

ANNEXURE-A, & B, TO PRODUCT STANDARD SG12927

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SWE	PI No.: 240992437	Enq. No.: PO No.:
W.O. Nos. : 97066Q47602/04		

1. Project Data

Work order No	Project	P.I NO.
97066Q47602 & 04 97066Q47502	2X660 MW UDANGUDI COAL BASED STPP STAGE I (M/S TANGEDCO)	240992437

2. Site Condition

Ambient Temp (min/max/design) deg Celcius	Humidity (%)	Altitude (mtr)	Atmospheric condition	Installation
1.1/55/50	>95	<1000	Highly polluted and saline environment	Indoor

3. Miscellaneous inputs (tick (√)/ Purchaser to indicate against the requirement)

a.	Auxiliary Supply for Relays	220 DC
b.	Auxiliary Supply for Data Concentrator	220 DC (Redundant)
c.	Prot. CT Secondary	1A (√) / 5A () / Not Applicable ()
d.	Diff./REF CT Secondary	1A (√) / 5A () / Not Applicable ()
e.	Earth Fault CT secondary	1A (√) / 5A () / Not Applicable ()
f.	Open Delta Voltage for Directional	110/3VAC() / Not Applicable (√)
g.	PT Synchronization secondary voltage	63.5VAC () / 110VAC (√) / Not Applicable ()
h.	Relay shall have protection against Harsh Environment (Highly polluted and saline environment)	No () / Yes (√)
i.	Motor diff Relay part of main motor Protection Relay	No (√) / Yes () - Separate Item
j.	Trafo diff Relay part of main trafo Protection Relay	No (√) / Yes () - Separate Item
k.	RTD/ BTM Inputs (Nos) (For Motor Protection)	No (√) / Yes () & Nos ()

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l.	Protocol for Communication of relays	IEC open Protocol (IEC-61850) (√) / MODBUS-RTU ()
m.	Protocol for Communication of DC with Upper Level system	(i) Relay Data -- IEC-60870-104 (√) (ii) Metering Data -- MODBUS-TCP IP Protocol (√)
n.	No of rear communication port on numerical relay for Networking	1 (one) (√) / 2 (Two) ()
o.	Redundancy Protocol	PRP () / HSRP () / Dual Ring w/o PRP (√) (at Ethernet level & above) / Not Applicable ()
p.	Topology for Communication from Relay to DC/Ethernet switch	Star (Redundant () / Star (Non-Redundant (√) / Not Applicable ()
q.	Topology for Communication of DC with HMI	Star (dual redundant link) (√) / Not Applicable ()
r.	System Communication Architecture	Enclosed (√) & DRG NO: (35210080719 Rev0) / Not Enclosed () / Not applicable ()
s.	Metering Network architecture (if applicable)	Enclosed (√) & DRG NO (35210080719 Rev0) / Not Enclosed () / Not applicable ()
t.	Time Synchronization Required	No () / Yes (√)
u.	Distance between feeder for cable differential relay and size & type of cable	Not Applicable (√) / Applicable () & Distance , Type
v.	Switchgear Control thru relay from HMI Required	No () / Yes (√)
w.	Project/Switchboard wise Item break-up	Enclosed (√) - Table A / Not Enclosed () / Not applicable ()
x.	Location of different Swbd or Switchgear Room Layout drawing	Enclosed (√) & Drawing No () / Not Enclosed (shall be informed later) / Not applicable (√)
y.	Integration of LT relays	Not Applicable (√) / Applicable () 200 Nos approx.), Type (Shall be informed during

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		detail engineering) & Protocol of LT relays (IEC open Protocol (IEC-61850) (√)/ MODBUS-RTU ())
z.	Data concentrator Panel paint shade	Powder coated, semi glossy, shade (shall be informed during detail engineering) (√)/ Not Applicable ()
	Data concentrator Panel Location	In BTG building control room (CCR Room)
aa.	HMI Console colour shade	Powder coated, semi glossy, shade (shall be informed during detail engineering) () / Not Applicable (√)
	HMI Console Desk Top colour shade	Powder coated, semi glossy, shade (shall be informed during detail engineering) () / Not Applicable (√)
	HMI Console location	Main control room 100 mtrs from Data Concentrator panel/ shall be informed during detail engineering) ()/ Not Applicable (√) ()
bb.	Customer approved sub-vendor List for communication Network items	Enclosed () & Annexure (E)/ Not Enclosed () / Not Applicable ()/(shall be informed during detail engineering) (√)

4.0 Following clauses of SG12927 Rev 05 not applicable for the project:

Clauses	3.01(h), 3.01(i), 3.01(k), 1.01.49, B2.05.00, B2.06.00, B2.07.00, B2.08.00,B2.09.00
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6.0 Protection & metering features required in relay (In addition to specified in SG12927 rev 05)

KEY FEATURES ↓	Item- 001 (Tick the reqmnt √)	Item- 002 (Tick the reqmnt √)	Item- 003(Tick the reqmnt √)	Item-004 (Tick the reqmnt √)	Item-005 (Tick the reqmnt √)	Item- 006 (Tick the reqmnt √)	Item- 007 (Tick the reqmnt √)
SHORT DESCRIPTION →	O/C+ E/F (FOR Incomer/Tie /Bus coupler)	O/C+ E/F (E FOR TRAFO /OUTGOI NG)	TRAFO DIFF Relay	MOTOR PROTN (FOR MOTOR)	MOTOR DIFF. PROTN RELAY	VOLTAGE PROTECTION RELAY	REF/SEF RELAY
3-Ph Directional Over current (67) with low set, high set and high set instantaneous							
Directional Earth Fault (67N) with low set, high set and high set instantaneous							
Stand By Earth Fault (64S)							√
3-Ph inrush current detector							
Neutral Displacement (64NDR)							
Under Frequency with time delay(81U)							
Over Freq with time delay (81O)							
df/dt element(4 Stages)							
Max. start time				√			
Motor Over Load pre-alarm				√			
Motor Re-acceleration							
Loss of load (37)				√			
Single Phasing (46)				√			
Under current				√			
Phase Reversal Protection (46R)				√			
Motor Stall protection				√			
Earth Fault thru CBCT (50N)		√		√			
Transformer Diff (87T) 3-winding							
KEY FEATURES ↓	Item- 001 (Tick the	Item- 002 (Tick the	Item- 003 (Tick the	Item-004 (Tick the	Item-005 (Tick the reqmnt √)	Item- 006 (Tick the	Item- 007 (Tick the

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SHORT DESCRIPTION →	reqmnt √)	reqmnt √)	reqmnt √)	reqmnt √)		reqmnt √)	reqmnt √)
	O/C+ E/F (SUITABLE FOR Incomer/Tie /Bus coupler)	O/C+ E/F (SUITABL E FOR TRAFO /OUTGOI NG)	TRAFO DIFF Relay	MOTOR PROTN (SUITABL E FOR MOTOR)	MOTOR DIFF. PROTN RELAY	VOLTAGE PROTECTION RELAY	REF/SEF RELAY
High Impedance Motor Diff. (87M)					√*		
Low impedance Motor diff. (87M)							
Bus Differential (87B)							
Check bus differential							
Cable Diff. prot. scheme (87F)							
Converter/Modem/Isolation Trf for cable differential (if reqd)							
Restricted Earth fault (REF1)			√				√
Restricted Earth fault (REF2)							
Breaker monitoring							
Synch-check (25)	√						
Metrosil					√*		√*
Stabilizing resistance					√*		√*
<u>Metering /Event Recording</u>							
3-Ph MVA	√	√	√	√			
3-Ph MVAR	√	√	√	√			
3-Ph MVAH	√	√	√	√			
Hour Run Meter				√			
BINARY INPUT/BINARY OUTPUT BESIDES RELAY FAIL W/D CONTACT	16/11	12/9	4/3	12/9	4/3	8/8	4/3
<u>No of CT/PT</u>	4/4	4/3	7/0	4/3	4/0	0/4	4/0
<u>OFFERED RELAY MODEL</u>							

*Quantity of Metrosil & stabilizing resistor required for Item #005 & #007 are covered against Item 008,009 & 010.

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ITEM-008	Metrosil suitable for 1 A rating
ITEM-009	Stabilizing Resistor (0-4000ohms)
ITEM-010	Stabilizing Resistor (0-1000ohms)
ITEM-011	Data Concentrator Panel as per SG12927 Rev05 & Annexure B
ITEM-012	Ethernet Switches as per SG12927 Rev05 & annexure B
ITEM-013	Cat 5e/6 Ethernet Cable as per SG12927 Rev05
ITEM-014	Optical Fibre Cable as per SG12927 Rev05 & Annexure B
ITEM-015	Relay Parameterization Device as per SG12927 Rev05 & Annexure B
ITEM-016	Port converter as per Annexure B
ITEM-017	Arc Flash Protection System as per Annexure B

PROTOCOL FOR MANUFACTURING CLEARANCE SCHEDULE

SL. NO.	ENQUIRY ITEM	ITEM DESCRIPTION	PROTOCOL	Vendor Compliance
1	01 to 10, 17	Numerical relays Including Metrocil and stabilizing resistor	- No manufacturing clearance required. - Vendor to inform delivery schedule from the date of receipt of PO / LOI from BHEL. - Vendor to submit FAT document if applicable within two (2) weeks after receipt of PO/LOI/ approved switchgear schematic drawing (if required) from BHEL. - Vendor to submit subsequent revised FAT documents within one week after receipt of comments from customer /BHEL. - Inspection of FAT of Numerical relays at vendor's work and obtaining MDCC/ Clear CHP is the responsibility of vendor. Hence vendor to quote delivery of items considering the above facts.	
2	12 &16	Ethernet switches , Port converter	- Vendors to submit the data sheet of Ethernet switches & Port Converter for Customer/ BHEL approval within six (6) weeks from the date of receipt of PO/ LOI from BHEL. - Manufacturing clearance shall be given by BHEL after receipt of approvals from customer. - Vendor to inform delivery schedule from the date of receipt of manufacturing clearance	

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			from BHEL. • Vendor to submit all subsequent revised data sheets within one week after receipt of comments from customer /BHEL.	
3	11to 15	Numerical relay Networking items Documents as per SG12927 CI-B4.02.00	• Vendor to submit all drawings/ documents/ GTPs for customer/ BHEL approval within four (4) weeks after receipt of inputs from BHEL. • Vendor to submit all subsequent revised drawings/ documents within two (2) weeks after receipt of customer/ BHEL comments. • Manufacturing clearance shall be given by BHEL after receipt of approvals from customer. • Vendor to inform delivery schedule from the date of receipt of manufacturing clearance.	
4	11to 15	Inspection schedule	• Inspection of networking items of PO at vendor's/ sub-vendor Manufacturer's work and obtaining MDCC/ Clear CHP is the responsibility of vendor. Hence vendor to quote delivery of items considering above facts. • Vendor to raise Inspection call to BHEL at least 15 days in advance for organizing Customer/ BHEL representatives for inspection.	

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9.0 Set of Documents Required (For each project)

ITEMS	Sets (along with the offer)	Sets (along with the supplies)	Sets (After P.O placement)
Technical Leaflet/ literature, panel cutout, overall dimension drawing, complete model no, wiring diagram of Each item.	1	-	-
User manual/Guide of Each item.	-	1	8
Routine test certificate	-	1	-
Scheme, datasheet, FDS, System architecture, bill of material, OGA of data concentrator panel, OGA of furniture & HMI etc for approval	-	1	8
QAP (Quality Approval Plan)	-	-	8
SAT (Site Acceptance test procedure)	-	-	8
FAT (Factory acceptance test procedure)	-	-	8

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ANNEXURE-B: VENDOR TO CONFIRM PROJECT SPECIFIC OTHER TECHNICAL REQUIREMENT

CLAUSE NO	SPECIFIC TECHNICAL REQUIREMENT	COMPLIED YES/NO	REMARKS
1.0	a. For REF/SEF Prot in Item # 007, Setting range shall be 5mA to 100mA. Ref setting written anywhere else is not applicable. stand By Earth fault min setting shall be 10 mA. b. for Item#001 , relay shall be suitable for detection of earth fault currents in the range of 1% (10mA).		
2.0	Numerical relay shall have the following features a) At least two group of settings b) Min. no of LEDs - 10 c) LCD Screen d) Front key pad for Parameter / Navigation. e) In built lockout function with front key resetting. f) EMC Compatible. g) No adopter / Convertor is acceptable. h) At least 10 disturbance recorder i) At least 5 Fault recorder j) Event recording at least 50 k) Unlimited logic gates l) In-built timers m) Freely programmable DI / DO. n) In built CB control function with interlocking. o) Goose messaging for inter tripping command and interlocking in addition to hardware interlocking. p) Non -Volatile memory with battery backup or suitable arrangement q) Time synchronization r) self-diagnosis		
3.0	a. EMS (Electrical Monitoring) system (Not in Bidder Scope) shall collect data from numerical protection relays and digital meters installed in various switchgear panels. The system shall have Ethernet switch for each switchgear/panel for the data exchange between switchgear equipment and data concentrators shall be through ring architecture over IEC-61850 protocol. b. Integrated Energy Management System (IEMS) (not in bidder scope) shall collect all data from Metering Devices installed in various switchgear panel. All the metering devices shall be looped on Modbus Rs485 multi drop (max 8 nos) and connected to Ethernet switch via modbus to Ethernet port converter. Ethernet switches shall be in ring and connected to DC panel.		
4.0	All the process data including analogue measurements, status signals, alarms etc. are acquired by the data concentrator from protection relays through IEC 61850 Ethernet Switches		
5.0	The data exchange between switchgear level relays and Ethernet switches shall take place using Ethernet cable.		
6.0	The data exchange between switchgear level Ethernet		

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	switches and data concentrator panel mounted Ethernet switches shall take place via single mode fiber-optic cable according to IEC 61850 standard.		
7.0	Data concentrator shall act as a gateway between numerical relays, EMS, IEMS system. The data concentrator shall be based on industrial hardware design operating on Windows operating system and to monitor and acquisition of the real-time data from numerical relays. It shall also provide a framework for monitoring this data at HMI. Data concentrator shall store the data day wise and it shall be possible to take back up of data at any time without affecting the normal operation of the system. Data concentrator shall have required number of TCP/IP ports for connection to EMS/IEMS having operators work station and engineering station PC.		
8.0	The IEDs shall communicate with data concentrator through IEC-61850 protocol on Ethernet medium. The data exchange between switchgear equipment and data concentrators shall be through ring architecture over IEC-61850 protocol. To achieve redundancy and no single point of failure between a single board, ring topology shall be used. Data concentrator shall be a part of the ring topology for the downstream communication with IED's. Independent rings shall be connected to different data concentrator. All Ethernet connections between the switches shall be fiber-optic cabling. The Ethernet medium shall transfer data for the following: IEC-61850 data nodes for real-time analog and status to be displayed on the HMI. Event record collection from the relays Engineering access for settings, and additional report functions		
9.0	<u>ARC Flash Protection System (Switchboard Wise)</u>		
9.01	The arc detection system shall be of the light sensitive & current sensitive type and shall detect and isolate only the faulted bus section of the switchgear so that healthy bus section Continues to operate satisfactorily.		
9.02	Complete Engineering, supply, installation, commissioning & demonstration of Arc Flash Protection system in switchboards/ panels at site and BHEL works shall be in bidder's scope.		

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9.03	Arc Flash detection feature shall preferably be inbuilt part of Numerical Relay. In case, due to technological constraints, if same feature is not available in Numerical relay, then separate module meeting arc flash protection requirement is also acceptable. In both cases, Total operating time shall be within 20 ms. If Arc Flash System is inbuilt part of Numerical relays, it shall be applicable for Item #001, #002, #004 & #006 only.		
9.04	Offered scheme should provide complete MV switchgear arc fault protection in Busbar, Cable/CT & breaker compartments. Offered Scheme should be based on 3 phase current as well as light detection principle to detect & isolate the particular fault zone. Scheme should not in any case maloperate in absence of detection of either current or light		
9.05	Arc Flash Protection scheme should be of proven design.		
9.06	All protection devices shall have valid Type Test certificates & shall be submitted for verification/approval to customer, if required.		
9.07	Dedicated Arc Fault protection relay/module offered shall be communicable type & shall communicate to switchgear Data concentrator/EMS. Also supply of necessary communication cable required shall be in the scope of bidder .Modules shall have IP54 degree of protection.		
9.08	Necessary fiber loops & point sensors required for Flash Detection of desired length in requisite quantity to meet the complete protection requirement of Busbar/cable termination/breaker chamber shall be considered in bidder's scope. Necessary Panel dimensions & switchboard dimensions given in Annexure C. Also refer Switchgear OGA Drawing No 35210005388, 35210005389 , 35210005390 , 35210005393 and 35210005396 for Ref.		
9.09	All Numerical relays/modules intended for Arc Flash protection shall have minimum 2 Nos of high speed solid state operating contacts for quick isolation during arc fault. Relays shall have necessary ports suitable for connecting fiber loop & point sensors. In case of dedicated module for Arc Flash protection, relay modules shall have watchdog contact for remote annunciation. All modules shall be communicable type.		
9.10	Failure of a control supply and de-energization of arc flash protection relay/module shall not initiate any circuit breaker /vacuum contactor operation.		

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9.11	Numerical relay/modules shall continuously supervise light sensors. In case of failure of light sensor, annunciation facility must be available in the relay/module. Separate indication & output contact on relay/modules for healthiness/failure of light sensors to be provided.		
9.12	Disturbance Record waveforms, event records & alarms shall be stored in Non-volatile memory of arc flash protection relay/module and failure of control supply shall not result in deletion of any of these data.		
9.13	All Numerical relays/modules intended for Arc Flash protection shall have event recording feature, recording of abnormalities and operating parameters with time stamping.		
9.14	All Numerical relays/modules shall have self-diagnostic feature with continuous self-check for power failure, program routines, memory and main CPU failures and a separate output contact for indication of any failure.		
9.15	Design of the relay must be immune to any kind of electromagnetic interference. Vendor to submit all related type test reports for the offered model along with the offer.		
9.16	Relays shall be suitable for Harsh Environment as mentioned in annexure A.		
9.17	Fiber optic loop sensors & point sensors shall be suitable to withstand 85 °C.		
9.18	(i) 10 % of Total quantity of Fiber loop sensors & Point sensors including sensor mounting kit shall be supplied as spare along with the scheme without any additional price implication. (ii) In case separate numerical relay/module based arc flash protection scheme is offered, then bidder to supply 2 nos module/ numerical relay of each type as spare without any price implication to BHEL.		
9.19	All hardware including sensor mounting kit required for successful commissioning of Arc Flash protection shall be in the scope of bidder.		
9.20	All items shall be guaranteed for successful operation for a period of 60 months from the date of receipt of complete lot of all items against the project. Support and maintenance for the package, including onsite support shall be provided as and when required during the guarantee period by the contractor/supplier without any additional charges to owner.		
9.21	Location of point sensor & looping of fiber sensor in BHEL MV switchgear to be informed by bidder so that necessary provision for fixing arrangements can be made in switchgear for mounting of the sensors.		

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9.22	Increase in no. of sensors or any other items due to increase in quantity of arc flash protection relays or modules (eg – two relays offered to meet the specification requirement in place of single relay/module) during detailed engineering stage (if required) shall be supplied without any price implication.		
9.23	Configuration/setting of Numerical relay or module for Arc Flash Protection shall be in the scope of bidder.		
9.24	Preparation of scheme for Arc Flash Protection for customer's approval before commercial bid opening,if required shall be in the scope of bidder.Bidder to depute engineer for across the table discussion with customer/consultant during tendering stage or P.O.stage,if required without any price implication.		
9.25	Bidder to depute their qualified technical representative for installation & commissioning of scheme in each switchboard/panel at site free of cost without any ceiling on number of visits and number of man days per visit. The support shall be provided upto the satisfaction of customer.		
9.26	Demonstration of Arc Flash Protection scheme to customer/consultant/BHEL for each switchboards/panels at site is in the scope of bidder.		
9.27	Necessary tools/equipment's etc. Required during demonstration, installation & commissioning shall be in the scope of bidder.		
9.28	Necessary programming software (with 2 license copies) required for configuration of Numerical relay &/or modules for Arc fault shall be supplied free of cost to BHEL.		
9.29	Formation & supply of necessary networking hardware's/software's like Ethernet switches, communication cable etc. required for establishing communication between arc flash protection modules & /or Numerical relays to Data Concentrator/MV switchgear SCADA shall be in bidders scope & same shall be supplied without any price implication.		
9.30	Bidder to Furnish bill of material of arc flash system along with offer.		
10.0	<u>Relay parametrisation Device</u>		
10.01	Processor- Intel Core I-7 processor or latest at the their ordering		
10.02	Installed memory- 4 GB or (latest configuration)		
10.03	Display -- 15.6" LED based latest		
10.04	<u>Operating System-</u> Microsoft Windows 764 bit latest at the through of supply		
10.05	Display Max. Resolution 1280X1024 or better		

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10.06	Hard Drive Capacity SATA II – 500 GB or solid state drive or latest		
10.07	Storage Controller type EIDE		
10.08	Installed RAM 4 GB upgraded up to 16 GB or higher		
10.09	RAM technology DDR SDRAM		
10.10	Max Supported RAM 16 GB or Higher		
10.11	Installed Cache memory 1024 KB		
10.12	CD / DVD type DVD + RW (Combo) or Blue ray		
10.13	Optical drive Read system 16 X (DVD – R/RW)		
10.14	USB Ports 3, 1 S Video		
10.15	Installed Video Memory 128 MB sharable with RAM		
10.16	Audio output type Integrated sound card with internal speakers		
10.17	Modem type 56 Kbps		
10.18	Analog Modulation protocol ITU V.90, ITU V.92		
10.19	Networking type Integrated 10 / 100 Eth, wireless access point		
10.20	Data link protocol IEEE 1394 / 802.116 wireless, Ethernet, fast Ethernet.		
10.21	Battery Technology Lithium Ion		
10.22	Carry bag Leather, shoulder carry type		
10.23	Warranty Three yr on site		
10.24	Preferable Make HP/DELL /IBM/SONY		
11.0	FIBRE OPTIC CABLES		
11.01	Mono mode type fibre optic cable with following parameters shall be provided		
11.02	Cable Type: Mono-mode with minimum 4 fibres		
11.03	Wavelength band optimized : 850nm / 1300nm / 1550nm		
11.04	Mode field diameter : 9-10µm + 10% of nominal value		
11.05	Cladding diameter : 125µm + 3		
11.06	Non-concentricity core/cladding : not more than 2µm		
11.07	Non-circularity of cladding : not more than 3µm		

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11.08	Cut-off wavelength : 1200nm		
11.09	Attenuation : less than 0.3-0.4 dB/km at 1300nm , less than 0.15-0.25 dB/km at 1550nm		
11.10	HDPE insulation shall be suitable for continuous conductor temperature of 85°C. The insulation material shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.		
11.11	The cables shall have HDPE primary insulation suitable for FRLS. Inner and outer jacket shall be made of extruded flame retardant HDPE.		
11.12	The cables shall be armoured. Armour shall be of galvanised steel wire / flat as per IS 3975.		
11.13	The cables shall be protected against termite and rodent attack. Necessary chemicals shall be added into the compound of the outer sheath.		
11.14	The material used in the construction of fibre optic cables shall be compatible with the properties of the cables and shall be in accordance with the relevant IS and IEC standards as stated above.		
11.15	Design requirements		
11.15.01	All cables shall be suitable for laying on racks, in ducts, trenches with chances of flooding by water and shall also be suitable for directly buried installation. All the cables shall be FRLS type designed to withstand mechanical, electrical and thermal stresses developed under steady state and transient operating conditions.		
11.15.02	The cables shall be capable of operating satisfactorily under the power supply and frequency variations, high ambient, high humid tropical climatic conditions as specified in project information		
11.15.03	The cables are proposed to be laid in multi-tier overhead cable racks, in concrete cable trenches. Derating factors for grouping and ambient temperature shall be furnished by successful bidder along with filled up datasheets during contract engineering stage.		
11.15.04	PVC insulation shall be suitable for continuous conductor temperature of 85°C and short circuit conductor temperature of 160 °C. The insulation material shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.		
11.15.05	All cables shall have PVC primary insulation as per IS 5831 Type C / IEC 502 suitable for FRLS. Inner and outer jacket shall be made of extruded flame retardant 90°C PVC to IS 5831 Type ST2 / IEC 502. Oxygen Index of PVC shall be over 29% and temperature index shall be over 250°C.		

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11.15.06	The cable cores shall be laid up with fillers between the cores wherever necessary. All the cables shall have distinct extruded PVC inner sheath.		
11.15.07	The cables shall be armoured. Armour over inner jacket shall be of galvanised steel wire / flat as per IS 3975.		
11.15.08	All the cores of single pair or multipair shall be twisted and twists shall not be less than 20 per metre.		
11.15.09	The outer sheath for analog and digital cables the colour shall be light blue and black respectively		
11.15.10	Running length of cable shall be printed atleast every 5m interval. For multipair cables, pair identification shall be provided with numbers at interval of not more than 250mm or as per vendor's standard.		
11.16	<u>Construction</u>		
11.16.01	The insulation shall be applied directly over the conductor by extrusion method. in such a way that it fits closely on the conductor and it shall be possible to remove it easily without damage to the conductor. Two cores shall be twisted to form a pair and four such pairs shall be twisted together to form a unit. Every pair shall be twisted with a lay of 40 to 50 mm and to be wrapped with polyester tape. Individual pair screening with edges frees poly aluminium tape with continuous drain wire of minimum overlap of 30%.		
11.16.02	The insulation shall be applied directly over the conductor by extrusion method. in such a way that it fits closely on the conductor and it shall be possible to remove it easily without damage to the conductor. Two cores shall be twisted to form a pair and four such pairs shall be twisted together to form a unit. Every pair shall be twisted with a lay of 40 to 50 mm and to be wrapped with polyester tape. Individual pair screening with edges frees poly aluminium tape with continuous drain wire of minimum overlap of 30%.		
11.16.03	The cable shall be then sheathed with FRLS PVC by extrusion method. The shielding and sheathing shall be so done that it fits firmly on to the cable and are easily removable without damage to the cores.		
11.17	Cable Reeling Drums		
11.17.01	The Cable drums shall be non returnable wooden or steel drums of sturdy construction		

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11.17.02	The wood used for the construction of the drums shall be of durable quality, properly seasoned and treated with Copper Nephthenates or Zinc Nephthenates for preserving the wood (Refer IS 401). Wood preservatives anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS 10418. All ferrous parts shall be treated with suitable rust preventive coating to avoid rusting during transit and storage.		
11.17.03	The surface of the drum and the outermost cable shall be covered with waterproof layer. Both the ends of the cable shall be properly secured with heat shrinkable PVC / Rubber caps, secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection.		
11.17.04	Each drum shall carry the manufacturer's name, purchaser's name, address and contract no., item no. and type, size and length of the cable and net and gross weight stenciled on both sides of the drum. A tag containing the same information shall be attached to the leading end of the cable.		
11.17.05	An arrow accompanied by suitable wording shall be stenciled on the ends of the drums of indicate which way it should be rolled. The number of each drum shall be either branded at the end of the drum or stamped on the metal disc attached to one end of the drum.		
11.18	Marking		
11.18.01	Marking on outer sheath:		
11.18.02	In addition to manufacturer's identification on cables as per IS, the following shall be embossed on the outer sheath at every 1m throughout the length of the cable: (i) Manufacturer's Name & Trade Name : (ii) Year of Manufacture : (iii) User's Name : (iv) Voltage grade : (v) Type of outer sheath : (vi) Type of inner sheath :		
11.18.03	The label which is securely attached to the reel or drum or coil shall have the following information: Purchaser's name and address : Purchase Order No. and item no. : Manufacturer's /Supplier Name : Length in meters : Gross Weight : Item code number and cable drum number : Direction of rotation of drum for unwinding by means of an arrow		

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12.0	<u>Ethernet Switches</u>		
12.01	Industrial grade managed type switches (L3 layer switch) shall be minimum 4x fibre (1000 Base-SX) , 1 Gbps uplink ports, configurable via browser interface and have a 50% spare capacity for future addition of LAN points.		
12.02	Support switch management functions, protocols and features including CLI, RMON, SNMP, VoIP, VLAN, QoS, STP/RSTP network resiliency protocols		
12.03	Possess integrated security features including Access Control Lists (ACL), protection from DoS attacks and broadcast/multicast storms, port blocking, MAC-ID filtering, support DHCP for static IP addressing, allow secure authentication during access.		
12.04	Powered from redundant, hot swappable AC and/or DC power supplies and shall be fan cooled with adequate monitoring and diagnostics of fault conditions using SNMP traps or other switch management alerts.		
12.05	High speed (1Gbps) operation. Glass fiber optic cables with MTRJ connectors.		
12.06	Dual redundant power supplies for increased network availability.		
12.07	Designed for harsh environment (IEC:61850-3 requirements for use in electrical substations)		
12.08	Full compliance with IEEE:802.3 and IEEE:802.3u Ethernet standards for universal interoperability		
12.09	Enhanced rapid spanning tree (IEEE:802.1w) for fault tolerance with fast recovery times (<5 ms)		
12.10	Virtual LAN (IEEE:802.1Q) for traffic segregation		
12.11	SNMP for network management. SNTP for time synchronization of the Ethernet switches		
13.0	<u>Serial to Ethernet converter (IT-015)</u>		
13.01	The device shall have following feature		
13.02	2 nos of serial (Rs485)port on Modbus RTU for interfacing with MFM/TVM and 2 nos of Ethernet port for interfacing with Ethernet switch.		
13.03	10/100 MBPS Ethernet port		
13.04	Asynchronous Isolated serial Port.		
13.05	RJ45 socket for Ethernet.		
13.06	Screw Terminal for Serial Port.		
13.07	Automatic detection of Devices.		

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13.08	Device configuration Utility.		
13.09	Operating Voltage :220 V DC		
13.010	Baud Rate Supported: 1200,2400,4800,9600,19200,38400,57600,115200		
13.011	Enclosure: Metallic.		
13.012	Make shall be of Customer approved make		
14.00	VDU for Data concentrator Panel		
14.01	The visual display unit (VDU) shall be 24" TFT monitor.		