front of the compartment shall be provided with the hinged single leaf door, with locking facilities.

In case of circuits controlled by MCBs, group of MCB feeders can be offered in common compartment. In such case number of MCB feeder to be used in a common compartment



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shall not exceed 4 (four) and front of MCB compartment, shall have a viewing port of toughen glass sheet for viewing and sheet steel door of module shall be lockable with star knob/panel key.

- 1.1.13. After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose over the cable terminations located in cable alley.
- 1.1.14. The minimum clearance in air between phases and between phase and earth for the entire run of horizontal and vertical busbars, shall be 25 mm. For all other components, the clearance between "two live parts", " A live part and an earthed part" and isolating distance shall be atleast ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for horizontal run of busbar minimum clearance of 25 mm should be maintained even if they are sleeved.
- 1.1.15. The temperature rise of horizontal & vertical busbars when carrying rated current along its full run shall in no case exceed 55°C, with silver plated joints and 40°C with all other type of joints over an outside ambient temperature of 50°C.
- 1.1.16. All busbar chambers shall be provided with removable bolted covers. The covers shall be provided with danger labels.
- 1.1.17. All identical circuit breakers and module chassis of same test size shall be fully interchangeable without having to carryout modifications.
- 1.1.18. All Circuit breaker boards shall be of Single Front type, with fully drawout circuit breakers, which can be drawn out without having to unscrew any connections. The circuit breakers shall be mounted on rollers and guides for smooth movement between SERVICE, TEST and ISOLATED positions and for withdrawal from the Switchboard. Testing of the breaker shall be possible in the TEST position.
- 1.1.19. Wherever two breaker compartments are provided in the same vertical section, insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.
- 1.1.20. All disconnecting contacts for power circuits shall be of robust design and fully self aligning. Fixed and moving contacts of the power drawout contact system shall be silver plated. Both fixed and moving contacts shall be replaceable.
- 1.1.21. All AC & DC boards shall be of double Front type.
- 1.1.22. All module shall be fixed type except air circuit breaker module, which shall be drawout type.
- 1.1.23. The connections from busbars to the main switch shall be fully insulated/shrouded, and securely bolted. The partition between the feeder compartment and cable alley may be non-metallic and shall be of such construction as to allow cable cores with lugs to be easily inserted in the feeder compartment for termination.



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- 1.1.24. All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to PURCHASER approval. Bidder shall submit dimensional drawings showing complete internal details of Busbars and module components, for each type and rating for approval.
- 1.1.25. The tentative power and control cable entries shall be from bottom. However, Purchaser reserves the right to alter the cable entries, if required, during detailed engineering, without any additional commercial implication.
- 1.1.26. Adopter panels and dummy panels required to meet the various busbar arrangements and layouts required shall be included in Bidder's scope of work.

## 1.2. **DERATING OF EQUIPMENTS**

- 1.2.1. The current ratings of all equipments as specified in the Single Line Diagram For AC & DC System are the minimum standards current ratings at a reference ambient temperature as per relevant Indian Standards.

## 1.3. **POWER BUS BARS AND INSULATORS**

- 1.3.1. All AC Distribution Boards shall be provided with three phase buses and a neutral bus bars and the DC Distribution Boards shall be provided with two busbars.
- 1.3.2. All busbars and jumper connections shall be of high conductivity aluminium/copper of adequate size.
- 1.3.3. The Cross-Section of the busbars shall be uniform through out the length of Switchgear and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents.
- 1.3.4. All busbars shall be adequately supported by adequate numbers of high strength type Polyester fibre glass Moulded Insulators to withstand short circuit withstand capability of panel. Separate supports shall be provided for each phase and neutral busbar. If a common support is provided anti-tracking barriers shall be provided between the supports.
- 1.3.5. All busbars joints shall be provided with high tensile steel bolts. Belleville/spring washers and nuts, so as to ensure good contacts at the joints. Non-silver plated Busbars joints shall be thoroughly cleaned at the joint locations and a suitable contact grease shall be applied just before making a joint.
- 1.3.6. All busbars shall be colour coded as per IEC: 60446.
- 1.3.7. The Bidder shall furnish calculations, establishing the adequacy of busbar sizes for specified current ratings, On the basis of short circuit current and temperature rise consideration at specified ambient temp.

## 1.4. **EARTH BUS**

- 1.4.1. A galvanised steel earthing shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded/bolted to the frame work of



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- 1.4.2. each panel and breaker earthing contact bar vertical bus shall be provided in each vertical section which shall in turn be bolted/welded to main horizontal ground bus.
- 1.4.3. The earth bus shall have sufficient cross-section to carry the momentary short circuit and short time fault currents to earth without exceeding the allowable temperature rise.
- 1.4.4. Suitable arrangements shall be provided at each end of the horizontal earth bus for bolting to Purchaser's earthing conductors. The horizontal earth bus shall project out the switchboard ends and shall have predrilled holes for this connection. A joint spaced and taps to earth bus shall be made through at least two bolts.
- 1.4.5. All non-current metal work of the Switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosures frame work and the truck shall be maintained even after painting.
- 1.4.6. The truck and breaker frame shall get earthed while the truck is being inserted in the panel and positive earthing of the truck and breaker frame shall be maintained in all positions. SERVICES & ISOLATED, as well as through out the intermediate travel.
- 1.4.7. Air Circuit Breaker (ACB) module frame shall get engaged to the vertical earth bus, before the disconnecting contacts on these module are engaged to the vertical busbar.
- 1.4.8. All metallic cases of relays, instruments and other panel mounted equipments shall be connected to earth by independent stranded copper wires of size not less than 2.5 mm<sup>2</sup>. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors and soldering is not acceptable. Looping of earth Connection which would result in loss of earth connection to the devices when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths or earth bus is acceptable.
- 1.4.9. VT and CT secondary neutral point earthing shall be at one place only, on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.
- 1.4.10. All hinged doors shall be earthed through flexible earthing braid.
- 1.4.11. Caution nameplate 'Caution-Live Terminals' shall be provided at all points where the terminals are like to remain live and isolation is possible only at remote end.
- 1.5. **AIR CIRCUIT BREAKERS**
- 1.5.1. Circuit breakers shall be three-pole air break horizontal drawout type and shall have inherent fault making and breaking capacities as specified in "Technical Parameters". The circuit breakers which meet specified parameter only after provision of releases or any other devices shall not be acceptable.
- 1.5.2. Circuit breakers shall be mounted along with its operating mechanism on a wheeled carriage. Suitable guides shall be provided to minimise misalignment of the breaker.
- 1.5.3. There shall be 'Service', 'Test' and 'Fully withdrawn' positions for the breakers. In 'Test' position the circuit breaker shall be capable of being tested for operation without energising the power circuits i.e. the power Contacts shall be disconnected while the



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- 1.5.4. Control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the 'SERVICE', 'TEST' OR FULLY WITHDRAWN' position. It shall be possible to close the door in TEST position.
- 1.5.5. All circuit breakers shall be provided with 4 NO and 4 NC potentially free auxiliary contacts. These contacts shall be in addition to those required for internal mechanism of the breaker. Separate limit switches each having required number of contacts shall be provided in both 'SERVICE' & 'TEST' position of the breaker. All contacts shall be rated for making continuously carrying and breaking 10 Amps at 230V AC and 1 Amp (Inductive) at 220V DC.
- 1.5.6. Suitable mechanical indications shall be provided on all circuit breakers to show 'OPEN', 'CLOSE', 'SERVICE', 'TEST' and 'SPRING CHARGED' positions.
- 1.5.7. Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half cycle of rated frequency.
- 1.5.8. All circuit breakers shall be provided with the interlocks as explained in further clauses.
- 1.5.9. Movement of a circuit breaker between SERVICE AND TEST positions shall not be possible unless it is in OPEN position. Attempted with drawl of a closed circuit breaker shall trip the circuit breaker.
- 1.5.10. Closing of a circuit breaker shall not be possible unless it is in SERVICE, TEST POSITION or in FULLY WITHDRAWN POSITION.
- 1.5.11. Circuit breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage to cover the stationary isolated contacts when the breaker is withdrawn. It shall however, be possible to open the shutters intentionally, against spring pressure for testing purpose.
- 1.5.12. A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.
- 1.5.13. Circuit breakers shall be provided with electrical anti-pumping and trip free feature, even if mechanical antipumping feature is provided.
- 1.5.14. Mechanical tripping shall be possible by means of front mounted RED 'Trip' push-button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.
- 1.5.15. Breaker controlled motors shall operate satisfactorily under the following conditions:
- (i) Direct on-line starting of Induction Motors rated 110 kW to 220 kW with a locked rotor current of seven times the rated current, and starting time of up to 30 seconds.
  - (ii) Breaking on-load, full load and locked rotor currents of Induction Motors for rated 100 kW to 220 kW.



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- 1.5.16. Means shall be provided to slowly close the circuit breaker in withdrawn position. If required for inspection and setting of Contacts, in service position slow closing shall not be possible.
- 1.5.17. Power operated mechanism shall be provided with a universal motor suitable for operation 220V DC Control supply with voltage variation from 90% to 110% rated voltage. Motor insulation shall be class 'E' or better.
- 1.5.18. The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring.
- 1.5.19. Once the closing springs are discharged, after the one closing operation of circuit breaker, it shall automatically initiate, recharging of the spring.
- 1.5.20. The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.
- 1.5.21. Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.
- 1.5.22. All circuit breakers shall be provided with closing and trip coils. The closing coils shall operate correctly at all values of Voltage between 85% to 110% at rated control voltage. The trip coil shall operate satisfactorily under all values of supply voltage between 70% to 110% of rated control voltage.
- 1.5.23. Provision for mechanical closing of the breaker only in 'TEST' and 'WITHDRAWN' positions shall be made.
- 1.5.24. **PROTECTION CO-ORDINATION**
- 1.5.24.1. It shall be the responsibility of the Contractor to fully co-ordinate the overload and short circuit tripping of the circuit breakers with the upstream and down stream circuit breakers/fuses/motor starters, to provide satisfactory discrimination.

## **1.6. MOULDED CASE CIRCUIT BREAKER (MCCB) and MCB**

- 1.6.1. MCCB shall in general conform to IEC: 60947 Part-2. All MCCB offered shall have  $I_{cs} = 100\% I_{cu}$  rating.
- 1.6.2. MCCB shall be flush mounted on the AC/DC distribution boards and shall have extended handle.
- 1.6.3. MCCBs shall be provided with thermo-magnetic type release for over current and short Circuit protection. The setting of the thermal release shall be adjustable between 80% to 100% of the rated current. The MCCB shall have breaking capacity not less than 20kA.
- 1.6.4. MCCBs used for ACDB incomers and Bus coupler shall be equipped with stored energy mechanism for electrical closing and tripping. All other MCCBs shall be manually operated. The operating handle should give a clear trip indication.



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1.6.5 Miniature circuit breaker (MCB) shall conform to IEC: 60898.

## 1.7 RELAYS

1.7.1 All relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent dust tight covers removable from the front. All protective relays shall have a drawout construction for easy replacement from the front. They shall either have built-in test facilities, or shall be provided with necessary test blocks and test switches located immediately below each relay. The auxiliary relays and timers may be furnished in non-drawout cases.

1.7.2 All AC relays shall be suitable for operation, at 50 Hz with 110 volts VT secondary and 1 amp or 5 amp CT secondary.

1.7.3 All protective relays and timers shall have at least two potentially free output contacts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate number of terminals shall be available on the relay cases for applicable relaying schemes.

1.7.4 All protective relays auxiliary relays and timers shall be provided with hand reset operation indicators (Flags) for analysing the cause of operation.

1.7.5 All relays shall withstand a test voltage of 2 KV (rms) for one minute.

1.7.6 Motor starters shall be provided with three element, ambient temperature compensated, time lagged, hand reset type overload relays with adjustable settings. The setting ranges shall be properly selected to suit the motor ratings. These relays shall have a separate black coloured hand reset push button mounted on compartment door and shall have at least one changeover contact.

1.7.7 All fuse-protected contactor-controlled motors shall have single phasing protection, either as a distinct feature in the overload relays (by differential movement of bimetallic strips), or as a separate device. The single phasing protection shall operate even with 80% of the set current flowing in two of the phases.

## 1.8 CONTACTORS

1.8.1 Motor starter contactors shall be of air break, electromagnetic type rated for uninterrupted duty as per IEC: 60947 Part 4.

1.8.2 Contactors shall be double break, non-gravity type and their main contacts shall be silver faced.

1.8.3 Direct on line starter contactors shall be of utilisation category AC2. These contactors shall be as per IEC:60947 Part 4.

1.8.4 Each contactor shall be provided with two (2) normally open (NO) and two (2) normally close (NC) auxiliary contacts.

1.8.5 Operating coils of contactors shall be of 230V AC unless otherwise specified elsewhere. The Contactors shall operate satisfactorily between 85% to 110% of the rated voltage. The Contactor shall drop out at 70% of the rated voltage.



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## 1.9 INSTRUMENT TRANSFORMERS

- 1.9.1 All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated condition and the outside ambient temperature is 50°C.
- 1.9.2 All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings of the associated switchgear.
- 1.9.3 All instrument transformer shall have clear indelible polarity markings. All secondary terminals shall be wired to a separate terminal on an accessible terminal block where star-point formation and earthing shall be done.
- 1.9.4 Current transformers may be multi or single core type. All voltage transformers shall be single phase type. The Bus VTs shall be housed in a separate compartment.
- 1.9.5 All VTs shall have readily accessible MCBs on both primary and secondary sides.

## 1.10 INDICATING INSTRUMENTS

- 1.10.1 All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96 mm square size with 90 degree scales, and shall have an accuracy class of 2.5 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.
- 1.10.2 All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for zero adjustment without removing or dismantling the instruments.
- 1.10.3 All instruments shall have white dials with black numerals and lettering. Black knife edge pointer with parallax free dials will be preferred.
- 1.10.4 Ammeters provided on Motor feeders shall have a compressed scale at the upper current region to cover the starting current.
- 1.10.5 Watt-hour meters shall be of 3 phase three element type, Maximum demand indicators need not be provided.

## 1.11 CONTROL & SELECTOR SWITCHES

- 1.11.1 Control & Selector switches shall be of rotary type with escutcheon plates clearly marked to show the function and positions. The switches shall be of sturdy construction suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred.
- 1.11.2 Circuit breaker selector switches for breaker Controlled motor shall have three stay put positions marked 'Switchgear', 'Normal' and 'Trial' respectively. They shall have two contacts of each of the three positions and shall have black shade handles.



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- 1.11.3 Ammeter and voltmeter selector switches shall have four stayput position with adequate number of contacts for three phase 4 wire system. These shall have oval handles. Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondaries.
- 1.11.4 Contacts of the switches shall be spring assisted and shall be of suitable material to give a long trouble free service.
- 1.11.5 The contact ratings shall be at least the following :
- |       |                             |                           |
|-------|-----------------------------|---------------------------|
| (i)   | Make and carry continuously | 10 Amp.                   |
| (ii)  | Breaking current at 220V DC | 1 Amp (Inductive)         |
| (iii) | Breaking current at 230V AC | 5 Amp (at 0.3 pf lagging) |

## 1.12 AIR BREAK SWITCHES

- 1.12.1 Air breaker switch shall be of the heavy duty, single throw group operated, load break, fault make type complying with IEC: 60947 Part-3.
- 1.12.2 The Bidder shall ensure that all switches are adequately rated so as to be fully protected by the associated fuses during all abnormal operating conditions such as overload, locked motor, short circuit etc.
- 1.12.3 Switch operating handles shall be provided with padlocking facilities to lock them in 'OFF' position.
- 1.12.4 Interlocks shall be provided such that it is possible to open the cubicle door only when the switch is in 'OFF' position and to close the switch only when the door is closed. However suitable means shall be provided to intentionally defeat the interlocks explained above.
- 1.12.5 Switches and fuses for AC/DC control supply and heater supply wherever required shall be mounted inside and cubicles.

## 1.13 PUSH BUTTONS

- 1.13.1 Push-buttons shall be of spring return, push to actuate type. Their contacts shall be rated to make, continuously carry and break 10A at 230V and 0.5A (inductive) at 220V DC.
- 1.13.2 All push-buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver alloy.
- 1.13.3 All push-buttons shall be provided with integral escutcheon plates marked with its function.
- 1.13.4 The colour of the button shall be as follows :
- |      |       |   |                                |
|------|-------|---|--------------------------------|
| (i)  | GREEN | : | For motor START, Breaker CLOSE |
| (ii) | RED   | : | For motor TRIP, Breaker OPEN   |



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(iii) BLACK : For overload reset.

1.13.5 All push-buttons on panels shall be located in such a way that Red-push-buttons shall always be to the left of green push-buttons.

#### 1.14 INDICATING LAMPS

1.14.1 Indicating lamps shall be of the panel mounting cluster LED type. The lamps shall have escutcheon plates marked with its function, wherever necessary.

1.14.2 Lamps shall have translucent lamp-covers of the following colours, as warranted by the application :

- (i) RED : For motor ON, Breaker CLOSED
- (ii) GREEN : For motor OFF, Breaker OPEN
- (iii) WHITE : For motor Auto-Trip
- (iv) BLUE : For all healthy conditions (e.g. control supply, and also for 'SPRING CHARGED')
- (v) AMBER : For all alarm conditions (e.g. overload) Also for 'SERVICE' and 'TEST' positions indicators.

1.14.3 Lamps shall be easily replaceable from the front of the cubicle.

1.14.4 Indication lamps should be located just above the associated push buttons/control switches. Red lamps shall invariable be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps along with the centre line of control switch/push button pair. Blue and Amber lamps should normally be located above the Red and Green lamps.

1.14.5 When associated with push-buttons, red lamps shall be directly above the green push button, and green lamps shall be directly above the red push-button. All indicating lamps shall be suitable for continuous operation at 90 to 110% of their rated voltage.

#### 1.15 FUSES

1.15.1 All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC Circuits shall be of class 2 type, 20 kA (RMS) breaking current at 400 AC, and for DC circuits Class 1 type 4 kA breaking current.

1.15.2 Fuses shall have visible operation indicators.

1.15.3 Fuses shall be mounted on fuses carriers, which are mounted on fuse bases, wherever it is not possible to mount fuses on carriers fuses shall be directly mounted on plug in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchgear.

1.15.4 Fuse rating shall be chosen by the Bidder depending upon the circuit requirements and these shall be subject to approval of PURCHASER.

#### 1.16 TERMINAL BLOCKS



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- 1.16.1 Terminal blocks shall be of 750 volts grade and have continuous rating to carry the maximum expected current on the terminals. It shall be complete with insulating barriers, clip-on-type/stud type terminals for Control Cables and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring on diagrams. It shall be similar to 'ELEMEX' standard type terminals, cage clamp type of Phoenix or WAGO or equivalent
- 1.16.2 Terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall be provided with short circuiting and earthing facilities. It shall be similar to 'Elem.' 'CATD' - Type.
- 1.16.3 In all circuit breaker panels at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks. Space for adding another 10% spare terminals shall also be available.
- 1.16.4 All terminal blocks shall be suitable for terminating on each side, two (2) Nos. of 2.5 mm square size standard copper conductors.
- 1.16.5 All terminals shall be numbered for identification and grouped according to the function. Engraved white-on-black labels shall be provided on the terminal blocks.
- 1.16.6 Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.
- 1.16.7 Terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal block. The minimum clearance between the first row of terminal block and the associated cable gland plate shall be 250 mm.
- 1.17 **NAME PLATES AND LABELS**
- 1.17.1 All switchgears, AC/DC distribution boards, shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.
- 1.17.2 All name plates shall be of non-rusting metal or 3-ply lamincoid with white engraved lettering on black back ground. Inscriptions and lettering sizes shall be subject to PURCHASER approval.
- 1.17.3 Suitable plastic sticker labels shall be provided for easy identification of all equipments, located inside the panel/module. These labels shall be positioned so as to be clearly visible and shall give the device number as mentioned in the module wiring drawings.
- 1.18 **SPACE HEATER**
- 1.18.1 Space heater shall be provided in all the boards for preventing harmful moisture condensation.



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1.18.2 The space heaters shall be suitable for continuous operation on 230V AC, 50 Hz, single phase supply, and shall be automatically controlled by thermostats. Necessary isolating switches and fuses shall also be provided.

## 1.19 CONTROL AND SECONDARY WIRING

1.19.1 All switchboards shall be supplied completely wired internally upto the terminal blocks ready to receive Purchaser's control cables.

1.19.2 All inter cubicle and inter panel wiring and connections between panels of same switchboard including all bus wiring for AC and DC supplies shall be provided by the bidder.

1.19.3 All internal wiring shall be carried out with 1100 V grade, single core, 1.5 square mm or larger stranded copper wires having colour coded, PVC insulation. CT circuits shall be wired with 2.5 square mm copper wires. Voltage grade and insulation shall be same as above.

1.19.4 Extra-flexible wires shall be used for wiring to device mounted on moving parts such as hinged doors.

1.19.5 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminals blocks.

## 1.20 POWER CABLES TERMINATION

1.20.1 Cable termination compartment and arrangement for power cables shall be suitable for stranded aluminium conductor, armoured XLPE/PVC insulated and sheathed, single core/three core, 1100 V grade cables.

1.20.2 All necessary cable terminating accessories such as Gland plates, supporting clamps and brackets, power cable lugs, hardware etc. shall be provided by the successful bidder, to suit the final cable sizes which would be advised later.

1.20.3 The gland plate shall be of removable type and shall cover the entire cable alley. Bidder shall also ensure that sufficient space is provided for all cable glands. For all single core cables, gland plates shall be of non-magnetic Material.

## 1.21 TYPE TESTS

1.21.1 Type tests reports on Panels (Switchgear and Control gear assemblies) as per IEC: 60439 Part-1 shall be submitted for the following tests in line with clause 9.0 of Chapter 2 GTR before the fabrication of switchgear is started:

- i) Verification of temperature rise limits
- ii) Verification of the dielectric properties
- iii) Verification of short circuit strength
- iv) Verification of the continuity of the protective circuit
- v) Verification of clearances and creepage distances
  
- vi) Verification of mechanical operation



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vii) Verification of degree of protection

- 1.21.2 Contractor shall submit type test reports for the following Switchgear and Control gears before the fabrication of switchgear is started:
1. Circuit breakers/MCCB as per IEC: 60947 Part 2.
  2. Protective Relays as per IEC: 60255.
  3. Lighting transformers as per IEC:60076
- For above equipments, test conducted once are acceptable (i.e. The requirement of test conducted within last five years shall not be applicable)

1.22 **ERECTION, TESTING AND COMMISSIONING**

- 1.22.1 The Contractor shall unload, erect, install, test and put into commercial use all electrical equipment included in this specification.
- 1.22.2 Equipment shall be installed in a neat, workman like manner so that it is level, plumb, square and properly aligned and oriented. Tolerance shall be as established in Contractor's drawings or as stipulated by purchaser. No equipment shall be permanently bolted down to foundations until the alignment has been checked and found acceptable by the purchaser.
- 1.22.3 Contractor shall furnish all supervision, labour tools equipment rigging materials, bolts, wedges, anchors, concrete inserts etc. in proper time required to completely install, test and commission the equipment.
- 1.22.4 Manufacturer's and purchaser's instructions and recommendations shall be correctly followed in handling, setting, testing and commissioning of all equipment.
- 1.22.5 Contractor shall move all equipment into the respective room through the regular door or openings specifically provided for this purpose. No part of the structure shall be utilised to lift or erect any equipment without prior permission of Purchaser.
- 1.22.6 All boards shall be installed in accordance with relevant code of practices and at Purchaser's instructions. All boards shall be installed on finished surfaces, concrete or steel stills. Contractor shall be required to install and align any channel sills which form part of foundations. In joining shipping sections of switchboards together adjacent housing of panel sections or flanged throat sections shall be bolted together after alignment has been completed. Power bus, enclosures ground and control splices of conventional nature shall be cleaned and bolted together being drawn up with torque spanner of proper size or by other approved means.
- 1.22.7 All boards shall be made completely vermin proof.
- 1.22.8 Contractor shall take utmost care in holding instruments, relaying and other delicate mechanism wherever the instruments and relays are supplied separately they shall be mentioned only after the associated panels have been erected and aligned. The packing materials employed for safe transit of instrument and relays shall be removed after ensuring that panel have been completely installed and to further movement of the same should be necessary. Any damage shall be immediately reported to Purchaser.



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1.22.9 Equipment furnished with finished coats of paint shall be touched by up Contractor if their surface is specified or marred while handling.

1.22.10 After installation of panels, power and control wiring and connections, Contractor shall perform operational tests on all switchboards, to verify proper operation of switchboards/panels and correctness of all equipment in each and every respect. The cable opening and cables entries for cables terminating to the panels shall be sealed with fire sealing materials.

## 1.23 COMMISSIONING CHECK TESTS

The Contractor shall carry out the following commissioning checks, in addition to the other checks and tests recommended by the manufacturers.

### 1.23.1 **General**

1.23.1.1 Check name plate details according to the specification.

1.23.1.2 Check for physical damage.

1.23.1.3 Check tightness of all bolts, clamps, joints connecting terminals.

1.23.1.4 Check earth connection.

1.23.1.5 Check cleanliness of insulators and bushings.

1.23.1.6 Check all moving parts for proper lubrication.

1.23.1.7 Check settings of all the relays.

### 1.23.2 **Circuit Breakers**

1.23.2.1 Check alignment of breaker truck for free movement.

1.23.2.2 Check correct operation of shutters.

1.23.2.3 Check control wiring for correctness of connections, continuity and IR values.

1.23.2.4 Manual operation of breaker completely assembled.

1.23.2.5 Power closing/opening operation, manually and electrically.

1.23.2.6 Breaker closing and tripping time.

1.23.2.7 Trip free and anti-pumping operation.

1.23.2.8 IR values, minimum pick up voltage and resistance of coils.

1.23.2.9 Contact resistance

1.23.2.10 Simultaneous closing of all the three phases.

1.23.2.11 Check electrical & mechanical interlocks provided.



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- 1.23.2.12 Check on spring charging motor, correct operation of limit switches, and time of charging.
- 1.23.2.13 All functional checks.
- 1.23.3 **Current Transformers**
- 1.23.3.1 Megger between winding and winding terminals to body.
- 1.23.3.2 Polarity test
- 1.23.3.3 Ratio identification checking of all ratios on all cores by primary injection of current.
- 1.23.3.4 Spare CT cores, if available, to be shorted and earthed.
- 1.23.4 **Voltage Transformer**
- 1.23.4.1 Insulation resistance test
- 1.23.4.2 Ratio test on all cores.
- 1.23.4.3 Polarity test.
- 1.23.4.4 Line connections as per connection diagram.
- 1.23.5 **Cubicle Wiring**
- 1.23.5.1 Check all switch developments.
- 1.23.5.2 Each wire shall be traced by continuity tests and it should be made sure that the wiring is as per relevant drawing. All interconnections between panels/equipment shall be similarly checked.
- 1.23.5.3 All the wires shall be meggered to earth.
- 1.23.5.4 Functional checking of all control circuit e.g. closing, tripping control, interlock, supervision and alarm circuit.
- 1.23.6 **Relays**
- 1.23.6.1 Check connections and wiring.
- 1.23.6.2 Megger all terminals to body.
- 1.23.6.3 Megger AC to DC terminals.
- 1.23.6.4 Check operating characteristics by secondary injection.
- 1.23.6.5 Check minimum pick up voltage of DC coils.



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- 1.23.6.6 Check operation of electrical/mechanical targets.
- 1.23.6.7 Relays settings.
- 1.23.6.8 Check CT and VT connections with particular reference to their polarities for directional relays, wherever required.

1.23.7 **Meters**

- 1.23.7.1 Check calibration by comparing it with a sub-standard.
- 1.23.7.2 Megger all insulated portions.
- 1.23.7.3 Check CT and VT connections with particular reference to their polarities for power type meters.

1.24 **SPECIAL TOOLS AND TACKLES**

- 1.24.1 The Bidder shall include in his proposal any special tools and tackles required for erection, testing commissioning and maintenance of the equipments offered.
- 1.24.2 The list of these special tools and tackles shall be given in the bid proposal sheets alongwith their respective prices.
- 1.24.3 The total price of the special tools and tackles shall be included in proposal sheets.

1.25 **EQUIPMENT TO BE FURNISHED**

- 1.25.1 The Bidder shall quote for various AC/DC distribution boards in accordance with this specification.
- 1.25.2 Standard scheme of interconnection of switchboards and distribution boards alongwith tentative feeder disposition for each board is indicated in Standard SLD of AC & DC system enclosed alongwith bid documents. The bidder shall quote board prices on the basis of standard SLD and their estimation of feeders for entire present and future bays requirement. Any other feeder required as per system requirement for efficient and reliable operation shall be deemed to be included in bidder's scope.
- 1.25.3 The Bill of Materials for each type of module shall be as under. These are minimum indicative requirement of the system. The necessary auxiliary relays, push buttons and indicating lamps shall be provided as per scheme requirement. Any other item/component required with in a module for efficient and reliable operation shall be deemed to be included in bidder's scope.
- 1.25.4 Module Type AE (Electrically controlled circuit breaker for incoming and Bus Coupler Circuit).
- (i) One (1) Triple pole air circuit breaker complete with all accessories and power operated mechanism as specified.
- (ii) Two (2) Neutral link.



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- (iii) Three (3) Current Transformer for metering.
- (iv) One (1) Ammeter with selector switch.
- (v) Three (3) Current Transformer for relaying.
- (vi) One (1) Triple pole instantaneous over-current relay having the setting range of 200-800% or 500-2000% of CT secondary and adjustable definite minimum time.
- (vii) One (1) Instantaneous earth fault relay having an adjustable setting range of 10-40% or 20 - 80% of CT secondary current and adjustable definite minimum time. The earth fault relay shall be provided with a stabilising resistor.
- (viii) One(1) set Current and Voltage transducers.
- (ix) One(1) set High speed tripping relays.

1.25.5

**Module Type - M1 (Circuit Breaker Controlled Motor Feeder)**

- (i) One (1) Triple pole Air Circuit Breaker complete with accessories, and power operated mechanism as specified.
- (ii) One (1) Three position 6 pole selector switch 'SWITCHGEAR/NORMAL /TRIAL'.
- (iii) Three (3) Current Transformer for metering.
- (iv) One (1) Ammeter with Ammeter Selector Switch
- (v) Three (3) Current Transformer for relaying.
- (vi) One (1) Triple pole instantaneous over-current relay for providing positive sequence current protection in all the three phases. The relay setting range shall be continuously adjustable between 200-800% or 400-1600% of CT secondary rated current as required.
- (vii) One (1) Double pole inverse definite minimum time over current relays connected in R & B phases for over current protection of motor rated 110 kW - 200 kW. The relay shall have an adjustable setting range of 50% - 200% of CT Secondary current and time setting range of 0-30 Second. The relay shall be CDGM-22 of EE or equivalent.
- (viii) One (1) Single pole adjustable definite time delay relay for motor overload alarm connected in Y-phase only. The relay shall



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have resetting ratio of not less than 90%. The relay shall have continuously adjustable time delay range of 2.5 to 25 Sec.

- (ix) One (1) Instantaneous earth fault relay having an adjustable setting range of 10-40% or 20-80% of CT secondary current. The earth fault relay shall be provided with a stabilising resistor.
- (x) One(1) set Current and Voltage transducers.
- (xi) One(1) set High speed tripping relay.

#### 1.25.6 **Module Type E**

- (i) One (1) Four pole MCCB

#### 1.25.7 **Module G-1 (VT Module with under Voltage Relay)**

- (i) Three (3)  $\frac{400}{\sqrt{3}} / \frac{110}{\sqrt{3}}$  volts single phase voltage transformer star/star connect with star point solidly earthed mounted on common draw out chassis. Accuracy Class 0.5 for protection and metering with 50VA Burden.
- (ii) Six (6) HRC Fuses mounted on the above chassis.
- (iii) One (1) Four position voltmeter selector switch.
- (iv) One (1) Voltmeter (0-500V)
- (v) One (1) Double pole instantaneous under voltage relays with continuous variable setting range of 40-80% of 110 Volts.
- (vi) One (1) Time delay pick up relay having a time setting range of 0.5 to 3 secs. with 3 'NO'. Self reset contacts, suitable for 220V DC.
- (vii) One (1) Auxiliary relay 220V DC with 2 NO. self reset contacts.
- (viii) Three (3) Indicating lamps with series resistor and colour lenses (Red, Blue & Yellow).

#### 1.25.8 **Module Type G-2**

- (i) Three (3) HRC Fuse
- (ii) One (1) Voltmeter (0-500V)
- (iii) One (1) Voltmeter selector switch four position (R-Y, Y-B, B-R OFF).



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- (iv) Three (3) Indication lamps (Red, Blue & Yellow)
- 1.25.9 **Module Type H & H (BC) (Isolating Switch Controlled Incoming Circuit)**
- (i) One (1) Four pole MCCB
- (ii) One (1) Red Indicating lamp to indicate isolating switch closed position.
- 1.25.10 **Module Type S : (DC Metering and Protection Module)**
- (i) One (1) Voltmeter 300-0-300V DC for 220V DC DB/Voltmeter 0-75V DC for 50V DCDB
- (ii) One (1) Three (3) position voltmeter selector switch
- (iii) One (1) Instantaneous under voltage relay with 95% of 220V DC. The resetting ratio of relay of relay should not be more than 1.25. The relay shall be provided with a series resistor and a push button across if for resetting (pick up) the relay at about 105% of the drop out voltage.
- (iv) One (1) Instantaneous over voltage relay with setting range of 110% of 220V DC. The resetting ratio of relay should not be less than 0.8. The relay shall have a push button in series of resetting the relay at about 95% of the operating voltage.
- (v) One (1) Earth leakage relay only for 220V DC system having adjustable pick up range between 3 to 7 milliamps the relay shall be suitable for 220V DC/230V AC Auxiliary supply.
- 1.25.11 **Module Type X**
- One (1) One (1) Double pole 250 V MCB/ MCCB suitable for 20kA for 1 sec. Fault level
- 1.25.12 **Module Type-DC (Incomer from Battery & Chargers)**
- (i) One (1) Double pole 250V DC MCCB for incomer from Battery.
- (ii) One (1) DC ammeter with shunt and range of 90-0-400 Amps. For 220V DC DB and 90-0-200 Amp for 50V DC DB.
- (iii) Two (2) Double pole 250V DC MCCB/MCB
- (iv) One (1) Double pole single throw 250V DC air break switch connecting battery & charger sections to DC DB.
- (v) *One(1) set Voltage and Current Transducers*
- 1.25.13 **Module Type DG-1 (Electrically Controlled Circuit Breaker for Incomer from DG Set)**



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- a) One (1) Triple pole circuit breaker complete with all accessories and power operated mechanism as specified.
- b) One (1) Frequency meter.
- c) One (1) Voltmeter with selector switch.
- d) One (1) Remote/Local Selector switch.
- e) Three (3) Current transformer for metering.
- f) Six (6) Current Transformers for differential protection (out of this 3 Nos. will be supplied loose for mounting in DG set panel).
- g) Three (3) Current transformer for relaying.
- h) One (1) Ammeter Selector Switch.
- i) One (1) Ammeter
- j) One (1) Wattmeter of range 0-300 KW.
- k) One (1) Three pole voltage controlled definite time delay relay having current setting range of 50-200% of CT secondary current and adjustable time delay 0.3 to 3 secs.
- l) One (1) Watt hour meter with six (6) digits and minimum count of one (1) kwh.
- m) One (1) Single pole definite time over current relay having a continuous setting range of 50-200% of CT secondary current and a time delay of 2.5-25 secs connected in CT of Y phase for overload alarm. The relay shall have a setting ratio of not less than 90%.
- n) One (1) Three pole differential protection relay having an operating current setting range of 10-40% of generator full load current. The relay shall be of high impedance type, with necessary stabilizing resistors.
- o) Two (2) Push buttons for Remote starting & stopping of DG Set (Red, Green).
- p) One(1) set Current and Voltage transducers.
- q) One(1) set High speed tripping relays.

1.25.14 **Module Type H1**

One (1) Double pole DC Switch with pad locking facility in off position.

1.25.15 **Module Type EL**



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- (i) One (1) Four pole MCCB
- (ii) One (1) Contactor
- (iii) Electronic Timer suitable for continuous operation, push button and selector switch be as per scheme requirement

1.26 **PARAMETERS**

1.26.1 **Power Supply**

1.26.1.1 AC System 3 phase, 4 wire, solidly earthed

- a) Voltage 400 Volts,  $\pm 10\%$
- b) Frequency 50 Hz  $\pm 2.5\%$
- c) Combined variation  $\pm 105\%$  Absolute Sum in Voltage & frequency
- d) Fault Level 20 kA (rms)

1.26.1.2 **DC System** 2 Wire, unearthed

- a) System voltage 220V  $\pm 10\%$
- b) Fault Level 4 kA
- c) System Voltage 48 V  $\pm 10\%$
- d) Fault Level --

1.26.2 **Control Supply Voltage**

- a) Trip and closing coils 220V DC Unearthed
- b) Spring charging 220V DC Unearthed

1.26.3 **Cubicle Data**

1.26.3.1 **Busbar Rating**

- a) Continuous for Vertical panels. As specified in Standard SLD For AC & DC system.
- b) Short time (1 sec. kA (rms) 20 kA



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- |    |                                      |                  |
|----|--------------------------------------|------------------|
| c) | Momentary (kA)<br>PEAK               | 45 kA            |
| d) | Ambient Temperature                  | 50°C             |
| e) | One Minute Power Frequency Withstand |                  |
|    | I. Power Circuit                     | 2500 Volts (rms) |
|    | II. Control Circuit                  | 2500 Volts (rms) |

1.26.3.2 **Cubicle Colour Finish**

- |    |          |                         |
|----|----------|-------------------------|
| a) | Interior | Smoke Grey shade No.692 |
| b) | Exterior | Smoke Grey shade No.692 |

1.26.4 **Circuit Breaker**

- |    |   |   |
|----|---|---|
| a) | Type  | Air Break   |
| b) | No. of poles  | 3   |
| c) | Voltage & Frequency                                     | 400 Volts, $\pm 10\%$ , 50 HZ + 2.5%  |
| d) | Rated Operating Duty                                    | As per IEC  |
| e) | Rated service short-circuit<br>Breaking capacity (Ics)  | 20 kA (RMS)   |
| f) | Short Circuit<br>making current                         | 45 kA (Peak)  |
| g) | Short time withstand<br>current for 1 sec.<br>duration. | 20 kA (RMS) for 1 sec.  |
| h) | Operating Mechanism<br>current for 1 sec.<br>duration.  | 20 kA (RMS) for 1 sec.  |
| i) | No. of auxiliary<br>contacts                            | 4 NO & 4 NC contacts for Purchaser's<br>use on fixed portion of the cubicle |
| j) | Short Circuit<br>breaking current                       |   |
|    | I. AC Component   | 20 kA (RMS)   |
|    | II. DC Component  | As per IEC: 60947 (Part 2)  |

1.26.5 **MOULDED CASE CIRCUIT BREAKER**

AC System

DC System



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a)	No. of poles	4	2
b)	Voltage & Frequency	400 Volts, $\pm 10\%$ 50 HZ $\pm 2.5\%$	250V
c)	Rated Operating Duty	As per IEC	
d)	Rated service short-circuit Breaking capacity (Ics)	20 kA (RMS)	4 kA
e)	Short Circuit making current	45 kA (Peak)	-
f)	No. of auxiliary Contacts ( only for incomer And bus-coupler MCCBs)	1 NO &1 NC	1 NO &1 NC
g)	Rated Ultimate Short Circuit breaking capacity		
	I. AC Component	20 kA (RMS)	As per IEC
	II. DC Component	As per IEC 60947	As per IEC 60947

1.26.6 **Meters**

a)	Accuracy class	2.5
b)	One minute power frequency withstand test voltage in KV	2.0

1.26.7 **Current Transformers**

a)	Type	Cast resin, Bar primary
b)	Voltage class and frequency	650V, 50 Hz
c)	Class of Insulation	E or better
d)	Accuracy class metering CT	Class 1, VA adequate for application but not less than 7.5 VA.
e)	Accuracy class protection CT	5 P 15, VA adequate for application, but not less than 7.5 VA.
f)	Accuracy class differential protection	PS, KPV = 300V
g)	Short Time Current Rating (for CTs Associated with	



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circuit breakers)

I.	Current	20 kA (RMS)
II.	Duration	One Second
III.	Dynamic Rating	45 kA (Peak)
IV.	One minute power frequency withstand test voltage.	2.5 kV (rms)

**1.26.8 Voltage Transformer**

a)	Type	Cast Resin
b)	Rated Voltage	
	Primary	400/ $\sqrt{3}$ V
	Secondary	110/ $\sqrt{3}$ V
c)	Method of connection	
	Primary	Star
	Secondary	Star
d)	Rated voltage factor	1.1 continuous, 1.5 for 3 seconds
e)	Class of insulation	E or better
f)	One minute power frequency withstand voltage	2.5 KV (RMS)
g)	Accuracy class	0.5, not less than 20VA

**1.26.9 Relay**

a)	One minute power Frequency withstand test	2 kV (rms)
----	---	------------

**1.26.10 Transducers (1 phase)**

	<b>Current</b>	<b>Voltage</b>
a) Operating Voltage	220 V DC	220V DC
b) I/P	1A.	110V AC
c) O/P	4-20 mA	4-20 mA
d) Type	Analogue	Analogue



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## 1.26.11 Lighting Transformers

Lighting transformers shall be of 100 KVA rating, 400/4400 V, 3 phase, 50 Hz Dry type natural air cooled type. The technical parameters of these lighting transformers are as follows:

### Technical Parameters of Lighting Transformer

Type of transformer	:	Dry type natural air cooled
Rating	:	100 KVA
Voltage ratio	:	400/400 volts
No. of phases	:	Three
Frequency	:	50 Hz
Winding connection	:	Dyn-1
Class of insulation	:	'B' class
Impedance	:	4% $\pm$ 10%
No. of taps & steps	:	5, $\pm$ 5% in steps of 2.5%
Ref. standard	:	IEC: 60076

## 1.27 AUTOMATIC CONTROL OF OUTDOOR LIGHTING

1.27.1 EL-type module of 400V Main lighting distribution board and Emergency lighting distribution board and shall be controlled by timer and contactor module to facilitate its operation automatically.

## 1.28 AUTOMATIC SUPPLY CHANGEOVER

Automatic changeover between Incomer I, Incomer II, and DG set is to be carried out during the failure of supply in one/or both the incomers. After the restoration of the supply, system shall be restored to normal condition automatically. The requirement of changeover under various conditions are as below:

- (i) Under normal conditions i.e. when supply is available in both the incomers, incomers I&II of 400 V Main switchboard, ACDB shall be in closed condition and Bus couplers and DG set breaker shall be in open condition.
- (ii) In case of failure of either of the sources, the incomer of that source shall trip and Bus coupler shall get closed. On restoration of supply, normal conditions described above are to be established automatically.
- iii) In case of failure of supply in both the sources, both incomers, incomers of ACDBs and ACDB Bus coupler shall trip and DG set breaker switched on. On restoration of one or both sources, DG set breaker shall trip, DG set stopped and conditions described in paragraph (i) / (ii) shall be restored.

To avoid unnecessary operation of switchgear for momentary disturbances all changeovers from one state to another shall be initiated after a time delay, after the conditions warranting such change has been detected.



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### 1.29

#### **ANALOGUE INPUTS**

LT System shall have provision of following analogue inputs for owner's substation automation purpose. These analogue inputs shall be generated by distinct transducers to be provided in respective modules. These inputs shall be wired up to respective terminal blocks.

#### **ANALOGUE INPUTS:**

- i) Voltage R-Y, Y-B, B-R of Main Switch Board section-I
- ii) Voltage R-Y, Y-B, B-R of Main Switch Board section-II
- iii) Current from LT transformer-I
- iv) Current from LT transformer-II
- v) Voltage of 220V DCDB-I
- vi) Voltage of 220V DCDB-II
- vii) Current from 220V Battery set-I
- viii) Current from 220V Battery set-II
- ix) Voltage of 48V DCDB-I
- x) Voltage of 48V DCDB-II
- xi) Current from 48V Battery set-I
- xii) Current from 48V Battery set-II

### 1.30

#### **DIGITAL (Potential Free) INPUTS:**

LT System shall have provision of following digital inputs for owner's substation automation purpose. These digital inputs shall be made available in the form of potential free contacts to be provided in respective modules. These potential free contacts shall be wired up to respective terminal blocks.

- i) Main (MSB) Incomer-I breaker On/Off
- ii) Main (MSB) Incomer-II breaker On/Off
- iii) Main(MSB) 400V Bus-I/II U/V
- iv) Main (MSB) bus coupler breaker on/off
- v) DG set breaker on/off
- vi) LT transformer-I Buchholz Alarm & trip
- vii) LT transformer-II Buchholz Alarm & trip
- viii) LT transformer-I WTI Alarm & trip
- ix) LT transformer-II WTI Alarm & trip
- x) LT transformer-I OTI Alarm & trip
- xi) LT transformer-II OTI Alarm & trip
- xii) 220 V DC-I earth fault
- xiii) 220V DC-II earth fault



*Kanjan*

**MONITORING, TESTING AND ANALYZING EQUIPMENT****1. Online monitoring Equipment (Dissolved Gas Analyzer)****Technical Specifications**

<b>Application</b>										
Online monitoring of fault gases, air components and moisture in transformer insulating fluids.										
<b>Technology</b>										
<b>Gas measurements</b>				Proprietary chromatographic method						
<b>Gas extraction</b>				Oil-immersed Teflon <sup>®</sup> tubing						
<b>Moisture measurements</b>				Oil-immersed relative saturation (RS) sensor						
<b>Communications</b>				Electrical isolation rated for substation environments						
<b>Performance</b>										
	H <sub>2</sub>	CO	CH <sub>4</sub>	C <sub>2</sub> H <sub>2</sub>	C <sub>2</sub> H <sub>4</sub>	C <sub>2</sub> H <sub>6</sub>	CO <sub>2</sub>	O <sub>2</sub>	N <sub>2</sub>	H <sub>2</sub> O
<b>Lower detection limit (LDL)</b>	ppm <sup>1)</sup>									2 ppm, or 2% RS
	0.5	10	0.2	0.2	0.2	0.2	15	500	2,000	
<b>Range<sup>1)</sup></b>	ppm									Saturation, or 100% RS
	0 - 20,000	0 - 30,000	0 - 100,000	0 - 100,000	0 - 200,000	0 - 200,000	0 - 100,000	0 - 100,000	0 - 150,000	
<b>Accuracy<sup>2)</sup></b>	(LDL plus X% of reading) ppm									3 ppm, or 3% RS
	X=5	X=5	X=5	X=5	X=5	X=6	X=5	X=15	X=15	
<b>Repeatability</b>	(LDL plus Y% of reading) ppm									2 ppm, or 2% RS
	Y=3	Y=3	Y=3	Y=3	Y=3	Y=4	Y=3	Y=10	Y=10	
<b>Resolution at LDL</b>	ppm									1 ppm, or 1% RS
	0.5	2	0.2	0.2	0.2	0.2	5	100	1,000	
<b>Measurement interval</b>	User configurable: 80, 160 and 240 minutes. Conditional cycle on alarm.									6 seconds
<b>Step response (typical)</b>	In 80 minutes: 95% H <sub>2</sub> ; 90% CO, CH <sub>4</sub> , CO <sub>2</sub> , O <sub>2</sub> , N <sub>2</sub> ; 80% C <sub>2</sub> H <sub>2</sub> , C <sub>2</sub> H <sub>4</sub> , C <sub>2</sub> H <sub>6</sub>									95% in 20 minutes
<b>Reliability</b>										
<b>Gas management</b>				Continuous monitoring of carrier and calibration gas pressure to detect and report gas leak errors and to predict cylinder replacement time						
<b>Enclosure and oil temperature conditioning</b>				Improves measurement accuracy and extends the lifetime of internal components						
<b>Power interruption protection</b>				250 ms advanced power loss system						
<b>Expected operating life (EOL)</b>				> 15 years						
<b>Operation</b>										
<b>Operating temperature range</b>				-50 to +55 °C; cold start -50 °C						

<b>Storage temperature range</b>	-40 to +75 °C
<b>Operating oil temperature range</b>	-40 to +120 °C
<b>Operating oil pressure range</b>	Full vacuum to 40 psi
<b>Operating humidity range</b>	0 - 100% RH
<b>Storage humidity range</b>	5 - 95%, non-condensing, with caps installed on the carrier gas inlet and outlet of the monitor
<b>Elevation range</b>	Up to 4,000 m
<b>Construction</b>	
<b>Width x height x depth</b>	Instrument: 610 x 489 x 337 mm (24 x 19 x 13.3 in.)
<b>Weight</b>	Instrument: 45 kg / 99 lbs
<b>Enclosures</b>	Instrument: 304 S.S., gauge 16, lockable Carrier gas manifold: 304 S.S., gauge 14, lockable option
<b>Oil circulation</b>	Anti-cavitation reciprocating pump, 10 - 60 ml/min.
<b>Oil flow monitoring</b>	System with low flow error
<b>Oil lines</b>	3/8 in. OD stainless steel
<b>Air bubble elimination</b>	Intelligent Bubble Trap
<b>Enclosure temperature conditioning</b>	Thermoelectric feedback
<b>Oil temperature conditioning</b>	Passive heat exchanger plus thermoelectric feedback
<b>Cooling</b>	Forced air
<b>Equipment protection</b>	Thermal cut-off fuse (77 °C), over-current mains fuse
<b>Oil sampling installation</b>	External quick-connect port plus sampling accessories
<b>Installation</b>	
<b>Calibration</b>	On-board NIST traceable calibration gas, automatic calibration, aluminum cylinder.
<b>Carrier gas requirements</b>	99.9999% He, 3600 psi maximum
<b>Maintenance</b>	Visual inspection every 12 months Carrier gas replacement every 48 months Calibration gas replacement every 48 months
<b>Electrical entry holes (standard)</b>	5 x 22.2 mm / 0.875 in. diameter
<b>Commissioning time</b>	5 hours installation, plus 4 - 12 hours before first readings
<b>Mounting</b>	Shock mounts
<b>Power requirements (no selection required)</b>	100 - 240 VAC $\pm 10\%$ <sup>4)</sup> , 50 - 60Hz, 1Ø, 350W 100 - 220 VDC $\pm 10\%$ <sup>4)</sup> , 350W / 10 A minimum client disconnect breaker
<b>Power conductor size</b>	Max. 2.05 mm / AWG 12
<b>Oil supply line length</b>	1.5 - 10.5 m / 5 - 35 ft
<b>Oil return line length</b>	1.5 - 10.5 m / 5 - 35 ft
<b>Communication and Data</b>	
<b>Front panel interface</b>	English 256 x 64 pixel display, vacuum fluorescent, day/night, screen-saver Three weatherproof, UV resistant buttons Menu functions for readings, alarms, databank, set-up and maintenance
<b>Communication</b>	SCADA: Modbus, DNP3 Level 2, Optional IEC 61850 kit Time Synchronization: SNTP HTTP: Manufacturer's Web Server Integrator: Manufacturer's System Protocol)
<b>Local communication port</b>	USB 2.0 (cable provided)

<b>Isolated communication ports (5 kV impulse, 2.6 kVAC)</b>	RS-485, RS-232, 2 x copper Ethernet, *See options
<b>Isolated analog ports (5 kV impulse, 2.6 kVAC)</b>	1 assignable 4-20 mA input, *See options
<b>Measurement alarms</b>	Programmable dual-level and trend alarms for all readings
<b>Relay outputs (250VAC, 5A; 48VDC, 1.5A)</b>	5 NO/NC contacts assignable for set-up, self-test and measurement alarm conditions, *See options
<b>Data storage</b>	at least 8 years
<b>Self-diagnostics</b>	190 error codes with intuitive descriptions and recommended client actions
<b>Interface Software</b>	
	English, French, Simplified and Traditional Chinese Local and remote configuration, maintenance, data downloads and diagnostic downloads
<b>Platforms</b>	Windows XP / Vista / Windows 7 / Windows 8 / Windows 10
<b>DGA data management and diagnostics</b>	Software integrates DGA data from monitors and portable analyzers with laboratory oil quality data. Diagnostic tools for fleet wide transformer health management (sold separately).
<b>Regulatory</b>	
<b>CE marking</b>	Low Voltage Directive 2006 / 95 / EC EMC Directive 2004 / 108 / EC WEEE Directive 2012 / 19 / EC RoHS Directive 2011 / 65 / EC
<b>EMC (Electromagnetic Compatibility)</b>	IEC/EN 61326 IEC/EN 61000-6-5 IEC/EN 61850-3 FCC part 15 (US) Class A, ICES-003 (Canada)
<b>Electrical safety</b>	IEC/EN 61010 IEC/EN 60255-27
<b>Ingress protection</b>	IEC/EN 60529, IP 56
<b>Shipping</b>	
<b>Gross weight</b>	Instrument: 56 kg / 124 lbs Standard accessories: 9 kg / 20 lbs
<b>Packaging dimensions</b>	Instrument: 775 x 700 x 521 mm (30.5 x 27.5 x 20.5 in.) Standard accessories: 560 x 510 x 270 mm (22 x 20 x 10.5 in.)
<b>Options (may be purchased as factory installed)</b>	
	IEC 61850 Ethernet communication kit Ethernet outdoor connectivity kit (copper) Optional client communication cards (choose 2 maxima per Monitor); <ul style="list-style-type: none"> <li>• Optical Ethernet card: Multimode, SC connector, 100BASE-FX, 1300 nm</li> <li>• 4-20mA card: 10 outputs plus 2 inputs (5 kV impulse, 2.6 kVAC)</li> <li>• Relay card: 5 NO/NC outputs (250 VAC, 5A; 48 VDC, 1.5A)</li> </ul>
<b>Accessories</b>	

	Mounting Stand Precision oil temperature probe (4-20mA) All metal stainless steel flexible oil lines Low-temperature insulated oil lines Isolation valves Radio modem (RS-485) Cellular modem (Ethernet) Sun shield to reduce thermal load in extreme hot environments Breather drain kit for humid environments
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## **2. Technical Specification of Three phase Relay Test Kit**

The Test Kit should be versatile solution for testing protection relays and schemes. This power system simulator performs the simplest through the most complex tests.

1. It is required to test poly phase and single phase electro mechanical, solid state and numerical relays
2. Should be computer based fully automatic type and all functions shall be computer controlled.
3. Should have Modular design.
4. Should be able to perform steady state, dynamic state, transient simulation tests and automated (computer controlled) testing of all types of relays, testing of protection equipment using any previously recorded or any generated transient signal
5. Should be able to provide voltage and current sources along with logic inputs, outputs and times in a single compact unit
6. Shall have minimum six independent controlled current sources and four independent controlled voltage sources. Six voltage sources will be preferred.
7. Kit shall have multiple ranges on a current source
8. The kit shall deliver constant power across all the current ranges
9. The output current and voltage sine waves should be generated digitally to increase test accuracy and reduce the testing time
10. Independent control of magnitude, phase angle and frequency/harmonics of all sources should be available for testing and simulate power system condition
11. Shall have adequate isolated inputs and isolated outputs. Outputs should be user configurable for NO (Normally Open) or NC (Normally Closed) configuration. Inputs should be able to sense contact or voltage. Inputs and outputs should be able to withstand 250 V AC/DC. Input and output response time should be 100 micro seconds for semiconductor switches or 10 m sec for relays.
12. Must be able to test high burden electro mechanical earth fault relays, differential relays to modern multifunction numerical microprocessor based protection relays without the need for additional instruments
13. Should work as a simulator. It should be provided with necessary software to generate dynamic state simulation data and it should be possible to replay digitally recorded faults and COMTRADE compliant transient data
14. Shall be fully electronically over load and short circuit protected
15. The test equipment shall have built in DC source
16. Shall be supplied with a calibration certificate traceable to Institute of Standard and Technology
17. The specification of the instrument shall remain stable irrespective of the change in temperature, power factor, input voltage, frequency changes.

### **FEATURES**

- Performs standard relay calibration and verification testing of high burden and microprocessor relays
- Analog testing of 1A and 5A protection devices
- Performs state simulation and transient testing
- Tests 0.2-class metering CTs and transducers
- Implements end-to-end testing of communications-based schemes with GPS time syncing
- Maximum of 12 Sources (six voltages, six current) configurable for bench testing and proof-of-concept testing for complicated relaying schemes
- Delivers full VA power with resistive, inductive and capacitive loads at maximum current rating (6x35, 3x70, 1x210 amps)
- Wi-Fi capable (optional)
- Control all sources from a tablet device for basic, manual protection testing

### 3. Technical Particular of Portable DC earth fault locator

S.No.	Particulars	Technical Parameters
1	Application	To identify the earth faults on live floating DC system in the Power Station/Substation without isolating any circuit.
2	Scope	This specification covers the design, manufacture, testing, supply & demonstration of operation of electronic DC Earth Fault Locator system capable of locating and pin-pointing earth faults in live upto 300 V DC as well as dead DC network. The offers shall include all accessories even though not specifically mentioned in this specification, but which are essential for satisfactory operation of the equipment offered as a whole.
3	Diagnosis method	On line, on live battery system. The kit shall be able to locate earth faults on live 220 V /110 V floating DC system, in EHV substations without isolating any circuits. Further the kit shall be able to detect the faults such as DC source mixing fault, Multiple location DC earth fault, High Resistance fault, Dead fault. Instrument shall have Noise / Harmonics free performance.
4	Multiple Location Fault	The equipment should be capable to identify fault even in the condition of multiple location earth fault.
5	Working of the DC Earth Fault Locator System	The equipment shall be suitable for use on underground power plant/switchyard circuits charged with voltage. It shall have noise free performance. The fault should be indicated by suitable audio-visual means without pre-calibration or parameter input on any other control and single button operation to check the fault is preferred.
6	Interference	Instrument during operation shall not cause any interference with the operation of sensitive protective relays, control equipment and communication network of the plant/substation. It shall be immune to 50 Hz substation environment as well. Maximum frequency of a transmitter for signal injection should be less than 20 Hz.
7	Range of operation	The equipment shall have fault detection range up to 400 kΩ in a charged DC system and function up to a distance of 1 KM. It shall be accurate enough to detect & pinpoint fault in the said range.
8	Power pack	Its power pack shall include built-in re-chargeable battery suitable for use from 230V, 50Hz AC mains through external adaptor or built-in charger.
9	Back Up	The equipment is provided with high back up more than 7 hours during critical fault diagnosis without any interruption
10	Sensitivity	Receiver sensitivity with Big Probe (50mm dia) & Small probe (15 mm dia) shall detect a small current of atleast 300 micro amps



11	Capacitive balance	The instrument should balance the capacitance of control cables automatically and the user should not be required to adjust any parameter for balancing the capacitance.
12	Voltage	The kit Source Voltage should not inject more than 10% of the DC System Voltage. i.e. less than 24 volts for 240 volts DC System. Maximum signal voltage of transmitter should be equal or less than 24 volts.
13	Digital display	Instrument should have digital display to indicate the Injected Voltage & currents
14	Provision to Adjust the signal strength of the Transmitter	Instrument should have provision to adjust the signal strength of the Transmitter to identify the DC earth leakages in highly induced noisy areas.
15	Short Circuit Current	The kit should inject no more than 3mA in order to avoid mal-operation of sensitive relays of protection system.
16	Sensors	The sensors should be suitable for use on the multicore control cables laid in the underground power station and over ground substation.
17	Calibration	The calibration of instrument should be stable over long periods of time without requiring calibration checks and adjustments.
18	Dual Battery System	The equipment shall be able to function satisfactorily in Dual Battery Bank System also.
19	Mixing of sources	The instrument shall find mixing of DC Sources, if any, in dual battery bank system without any need for manual capacitance balancing.
20	Minimum manual control	The kit should be simple to operate with very few controls and shall be automatic as far as possible.
21	Receiver waveform	Receiver unit should have provision to show the Graphical Trend wave form, Fault severity information to confirm the fault signals. It helps user to differentiate the between fault & Noise signals.
22	Service	The offered equipment shall be complete with all components necessary for their effective and trouble free operation available in India.
23	Environment	The instrument shall be highly rugged, light-weight, portable and of 'tropicalized' construction to enable it to withstand rough use under field conditions. It shall function reliably under ambient temperature range of 0-45 degree C and humidity up to 80% (noncondensing). The instrument kit shall conform to IP-67 degree of protection.

#### **4. Technical Specifications for Earthing Resistance Tester**

- 1) Voltage output: 70V P&P (At a test frequency different from 50Hz to avoid electromagnetic frequency)
- 2) Test frequency: 128 Hz
- 3) Resistance Range: 0.01 to 19.99 K $\Omega$ 's(Auto Range and Digital)
- 4) Measurement Accuracy:  $\pm 2\%$
- 5) Resolution: 0.01 $\Omega$
- 6) Short circuit current: 20 mA
- 7) Principle: 4 peg method /for soil resistivity and 3 peg method / Fall of potential method
- 8) Automatic suppression of interference
- 9) Should be able to test Earth Resistance of all points in the power station
- 10) The system should have Induction suppression filters & special filters designed for Power frequency leakage current & its harmonics to provide a rock steady & reliable, repeatable reading in power station environment & high accuracy.
- 11) Display: 4 & 1/2 digit Digital display

- 12) Protection control: Against Short circuit, over voltage, kit should have auto cut off features to protect the instrument
- 13) In built 12V 7AH rechargeable battery with advanced SMPS for long Duration usage
- 14) Battery charging: 230+/- 10% AC 50 Hz +/- 10%
- 15) Accessories: 4 pegs, suitable cables for high frequency operation carrying case Instruction manual and others

## B) 5. NON CONTACT VOLTAGE DETECTOR ALONG WITH 5 METER TELESCOPIC FIBER GLASS ROD

### 1. SCOPE

- 1.1 Supply of High Voltage Detectors suitable for detection of liveness of 230V to 765 KV overhead line (bare conductor). The HV Detector starts producing visual indication as well as audio annunciation indicating that the line is LIVE and not safe to earth and carry any operation. As well High voltage detector should indicate the induced voltage presence on bare conductors.

### 2. TECHNICAL PARAMETERS:

Sl. No.	Description	Specification
1.	Standards Applicable	The performance and testing of the High Voltage Detector shall conform to the following Indian / International standards.  Application of Non-contact voltage detector are used in Power Transmission lines, Distribution Lines & sub stations to detect the presence of the voltage in charged 230V to 765kV level on bare conductors & also detect the induced voltages in un charged substation Bays, Bus bars, Transmission Line, Distribution lines for safe operation do the maintenance activities.
2.	Detection Range	The High Voltage Detector should have the unique capability to warn the user of the presence of high voltage from a safe distance and must be exceptionally sensitive  <b>1.5 meters for 66KV,</b> <b>2.2 meters for 132KV,</b> <b>3 meters for 220KV a</b> <b>4 meters for 400KV &amp; 5 Meters from 765kV Voltage level.</b>
3.	Functions	1. Non-contact voltage detection 2. Induced voltage presence on un charged Lines
4.	Selectable Voltage range	Sensing voltage selector- 230V/11kV/33kV/66kV/132kV/220kV/400 KV & 765kV
5.	General & Constructional Requirements	1. High Voltage Detector shall be designed and constructed in such a way so as to avoid any danger to the operating personnel during use and under normal conditions. It should have the capability to warn the user by audio annunciation as well as visual indication of the presence of voltage from a safe distance.



Sl. No.	Description	Specification
		<p>2. Bright high intensity LEDs (preferably red coloured) to provide clear visual indication even in unfavourable daylight conditions. A buzzer produces a loud beep which is audible even in noisy back grounds.</p> <p>3. The High Voltage Detector should have Self-test button to test battery and proper functioning of HV detector and the facility of easy replacement of the power supply battery.</p> <p>4. The High Voltage Detector should have universal connecting link for the attachment of the Telescopic rod.</p> <p>5. The Telescopic rod should be of non-allergic, Premium Quality Fiber Glass Material with upper stick foam filled (High voltage tested material) with Piece to piece self-Locking arrangement.</p> <p>6. All insulating material used in the construction of High Voltage Detector shall be non hygroscopic, non-ageing and of tested quality.</p> <p>7. The detector should not have any external accessibility to change the voltage or the sensing distance to ensure the safety of the user.</p>
6.	Detection Indication	<p>1. The High Voltage Detector shall give the indication with High Intensity LED's with flashing arrangement there by providing the suitable indication in day light.</p> <p>2. The High Voltage Detector shall give audible sound for the presence of live line so that it can be suitably used in populated and noise areas for easy operation.</p>
7.	Self-Diagnostic Feature	The High Voltage Detector shall be capable of performing complete self-diagnostic check in off-line mode with buzzer & flashing LED to ensure the correct working of the probe.
8.	Power Supply	9V Battery or Rechargeable & replaceable Battery suitable to be charged through a single phase, 230V Supply.
9.	Suitable Carrying Case	The High Voltage Detector with accessories shall be supplied with the carrying case to be carried by the operating person easily.
10.	Environment	<p>Temp: -10-60 Deg C.</p> <p>Humidity: 90% non-condensing</p> <p>The test kit shall meet the EMI/EMC requirement as per relevant IEC/IS/equivalent standard.</p>
11.	Certifications	<p>The tenderer shall furnish detailed type test certificates of the offered Instrument for all the tests as per relevant Indian Standard/ CPRI / International standards from NABL accredited Laboratory.</p> <p>With respect to High Voltage Test Techniques:</p> <ol style="list-style-type: none"> <li>1. Measurement of leakage current before Humidity test</li> <li>2. Humidity test</li> </ol>

Sl. No.	Description	Specification
		<ol style="list-style-type: none"><li>3. Measurement of leakage current after Humidity test</li><li>4. Power Frequency Voltage Withstand test from CPRI Lab or any other NABL accredited</li><li>5. Insulation Resistance test</li><li>6. IP 54 rating for field usages or better</li></ol>



## **CHAPTER 24 : FIRE PROTECTION**

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Appendix-I P&I for Hydrant & HVW Spray System for 400kV Substation



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**TECHNICAL SPECIFICATION FOR**  
**FIRE PROTECTION SYSTEM**

**1.00.00 INTENT OF SPECIFICATION**

This section covers the design and performance requirements of the following types of fire protection systems;

- a. Hydrant System
- b. High Velocity Water (H.V.W) Spray System
- c. Fire Detection and alarm System
- d. Portable Fire Extinguishers
- e. Wheel/ Trolley mounted Fire Extinguishers

1.00.01 It is not the intent to completely specify all details of design and construction. Nevertheless, the system design and equipment shall conform in all respects to high standard of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the Owner. The system design shall also conform to NFPA norms.

1.00.02 The scope of work include complete earthwork (i.e. excavation, backfilling etc.) for the entire buried piping for the system, valve pits and pipe supports for buried, entrenched and overground piping.

1.00.03 The equipment offered shall comply with the relevant latest International Standards **unless specified otherwise**. The Deluge valves, HVW spray nozzles & quartzoid bulb detectors shall have the approval of any of the following agencies;

- a. UL of USA.
- b. F M of USA
- c. LPCB of UK or
- d. VDS of Germany,

1.00.04 Ambient temperature for design of all equipment shall be considered as 50°C.

1.00.05 The piping and instruments diagram for Hydrant and HVW spray system for 400kV switchyard is enclosed at Appendix-I. respectively. The successful bidder shall prepare detailed layout and piping drawing



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based on this drawing and other drawings such as road, drainage, cable trench, switch yard layout, etc. as furnished by the Employer during detailed engineering.

## 2.00.00 DESIGN AND CONSTRUCTION

### 2.01.00 Hydrant System

Hydrant system of fire protection essentially consists of a large network of pipe, both under ground and over ground which feeds pressurised water to a number of hydrant valves, indoor (if applicable) as well as outdoor. These hydrant valves are located at strategic locations near buildings, Transformers and Reactors. Hose pipes of suitable length and fitted with standard accessories like branch pipes, nozzles etc., are kept in Hose boxes. In case of emergency, these hoses are coupled to the respective hydrant valves through instantaneous couplings and jet of water is directed on the equipment on fire. Hydrant protection shall be provided for the following in all substations of voltage levels 132kV and above (This is not applicable for extension of existing 220kV and 132kV substations where Hydrant system is not available). At least one hydrant post shall be provided for every 60m of external wall measurement of buildings.

- a) Control room building
- b) L.T. Transformer area.
- c) Fire Fighting pump House.
- d) Stores
- e) Transformers
- f) Shunt Reactors/ Bus Reactors.

2.01.01 A warning plate shall be placed near the hydrant points for the transformers and reactors substations to clearly indicate that water shall be sprayed only after ensuring that the power to the transformer/ reactor which is on fire is switched off and there are no live parts within 20metres of distance from the personnel using the hydrant.

### 2.02.00. HIGH VELOCITY WATER (H.V.W) SPRAY SYSTEM



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H.V.W. spray type fire protection essentially consists of a network of projectors and an array of heat detectors around the Transformer/Reactor to be protected. On operation of one or more of heat detectors, Water under pressure is directed to the projector network through a Deluge valve from the pipe network laid for this system. This shall be provided for transformers and reactors in all 132kV & above substations (This is not applicable for extension of existing 220kV and 132kV substations where HVWS system is not available). Wet detection initiation system shall be employed for automatic operation.

The system shall be designed in such a way that the same can be extended to protect additional Transformer/ Reactor to be installed in future. However, for the purpose of design it shall be assumed that only one Transformer/ Reactor will be on fire. The main header pipe size in the yard shall be 200mmNB(for 220kV & 132kV switchyard). Branch to the equipment (shall not be more than 20metres length) shall be of the same size as of deluge valve.

2.02.01 The Electrical clearance between the Emulsifier system pipe work and live parts of the protected equipment shall not be less than the values given below :

1.	245 kV bushing	2150 mm
2.	145 kV bushing	1300 mm
3.	52 kV bushing	630 mm
4.	36 kV bushing	320 mm

2.02.02 System shall be designed in such a way that the Water pressure available at any spray nozzle shall be between 3.5bar and 5.0bar and shall be demonstrated through hydraulic calculations. Water shall be applied at a minimum rate of 10.2 LPM/M<sup>2</sup> of the surface area of the transformer / Reactor including radiator, conservator, oil pipes, bushing turrets, etc. (including bottom surface for transformer). The nozzle arrangement shall ensure direct impingement of water on all exterior surfaces of transformer tank, bushing turrets, conservator and oil pipes, except underneath the transformer, where horizontal spray may be provided.



### 2.02.03 **Deluge Valve**

Deluge Valve shall be water pressure operated manual reset type. The Deluge valve shall be closed water tight when water pressure in the heat detector pipe work is healthy and the entire pipe work shall be charged with water under pressure upto the inlet of the Deluge valve. On fall of water pressure due to opening of one or more heat detectors, the valve shall open and water shall rush to the spray water network through the open Deluge valve. The valves shall be manually reset to initial position after completion of operation. Each Deluge Valve shall be provided with a water motor gong which shall sound an alarm when water after passing through the Deluge valve, is tapped through the water motor.

Each Deluge valve shall be provided with a local panel with provision of opening of Deluge valve from local and remote from control room/ remote centre. In addition to this, each valve shall be provided with local operation latch.

Deluge valves of 100mmNB size shall be used if the flow requirement is  $\leq 200\text{m}^3/\text{hr}$  and 150mmNB size shall be used for flow requirement  $>200\text{m}^3/\text{hr}$ .

Test valves shall simulate the operation of Deluge valves and shall be of quick opening type. The general construction shall conform to requirements under clause no.7.00.00 for piping, valves and specialities.

### 2.02.04 **High Velocity Spray Nozzles (Projectors)**

High velocity spray system shall be designed and installed to discharge water in the form of a conical spray consisting of droplets of water travelling at high velocity, which shall strike the burning surface with sufficient impact to ensure the formation of an emulsion. At the same time the spray shall efficiently cut off oxygen supply and provide sufficient cooling.

2.02.05 Minimum set point of the heat detectors used in the HVW spray system shall be  $79^\circ\text{C}$ . The optimum rating shall, however, be selected by the Bidder, keeping in mind the maximum and minimum temperature attained at site.

### 2.03.00 **Fire Detection and alarm System**

This system shall be provided for control room building and Switchyard panel rooms of substations.



2.03.01 Suitable fire detection system using smoke detectors and/or heat detectors shall be provided for the entire building, including corridor and toilets. Fire detectors shall be located at strategic locations in various rooms of the building. Each Switchyard panel room shall be considered a separate zone. Adequate number of extra zones shall be provided for Switchyard panel rooms for future bays identified in Single line diagram of the substation. The operation of any of the fire detectors/ manual call point should result in the following;

1. A visual signal exhibited in the annunciation panels indicating the area where the fire is detected.
2. An audible alarm sounded in the panel, and
3. An external audible alarm sounded in the building, location of which shall be decided during detailed engineering.
4. If the zone comprises of more than one room, a visual signal shall be exhibited on the outer wall of each room.

2.03.02 Each zone shall be provided with two zone cards in the panel so that system will remain healthy even if one of the cards becomes defective.

2.03.03 Coverage area of each smoke detector shall not be more than 80 m<sup>2</sup> and that of heat detectors shall not be more than 40 m<sup>2</sup>. Ionisation type smoke detectors shall be provided in all areas except pantry room where heat detectors shall be provided. If a detector is concealed, a remote visual indication of its operation shall be provided. Manual call points (Break glass Alarm Stations) shall be provided at strategic locations in the control room building. All cabling shall be done through concealed conduits.

2.03.04 Cables used should be exclusively for fire detection and alarm system and shall be 2Cx1.5sq.mm Cu. cables. Un-armoured PVC insulated FR cables conforming to latest IEC / International standards shall be used.

2.04.00 Portable and Wheel/ Trolley mounted Fire Extinguishers

2.04.01 Portable Fire Extinguishers

Adequate number of portable fire extinguishers of pressurised water, dry chemical powder, and Carbon dioxide type shall be provided in suitable locations in control room building and FFPH building as indicated in the drawing. In addition to this one (1) CO<sub>2</sub> type fire extinguisher of 4.5kg capacity shall be provided for each Switchyard panel room. These extinguishers will be used during the early phases of fire to prevent its spread and costly damage.





The design, construction & testing of portable fire extinguishers shall meet the requirements as per clause 10.00.00.

#### 2.04.02 Wheel/ Trolley mounted Fire Extinguishers

Wheel/Trolley mounted Mechanical foam type fire extinguishers of 50litre capacity, conforming to latest international standards, shall be provided for the protection of the following:

1. Transformers and reactors in 220kV and 132 kV substations where Hydrant/HVWS system is not available. Two (2) nos. for each 220kV or 132kV transformer and reactor.
2. LT transformers in all substations. One (1) no. for each LT transformer.

The design, construction & testing of Mechanical foam type 50 litre capacity shall meet the requirements of relevant International Codes and clause 10.00.00 of this specification.

#### 2.05.00 Water Supply System

For **for 220kV and 132kV** level substations water for hydrant & HVW system shall be supplied by one electrical motor driven pump of rated capacity **273m<sup>3</sup>/hr.** at 70MWC head, with another pump of same capacity , driven by diesel engine, shall be used as standby. Water storage tank with two compartments of adequate capacity shall be provided. Pumps shall work under positive suction head. Annunciations of the hydrant & HVW spray systems shall be provided in fire water pump house and repeated in control room. Provision for sending data to remote control centre shall also be available.

The outdoor piping for the system in general shall be laid above ground on concrete pedestals with proper supporting arrangement. However, at road/rail crossings, in front/access of buildings, places where movement of cranes/vehicles is expected and at any other place where above ground piping is not advisable, the pipes shall be laid underground. Such locations shall be finalised during detailed engineering.

The whole system will be kept pressurised by providing combination of air vessel and jockey pump of 10.8M<sup>3</sup>/hr. capacity at 80MWC. The capacity of air vessel shall not be less than 3m<sup>3</sup>. Minor leakage will be met by Jockey pump. One additional jockey pump shall be provided as standby. All pumps shall be of horizontal centrifugal type. Pumps and air vessel with all auxiliary equipment will be located in firewater pump



house. A pressure relief valve of suitable rating shall be provided in water header to release excess pressure due to atmospheric temperature variations.

Operation of all the pumps shall be automatic and pumps shall be brought into operation at preset pressure. Fire pumps shall only be stopped manually. Manual start/stop provision shall be provided in local control panel.

2.05.01 The general design of the fire fighting pump sets shall meet the requirements under clauses no.5.00.00 for Horizontal centrifugal pumps, no.6.00.00 for Diesel engines and no.12.00.00 for Electrical motors.

2.05.02 Each pump shall be provided with a nameplate indicating suction lift/delivery head, capacity and number of revolutions per minute.

2.05.03 Design, construction, erection, testing and trial operation of piping, valves, strainers, hydrant valves, hoses, nozzles, branch pipes, hose boxes, expansion joints etc. shall conform to the requirements of clause no. 7.00.00.

#### 2.06.00 **Instrumentation and Control System**

2.06.01 All instruments like pressure indicators, differential pressure indicators, pressure switches, level indicators, level switches, temperature indicators, alarms and all other instruments and panels as indicated in the specification and drawings and those needed for safe and efficient operation of the whole system shall be furnished according to the requirements of clause 11.00.00. Pump running/ fails to start signal shall be taken from the pressure switch immediately after the discharge of the pump.

#### 2.06.02 **Control Panel**

Power feeder for motors will be from switchgear board located in control building but control supply for all local control panels, annunciation panels, battery charger units, space heaters etc. shall be fed from the AC and DC distribution boards located in pump house. These AC & DC distribution boards will be fed from the switchgears and DCDBs located in control building.

a) Panel for motor driven fire water pump

The panel shall be provided with the following:

1. TPN switch 1 No.



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- |    |   |       |
|----|---|-------|
| 2. | Auto/manual selection facility              |       |
| 3. | Start/Stop facility<br>with indication lamp | 1 Set |
| 4. | DOL starter with<br>thermal O/L relay       | 1 Set |
| 5. | Indicating lamp showing<br>power ON         | 1 Set |
| 6. | Indication lamp with drive<br>ON/OFF        | 1 Set |
| 7. | Indication lamp showing<br>Motor Trip       | 1 No. |

**Additional provisions shall be made for controlling the following from the remote control centre:**

1. Auto/manual selection facility
2. Start/Stop facility

Main power cable from breaker feeder of main switchboard shall be terminated in this panel and another cable shall emanate from this panel which shall be terminated at motor terminals.

- |    |                                |      |
|----|--------------------------------|------|
| b) | Panel for Two nos. Jockey Pump | 1No. |
|----|--------------------------------|------|

The panel shall be provided with the following :

- |    |   |                     |
|----|---|---------------------|
| 1. | Fuse-switch unit for Jockey pumps   | 1 Set for each pump |
| 2. | Auto/manual selection facility<br>for each pump                                   |                     |
| 3. | Selector switch for<br>selecting either jockey pump                               | 1 No.               |
| 4. | D.O.L. starter with overload<br>relay self-resetting type,<br>for all the drives. | 1 No. each          |



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- |    |  |                     |
|----|--|---------------------|
| 5. | Start/stop push button for Jockey Pump with indication lamp with pad-locking arrangements in stop position | 1 Set for each pump |
| 6. | Indication lamp for trip indication  | 1 No. each for pump |

**Additional provisions shall be made for controlling the following from the remote control centre:**

- |    |   |       |
|----|---|-------|
| 1. | Auto/manual selection facility for each pump.                           |       |
| a) | Panel for 2 Nos. battery charger & Diesel Engine driven fire water pump | 1 No. |

The panel shall be provided with the following :

- |    |   |            |
|----|---|------------|
| 1. | Auto/Manual selection facility for Diesel Engine driven pump                      | 1 No.      |
| 2. | Start/Stop facility with indication lamp  | 1 Set      |
| 3. | Indicating lamp showing drive ON/OFF  | 1 Set      |
| 4. | D.C. Voltmeter/Ammeter in the battery charger circuit                             | 1 No. each |
| 5. | Battery charger will be as per specification described                            | 1 Set      |
| 6. | Selector switch for selecting either of battery chargers for the battery sets.    | 1 No.      |
| 7. | Selector switch for selecting either set of batteries for Diesel engine starting. | 1No.       |
| 8. | Selector switch for boost charging/Trickle charging of battery set.               | 1 Set      |



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**Additional provisions shall be made for controlling the following from the remote control centre:**

**1. Manual Start/Stop of Diesel Engine**

- d) Individual local control panel is to be considered for each transformer/ Reactor deluge system wherever these equipment are envisaged. This panel shall contain push buttons with indicating lamps for spray ON/OFF operation in the valve operation circuit. Push buttons shall be concealed behind glass covers, which shall be broken to operate the buttons. Provision shall be made in the panel for the field signal for the annunciations such as spray ON and fire in the Transformer/Reactor. A signal for spray ON shall also be provided in the control room fire alarm panel for employer's event logger. Remote operation facility to open the Deluge valve from control room/ remote centre shall also be provided.

**2.06.03 Annunciation Panels**

- a) Location: Fire Water Pump House
- i) Indicating lamps showing power supply "ON".
- ii) Annunciation windows complete with buttons. Details are as follows:

Sl.No.	Description	Number
1.	Electric motor driven fire water pump running	1
2.	Electric motor driven fire water pump fails to start	1
3.	Diesel engine driven fire water pump running.	1
4.	Diesel engine driven water pump fails to start	1
5.	Jockey pump-1 running	1
6.	Jockey pump-1 fails to start	1
7.	Jockey pump-2 running	1
8.	Jockey pump-2 fails to start	1
9.	Fire in Transformer/ Reactor	1 for each



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		equipment
10.	Deluge system operating for Transformer/Reactor	1 for each equipment
11.	Header pressure low	1
12.	Fire in smoke detection system zone (Common Fire Signal)	1
13.	Water storage tank water level low	2
14.	High speed diesel tank level low	1
15.	Spare	10

-----

b) **Location: Substation Control Room**

- i) Indication lamp showing power supply 'ON'
- ii) Provision shall be made in the panel for a signal for spray ON for each Transformer/Reactor for owner's use for event logger.
- iii) Each Switchyard panel room shall be considered as separate zone for fire detection and alarm system.
- iv) Following annunciations shall be provided.

Sl.No.	Description	Number
1.	Fire in Transformer/ Reactor	1 for each equipment
2.	Diesel engine driven fire water pump in operation	1
3.	Motor driven fire water pump in operation	1
4.	Jockey pump in operation	1



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5.	Fire fighting Water storage tank level Low	2
6.	Fire/Fault (zone alarm module)	1+1(duplicate) For each zone as applicable
7.	Spare windows complete in all respect, with relays	10
8.	Spare zone alarm modules	Number of future A/c Kiosks required for the bays identified as per SLD

- 
- c) Each annunciation panel shall be provided with a hooter. A hooter in parallel to the hooter in fire panel shall be provided in the security room of substation for alert in case of fire.
- d) Indication for fault in respective areas shall also be provided. Each zone alarm module shall exhibit 'FIRE' and 'FAULT' conditions separately.
- e) **Provision for sending data to Remote Control Unit for the following**
- (i) Fire in Switchyard Panel Room (Switchyard Panel room shall be considered as separate zone for fire detection and alarm system).
  - (ii) Fire in Transformer/Reactor (1 for each equipment)
  - (iii) Diesel engine driven fire water pump in operation.
  - (iv) Motor driven fire water pump in operation
  - (v) Fire/Fault in Control Room.
  - (vi) Water Storage tank level (low and very low for each storage tank).
  - (vii) High Speed Diesel tank level (low & very low)
  - (viii) AC Mains Supply Healthy/Fail for Main Pump & Jockey Pump
  - (ix) DC Control Supply Healthy/Fail for Main Pump & Jockey Pump
  - (x) DC Control Supply Healthy/Fail for Diesel Engine driven pump.

2.06.04 The control and interlock system for the fire protection system shall



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meet the following requirements:

**1. Electric Motor Driven Fire water Pump**

Pump should start automatically when the System header pressure is low.

Pump should be stopped manually only. Pump should also be started manually if required from local control panel.

**2. Diesel Engine Driven Standby Pump**

The pump should automatically start under any of the following conditions:

- a) System Header pressure low.
- b) Electric motor operated fire water pump fails to start.

Pump should be stopped manually only. Pump should also be started manually if required from the local control panel. The battery set which is connected for starting of Diesel engine shall not be subjected to boost charge.

**3. Jockey Pump**

It shall be possible to select any one of the Jockey pumps as main and the other as standby. Main Jockey pump shall start automatically when water pressure in header falls below the set value. If the main jockey pump fails to start then the standby should start. Jockey pump shall stop automatically when the pressure is restored to its normal value.

Manual starting/stopping shall be possible from the local control panel.

**3.00.00 TESTS**

**3.01.00 Shop Tests**

3.01.01 Shop tests of all major equipment centrifugal pumps, diesel engines, electrical drive motors, piping, valves and specialties, pressure and storage vessels, MCC, electrical panels, controls, instrumentation etc. shall be conducted as specified in various clauses and as per applicable standards/codes.



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3.01.02 Shop tests shall include all tests to be carried out at Contractor's works, works of his sub-contractor and at works where raw materials supplied for manufacture of equipment are fabricated. The tests to be carried out shall include but not be limited to the tests described as follows :

- a) Materials analysis and testing.
- b) Hydrostatic pressure test of all pressure parts, piping, etc.
- c) Dimensional and visual check.
- d) Balancing test of rotating components.
- e) Response of heat/smoke detectors.
- f) Performance characteristics of HVW spray nozzles (projectors).
- g) Flow rate and operational test on Flow control valves.
- h) Operational test of alarm valve (water-motor gang).
- i) Calibration tests on instruments and tests on control panel.
- j) Destruction/burst tests on 2% or minimum one (1) no. of hoses and portable type fire extinguishers for each type as applicable. Any fraction number shall be counted as next higher integer.
- k) Performance test on fire extinguishers as required in the code.

3.01.03 In the absence of any Code/Standard, equipment shall be tested as per mutually agreed procedure between the supplier and the Employer.

3.01.04 A comprehensive visual and functional check for panels would be conducted and will include a thorough check up of panel dimensions, material of construction, panel finish, compliance with tubing and wiring specifications, quality of workmanship, proper tagging & locations of instruments/accessories. The wiring check shall be complete point to point ring out and check for agreement with installation drawings and equipment vendor prints of the complete system and an inspection of all field connection terminals and levelling.

3.01.05 All test certificates and reports shall be submitted to the Employer for approval.

3.01.06 The Employer's representative shall be given full access to all tests. The manufacturer shall inform the Employer allowing adequate time so



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that, if the Employer so desires, his representatives can witness the test.

### 3.02.00 **Pre-commissioning Tests**

#### 3.02.01 **General**

- a) All piping and valves, after installation will be tested hydraulically at a pressure of 16kg/cm<sup>2</sup> for a period of 30 minutes to check against leak tightness.
- b) All manually operated valves/gates shall be operated throughout 100% of the travel and these should function without any trouble whatsoever, to the satisfaction of the Employer.
- c) All pumps shall be run with the specified fluid from shut off condition to valve wide open condition. Head developed will be checked from the discharge pressure gauge reading. During the test, the pumps and drives shall run smoothly without any undue vibration, leakage through gland, temperature rise in the bearing parts, noise, flow pulsation etc.
- d) All pressure vessels should be tested hydraulically at the specified test pressure, singly or in the system.
- e) Painting shall be checked by dry type thickness gauges.
- f) Visual check on all structural components, welding, painting etc. and if doubt arises, these will be tested again.
- g) All test instruments and equipment shall be furnished by the Contractor to the satisfaction of the Employer.
- h) Automatic starting of all the fire pumps by operating the test valves.
- i) Automatic operation of the Jockey pump
- j) Operation of the Deluge valve by breaking a detector as well as manual and remote operation of the deluge valve.
- k) Operation of entire annunciation system.

Replacement of fused/damaged quartzoid bulb detectors during the test shall be responsibility of contractor.

#### 3.02.02 After erection at site, the complete HVW spray protection and hydrant



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system shall be subject to tests to show satisfactory performance for which detailed procedure shall be submitted for Employer's approval.

Full flow tests with water shall be done for the system piping as a means of checking the nozzle layout, discharge pattern and coverage, any obstructions and determination of relation between design criteria and actual performance, also to ensure against clogging of the smaller piping and the discharge devices by foreign matter carried by the water.

Rigidity of pipe supports shall also be checked during the water flow.

3.02.03 All the detectors installed shall be tested for actuation by bringing a suitable source of heat/smoke near the detector and creating a stream of hot air/ smoke over the detector. The exact procedure of this test shall be detailed out by the Employer to the successful Bidder.

#### 4.00.00 **SPARE PARTS**

The Contractor shall indicate in his scope of supply all the mandatory spares in the relevant schedules. The list of mandatory spares is indicated in 'Section - Projects'.

#### 5.00.00 **HORIZONTAL CENTRIFUGAL PUMPS**

This clause covers the design, performance, manufacturing, construction features and testing of horizontal centrifugal pumps used for the purpose of fire fighting.

5.01.00 The materials of the various components shall conform to the applicable BS/ASTM/DIN Standards.

5.01.01 In case of any contradiction with the aforesaid standards and the stipulations as per the technical specification as specified hereinafter, the stipulations of the technical specification shall prevail.

#### 5.02.00 **General Performance Requirements**

5.02.01 The pump set shall be suitable for continuous operation at any point within the "Range of operation".

5.02.02 Pumps shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off.

5.02.03 Pumps shall be capable of furnishing not less than 150% of rated capacity at a head of not less than 65% of the rated head. The shut off head shall not exceed 120% of rated head. Range of operation shall be 20% of rated flow to 150% of rated flow.



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5.02.04 The pump-motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any mal-operation of the system.

5.02.05 **Drive Rating**

The drive rating shall not be less than the maximum power requirement at any point within the "Range of Operation" specified.

During starting under reverse flow condition, the motor shall be capable of bringing the pump to rated speed at normal direction with 90% rated voltage at motor terminals.

5.02.06 Pump set along with its drive shall run smooth without undue noise and vibration. Acceptable peak to peak vibration limits shall guided by applicable standards.

5.02.07 The Contractor under this specification shall assume full responsibility in the operation of the pump and drive as one unit.

5.03.00 **Design & Construction**

5.03.01 Pump casing may be axially or radially split. The casing shall be designed to withstand the maximum pressure developed by the pump at the pumping temperature.

5.03.02 Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self-venting & priming. Casing drain, as required, shall be provided complete with drain valves.

5.03.03 Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610.

5.03.04 Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.

5.03.05 **Impeller**

The impeller shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft impellers shall be secured to the shaft by an additional locknut or cap screw. All screwed fasteners shall tighten in the direction of normal rotation.

5.03.06 **Wearing Rings**



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Replaceable type wearing rings shall be furnished to prevent damage to impeller and casing. Suitable method of locking the wearing ring shall be used.

#### 5.03.07 **Shaft**

Shaft size selected shall take into consideration the critical speed, which shall be at least 20% away from the operating speed. The critical speed shall also be at least 10% away from runaway speed.

#### 5.03.08 **Shaft Sleeves**

Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.

5.03.09 Shaft sleeves shall be securely fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

#### 5.03.10 **Bearings**

Bearings of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its "Range of Operation" and also at the shut-off condition. The bearing shall be designed on the basis of 20,000 working hours minimum for the load corresponding to the duty point.

Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearing housing.

#### 5.03.11 **Stuffing Boxes**

Stuffing box design shall permit replacement of packing without removing any part other than the gland. Stuffing boxes shall be sealed/cooled by the fluid being pumped and necessary piping, fittings, valves, instruments, etc. shall form an integral part of the pump assembly.

#### 5.03.12 **Shaft Couplings**

All shafts shall be connected with adequately sized flexible couplings of suitable design. Necessary guards shall be provided for the couplings.

#### 5.03.13 **Base Plates & Sole Plate**

A common base plate mounting both for the pump and drive shall be



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furnished.

The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimise misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust etc. Suitable drain taps and drip lip shall be provided.

#### 5.03.14 Material of Construction

All materials used for pump construction shall be of tested quality. Material of construction of the major parts of the pumps shall be as given below or superior as per relevant latest International standards:

- |                 |                                    |
|-----------------|------------------------------------|
| a) Casing       | Casting Grade 17 of BS 1452        |
| b) Impeller     | Bronze Grade LG2-C of BS1400       |
| c) Wearing ring | Bronze Grade LG2-C of BS1400       |
| d) Shaft        | Mild Steel.                        |
| e) Shaft sleeve | Bronze Grade LG2-C of BS1400       |
| .               |                                    |
| f) Stuffing box | 2.5% Nickel CI Grade 17 of BS 1452 |
| g) Gland        | --- do ---                         |

#### 5.03.15 Balancing

All rotating components shall be statically and dynamically balanced at shop.

5.03.16 All the components of pumps of identical parameters supplied under this specification shall be interchangeable.

#### 5.04.00 Tests and Inspection

5.04.01 The manufacturer shall conduct all routine tests required to ensure that the equipment furnished conform to the requirements of this specification and are in compliance with the requirements of applicable Codes and Standards. The particulars of the proposed tests and the procedures for the tests shall be submitted to the Employer/Engineer for approval before conducting the tests.

5.04.02 Where stage inspection is to be witnessed by Employer, in addition to above, the Bidder shall submit to the Employer/Engineer at the



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beginning of the contract, the detailed PERT-Chart showing the manufacturing programme and indicating the period where Employer or his authorised inspecting agency are required at the shop.

**5.04.03 Material of Construction**

All materials used for pump construction shall be of tested quality. Materials shall be tested as per the relevant standards and test certificates shall be made available to the Employer/Engineer.

5.04.04 Where stage inspection is to be witnessed by Employer, all material test certificates shall be correlated and verified with the actual material used for construction before starting fabrication, by Employer's Inspector who shall stamp the material. In case mill test certificates for the material are not available, the Contractor shall carry out physical and chemical tests at his own cost from a testing agency approved by the Employer, as per the requirements of specified material standard. The samples for physical and chemical tests shall be drawn up in presence of Employer's inspector who shall also witness the tests.

5.04.05 Shaft shall be subjected to 100% ultrasonic test and machined portion of the impeller shall be subject to 100% DP test. On finished shaft DP test will also be carried out.

**5.04.06 Hydraulic test at shop**

All pressure parts shall be subjected to hydraulic testing at a pressure of 150% of maximum pressure generated by the pump at rated speed or 200% of total dynamic head whichever is higher, for a period not less than one (1) hour.

**5.04.07 Performance test at shop**

Pumps shall be subjected to routine tests to determine the performance of the pumps. These tests shall be conducted in presence of Employer/Engineer's representative as per the requirements of the ASME Power Test Code PTC 8.2/BS- 599/I.S.S., latest edition. Routine tests shall be done on all the pumps.

5.04.08 Performance tests shall be conducted to cover the entire range of operation of the pumps. These shall be carried out to span 150% of rated capacity upto pump shut-off condition. A minimum of five combinations of head and capacity are to be achieved during testing to establish the performance curves, including the design capacity point and the two extremities of the Range of operation specified.

5.04.09 Tests shall preferably be conducted alongwith the actual drives being supplied.

5.04.10 The Bidders shall submit in his proposal the facilities available at his



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works to conduct performance testing. If because of limitations of available facilities, a reduced speed test or model test has to be resorted to establish pump performance, the same has to be highlighted in the offer.

- 5.04.11 In case of model testing, the stipulations of latest edition of applicable standards shall be binding. Prototype or model tests, however, shall be conducted with the suction condition identical to the field conditions i.e. sigma values of prototype and model is to be kept same.
- 5.04.12 Prior to conducting model testing, calculations establishing model parameters, sizes and test procedure will be submitted to Employer/Engineer for approval.
- 5.04.13 All rotating components of the pumps shall be subjected to static and dynamic balancing tests.
- 5.04.14 The Employer or his authorised representative shall have full access to all tests. Prior to performance tests, the Contractor shall intimate the Employer allowing adequate time so that if the Employer so desires, his representative can witness the test.
- 5.04.15 Report and test certificates of the above tests shall be submitted to the Employer/Engineer for approval.
- 5.04.16 **Pre commissioning tests.**

After installation, pumps offered may be subjected to testing at field also by Employer. If the performances at field are not found to meet the requirement, then the equipment shall be rectified by the Contractor without any extra cost. Prior to performance testing, the procedure for such tests will be mutually agreed between Employer and Contractor. The Contractor shall furnish all necessary instruments, accessories and personnel for testing. Prior to testing, the calibration curves of all instruments and permissible tolerance limit of instruments shall be mutually agreed upon.

## 6.00.00 **DIESEL ENGINES**

This Clause covers the design, performance, manufacturing construction features and testing of compression ignition diesel engines, used primarily for driving centrifugal pumps, used for the purpose of fire fighting.

### 6.01.00 **Design and Construction**

#### **General**

- 6.01.01 The diesel engine shall be of multicylinder type four-stroke cycle with mechanical (airless) injection, cold starting type.



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- 6.01.02 The continuous engine brake horse power rating (after accounting for all auxiliary power consumption) at the site conditions shall be atleast 20% greater than the requirement at the duty point of pump at rated RPM and in no case, less than the maximum power requirement at any condition of operation of pump.
- 6.01.03 Reference conditions for rated output of engine shall be as per ISO:3046, part I.
- 6.01.04 The engine shall be designed with regard to ease of maintenance, repair, cleaning and inspection.
- 6.01.05 All parts subjected to substantial temperature changes shall be designed and supported to permit free expansion and contraction without resulting in leakage, harmful distortion or misalignment.
- 6.01.06 **Starting**

The engine shall be capable of both automatic and manual start. The normal mode of starting is automatic but in the event of failure of automatic start or at the discretion of the operator, the engine can be started manually from the LCP.

Since the fire pumping unit driven by the diesel engine is not required to run continuously for long periods and the operation will not be frequent, special features shall be built into the engine to allow it to start within a very short period against full load even if it has remained idle for a considerable period.

- 6.01.07 If provision for manual start (cranking) is provided, all controls/mechanisms, which have to be operated during the starting process, shall be within easy reach of the operator.
- 6.01.08 Automatic cranking shall be effected by a D.C. motor having high starting torque to overcome full engine compression. Starting power will be supplied from either of the two (2) sets of storage batteries. The automatic starting arrangement shall include a 'Repeat Start' feature for 3 attempts. The battery capacity shall be adequate for 3 (three) consecutive starts without recharging with a cold engine under full compression.
- 6.01.09 The batteries shall be used exclusively for starting the diesel engine and be kept fully charged all the time in position. Arrangement for both trickle and booster charge shall be provided.

Diesel engine shall be provided with two (2) battery charger units of air-cooled design. The charger unit shall be capable of charging one (1) set of battery at a time. Provision shall, however, be made so that any one of the charger units can be utilised for charging either of the two (2)



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batteries.

6.01.10 For detail design of battery and battery charger, sub-section Electrical may be referred to.

6.01.11 **Governing System:**

The engine shall be fitted with a speed control device, which will control the speed under all conditions of load.

6.01.12 The governor shall offer following features:

a) Engine should be provided with an adjustable governor capable of regulating engine speed within 5% of its rated speed under any condition of load between shut-off and maximum load conditions of the pumps. The governor shall be set to maintain rated pump speed at maximum pump load.

b) Engine shall be provided with an over speed shut-down device. It shall be arranged to shut-down the engine at a speed approximately 20% above rated engine speed and for manual reset, such that the automatic engine controller will continue to show an over speed signal until the device is manually reset to normal operating position (Vol.II, NFPA, 1978).

6.01.13 The governor shall be suitable for operation without external power supply.

6.01.14 **Fuel System**

The diesel engine will run on High Speed Diesel.

6.01.15 The engine shall be provided with fuel oil tank of 250 litres capacity. The fuel oil tank shall preferably be mounted near the engine. No fuel oil tank will be provided by the Employer.

6.01.16 The fuel oil tank shall be of welded steel constructed to relevant standards for mild steel drums. The outlet of the tank shall be above the inlet of fuel injection pump of the diesel engine to ensure adequate pressure at suction of injection pump.

6.01.17 The fuel oil tank shall be designed in such a way that the sludge and sediment settles down to the tank bottom and is not carried to the injection pump. A small sump shall be provided and fitted with drain plug to take out sludge/sediment and to drain oil. Adequate hand holes (greater than 80 mm size) shall be provided to facilitate maintenance.

6.01.18 Pipeline carrying fuel oil shall be gradually sloped from the tank to the injection pump. Any valve in the fuel feed pipe between the fuel tank and the engine shall be placed adjacent to the tank and it shall be



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locked in the open position. A filter shall be incorporated in this pipeline, in addition to other filters in the fuel oil system. Pipe joints shall not be soldered and plastic tubing shall not be used. Reinforced flexible pipes may also be used.

6.01.19 The complete fuel oil system shall be designed to avoid any air pocket in any part of the pipe work, fuel pump, sprayers/injectors, filter system etc. No air relief cock is permitted. However, where air relief is essential, plugs may be used.

6.01.20 A manual fuel pump shall be provided for priming and releasing of air from the fuel pipelines.

#### 6.01.21 **Lubricating Oil System**

Automatic pressure lubrication shall be provided by a pump driven by the crank shaft, taking suction from a sump and delivering pressurised oil through cooler and fine mesh filters to a main supply header fitted in the bed plate casing. High pressure oil shall be supplied to the main and big end bearings, cam-shaft bearings, cam-shaft chain and gear drives, governor, auxiliary drive gears etc. Valve gear shall be lubricated at reduced pressure through a reducing valve and the cams by an oil bath.

#### 6.01.22 **Cooling Water System**

Direct cooling or heat exchanger type cooling system shall be employed for the diesel engine. Water shall be tapped from the fire pump discharge. This water shall be led through duplex strainer, pressure breakdown orifice and then after passing through the engine, the water at the outlet shall be taken directly to the sump through an elevated funnel.

#### 6.02.00 **Testing & Inspection**

6.02.01 The manufacturer shall conduct all tests required, to ensure that the equipment furnished conforms to the requirement of this sub-section and in compliance with requirements of applicable codes. The particulars of the proposed tests and the procedure for the tests shall be submitted to the Employer for approval before conducting the tests.

6.02.02 At manufacturer's works, tests shall be carried out during and after completion of manufacture of different component/parts and the assembly as applicable. Following tests shall be conducted.

6.02.03 Material analysis and testing.

6.02.04 Hydrostatic pressure testing of all pressure parts.

6.02.05 Static and dynamic balance tests of rotating parts at applicable over-



speed and determination of vibration level.

- 6.02.06 MPI/DPT on machined parts of piston and cylinder.
- 6.02.07 Ultrasonic testing of crankshaft and connecting rod after heat treatment.
- 6.02.08 Dimensional check of close tolerance components like piston, cylinder bore etc.
- 6.02.09 Calibration tests of all fuel pumps, injectors, standard orifices, nozzles, instruments etc.
- 6.02.10 Over speed test of the assembly at 120% of rated speed.
- 6.02.11 Power run test.
- 6.02.12 Performance test of the diesel engine to determine its torque, power and specific fuel consumption as function of shaft speed. Performance test of the engine shall be carried for 12 hours out of which 1 hour at full load and one hour at 110% overload.
- 6.02.13 Measurement of vibration & noise.

(i) Measurement of vibration

The vibration shall be measured during full load test as well as during the overload test and limit shall be 100 microns.

(ii) Measurement of noise level

The equivalent 'A' weighted sound level measured at a distance of 1.5 M above floor level in elevation and 1.0 M horizontally from the base of the equipment, expressed in dB to a reference of 0.0002 microbar shall not exceed 93 dBA.

Above tests for vibration shall be repeated at site as pre-commissioning tests.

- 6.02.14 Adjustment of speed governor as per BS:5514.
- 6.02.15 Diesel engine shall be subjected to routine tests as per BS:5514.

**7.00.00 PIPING, VALVES AND SPECIALITIES**

This clause covers the design, manufacture, shop testing, erection, testing and commissioning of piping, valves and specialities.

**7.02.00 Scope**



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The piping system which shall include but not be limited to the following:

- 7.02.01 Plain run of piping, bends, elbows, tees, branches, laterals, crosses, reducing unions, couplings, caps, expansion joints, flanges, blank flanges, thrust blocks, anchors, hangers, supports, saddles, shoes, vibration dampeners, sampling connections, hume pipes etc.
- 7.02.02 Gaskets, ring joints, backing rings, jointing material etc. as required. Also all welding electrodes and welding consumables including special ones, if any.
- 7.02.03 Instrument tapping connections, stubs etc.
- 7.02.04 Gate and globe valves to start/stop and regulate flow and swing check valves for one directional flow.
- 7.02.05 Basket strainers and Y-type strainers
- 7.02.06 Bolts, nuts, fasteners as required for interconnecting piping, valves and fittings as well as for terminal points. For pipe connections into Owner's R.C.C. works, Bidder will furnish all inserts.
- 7.02.07 Painting, anti-corrosive coatings etc. of pipes and equipment.

Adequate number of air release valves shall be provided at the highest points in the piping system to vent any trapped air in the system.

7.03.00 **Design**

7.03.01 Material of construction of various pipes shall be as follows :

(a) **Buried Pipes**

Mild steel black pipes as per ASTM A53 medium grade suitably lagged on the outside to prevent soil corrosion, as specified elsewhere.

(b) **Overground Pipes normally full of water**

Mild steel black pipes as per ASTM A53 medium grade.

(c) **Overground pipes normally empty, but periodic charge of water and for detector line for HVW System.**

Mild steel galvanised pipes as per ASTM A53 medium grade.

7.03.02 All fittings to be used in connection with steel pipe lines upto a size of 80 mm shall be as per ASTM A53 Mild steel tubulars and other wrought



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steel pipe fittings, Heavy grade. Fittings with sizes above 80 mm upto 150 mm shall be fabricated from ASTM A53 Heavy grade pipes or steel plates having thickness not less than those of ASTM A53 Heavy grade pipes. Fittings with sizes above 150 mm shall be fabricated as per ASTM A53 standard. All fitting used in GI piping shall be threaded type. Welding shall not be permitted on GI piping.

- 7.03.03 Pipe sizes shall not be less than the sizes indicated in the attached drawings.
- 7.03.04 For steel pipeline, welded construction should be adopted unless specified otherwise.
- 7.03.06 All piping system shall be capable of withstanding the maximum pressure arising from any condition of operation and testing including water hammer effects.
- 7.03.09 Gate/sluice valve shall be used for isolation of flow in pipe lines and **construction** shall be as per BS 5150. Valves shall be of rising spindle type and of PN 1.6 class
- 7.03.10 Gate Valves shall be provided with the following :
- (a) Hand wheel.
  - (b) Position indicator.
  - (c) Locking facility (where necessary).
- 7.03.11 Gate valves shall be provided with back seating bush to facilitate gland removal during full open condition.
- 7.03.12 Globe valves shall be provided with contoured plug to facilitate regulation and control of flow. All other requirements should generally follow those of gate valve.
- 7.03.13 Non-return valves shall be swing check type. Valves will have a permanent "arrow" inscription on its body to indicate direction of flow of the fluid.
- 7.03.14 Whenever any valve is found to be so located that it cannot be approached manually from the nearest floor/gallery/platform hand wheel with floor stand or chain operator shall be provided for the same.
- 7.03.15 Valves below 50 mm size shall have screwed ends while those of 50 mm and higher sizes shall have flanged connections.
- 7.03.14 **Basket Strainer**
- a) Basket strainers shall be of 30mesh and have the following



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materials of construction :

Body: Fabricated mild steel (Tested Quality). Strainer Wires: stainless steel (AISI : 316), 30 SWG, suitably reinforced.

- b) Inside of basket body shall be protected by two (2) coats of heavy duty bitumastic paint.
- c) Strainers shall be Simplex design. Suitable vent and drain connections with valves shall be provided.
- d) Screen open area shall be at least 4 times pipe cross sectional area at inlet.
- e) Pressure drop across strainer in clean condition shall not exceed 1.5 MWC at 410M<sup>3</sup>/hr (for 765kV/400kV substations) and 1 MWC at 273M<sup>3</sup>/hr flow (for 220kV & 132kV substations). Pressure drop test report of strainer of same design shall be furnished.

#### 7.03.15 Y-type On-line Strainer

Body shall be constructed of mild steel (tested quality). Strainer wires shall be of stainless steel AISI:316, 30 SWG, 30 mesh.

Blowing arrangement shall be provided with removable plug at the outlet. Screen open area shall be atleast 4 times pipe cross-sectional area at inlet.

Pressure drop test report of strainer of same design shall be furnished.

#### 7.03.16 Hydrant Valve (Outdoor) and Indoor Hydrant Valves (Internal Landing Valves).

The general arrangement of outdoor stand post assembly, consisting of a column pipe and a hydrant valve with a quick coupling end shall be as per TAC requirement.

Materials of construction shall be as follows or superior :

- a) Column pipe M.S. ASTM A53 med. grade.
- b) Hydrant Valve
  - i) Body Stainless steel.
  - ii) Trim Leaded tin bronze.
  - iii) Hand Wheel Cast Iron.



- |                              |                   |
|------------------------------|-------------------|
| iv) Washer, gasket, etc.     | Rubber.           |
| v) Quick coupling connection | Leaded tin bronze |
| vi) Spring                   | Phosphor Bronze.  |
| vii) Cap and chain           | Leaded tin bronze |

The general design of hydrant valve shall conform to relevant latest international standards.

#### 7.03.17 **Hoses, Nozzles, Branch pipes and Hose boxes**

- (a) Hose pipes shall be of reinforced rubber-lined canvas construction with nominal size of 63 MM (2 1/2") and lengths of 15 metre or 7.5 metre, as indicated elsewhere.
- (b) Hosepipes shall be capable of withstanding an internal water pressure of not less than 35.7 kg/cm<sup>2</sup> without bursting. It must also withstand a working pressure of 8.5 kg/cm<sup>2</sup> without undue leakage or sweating.
- (c) Each hose shall be fitted with instantaneous spring lock type couplings at both ends. Hose shall be fixed to the coupling ends by copper rivets and the joint shall be reinforced by 1.5 mm galvanised mild steel wires and leather bands.
- (d) Branch pipes shall be constructed of copper and have rings of leaded tin bronze at both ends. One end of the branch pipe will receive the quick coupling while the nozzles will be fixed to the other end.
- (e) Nozzles shall be constructed of leaded tin bronze.
- (f) Suitable spanners of approved design shall be provided in adequate numbers for easy assembly and dismantling of various components like branch pipes, nozzles, quick coupling ends etc.
- (g) Hose pipes fitted with quick coupling ends, branch pipes, nozzles spanner etc. will be kept in a hose box, which will be located near point of use.
- (h) All instantaneous couplings, as mentioned under clause Nos.3.03.19, 3.03.20 and 3.03.21 above shall be of identical design (both male and female) so that any one can be interchanged with another. One male, female combination shall get locked in by mere pushing of the two halves together but will provide leak tightness at



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a pressure of 8 kg/cm<sup>2</sup> of water. Designs employing screwing or turning to have engagement shall not be accepted.

#### 7.04.00 **Fabrication & Erection**

7.04.01 The contractor shall fabricate all the pipe work strictly in accordance with the related approved drawings.

#### 7.04.02 **End Preparation**

- (a) For steel pipes, end preparation for butt welding shall be done by machining.
- (b) Socket weld end preparation shall be sawing/machining.
- (c) For tees, laterals, mitre bends, and other irregular details cutting templates shall be used for accurate cut.

#### 7.04.03 **Pipe Joints**

- (a) In general, pipes having sizes over 25 mm shall be joined by butt welding. Pipes having 25 mm size or less shall be joined by socket welding/screwed connections. Galvanised pipes of all sizes shall have screwed joints. No welding shall be permitted on GI pipes. Screwed joints shall have tapered threads and shall be assured of leak tightness without using any sealing compound.
- (b) Flanged joints shall be used for connections to vessels, equipment, flanged valves and also on suitable straight lengths of pipe line of strategic points to facilitate erection and subsequent maintenance work.

#### 7.04.04 **Overground Piping**

- (a) Piping to be laid overground shall be supported on pipe rack/supports. Rack/supports details shall have to be approved by Employer/Engineer.
- (b) Surface of overground pipes shall be thoroughly cleaned of mill scale, rust etc. by wire brushing. Thereafter one (1) coat of **red oxide primer** shall be applied. Finally two (2) coats of synthetic enamel paint of approved colour shall be applied.

#### 7.04.05 **Buried Pipe Lines**

- (a) Pipes to be buried underground shall be provided with protection against soil corrosion by coating and wrapping with two coats of coal tar hot enamel paint and two wraps of reinforced fibre glass tissue. The total thickness of coating and wrapping shall not be less than 3 mm. Alternatively corrosion resistant tapes can also be used



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for protection of pipes against corrosion.

- (b) For Coating and wrapping, holiday testing to be performed inline with latest ASTM standards.
- (c) Buried pipelines shall be laid with the top of pipe one meter below ground level.
- (d) At site, during erection, all coated and wrapped pipes shall be tested with an approved Holiday detector equipment with a positive signalling device to indicate any fault hole breaks or conductive particle in the protective coating.

#### 7.05.00 **General Instruction for Piping Design and Construction**

7.05.01 While erecting field run pipes, the contractor shall check, the accessibility of valves, instrument tapping points, and maintain minimum headroom requirement and other necessary clearance from the adjoining work areas.

7.05.02 Modification of prefabricated pipes, if any, shall have to be carried out by the contractor at no extra charge to the Employer.

#### 7.05.03 **Welding**

- (i) Welding shall be done by qualified welders only.
- (ii) Before welding, the ends shall be cleaned by wire brushing, filing or machine grinding. Each weld-run shall be cleaned of slag before the next run is deposited.
- (iii) Welding at any joint shall be completed uninterrupted. If this cannot be followed for some reason, the weld shall be insulated for slow and uniform cooling.
- (iv) Welding shall be done by manual oxyacetylene or manual shielded metal arc process. Automatic or semi-automatic welding processes may be done only with the specific approval of Employer/ Consultant.
- (v) As far as possible welding shall be carried out in flat position. If not possible, welding shall be done in a position as close to flat position as possible.
- (vi) No backing ring shall be used for circumferential butt welds.



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- (vii) Welding carried out in ambient temperature of 5°C or below shall be heat-treated.
- (viii) Tack welding for the alignment of pipe joints shall be done only by qualified welders. Since tack welds form part of final welding, they shall be executed carefully and shall be free from defects. Defective welds shall be removed prior to the welding of joints.

Electrodes size for tack welding shall be selected depending upon the root opening.

- (ix) Tacks should be equally spaced as follows :

for 65 NB and smaller pipes : 2 tacks

for 80 NB to 300 NB pipes : 4 tacks

for 350 NB and larger pipes : 6 tacks

- (x) Root run shall be made with respective electrodes/filler wires. The size of the electrodes/filler wires. The size of the electrodes shall not be greater than 3.25 mm (10 SWG) and should preferably be 2.3 mm (12 SWG). Welding shall be done with direct current values recommended by the electrode manufacturers.
- (xi) Upward technique shall be adopted for welding pipes in horizontally fixed position. For pipes with wall thickness less than 3 mm, oxyacetylene welding is recommended.
- (xii) The root run of butt joints shall be such as to achieve full penetration with the complete fusion of root edges. The weld projection shall not exceed 3 mm inside the pipe.
- (xiii) On completion of each run craters, weld irregularities, slag etc. shall be removed by grinding or chipping.
- (xiv) Fillet welds shall be made by shielded metal arc process regardless of thickness and class of piping. Electrode size shall not exceed 10 SWG. (3.25 mm). At least two runs shall be made on socket weld joints.

## 7.06.00 Tests at Works

### 7.06.01 Pipes

- (i) Mechanical and chemical tests shall be performed as required in the codes/standards.
- (ii) All pipes shall be subjected to hydrostatic tests as required in the codes/standards.



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- (iii) 10% spot Radiography test on welds of buried pipes shall be carried out as per ASME VIII.

#### 7.06.02 Valves

- (i) Mechanical and chemical tests shall be conducted on materials of the valve as required in the codes/standards.
- (ii) All valves shall be tested hydrostatically for the seat as well as required in the code/standards for a period of ten minutes.
- (iii) Air test shall be conducted to detect seat leakage.
- (iv) Visual check on the valve and simple operational test in which the valve will be operated thrice from full open to full close condition.
- (v) No repair work on CI valve body, bonnet or wedge shall be allowed.

#### 7.06.03 Strainers

- (i) Mechanical and chemical tests shall be conducted on materials of the strainer.
- (ii) Strainers shall be subjected to a hydrostatic test pressure of 1.5 times the design pressure or 10 kg/cm<sup>2</sup>g whichever is higher for a period of one hour.

#### 7.06.04 Hydrant valves and Indoor Hydrant Valves (Internal Landing Valves)

- (i) The stand post assembly along with the hydrant valve (valve being open and outlet closed) shall be pressure tested at a hydrostatic pressure of 21 kg/cm<sup>2</sup>g to detect any leakage through defects of casting.
- (ii) Flow test shall be conducted on the hydrant valves at a pressure of 7 kg/cm<sup>2</sup>g and the flow through the valve shall not be less than 900 litres/min.
- (iii) Leak tightness test of the valve seat shall be conducted at a hydrostatic test pressure of 14 kg/cm<sup>2</sup>g.

#### 7.06.05 Hoses, Nozzles, Branch Pipes and Hose Boxes

Reinforced rubber-lined canvas hoses shall be tested hydrostatically. Following tests shall be included as per relevant latest International standard.



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- a) Hydrostatic proof pressure test at 21.4 kgf/cm<sup>2</sup>
- b) Internal diameter

The branch pipe, coupling and nozzles shall be subjected to a hydrostatic test pressure of 21 kg/cm<sup>2</sup> for a period of 2<sup>1</sup>/<sub>2</sub> minutes and shall not show any sign of leakage or sweating.

Dimensional checks shall be made on the hose boxes and nozzle spanners.

#### 8.00.00 **AIR VESSELS**

8.01.00 Air vessels shall be designed and fabricated of mild steel as class-II vessels as per BS 5500 for a pressure of 14kg/cm<sup>2</sup> and shall be minimum 3 m<sup>3</sup> capacity.

8.02.00 Inside surface of the tank shall be protected by anti-corrosive paints/coatings/linings as required.

8.03.00 Outside surfaces of the vessels shall be provided with one (1) coat of red lead primer with two (2) coats of synthetic enamel paint of approved colour and characteristics.

#### 8.04.00 **Tests & Inspection**

8.04.01 Air vessels shall be hydraulically tested at 21kg/cm<sup>2</sup> for a period not less than one (1) hour.

8.04.02 All materials used for fabrication shall be of tested quality and test certificates shall be made available to the Owner.

8.04.03 Welding procedure and Welder's qualification tests will be carried out as per relevant International Standard.

8.04.04 NDE tests, which will include 100% Radiography on longitudinal seams and spot Radiography for circumferential seams, for pressure vessel will be carried out.

#### 9.00.00 **HEAT DETECTORS/FIRE DETECTORS AND SPRAY NOZZLES**

##### 9.00.01 **Intent of Specification**

This specification lays down the requirements of the smoke detectors, heat detectors and spray nozzles for use in various sub-systems of the fire protection system.

##### 9.00.02 **Codes and Standards**



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All equipment supplied shall conform to internationally accepted codes and standards.

**9.01.00 Heat Detectors, Quartzoid bulb type. (Used in HVW spray system)**

- a) Heat detectors shall be of any approved and tested type. Fusible chemical pellet type heat detectors are however not acceptable.
- b) Temperature rating of the heat detector shall be selected by the Bidder taking into consideration the environment in which the detectors shall operate. Minimum set point shall, however, be 79°C.
- c) Heat detectors shall be guaranteed to function properly without any maintenance work for a period of not less than twenty five (25) years.
- d) The heat detectors shall be mounted on a pipe network charged with water at suitable pressure. On receipt of heat from fire, the heat detector will release the water pressure from the network. This drop in water pressure will actuate the Deluge valve.

**9.02.00 HVW Spray Nozzles (Projectors)**

High velocity water spray system shall be designed and installed to discharge water in the form of a conical spray consisting of droplets of water travelling at high velocity which shall strike the burning surface with sufficient impact to ensure the formation of an emulsion. At the same time the spray shall efficiently cut off oxygen supply and provide sufficient cooling. Integral non-ferrous strainers shall be provided in the projectors ahead of the orifice to arrest higher size particle, which are not allowed to pass through the projectors.

**9.03.00 Fire Detectors (Used in fire detection and alarm system)**

- 9.03.01 Fire detectors shall be approved by FOC-London or similar international authorities.
- 9.03.02 Both smoke and heat type fire detectors shall be used. Bidder shall clearly indicate the mode of operation of detectors in his proposal.
- 9.03.03 The set point shall be selected after giving due consideration for ventilating air velocity and cable insulation.
- 9.03.04 Fire detectors shall be equipped with an integral L.E.D. so that it shall be possible to know which of the detectors has been operated. The detectors, which are to be placed in the space above the false ceiling or in the floor void shall not have the response indicators on the body but shall be provided with remote response indicators.



9.03.05 Approval from competent authority shall be made available for ionisation type smoke detectors. All required accessories shall also be included in the scope of supply.

9.03.06 Fire detectors shall be guaranteed to function properly without any maintenance work for a period of not less than ten (10) years.

**10.00.00 PORTABLE AND WHEEL/ TROLLEY MOUNTED FIRE EXTINGUISHERS**

10.00.01 This specification lays down the requirement regarding fire extinguishers of following types :

Portable fire extinguishers.

- a) Pressurised water type.
- b) Dry chemical powder type
- c) Carbon Dioxide type

Wheel/ Trolley mounted fire extinguishers.

- a) Mechanical foam type

10.00.02 All the extinguishers offered by the Bidder shall be of reputed make.

**10.01.00 Design and Construction**

10.01.01 All the portable extinguishers shall be of freestanding type and shall be capable of discharging freely and completely in upright position.

10.01.02 Each extinguisher shall have the instructions for operating the extinguishers on its body itself.

10.01.03 All extinguishers shall be supplied with initial charge and accessories as required.

10.01.04 Portable type extinguishers shall be provided with suitable clamps for mounting on walls or columns.

10.01.05 All extinguishers shall be painted with durable enamel paint of fire red colour conforming to relevant International Standards.

10.01.06 Pressurisation of water type fire extinguishers shall either be done by compressed air or by using gas cartridge. Both constant air pressure and the gas pressure type shall conform to their latest relevant



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International standards.

10.01.07 Dry chemical powder type portable extinguisher shall conform to its latest relevant International standards.

10.01.08 Carbon Dioxide type portable extinguisher and Carbon Dioxide type trolley mounted extinguisher shall conform to their latest relevant International standards.

10.01.09 Wheel/ trolley mounted fire extinguishers of 50 litre capacity Mechanical foam type shall conform to its **latest relevant International standards**.

#### 10.02.00 **Tests and Inspection**

10.02.01 A performance demonstration test at site of five (5) percent or one (1) number whichever is higher, of the extinguishers shall be carried out by the Contractor. All consumable and replaceable items require for this test would be supplied by the Contractor without any extra cost to Employer.

10.02.02 Performance testing of extinguisher shall be in line of applicable International Standards. In case where no International Standard is applicable for a particular type of extinguisher, the method of testing shall be mutually discussed and agreed to before placement of order for the extinguishers.

#### 10.03.00 **Painting**

Each fire extinguisher shall be painted with durable enamel paint of fire red colour conforming to relevant International Standards.

#### 11.00.00 **INSTRUMENTS**

##### 11.00.01 **Intent of Specification**

The requirements given in the sub-section shall be applicable to all the instruments being furnished under this specification.

11.00.02 All field mounted instruments shall be weather and dust tight, suitable for use under ambient conditions prevalent in the subject plant. All field mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance can be achieved.

##### 11.01.00 **Local Instruments**

Pressure/ Differential Gauges & Switches.



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- 11.01.01 The pressure sensing elements shall be continuous 'C' bourdon type.
- 11.01.02 The sensing elements for all gauges/switches shall be properly aged and factory tested to remove all residual stresses. They shall be able to withstand atleast twice the full scale pressure/vacuum without any damage or permanent deformation.
- 11.01.03 For all instruments, connection between the pressure sensing element and socket shall be braced or hard soldered.
- 11.01.04 Gauges shall be of 150 mm diameter dial with die-cast aluminium, stoved enamel black finish case, aluminium screwed ring and clear plastic crystal cover glass. Upper range pointer limit stop for all gauges shall be provided.
- 11.01.05 All gauges shall be with stainless steel bourdon having rotary geared stainless steel movements.
- 11.01.06 Weatherproof type construction shall be provided for all gauges. This type of construction shall be fully dust tight, drip tight, weather resistant and splash proof with anti-corrosive painting conforming to NEMA- 4.
- 11.01.07 All gauges shall have micrometer type zero adjuster.
- 11.01.08 Neoprene safety diaphragm shall be provided on the back of the instruments casing for pressure gauges of ranges 0-10 Kg/cm<sup>2</sup> and above.
- 11.01.09 Scales shall be concentric, white with black lettering and shall be in metric units.
- 11.01.10 Accuracy shall be  $\pm 1.0$  percent of full range or better.
- 11.01.11 Scale range shall be selected so that normal process pressure is approximately 75 percent of full scale reading. For pressure gauges and pressure switches, the range shall not be less than 0 -16 Kg/cm<sup>2</sup>
- 11.01.12 All gauges shall have 1/2 inch NPT bottom connection.
- 11.01.13 All instruments shall conform to their **latest relevant International standards.**
- 11.01.14 All instruments shall be provided with 3 way gauge isolation valve or cock. Union nut, nipple and tail pipe shall be provided wherever required.
- 11.01.15 Switch element contact shall have two (2) NO and two (2) NC contacts rated for 240 Volts, 10 Amperes A.C. or 220 Volts, 5 Amperes D.C. Actuation set point shall be adjustable throughout the range. ON-OFF



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differential (difference between switch actuation and de-actuation pressures) shall be adjustable. Adjustable range shall be suitable for switch application.

11.01.16 Switches shall be sealed diaphragm, piston actuated type with snap action switch element. Diaphragm shall be of 316 SS.

11.01.18 Necessary accessories shall be furnished.

#### 11.02.00 **Timers**

11.02.01 The timers shall be electro-mechanical type with adjustable delay on pick-up or reset as required.

11.02.02 Each timer shall have two pairs of contacts in required combination of NO and NC.

#### 11.03.00 **Level Gauges/Indicator/Switches**

##### 11.03.01 **Level Gauges**

- i) Gauge glasses shall be used for local level indication wherever shown in the flow diagram.
- ii) Gauge glasses, in general, shall be flag glass type with bolted cover. Body and cover material shall be of carbon steel with rubber lining.
- iii) Level coverage shall be in accordance with operating requirements. Maximum length of a single gauge glass shall not exceed 1.4 M. Should a larger gauge glass be required, multiple gauges of preferably equal length shall be used with 50 mm overlap in visibility.
- iv) Reflex type gauge glasses shall be used for colourless liquids and transparent type gauge glasses shall be used for all liquids having colour.
- v) Each gauge glass shall be complete with a pair of offset valves. Valves shall have union bonnet, female union level connection, flanged tank connection, and vent and drain plug.
- vi) Offset valves shall have corrosion resistant ball-check to prevent fluid loss in the event of gauge glass breakage. Valve body shall have a working pressure of 200 percent of the maximum static pressure at the maximum process fluid temperature. Valve body materials shall be of carbon steel with rubber lining.

##### 11.03.02 **Level Indicators**



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- i) Float type mechanical level gauges with linear scale type indicator shall be offered for measuring level of tanks wherever shown in the flow diagram.
- ii) AISI-316 stainless steel float, guide rope and tape shall be used. Housing shall be of mild steel painted with anti-corrosive painting.
- iii) The scale indicator shall be provided at a suitable height for ease of reading.
- iv) Accuracy shall be + 1% of scale range or better.

#### 11.03.03 **Level Switches**

- i) Level switches shall be of ball float operated magnetic type complete with cage.
- ii) Materials of construction shall be suitable for process and ambient conditions. The float material shall be AISI-316 stainless steel.
- iii) Actuating switches shall be either hermetically sealed mercury type or snap acting micro-switches. Actuation set point shall be adjustable. ON-OFF differential (difference between switch actuation and de-actuation levels) shall be adjustable. Adjustable range shall be suitable for switch application. All switches shall be repeatable within + 1.0 percent of liquid level change required to activate switch. Contacts shall be rated for 50 watts resistive at 240 V A.C. Number of contacts shall be two NO and two NC for each level switch.

#### 11.04.00 **Solenoid Valves**

11.04.01 The body of the valves shall be Forged brass or stainless steel.

11.04.02 The coil shall be continuous duty, epoxy moulded type Class-F, suitable for high temperature operation.

11.04.03 The enclosure shall be watertight, dust-tight and shall conform to NEMA-4 Standard.

11.04.04 The valves shall be suitable for mounting in any position.

#### 11.05.00 **Switches, Lamps, Meters Etc.**

All electrical components on the panel namely push buttons, switches, lamps, meters etc. shall meet the requirements of sub-section Electrical enclosed with the specification.

11.06.00 All local instruments shall be inspected by Employer/Consultant as per



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the agreed quality plan.

11.07.00 Makes of control panel and local instruments, accessories shall be as per Employer's approval.

## 12.00.00 **ELECTRIC MOTORS**

### 12.01.00 **General**

12.01.01 This clause covers the requirements of three phase squirrel cage induction motors and single-phase induction motors.

12.01.02 The motors to be furnished, erected and commissioned as covered under this specification shall be engineered, designed, manufactured, erected, tested as per the requirements specified herein. These requirements shall however be read along with the requirements of the respective driven equipment being supplied under the specification of which this specification forms a part.

12.01.03 The motor supplied under this specification shall conform to the standards specified in GTR.

12.01.04 Terminal point for all motors supplied under this specification shall be at the respective terminal boxes.

12.01.05 Materials and components not specifically stated in this specification but are necessary for satisfactory operation of the motor shall be deemed to be included in the scope of supply of this specification.

12.01.06 Notwithstanding anything stated in this motor specification, the motor has to satisfy the requirement of the mechanical system during normal and abnormal conditions. For this the motor manufacturer has to co-ordinate with the mechanical equipment supplier and shall ensure that the motor being offered meets the requirements.

### 12.02.00 **Codes & Standards**

12.02.21 The design, manufacture, installation and performance of motors shall conform to the provisions of latest Electricity Act and Electricity Rules. Nothing in these specifications shall be construed to relieve the Contractor of his responsibility.

12.02.22 In case of contradiction between this specifications and IEC, the stipulations of this specification shall be treated as applicable.

12.02.23 National Electrical code for hazardous location and relevant NEMA standard shall also be applicable for motors located in hazardous location.

### 12.03.00 **Design Features**



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### 12.03.01 Rating and type

- (i) The induction motors shall be of squirrel cage type unless specified otherwise.
- (ii) The motors shall be suitable for continuous duty in the specified ambient temperature.
- (iii) The MCR KW rating of the motors for 50°C ambient shall not be less than the power requirement imposed at the motor shaft by the driven equipment under the most onerous operation conditions as defined elsewhere, when the supply frequency is 51.5 Hz (and the motor is running at 103% of its rated speed).
- (iv) Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously in the system having the following particulars :
  - a) Rated terminal voltage
    - From 0.2 to 200 KW      400V (3 Phase, solidly earthed)
    - Below 0.2 KW            230 V (1 Phase, solidly earthed)Variation in voltage  $\pm 6\%$ .
  - b) Frequency      50 Hz  $\pm 3\%$ .
  - c) Any combination of (a) & (b)

### 12.03.02 Enclosure

Motors to be installed outdoor and semi-outdoor shall have hose proof enclosure equivalent to IP-55. For motors to be installed indoor, the enclosure shall be dust proof equivalent to IP-54.

### 12.03.03 Cooling method

Motors shall be TEFC (totally enclosed fan cooled) type.

### 12.03.04 Starting requirements

- (i) **Induction motor**
  - a) All induction motors shall be suitable for full voltage direct on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without



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exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.

- b) Motors shall be capable of withstanding the electro-dynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
- c) The starting current of the motor at rated voltage shall not exceed six (6) times the rated full load current subject to tolerance as given in IEC 60034.
- d) Motors when started with the driven equipment imposing full starting torque under the supply voltage condition specified under Clause 12.03.01 (iv) (a) shall be capable of withstanding at least two successive starts with coasting to rest between starts and motor initially at the rated load operating temperature. The motors shall also be suitable for three equally spread starts per hour, the motor initially at a temperature not exceeding the rated operating temperature.
- e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than the starting time with the driven equipment at minimum permissible voltage (clause 12.03.04 (i) (a) by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speeds lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

#### 12.03.05 Running requirements

- (i) When the motors are operating at extreme condition of voltage and frequency given under clause no.12.03.01 (iv) the maximum permissible temperature rise over the ambient temperature of 50°C shall be within the limits specified in IEC 60034 after adjustment due to increase ambient temperature specified herein.
- (ii) The double amplitude of motor vibration shall be within the limits specified in IEC/International standards. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.
- (iii) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.
- (iv) Induction motors shall be so designed as to be capable of withstanding the voltage and torque stresses developed due to the



difference between the motor residual voltage and incoming supply voltage during fast changeover of buses. The necessary feature incorporated in the design to comply with this requirement shall be clearly indicated in the proposal.

- (v) Motors shall be capable of developing the rated full load torque even when the supply voltage drops to 70% of rated voltage. Such operation is envisaged for a period of one second. The pull out torque of the induction motors to meet this requirement shall not be less than 205% of full load torque.
- (vi) The motors shall be capable of withstanding for 10 seconds without stalling or abrupt change in speed (under gradual increase of torque) an excess torque of 60 percent of their rated torque, the voltage and frequency being maintained at their rated value.
- (vii) Guaranteed performance of the motors shall be met with tolerances specified in respective standards.

#### 12.04.00 **Construction Features**

##### 12.04.01 **Stator**

###### (i) **Stator frame**

The stator frames and all external parts of the motors shall be rigid fabricated steel or of casting. They shall be suitably annealed to eliminate any residual stresses introduced during the process of fabrication and machining.

###### (ii) **Stator core**

The stator laminations shall be made from suitable grade magnetic sheet steel varnished on both sides. They shall be pressed and clamped adequately to reduce the core and teeth vibration to minimum.

###### (iii) **Insulation and winding**

All insulated winding conductor shall be of copper. The overall motor winding insulation for all 400 volts motors shall be of epoxy thermosetting type i.e., class 'F' but limited to class-B operating from temperature rise consideration. Other motors may be of conventional class-B type. The windings shall be suitable for successful operation in hot, humid, tropical climate with the ambient temperature of 50°C.

##### 12.04.02 **Rotor**

- (i) Rotors shall be so designed as to keep the combined critical speed with the driven equipment away from the running speed by atleast 20%.



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- (ii) Rotors shall also be designed to withstand 120% of the rated speed for 2 minutes in either direction of rotation.

#### 12.04.03 Terminal box leads

- (i) For motors of 400 Volts and below a single terminal box may be provided for power and accessories leads.
- (ii) Terminal boxes shall be of weatherproof construction designed for outdoor service. To eliminate entry of dust and water, gaskets of neoprene or approved equivalent shall be provided at cover joints and between box and motor frame.
- (iii) Terminal box shall be suitable for top and bottom entry of cables.
- (iv) Unless otherwise approved, the terminal box shall be capable of being turned through 360° in steps in 90°.
- (v) The terminals shall be complete with all accessories for connecting external cables. They shall be designed for the current carrying capacity and shall ensure ample phase to phase to ground clearances.
- (vi) Suitable tinned brass compression type cable glands and cable lugs shall be supplied by the Contractor to match Employer's cable.
- (vii) Terminal box for single core cable shall be of non- magnetic material.
- (viii) Marking of all terminals shall be in accordance with IEC / International standard..

#### 12.04.04 Rating Plates

- (i) Rating plates shall be provided for all motors giving the details as called for in IEC 60034 (for three phase squirrel cage induction motors).
- (ii) In addition to above, the rating plate shall indicate the following :
  - a) Temperature rise in °C under normal working conditions.
  - b) Phase sequence corresponding to the direction of rotation for the application.
  - c) Bearing identification number (in case of ball/ roller bearing) and recommended lubricants.



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#### 12.04.05 **Other Constructional Features**

- (i) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of Employer's earthing conductor to be specified to the successful Bidder.
- (ii) Motor weighing more than 25 kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

#### 12.05.00 **Paint and Finish**

12.05.01 Motor external parts shall be finished and painted to produce a neat and durable surface, which would prevent rusting and corrosion. The equipment shall be thoroughly degreased, all sharp edges and scales removed and treated with one coat of primer and two coats of grey enamel paint.

12.05.02 Motor fans shall also be painted to withstand corrosion.

12.05.03 All fasteners used in the construction of the equipment shall be either of corrosion resistant material or heavy cadmium plated.

12.05.04 Current carrying fasteners shall be either of stainless steel or high tensile brass.

#### 12.06.00 **Tests at Manufacturers Works**

12.06.01 Motors shall be subject to routine tests in accordance with IEC 60034.

12.06.02 In addition, the following tests shall also be carried out :

- a) 20% over speed test for 2 minutes on all rotors.
- b) Measurement of vibration.
- c) Measurement of noise level.
- d) Phase sequence and polarity checks relative to mechanical rotation.

#### 12.06.03 **Tests after installation at site**

- (i) After installation and commissioning at site, the motors alongwith the driven equipment shall be subject to tests to ascertain their conformity with the requirement of this specification and those of the driven equipment specification and the performance data quoted by the Bidder.



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- (ii) In case of non-conformity of the motor with these specifications and performance requirement, the Engineer may at his discretion reject or ask for necessary rectification/replacement as detailed in general Terms and Conditions of Contract (GCC) Volume-I.

### 13.00.00 **BATTERY & BATTERY CHARGERS**

This clause covers the design, performance, manufacturing, construction features and testing of Battery and Battery charger used primarily for starting the diesel engine driving the fire water pumps. Battery Chargers shall be housed in Diesel Engine Panel.

#### 13.01.00 **General Information**

13.01.01 The equipment specified hereinafter are required for starting the diesel engines and other operation of the plant as required.

13.01.02 For each diesel engine there shall be two (2) sets of Battery and two (2) sets of Battery Charger.

13.01.03 The D.C. voltage shall be obtained normally after necessary rectification by battery charger. The Battery Charging system shall be capable of meeting the following requirements :

13.01.04 Float charging the Battery.

13.01.05 Boost Charging the Battery.

13.01.06 The battery shall be large enough to crank the engine **3** times without charging in between and without getting drained to an extent which will affect its life.

13.01.07 The Bidder shall indicate the battery voltage and battery capacity in Ampere- Hour at ten (10) hour discharge rate. The battery voltage at any time during operation shall not be less than the minimum voltage required for operation of the D.C. loads.

#### 13.02.00 **General Design**

The Battery shall be located indoor

##### 13.02.01 **Battery**

- (i) The cells shall be lead-acid type. The Battery shall be automotive type.
- (ii) The cells shall be sealed in type with anti-splash type vent plug.
- (iii) The cell terminal posts shall be provided with connector bolts and



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nuts, effectively coated with lead to prevent corrosion. Lead or lead coated copper connectors shall be furnished to connect up cells of battery set.

- (iv) Positive and Negative terminal posts shall be clearly and indelibly marked for easy identification.
- (v) The electrolyte shall be of battery grade Sulphuric Acid. Water for storage batteries conforming to relevant standards shall be used in the preparation of the electrolyte.

### 13.02.02 **Battery Charger**

- (i) The Bidder shall furnish the battery charging scheme complete with all necessary accessories such as transformers, switches, fuses, starters, contactors, diodes, ammeters, voltmeters and other devices as required for trouble free operation. All devices and equipment shall conform to relevant International Standard or shall be Superior to it.
- (ii) The scheme of the battery charger shall be such that the battery can be charged automatically as well as manually.
- (iii) The boost charger shall have sufficient capacity to restore a fully discharged Battery to a state of full charge in eight (8) hours with some spare margin over maximum charging rate. Suitable provision shall be kept so that, for a particular engine, any of the two (2) charger units can be used for charging any of the two (2) batteries.
- (iv) The instruments, switches and lamps shall be flush/semi-flush mounted on the front panel. Name plate of approved type shall be provided for each of these equipment.
- (v) The panel shall be complete with internal wiring and input-output terminal block. Terminal blocks shall be clip on type of suitable rating. All equipment and wire terminals shall be identified by symbols corresponding to applicable schematic/wiring diagram.
- (vi) Space heaters of adequate capacity shall be provided to prevent moisture condensation in the panel.

### 13.03.00 **Testing**

13.03.01 The Battery Charger shall also be subjected to the following tests at manufacturer's works as per IEC 60146.

13.03.02 Insulation test.

13.03.03 Connection checking.



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- 13.03.04 Measurement of voltage regulation.
- 13.03.05 Auxiliary of devices.
- 13.03.06 Alternating current measurement.
- 13.03.07 Performance test.
- 13.03.08 Temperature rise test.
- 13.03.09 Following acceptance tests shall be carried out in batteries as per IEC/International standard.
- a) Marking and packing
  - b) Verification of dimensions
  - c) Test for capacity
  - d) Test for voltage during discharge

Battery and battery charger shall be checked for auto charging and providing sufficient power for three consecutive starting kicks to diesel engine within five minutes with A.C. supply switched off.

## 14.00.00 **CONTROL & ANNUNCIATION PANELS**

### 14.01.00 **Intent of Specification**

The following requirement shall be applicable to the control and annunciation panels furnished under these specifications.

### 14.02.00 **General Information**

- 14.02.01 The equipment specified herein are required for controlling, metering, monitoring and indication of electrical systems of the plant offered.
- 14.02.02 The selection and design of all the equipment shall be so as to ensure reliable and safe operation of the plant and shall be subjected to approval by the Employer.
- 14.02.03 The reference ambient temperature outside the panel shall be taken as 50°C and relative humidity 100%.

### 14.03.00 **Equipment to be Furnished**



Control & annunciation panels shall be furnished complete with all accessories and wiring for safe and trouble free operation of the plant. Details are included in sub-section General.

#### 14.04.00 **Constructional Details**

- 14.04.01 The panel frames shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.5 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary.
- 14.04.02 Panels shall be of free standing type and shall be provided with hinged door with locking arrangement. The access doors, cutest and covers shall be equipped with neoprene/synthetic rubber gaskets (conforming to IEC 60149) all around and the latches sufficiently strong to hold them in alignment when closed. The panels to be installed outdoor or semi outdoor shall have a degree of protection of IP:55 and those installed indoor shall have a degree of protection of IP:52 as per IEC 60947.
- 14.04.03 If a panel consists of a number of panels, each panel should be mounted side by side and bolted together to form a compact unit, when two panels meet, the joints shall be smooth, close fittings and un-obstructive.
- 14.04.04 Removable eye bolt or lifting lugs shall be provided on all panels to facilitate easy lifting.
- 14.04.05 The heights of all operating equipment on the panel shall be between 800 mm to 1600 mm from the finished floor level. The proper supporting arrangement shall be provided by the Contractor.
- 14.04.06 Cable entries to the panel may be from bottom or top. The cable entry required will be intimated to the successful Bidder. A suitable removable gland plate of 3 mm thick shall be mounted not less than 200 mm above the floor level.
- 14.04.07 All equipment mounted on the front face of the panels shall be flush or semi-flush type. All equipment shall be so located that their terminal and adjustment are readily accessible for inspection or maintenance and their removal and replacement can be done without interruption of service to other equipment. The contractor shall submit the panel general arrangement drawings clearly bringing out internal mounting details, dimensions of equipment, clearance between the equipment and the edges of the panel, for approval.

#### 14.05.00 **Name Plates and Labels**

- 14.05.01 Each panel shall be provided with prominent, engraved identification plates for all front mounted equipment. Panel identification name plate



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shall be provided at front and rear as required.

14.05.02 All name plates shall be of non-rusting metal or 3 ply lamicold, with white engraved lettering on black background. Inscription and lettering sizes shall be subjected to Employer's approval.

14.05.03 Suitable plastic sticker labels shall be provided for easy identification of all equipment located inside the panel. These labels shall be positioned so as to be clearly visible and shall give the device number, as mentioned in the wiring drawings.

#### 14.06.00 **AC/DC Power Supply**

14.06.02 The Employer will provide one feeder each for AC and DC to the panel. The Contractor shall make for his own arrangements for providing these power supplies to different panels.

14.06.02 The Contractor shall provide suitable isolating switch fuse unit in the control panel for receiving the above incoming AC and DC supplies. Fuse and link shall be provided for isolating of individual circuit without disturbing other circuits.

#### 14.07.00 **Wiring**

14.07.01 All inter panel wiring and connections between panels (if there is group of panels) including all bus wiring for AC & DC supplies shall be provided by the Contractor.

14.07.02 All internal wiring shall be carried out with 1100 V grade, single core, 1.5 square mm or larger stranded copper wires having colour-coded PVC insulation. CT circuits shall be wired with 2.5 square mm copper wires, otherwise similar to the above.

14.07.03 Extra-flexible wire shall be used for wiring to devices mounted on moving parts such as doors.

14.07.04 Spare contacts of auxiliary relays, timers and switches shall be wired out to the terminal blocks as required by the Employer/Engineer at the time of detailed engineering.

#### 14.08.00 **Terminal Blocks**

14.08.01 Terminal Blocks shall be of 650V grade, rated for 10 Amps and in one-piece moulding. It shall be complete with insulating barriers, clip-on-type terminals, and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring diagrams. It shall be similar to 'Elmex-Standard' type terminals.

14.08.02 Terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal block.



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14.08.03 The terminal blocks shall have at least 20% spare terminals.

**14.09.00 Grounding**

A continuous copper bus 25 x 3 mm size shall be provided along the bottom of the panel structure. It shall run continuously throughout the length of the panel and shall have provision at both ends for connection to the station grounding grid (25 x 6 mm MS Flat).

**14.10.00 Space Heater and Lighting**

14.10.01 Space heaters shall be provided in the panels for preventing harmful moisture condensation.

14.10.02 The space heaters shall be suitable for continuous operation on 230V AC, 50 Hz, single phase supply and shall be automatically controlled by thermostat. Necessary isolating switches and fuses shall also be provided.

14.10.03 Free standing panel shall have a 230V AC, plug point and a fluorescent light operated by door switch.

**14.11.00 Control and Selector Switches**

14.11.01 Control and selector switches shall be of rotary type, with escutcheon plates clearly marked to show the function and positions.

14.11.02 Control/selector switches shall be spring return or stay put type as per the requirements. Handles of control/selector switches shall be black in colour. Shape and type of handles shall be to the approval of the Employer.

14.11.03 The contact ratings shall be at least the following :

- i) Make and carry continuously 10 Amp.
- ii) Breaking current at 240V DC 1Amp. (Inductive)
- iii) Breaking current at 240V DC 5 Amp. at 0.3 p.f. lagging

**14.12.00 Push Buttons**

14.12.01 Push buttons shall be spring return, push to actuate type and rated to continuously carry and break 10A at 230V AC and 0.5A (Inductive) at 220V DC. The push buttons shall have at least 1 NO and 1 NC contact. All contact faces shall be of silver or silver alloy.

14.12.02 All push buttons shall be provided with integral escutcheon plates



marked with its function.

14.12.03 The colour of buttons shall be as follows :

Green For motor START, Breaker CLOSE, Valve/ damper OPEN.

Red For motor TRIP, Breaker OPEN, Valve/ damper CLOSE.

Black For all annunciation functions, overload reset and miscellaneous.

14.12.04 Red push buttons shall always be located to the left of green push buttons. In case of clinker grinder etc. the push buttons would be black-red-green from left to right.

#### 14.13.00 **Indicating Lamps**

14.13.01 Indicating lamps shall be of the panel mounting, filament type and of low-watt consumption. Lamps shall be provided with series resistors preferably built-in- the lamps assembly. The lamps shall have escutcheon plates marked with its function, wherever necessary.

14.13.02 Lamp shall have translucent lamp covers of the following colours :

Red for motor OFF, Valve/damper OPEN, Breaker CLOSED.

Green for motor ON, Valve/damper CLOSED, Breaker OPEN.

White for motor AUTO-TRIP.

Blue for all healthy conditions (e.g. control supply, lub oil pressure and also for spring charged).

Amber for all ALARM conditions (e.g. pressure low, over load and also for 'service' and 'Test' position indication).

14.13.03 Bulbs and lamps covers shall be easily replaceable from the front of the panel.

14.13.04 Indicating lamps should be located directly above the associated push button/control switches. Red lamps shall variably be located to the right of the green lamp. In case a white lamp is also provided, it shall be placed between the red and green lamps. Blue and amber lamps should normally be located above the red and green lamps.

#### 14.14.00 **Fuses**

14.14.01 All fuses shall be of HRC cartridge plug-in-type and shall be of suitable rating, depending upon circuit requirements.



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14.14.02 All fuses shall be mounted on fuse carriers, which shall be mounted on fuse-bases.

#### 14.15.00 **Contactors**

14.15.01 Contactors shall be of air break, electromagnetic type rated as per requirement.

14.15.02 Operating coils of AC contactors shall be of 230V AC or 220V DC as required. AC contactors shall operate satisfactorily between 85% to 110% of the rated voltage. The Contactor shall not drop out at 70% of the rated voltage.

14.15.03 DC contactors shall have a coil voltage of 220V DC and shall be suitable for satisfactory continuous operation at 80% to 110% of the rated voltage.

#### 14.16.00 **Relays and Timers**

14.16.01 All auxiliary relays & timers shall be of proven design and of reputed make. Contacts of relays and timers shall be of solid silver or silver cadmium oxide or solid silver faced. Timers shall have the provision to adjust the delay on pick-up or reset as required.

14.16.02 All relays and timers shall have at least two NO and two NC contacts.

14.16.03 All relays and timers shall be suitable for 230V AC and 220V DC as required. DC relays shall operate satisfactorily between 70% to 110% and AC relays shall be suitable for voltage variation between 80% to 110%.

#### 14.17.00 **Indication Instruments**

14.17.01 All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96 mm square size with 90 degree scales and shall have an accuracy class of 2.0 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.

14.17.02 All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for zero adjustment removing or dismantling the instruments.

14.17.03 All instruments shall have white dials with black numerals and lettering. Black knife edge pointer with parallax free dials will be preferred.

14.17.04 Ammeters provided on motor feeders shall have a compressed scale at the upper current region to cover the starting current.



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## 14.18.00 **Annunciation System**

- 14.18.01 The annunciation system shall be complete with all necessary relays, flashers and other accessories required for the proper operation of the equipment and shall be completely solid state. The control circuit shall be mounted on plug-in type glass epoxy printed circuit boards. Audible alarms for the system shall be mounted inside the panel. One set of acknowledge, test and reset push buttons shall be mounted on the panel.
- 14.18.02 Indications shall be engraved on Acrylic inscription plate window and shall be visible clearly when the indication lamp is lighted (black letters on white background). Each window shall be provided with two lamps.
- 14.18.03 Audible hooter shall sound when a trouble contact operates and shall continue to sound until the acknowledge button is pressed. In addition to the hooters provided on annunciation panels, a hooter shall be provided outside FFPH which shall sound in any fire alarm condition.
- 14.18.04 Indication lamps shall flash when trouble contact operates and shall continue flashing until acknowledge button is pressed.
- 14.18.05 After acknowledge button is pressed, the hooter and flashing shall stop but the indication lamp shall remain lighted.
- 14.18.06 After trouble is cleared indication lamps shall be ready and shall go off only when reset.
- 14.18.07 Silencing the hooter in conjunction with one trouble contact shall not stop and hooter sounding if another trouble contact operates.
- 14.18.08 When test button is pressed, all lamps shall flash and hooter shall sound.
- 14.18.09 Annunciator systems shall operate on 220V DC Systems.
- 14.18.10 The annunciation system shall include alarm for AC control system failure (working on DC supply), DC supply failure (working on AC supply) and test facilities for these alarms.
- 14.18.11 List of annunciations required on the panels has been listed elsewhere. The Contractor shall also provide additional annunciations if desired by the Employer/Engineer during Vendor drawing review stage and for such additional annunciations no extra charges shall be claimed by the Contractor, if the number of such additions are within 10% of the number stipulated in this specification.
- 14.18.12 20% spare windows shall be provided on the panel.



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## 14.19.00 **Painting**

14.19.01 **Painting procedure adopted shall conform to requirements given in GTR.** The paint thickness shall not be less than **60** microns. Finished parts shall be coated by peelable compound by spraying method to protect the finished surface from scratches, grease, dirt and oily spots during testing, transportation handling and erection.

## 14.20.00 **Tests**

14.20.01 Following tests/inspection shall be carried out by the Contractor in the presence of Employer's representative :

### (A) Factory Tests

1. Compliance with approved drawings, data and specification.
2. Visual check for workmanship.
3. Wiring continuity and functional checks.
4. Calibration of instruments, relays and metres wherever required by inspector.
5. HV test
6. Insulation resistance measurement before and after HV test.

### (B) Inspection/Testing at site :

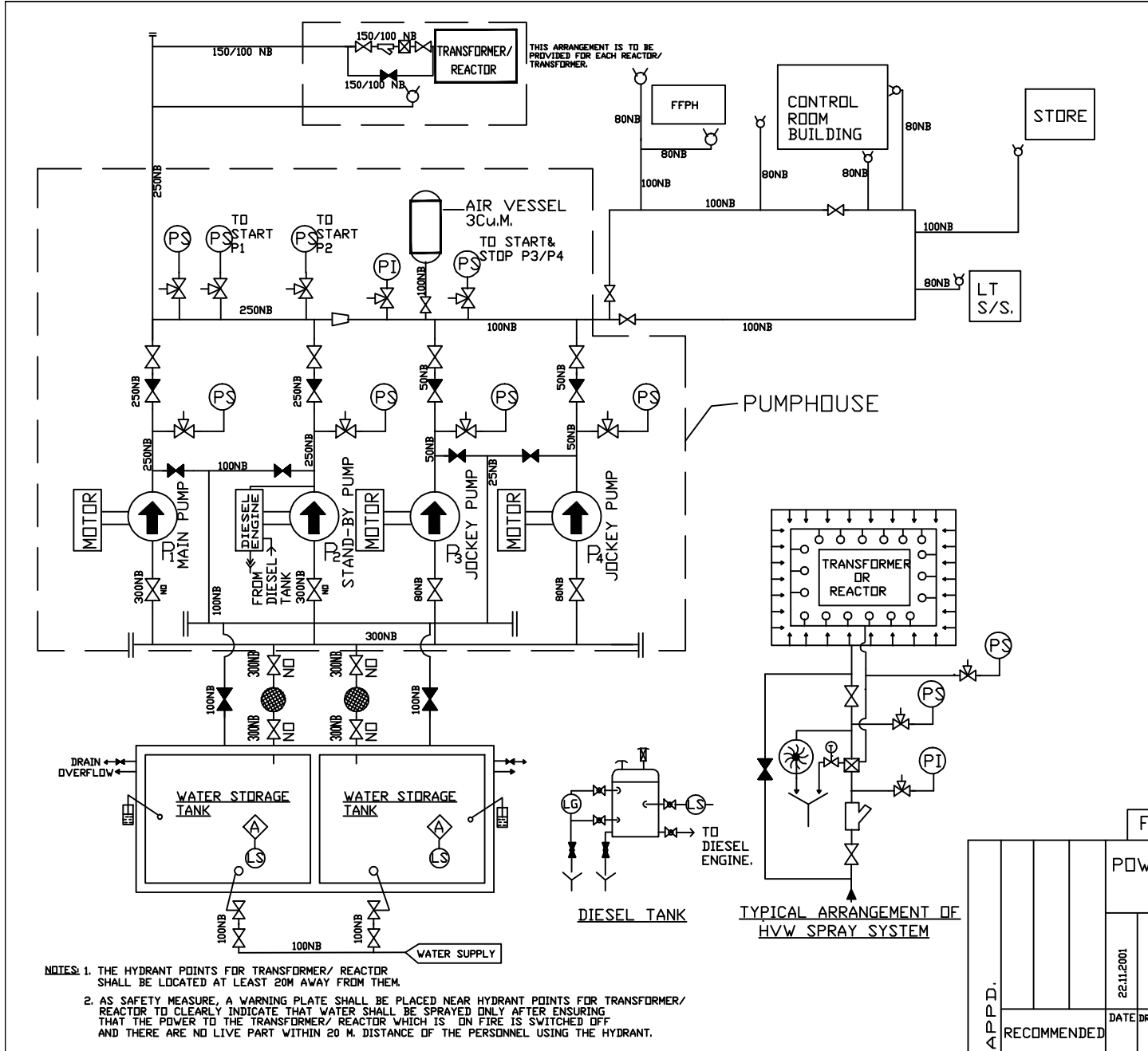
1. IR test before and after HV test
2. HV Test
3. Functional Testing.

### (C)

1. The Fire detection and annunciation panel shall be subjected to functional tests.
2. The Annunciation System shall be routine tested



*Manjiv*



APPENDIX-I  
TO TECHNICAL SPECIFICATION  
FOR FIRE PROTECTION SYSTEM REV.-6

- LEGEND**
- ◇ ALARM
  - ⊗ GATE VALVE NORMALLY OPEN
  - ⊘ GATE VALVE NORMALLY CLOSED
  - ⊗ NON-RETURN VALVE
  - ⊗ GLOBE VALVE NORMALLY OPEN
  - ⊘ GLOBE VALVE NORMALLY CLOSED
  - ⊗ FLOAT OPERATED GATE VALVE
  - ⊗ TEST VALVE
  - ⊗ PRESSURE GAUGE
  - ⊗ PRESSURE SWITCH
  - ⊗ LEVEL GAUGE
  - ⊗ LEVEL SWITCH
  - ⊗ BASKET STRAINER
  - ⊗ FLOAT OPERATED LEVEL GAUGE
  - ⊗ Y-TYPE STRAINER
  - ⊗ WATER MOTOR GONG
  - ⊗ REDUCER
  - ⊗ THREE WAY COCK/ VALVE
  - ⊗ VENT
  - ⊗ DRAIN
  - ⊗ OUT DOOR HYDRANT
  - ⊗ QUARTZOID BULB DETECTOR
  - ⊗ HVW SPRAY NOZZLE
  - ⊗ PUMP
  - ⊗ WATER LINE
  - ⊗ DELUGE VALVE

**NOTES:** 1. THE HYDRANT POINTS FOR TRANSFORMER/ REACTOR SHALL BE LOCATED AT LEAST 20M AWAY FROM THEM.  
2. AS SAFETY MEASURE, A WARNING PLATE SHALL BE PLACED NEAR HYDRANT POINTS FOR TRANSFORMER/ REACTOR TO CLEARLY INDICATE THAT WATER SHALL BE SPRAYED ONLY AFTER ENSURING THAT THE POWER TO THE TRANSFORMER/ REACTOR WHICH IS ON FIRE IS SWITCHED OFF AND THERE ARE NO LIVE PART WITHIN 20 M. DISTANCE OF THE PERSONNEL USING THE HYDRANT.

FOR TENDER PURPOSE ONLY

POWER GRID CORPORATION OF INDIA LIMITED				
(A GOVERNMENT OF INDIA ENTERPRISE)				
APP.D.	22.11.2001	A.JXAVIER	A.JXAVIER	PROJECT: 765kV AND 400kV SUBSTATION
	DATE	DRAWN	CHKD.	APPD.
RECOMMENDED				TITLE: PIPING & INSTRUMENTATION DIAGRAM FOR HYDRANT & HVW SPRAY SYSTEM.
	DRG.ND.	C/ENGG/STD/FP/1	REV.	4
	NTS	Sheet 1 of 1		

*Navin*