

**Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

BOQ CUM PRICE SCHEDULE FOR IP BASED PA SYSTEM -SUPPLY (ANNEXURE-1)

Sl. No.	Item Code	Item Name	MAKE/ MODEL	UOM	Quantity	UNIT EX-WORKS PRICE (Rs.)	TOTAL EX-WORKS PRICE (Rs.)	FREIGHT@...% (Rs.)	TOTAL EX-WORKS PRICE + FREIGHT (Rs.)	GST@18% (Rs.)	TOTAL F.O.R Price (Rs.)
(A)		MAIN ITEMS									
1	557-11050-A	IP BASED PA CONTROLLER		NOS	1						
2	557-11025-A	MASTER CONTROL STATION (MCS) WITH EXTENSION AMPLIFIER		NOS	2						
3	557-11051-A	FIELD CALL STATION (FCS) TYPE-A		NOS	7						
4	557-11052-A	FIELD CALL STATION (FCS) TYPE-B		NOS	75						
5	557-11011-A	DESKTOP STATION (DTS) TYPE-C		NOS	20						
6	557-11053-A	CONE TYPE SPEAKER		NOS	18						
7	557-11019-A	HORN TYPE SPEAKER - 15W		NOS	72						
8	557-11054-A	FALSE CEILING TYPE SPEAKER		NOS	19						
9	557-11014-A	EXTENSION AMPLIFIER FOR MCS & DTS		NOS	22						
10	557-11002-A	ACOUSTIC HOOD		NOS	32						
11		INDUSTRIAL NETWORK/ ETHERNET DISTRIBUTION SWITCH									
11.1	557-11057-A	24 PORT		NOS	3						
11.2	557-11058-A	16 PORT		NOS	2						
11.3	557-11059-A	8 PORT		NOS	24						
12	557-11060-A	CABINET TO HOUSE ETHERNET SWITCH & PASSIVE FIBER OPTIC COMPONENTS AND TERMINATION KIT		NOS	28						
13	557-11061-A	UPS		NOS	4						
14	557-11062-A	LAPTOP WITH PA SYSTEM SOFTWARE		NOS	2						
15	557-11063-A	WALL MOUNTED DB (16 OUTGOING)		NOS	15						
16	557-11048-A	MISC. ITEMS (As per Annexure-1A)		LOT	1						
17		PA SYSTEM CABLE (As per Annexure-1B)		LOT	1						
18	557-11055-A	ERECTION HARDWARE (AS PER ANNEXURE-1C)		LOT	1						
19	557-11026-A	O&M SPARE (RECOMMENDED SPARES) (Bidder to furnish list as per ANNEXURE-1D)		LOT	1						
20	557-11039-A	SPECIAL TOOLS & TACKLES (Bidder to furnish list per ANNEXURE-1E)		LOT	1						
21	557-11013-A	E&C SPARE (Bidder to furnish list as per ANNEXURE-1F)		SET	1						
TOTAL OF ABOVE											
Notes											
1	ITEM WISE PRICES WITH QUANTITY OF EACH ITEM OF FOLLOWING SHALL BE FURNISHED ALONG WITH BID:										
a)	MISC. ITEMS-AS PER ANNEXURE-1A										
b)	PA SYSTEM CABLE-AS PER ANNEXURE-1B										
c)	ERECTION HARDWARE- AS PER ANNEXURE-1C										
d)	O&M SPARE (RECOMMENDED SPARES)- AS PER ANNEXURE-1D										
e)	SPECIAL TOOLS & TACKLES - AS PER ANNEXURE-1E										
f)	E&C SPARE - AS PER ANNEXURE-1F										
2	ADDITION/DELETION OF QUANTITIES SHALL BE APPLICABLE AT THE QUOTED PRICES. THE UNIT RATE OF SUPPLY OF ALL EQUIPMENTS AND SERVICES QUOTED BY THE BIDDERS SHALL BE FIRM FOR A VARIATION OF QUANTITIES, WHICH SHALL BE AS PER NIT.										
3	BIDDERS SHALL FURNISH THE REPORTS OF THE TYPE TEST FOR THE EQUIPMENTS/ITEMS ORDERED UNDER THIS CONTRACT. IN CASE BIDDER IS NOT ABLE TO SUBMIT REPORT OF TYPE TEST(S), OR IN CASE TYPE TEST REPORTS ARE NOT FOUND TO BE MEETING THE SPECIFICATION/RELEVANT STANDARD REQUIREMENTS, THEN TYPE TESTING SHALL BE CONDUCTED UNDER THIS CONTRACT WITHOUT ANY COMMERCIAL IMPLICATION TO BHEL, AND REPORTS SHALL BE SUBMITTED FOR APPROVAL. NO CHARGES SHALL BE PAID FOR TESTING UNDER SUCH CIRCUMSTANCES.										
4	SUPPLY, FABRICATION & PAINTING OF SUPPORT STRUCTURE FOR PA SYSTEM EQUIPMENT SHALL BE IN BIDDER'S SCOPE.										
5	SUPPLY, TERMINATION AND LAYING OF CABLE REQUIRED OF PA SYSTEM SHALL BE IN BIDDER'S SCOPE.										
6	INSTRUMENTS REQUIRED FOR TESTING & COMMISSIONING SHALL BE ARRANGED BY THE BIDDER AND SHALL BE TAKEN BACK BY BIDDERS.										

**Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

Annexure-1A Misc. Items (SUPPLY)

Sl. No.	Item Code	Item Name	UOM	Quantity	UNIT EX-WORKS PRICE (Rs.)	TOTAL EX-WORKS PRICE (Rs.)	FREIGHT@...% (Rs.)	TOTAL EX-WORKS PRICE + FREIGHT (Rs.)	GST@18% (Rs.)	TOTAL F.O.R Price (Rs.)
1		(Additional item, if required for completeness of system Such As Passive Fiber Optic Components and termination kit consisting of Fiber panel, Information outlet, LIU, face plates, SC Coupler, Fiber Optic Drawer with Pigtail, various connectors,Hume pipe (Bidder to furnish list))	Lot	1						

**Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

Annexure-1B PA system Cable (SUPPLY)

Sl. No.	Item Code	Item Name	UOM	Quantity	UNIT EX- WORKS PRICE (Rs.)	TOTAL EX- WORKS PRICE (Rs.)	FREIGHT @...% (Rs.)	TOTAL EX- WORKS PRICE + FREIGHT (Rs.)	GST@18 % (Rs.)	TOTAL F.O.R Price (Rs.)
1	557-11064-A	FO Cable	Lot	1						
2	557-11065-A	Cat-6 Cable	Lot	1						
3	557-11066-A	Signal Cable for Speaker	Lot	1						
4	557-11067-A	Power Cable	Lot	1						
5		Any other cable (if required)	Lot	1						

Note:

1		Refer technical specification for any additional cable/items requirement
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**Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

Annexure-1D O&M Spare (Recommended Spares for 3 years)

Sl. No.	Item Name	MAKE & MODEL	UOM	Quantity	UNIT EX-WORKS PRICE (Rs.)	TOTAL EX-WORKS PRICE (Rs.)	FREIGHT@...% (Rs.)	TOTAL EX-WORKS PRICE + FREIGHT (Rs.)	GST@18 % (Rs.)	TOTAL F.O.R Price (Rs.)
1										

Notes:

1	Bidder to submit a list in above format of recommended spare parts for three (3) years satisfactory and trouble-free operation, indicating the itemized price of each item of the spares. The final quantity shall be decided during detail engineering and amount shall be payable as per actual supplied quantities.									
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**Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

Special Tools & Tackles - As per Annexure-1E

Sl. No.	Item Name	MAKE & MODEL	UOM	Quantity	UNIT EX-WORKS PRICE (Rs.)	TOTAL EX-WORKS PRICE (Rs.)	FREIGHT@... % (Rs.)	TOTAL EX-WORKS PRICE + FREIGHT (Rs.)	GST@18% (Rs.)	TOTAL F.O.R Price (Rs.)
1										

Notes:

1	Bidder to submit a list in above format of special tools & tackles, indicating the itemized price of each item. The final quantity shall be decided during detail engineering and amount shall be payable as per actual supplied quantities.
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**Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

E&C Spare- As per Annexure-1F

Sl. No.	Item Name	MAKE & MODEL	UOM	Quantity	UNIT EX- WORKS PRICE (Rs.)	TOTAL EX- WORKS PRICE (Rs.)	FREIGHT@ ..% (Rs.)	TOTAL EX- WORKS PRICE + FREIGHT (Rs.)	GST@18% (Rs.)	TOTAL F.O.R Price (Rs.)
1										

Notes:

1	Bidder to submit a list in above format of E&C spare, indicating the itemized price of each item. The final quantity shall be decided during detail engineering and amount shall be payable as per actual supplied quantities.
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**Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

BOQ CUM PRICE SCHEDULE FOR PA SYSTEM (E&C)-ANNEXURE-2

(B)	E&C							
Sl. No.	Item Code	Item Name	UOM	Quantity	Unit Ex-works Price (Rs.)	Total Ex-works Price (Rs.)	GST@18% (Rs.)	Total Price including GST (Rs.)
1	557-11050-C	IP BASED PA CONTROLLER	NOS	1				
2	557-11025-C	MASTER CONTROL STATION (MCS) WITH EXTENSION AMPLIFIER	NOS	2				
3	557-11051-C	FIELD CALL STATION (FCS) TYPE-A	NOS	7				
4	557-11052-C	FIELD CALL STATION (FCS) TYPE-B	NOS	75				
5	557-11011-C	DESKTOP STATION (DTS) TYPE-C	NOS	20				
6	557-11053-C	CONE TYPE SPEAKER	NOS	18				
7	557-11019-C	HORN TYPE SPEAKER - 15W	NOS	72				
8	557-11054-C	FALSE CEILING TYPE SPEAKER	NOS	19				
9	557-11014-C	EXTENSION AMPLIFIER FOR MCS, FMS & DTS	NOS	22				
10	557-11002-C	ACOUSTIC HOOD	NOS	32				
11		INDUSTRIAL NETWORK/ ETHERNET DISTRIBUTION SWITCH						
11.1	557-11057-C	24 PORT	NOS	3				
11.2	557-11058-C	16 PORT	NOS	2				
11.3	557-11059-C	8 PORT	NOS	24				
12	557-11060-C	CABINET TO HOUSE ETHERNET SWITCH & PASSIVE FIBER OPTIC COMPONENTS AND TERMINATION KIT	NOS	28				
13	557-11061-C	UPS	NOS	4				
14	557-11063-C	WALL MOUNTED DB (16 OUTGOING)	NOS	15				
15	557-11048-C	MISC ITEMS (AS PER ANNEXURE-2A)	LOT	1				
16		PA SYSTEM CABLE (AS PER ANNEXURE-2B)	LOT	1				
17	557-11055-C	ERECTION HARDWARE (AS PER ANNEXURE-2C)	LOT	1				
TOTAL OF ABOVE								

Notes	
1	ITEM WISE PRICES WITH QUANTITY OF EACH ITEM OF FOLLOWING SHALL BE FURNISHED ALONG WITH BID:
a)	MISC. ITEMS-AS PER ANNEXURE-2A
b)	PA SYSTEM CABLE-AS PER ANNEXURE-2B
c)	ERECTION HARDWARE- AS PER ANNEXURE-2C
2	ADDITION/DELETION OF QUANTITIES SHALL BE APPLICABLE AT THE QUOTED PRICES. THE UNIT RATE OF SUPPLY OF ALL EQUIPMENTS AND SERVICES QUOTED BY THE BIDDERS SHALL BE FIRM FOR A VARIATION OF QUANTITIES, WHICH MAY BE TO THE EXTENT OF +/- 30% OF TOTAL EX. WORKS VALUE DERIVED BASED ON THE ORDERED QUANTITY.
3	BIDDERS SHALL FURNISH THE REPORTS OF THE TYPE TEST FOR THE EQUIPMENTS/ITEMS ORDERED UNDER THIS CONTRACT. IN CASE BIDDER IS NOT ABLE TO SUBMIT REPORT OF TYPE TEST(S), OR IN CASE TYPE TEST REPORTS ARE NOT FOUND TO BE MEETING THE SPECIFICATION/RELEVANT STANDARD REQUIREMENTS, THEN TYPE TESTING SHALL BE CONDUCTED UNDER THIS CONTRACT WITHOUT ANY COMMERCIAL IMPLICATION TO BHEL, AND REPORTS SHALL BE SUBMITTED FOR APPROVAL. NO CHARGES SHALL BE PAID FOR TESTING UNDER SUCH CIRCUMSTANCES.
3	SUPPLY, FABRICATION & PAINTING OF SUPPORT STRUCTURE FOR PA SYSTEM EQUIPMENT SHALL BE IN BIDDER'S SCOPE..
4	SUPPLY, TERMINATION AND LAYING OF CABLE REQUIRED OF PA SYSTEM SHALL BE IN BIDDER'S SCOPE.
5	INSTRUMENTS REQUIRED FOR TESTING & COMMISSIONING SHALL BE ARRANGED BY THE BIDDER AND SHALL BE TAKEN BACK BY BIDDERS.

**Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

Annexure-2A Misc. Items (E&C)

Sl. No.	Item Code	Item Name	UOM	Quantity	Unit Ex-works Price (Rs.)	Total Ex-works Price (Rs.)	GST@18% (Rs.)	Total Price including GST (Rs.)
1		(Additional item, if required for completeness of system Such As Passive Fiber Optic Components and termination kit consisting of Fiber panel, Information outlet, LIU, face plates, SC Coupler, Fiber Optic Drawer with Pigtail, various connectors,Hume Pipe (Bidder to furnish list))	Lot	1				


Sagardighi Thermal Power Project**1x660 MW Unit No. 5, Phase - III****Annexure- 2B PA system Cable (E&C)**

Sl. No.	Item Code	Item Name	UOM	Quantity	Unit Ex-works Price (Rs.)	Total Ex-works Price (Rs.)	GST@18% (Rs.)	Total Price including GST (Rs.)
1	557-11064-C	FO Cable	Lot	1				
2	557-11065-C	Cat-6 Cable	Lot	1				
3	557-11066-C	Signal Cable for Speaker	Lot	1				
4	557-11067-C	Power Cable	Lot	1				
5		Any other cable (if required)	Lot	1				
Note:								
1		Refer technical specification for any additional cable/items requirement						

**Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

Annexure-2C PA system Erection Hardware (E&C)





Sl. No.	Item Name	UOM	Quantity	Unit Ex-works Price (Rs.)	Total Ex-works Price (Rs.)	GST@18% (Rs.)	Total Price including GST (Rs.)
1	Rigid steel Conduit	LOT	1				
2	Flexible Conduit	LOT	1				
3	Special Fitting	LOT	1				
4	Distribution Frames & Junction Boxes	LOT	1				
5	Cable Glands	LOT	1				
6	Earthing wire	LOT	1				

	PRE-QUALIFICATION REQUIREMENTS FOR PUBLIC ADDRESS SYSTEM (IP BASED) 1X660MW SAGARDIGHI TPS	DOC. NO. PE-PQ-445-557-E001
		REVISION NO. 00 DATE 18.11.2023
		SHEET NO.2 OF 2

d) If bidder happens to be having valid collaboration agreement/ MOU/ licensing agreement with some other company, then the credentials of collaborator/ MOU partner/ licensing company can also be considered for meeting PQR.

If bidder(s) qualifies on the basis of credentials of his principal/ JV partner/ Collaborator/ joint bidder etc., then the principal/ JV partner/ Collaborator/ MOU partner/ joint bidder shall be responsible for overall design vetting and warranty/ guarantee of the package. The scope matrix clearly defining their respective roles including design vetting, manufacturing of critical component, E&C etc. etc. and warranty/ guarantee shall be submitted along with the offer.

- Bidder to note that the arrangement of bidding (joint bid partners/ collaborator/ MOU partner/ licensing company etc.) once offered to BHEL as a part of bidding documents cannot be changed till the execution of the project.
- Consideration of offer shall be subject to customer's approval of bidders, if applicable.
- Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self-attested English translated document should also be submitted.
- Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities and capacity of the bidder/collaborators to perform the contract, should the circumstances warrant such assessment in the overall interest of BHEL.
- After satisfactory fulfillment of all the above criteria/ requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.
- PQR no. 4 is in line with customer provenness criteria

PREPARED BY  NAME: MANJU BHATNAGAR DESIGNATION: DY MANAGER	PREPARED BY  NAME: HEMA KUSHWAHA DESIGNATION: DGM	REVIEWED BY  NAME: PRAVEEN DUTTA DESIGNATION: AGM	APPROVED BY  NAME: DEBASISA RATH DESIGNATION: AGM-DH (E)
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1X660 MW SAGARDIGHI TPS UNIT#5 PHASE-III

**TECHNICAL SPECIFICATION FOR
IP BASED PUBLIC ADDRESS SYSTEM**

DOC. NO. PE-TS-445-557-E001, REV00



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA**



**TECHNICAL SPECIFICATION FOR
IP BASED PA SYSTEM**

**1X660MW SAGARDIGHI TPS UNIT#5
PHASE-III**

SPECIFICATION NO. PE-TS-445-557-E001

VOLUME II

SECTION

REVISION 00

DATE: 15.11.2023

SHEET 1 OF 1

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	TOTAL NO. OF SHEETS=	100
	(INCLUDING COVER/ SEPARATOR SHEETS)	



**TECHNICAL SPECIFICATION FOR
IP BASED PA SYSTEM**

**1X660MW SAGARDIGHI TPS UNIT#5
PHASE-III**

SPECIFICATION NO. PE-TS- 445-557-E001

VOLUME II

SECTION I

REVISION 00

DATE: 15.11.2023

SHEET 1 of 1

COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.
2. There is no deviation with respect to specification other than those furnished in the 'schedule of deviations'.
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ-Cum-Price schedule' of the specification shall not be considered (i.e., technical description & quantities as per specification shall prevail).

BIDDER'S STAMP & SIGNATURE



**TECHNICAL SPECIFICATION FOR
IP BASED PUBLIC ADDRESS SYSTEM**

SPECIFICATION NO. PE-TS-445-557-E001

VOLUME II

SECTION : I

**1X600 MW SAGARDIGHI TPS UNIT#5 PHASE-
III**

REVISION 0

DATE 15.11.2023

SECTION – 'I'

SPECIFIC TECHNICAL REQUIREMENT

PUBLIC ANNOUNCEMENT SYSTEM

1.00.00 INTENT OF SPECIFICATION

- 1.00.01 This specification is intended to cover the design and engineering, manufacture, assembly, Inspection and testing at Bidder's works; delivery including packaging, crating in road worthy packing, installation and commissioning ~~freight, insurance, all taxes & duties~~ and other charges as applicable for the items and all accessories specified in the scope of supply and as required for safe and trouble free operation of creating one new Node Controller, Field Call Stations and Loud speakers **in BOP areas of 5th Unit** , interfacing the new IP based Public Address (PA) SYSTEM with existing IP PA system in 3&4 unit and installing new and additional Field Call Stations and Loudspeakers which will be connected to existing IP based CHP PA System at new CHP areas under Unit#5
- 1.00.02 The PA system covered herein shall also include site unloading, handling, intra site transportation, site storage, complete erection, final check –up, testing and commissioning and all other incidental works thereto (like labour, supervision, supply of erection equipment and consumables as necessary) of the equipment and accessories to be supplied under this specification as specified here under.
- 1.00.03 It is not the intent to completely specify all details of design ,construction and interfacing with the existing PA system herein. Nevertheless, the system shall conform to high standard of engineering, design and workmanship in all respects and shall be capable of performing satisfactorily in continuous commercial operation under the specified environmental condition.

2.00.00 ABBREVIATION

- BOQ - Bill of Quantities
- CCB - Central Control Building
- CCR - Central Control Room
- DCS - Distributed Control System
- DVSP - Digital Voice Storage Playback
- GCC - General Conditions of Contract
- LED - Light Emitting Diode
- LOI - Letter Of Intent
- MDF - Main Distribution Frame
- MTTR - Mean Time To Repair

- PA - Public Address
- PABX - Private Automatic Branch Exchange
- PC - Personal Computer
- QAP - Quality Assurance Plan
- RH - Relative Humidity
- RMS - Root Mean Square
- SPL - Sound Pressure Level
- UCR - Utilities Control Room
- UHF - Ultra High Frequency
- UPS - Uninterruptible Power Supplies

3.00.00 SCOPE OF WORK

3.01.00 General

- 3.01.01 The scope of work in this document specifies the technical & contractual requirements for the design, supply, erection, testing and commissioning of adding new Field Call Stations and Loud speakers in new CHP areas and connecting the new FCS and Loudspeakers to existing **IP PUBLIC ADDRESS (PA) SYSTEM of CHP of Unit 3 and 4. The scope also includes the** creation of one new node and interfacing of the new IP PUBLIC ADDRESS (PA) SYSTEM with existing IP PUBLIC ADDRESS (PA) SYSTEM of BTG and BOP area of Unit 3 and 4 for the Project as “turn-key” plant-wide stand-alone package unit with suitable interfaces as specified.
- 3.01.02 Bidder shall be fully responsible for both the products and their relevant compliance with the requirements of the specification.
- 3.01.03 Provisions included in the specification will not be limitative to the scope of work.
- 3.01.04 Bidder shall provide for any further activities which will improve the quality & performance of the system offered.
- a) Tentative equipment type & location of Public Address System is listed in the Enclosure-A. Based on project requirement the quantities required shall be supplied by the Bidder and detailed information and quantities shall be furnished by the Bidder during detailed engineering for Owner’s review.
 - b) Bidder shall indicate the unit price for each type and size of equipment / items

detailed particulars such as equipment rating, contract value, name of the Owner, year of supply etc.

3.02.00 Inclusion in Supply

Bidder's scope of supply shall include but shall not be limited to following.

01. Plant IP Public Address & Paging System Node Controller compatible with existing IP based PA System for Unit # 3 and 4, Call Stations, Loudspeakers, Ethernet Switch, Sound Proof Hood, Laptop/Computer for Programming, Configuration and Diagnostic software for the new Node Controller which shall be connected to the existing IP based BTG and BOP PA System etc. with all accessories specified herein/Data sheet and other Technical Attachment Sheets.
02. Laptop/Computer for Programming, Configuration and Diagnostic software for the Call Stations and Loudspeakers which shall be added to the existing IP based CHP PA System
Refer clause no. 19.00.00 for Laptop specification
03. Development, supply & installation of required software for the total system.
04. Associated copper, Cat6 and fibre optic cable for interconnection.
05. Necessary erection hardware.
06. Recommended spares for 3 (three) years for the entire system trouble free operation.
07. Accommodation, transportation and all necessary permits, clearances and protective safety equipment for Bidder's personnel.
08. Mandatory spares as specified.
09. Erection / commissioning spares.
10. Consumables.
11. Special Tools & Tackle and test equipment.
12. Earthing as required for PA system
13. The items not mentioned but required for successful completion and guarantee run of the project / system including modification, addition in existing system shall be in the scope of the tenderer
Refer BOQ cum price schedule for complete items for the project

3.03.00 Scope of Service

Following service shall be provided by Bidder for equipment & systems supplied under this specification. However, Bidder has to provide the services required for completeness and correctness of the system irrespective of whether it is mentioned in the specification or not:-

01. Manufacture of all items as per requirement of specification, assembly etc.
02. System Engineering, development of software etc.
03. Furnishing drawings, documents, data sheets, manuals/catalogs as specified
04. Inspection and testing at Bidder's works as per the Quality Assurance Plan
05. Packing and forwarding of all equipment included under this specification.
06. Erection, Installation and commissioning, site testing of equipment supplied under this specification.
07. Laying & Termination of signal, power and grounding cables, providing earthing of the system and equipment as specified.
08. Establish the specified interfaces and demonstrate operation. Interfacing the new IP PA system Node Controller with existing IP based PA system of unit# 3 and 4.
09. Establish the specified interfaces and demonstrate operation. Connecting the new IP PA system Call Stations and Loudspeakers with existing IP based PA system of CHP.
10. Vendor will, during the time of detail engineering and installation of the quoted system, interact and coordinate with any other agency regarding collection/retrieval of inputs/information/data and all such works shall be under the scope of this Vendor. If necessary, the Bidder shall contact the Owner before submission of their quotation.
11. Project management and scheduling including micro-planning in specific work area and reporting progress periodically.
12. Site modification and preparation of "as-built" documentation".
13. Prepare "Handing Over" protocol and hand over system to Owner.
14. Securing certification from relevant authorities, wherever applicable.

3.04.00 Scope of Documentation

01. Prepare work definition and interfacing requirements of all system components.
02. Provide system design documentation.
03. Provide all commissioning and test procedures.
04. Provide inspection, commissioning and test procedures for Owner's

approval.

05. Operating & service manuals and handbooks.

06. Tag all equipment as per Project Specification Project Procedure.

4.00.00 PERFORMANCE GUARANTEE

4.00.01 The Systems / Equipment to be supplied under this specification shall meet the guaranteed performance specified in the enclosed data sheet, specification sheet and technical attachment sheet when operating at the rated / specified conditions. The acceptance of the System / Equipment shall be subject to satisfying these parameters during shop test at Bidder's works and / or at site installation in complete assembled condition.

4.00.02 Performance figures quoted by Bidder shall be guaranteed within the tolerance permitted by relevant standards. In case of failure of the equipment to meet the guarantee, the equipment may be liable for rejection or the decline in performance from the guaranteed performance figures will be rectified by the Bidder without any extra cost.

5.00.00 TECHNICAL DESCRIPTION

5.01.00 General Requirements

5.01.01 For BTG and BOP areas, there shall be Node Controller, Desk top Call Stations, Indoor Call Stations, Out door Call Stations and Ethernet Distribution Switching units. The Call Stations (IP addressable type) and Loud speakers shall be connected to new node Controller and subsequently, the new Node Controller, located at Central Equipment Room Unit#5 shall be connected to the existing node of IP PA System of Unit 3 and 4 (Industronic make) for all areas in new BTG and BOP areas under Unit#5 over dual redundant OFC network. The connectivity of Call Stations and loudspeakers shall be through Cat 6 or paired cable.

5.01.02 For CHP areas, the Call Stations (IP addressable type) and Loud speakers shall be connected to the existing IP based CHP PA System Controller (Commend make). The connectivity of Call Stations and loudspeakers shall be through Cat 6 or paired cable.

5.01.03 The system will be installed in an adverse industrial environment. Equipment in some areas will be subject to vibration, dust, oil/water vapours as prevalent in thermal generating plant.

The new PA Controller at CER , Unit# 5 shall cater the areas such as entire Boiler area, Power house: building, Vacuum Pump house U#5, CW pump house area, CPU Control room. The different types of speakers and Call Stations shall be deployed over locations around each of the nodes. In noisy areas shall be used along with acoustic Hood .

5.01.04 The existing PA Controller of IP based CHP PA System (Commend make) shall serve the areas around CHP such as wagon tippler, Bunker floors, Crusher House etc. The new speakers, FCS for new areas under CHP in Unit#5 shall be connected to the PA controller through fiber optic cable network and Cat

6/ Paired cable. The structure of the fiber optic cable backbone, field ethernet switches, number of master call stations etc may be subject to changes during detail engineering stage. The different types of speakers and Call Stations shall be deployed over locations around each of the nodes. In noisy areas shall be used along with acoustic Hood.

- 5.01.05 Equipment shall be self-protecting against transients in the input A.C supply and against failure of any component or cable in the entire communication system. The In-Plant Paging system shall provide zoned and plant-wide paging together with a min 2 party communication channels within each zone or plant area.
- 5.01.06 Required functions for individual stations shall be programmable and configurable through pre-loaded software that permits local changes to the configuration. Levels of system access and privileges shall only be assignable to selected individuals.
- 5.01.07 The area coverage will be such that calls will be clearly audible in the paged operating areas and their surrounding space.
- 5.01.08 The plant area shall be divided into zones each with sections. Final distribution of units over the zones will be finalised during detailed design. This will be related to area configuration and other operational objectives.
Refer clause no. 6.04.06 & Enclosure-A for details of zones
- 5.01.09 Some PA and Industrial Talkback field call station units may be located in areas with a fair degree of background noise. Therefore, the requirements shall be for directional dynamic microphones, with strong noise suppression together with input/pre-amplifier sections including filtering and speech compression giving the highest practicable levels of intelligibility.
- 5.01.10 The In-Plant Paging system shall provide zoned and plant-wide paging together with a minimum of 2 Channel-party communication channels within each zone or plant area and allowing minimum one (1) simultaneous conversation within the area (zone).
- 5.01.11 Facilities shall be provided for local loudspeaker muting to prevent acoustic feedback that may be generated from nearby access panels.
- 5.01.12 Any field call station can selectively dial any other call station from its inbuilt dialling pad without the manual intervention of any zonal operator. The intelligence unit, dialling button/keypad etc shall be an integral part of the call station and shall not be procured from different OEMs and combined.
- 5.01.13 All the system elements in PA and Industrial Talkback system viz. Node Controller, field call station, speaker shall be sourced from the same OEM.
- 5.01.14 The powering philosophy for PA and Industrial Talkback system and other allied accessories shall be as under.
- a) The system will be powered from a suitable Central UPS system located in main plant under Purchaser's scope. The power distribution board, MCB, power supply cable and other sundry items required for powering the equipment shall be provided by the Bidder. The UPS power supply at various locations for Call Stations and loud speakers, if required shall be

shall be under the scope of the Bidder. For other offsite areas, where UPS power from the nearest UPS system is if not available, individual Mini UPS shall be provided by bidder. For Mini UPS specification refer cl. no.20.00.00

Extending the UPS power supply from the distribution boards up to the equipment and providing all cables, distribution boards, MCB etc shall be under the scope of the Bidder.

b) The distribution board, 3 core, 2.5 sqmm power supply cable and protection device such as MCB etc. shall be provided by the Bidder. Extending the power supply upto the point of installation of telecom equipment , providing power supply cable , MCB etc. shall fall under the scope of works of the Bidder.

c) The power supply unit shall be able to supply the whole equipment load and allow 50% future growth. It shall be fitted with suitable optical indication of correct working condition

5.01.15 The Bidder shall provide the earthing of the system system as per their industry standard. The telecom earth shall be connected to the electronic earthing system by the Bidder under their scope.

5.02.00 Detailed Characteristics

5.02.01 The equipment shall be fully solid state type, microprocessor based and programmable.

5.02.02 The Operator Access Unit/Desk Top Call Station shall be microprocessor based and connected to the New Node Controller using Cat6 or suitable cables.

5.02.03 New Node PA Controller at CER shall be fibre optic interfaces to establish optical communication over OFC link with existing IP based PA System of Industronic make.

5.02.04 Configuration of the system shall be achieved by software for maximum flexibility. A "user friendly" setting up and checking routine shall be provided which enables an operator using a PC to implement speed commissioning and fault finding functions. The use of these methods shall allow adjustments to be easily made when the system is installed without resulting in modifications to the system wiring. The system shall be provided with standard serial interface (preferably a USB connection) to be connected with a laptop for local and remote access for maintenance and operations activities. One Notebook PC shall be provided for these functions.

5.02.05 All software utilized shall be the latest and upgraded version.

5.02.06 The system shall be designed to comply with EMI and RFI Regulations particularly the requirements of IEC 61000 series.

5.02.07 The existing PA System for CHP area-Unit 3 and 4 is of Commend make and existing PA System for non-CHP area-Unit 3 and 4 is of Industronic make.

5.03.00 NEW PA NODE

- a) New node voice and alarm distribution equipment shall be located in a standard 19 inch racks and shall comprise of :-
 - [01] A microprocessor adaptable communications engine "node", which shall provide voice and alarm management and system diagnostic surveillance.
 - [02] Intelligent compound Bipolar/Mosfet 'D' type audio power amplifier plug/out modules. Alternatively, external audio power amplifier shall also be usable.
- b) The system shall not depend upon the presence of the P.C. for any operational function.
- c) It shall be possible to download all configuration parameters and to retrieve the status of the voice alarm system either locally or from a remote location without taking the system out of service.
- d) The system shall operate in distributed networked mode where the remote nodes are connected to the central control equipment via fibre optic rings and spurs from the fiber optic rings.
- e) Power supplies will be 240 VAC / 50 Hz / Single Phase UPS System.

5.03.01 Interface with existing PA System

An interface to the existing IP based PA system shall be provided to enable users to broadcast speech announcements from new PA system loud speakers and Call Stations to the existing one and vice versa. The system interface to the existing PA system shall be based on open industry standard protocol and include the necessary software and hardware requirement. The connectivity with the existing PA System shall be dual OFC Ring architecture. Facilities shall be included to prevent acoustic feedback that may be generated from call stations situated close to loud-speakers.

5.04.00 Technical Features

5.04.01 The design of the system and distribution of loudspeakers and flashing lights shall be based on the following requirements :

- a) The alarm signal level at every location on the installation shall exceed background noise level, at that location, by at least 10 dB. Greater than 20dB is undesirable.

5.04.02 The main design criteria for coverage shall be:

- a) Areas with average noise level below 86 dBA shall have complete audible voice and alarm coverage with all loudspeakers working, and complete alarm tone coverage with half the loudspeakers on.
- b) Areas with average noise level above 83 dBA shall have a partial audible voice coverage during operation. Alarm and voice signals shall be completely audible when ambient sound level is reduced below 83 dBA as during maintenance.

- c) Loudspeakers will also be installed in areas where the audible communication is impossible during normal operation due to high ambient noise level. The system in that particular area shall be designed for the situation when the particular noise is shut off.
 - d) The Bidder shall be fully responsible for the design and distribution of loudspeakers across the plant including all buildings to ensure intelligible and adequate message broadcast.
- 5.04.03 After the completion of installation the system coverage shall be tested using SPL meter to ensure adequate coverage of the plant and its associated buildings.
- 5.05.00 System Cabinet
- 5.05.01 The control sub-system, speech amplifiers and their ancillary devices shall be housed in a 19" standard rack mounted system cabinet with all control, power circuits and necessary amplifiers and shall be supplied in pre-wired conditioned and shall be completely tested at manufacturer's works prior to despatch.
- 5.05.02 This shall meet the technical requirements as described in clause no. of the specification 14.00.00 of this specification
- 5.06.00 Control Sets
- 5.06.01 A directional gooseneck microphone shall form part of each control set. When the microphone shall be use, nearby loudspeakers shall be muted to avoid acoustic feedback. The microphone amplifier shall be fitted with an automatic gain control for convenience in use.
- 5.06.02 Each control set shall be equipped as minimum with the following:
- a) A magnet dynamic, gooseneck microphone and a telephone handset with automatic switch from the microphone to the handset upon lifting the last one.
 - b) Necessary lamps, push buttons, switches, and indicators to monitor and control the system.
- 5.07.00 Loud Speaker
- 5.07.01 General Requirements
- a) The loudspeakers shall be normal, weatherproof in all locations and explosion proof type, depending upon the location in which they will be installed.
 - b) The nominal power is intended as the power of a sinusoidal signal continuously applicable without damage. All speakers shall have the same rated power and shall be adjusted to provide the required coverage.

- c) The primary winding of the transformer shall be tapped so that the loudspeakers will absorb from the line 100%, 50%, 20%, or 10% of its power, according to the tap used.
- d) The reproduced frequency band shall be at least 370 to 6000 Hz for all the transducers, within +/-6 dB range.

5.07.02 Weatherproof Loudspeakers

- a) They shall have protection to meet IP 65, IEC 60529 Publication.
- b) The explosion proof requirement shall be in accordance with the area classification in which it will be installed.
- c) The utilised material shall be polyester resin armoured with fibre glass or equivalent, suitable to resist the aggressive atmosphere. The loudspeakers shall have a diffusion angle between 100° and 120° with the minimum sound pressure level, measured 1 m away along the diffusion axis, when a continuous constant level sinusoidal sound signal with 1 W power is applied and the transformer is tapped for the maximum absorbed power shall be minimum 107 dBA.
- d) The indoor loudspeakers installed in various buildings shall provide pleasant appearance and blend with the surroundings.

5.07.03 Acoustic Feedback Protection

The system shall be fitted with devices to enable and affect frequency shifting of voice input during PABX radio access. Acoustic feedback via telephone or radio connection to the PA/alarm system can only be totally eliminated by the use of a digital voice storage/play-back (DVSP) unit.

5.07.04 Power Supply Unit

- a) Refer clause no. 5.01.14 (a)
Distribution board shall be fixed, modular type, sheet steel, IP 54 enclosure and Free standing (can be attended from both front & back) Individual MCB to be provided in incoming as well as in outgoing of distribution board.
- b) The distribution board, 3 core, 2.5 sqmm power supply cable and protection device such as MCB etc. shall be provided by the Bidder. Extending the power supply upto the point of installation of telecom equipment , providing power supply cable , MCB etc. shall fall under the scope of works of the Bidder.
- c) The power supply unit shall be able to supply the whole equipment load and allow 50% future growth. It shall be fitted with suitable optical indication of correct working condition.

- 5.08.00 Mean Time to Repair (MTTR)
- 5.08.01 The design and construction of the PA system shall ensure high reliability and availability.
- 5.08.02 The PA system shall employ modular constructional techniques in its design. Allowing a first line maintenance philosophy of module replacement to be implemented.
- 5.08.03 The average module replacement time for the system is less than 1 hour as long as the correct spares holding are maintained as recommended by Bidder.
- 5.09.00 PA Node System
01. System : Min.2-Channel Page & Party
 02. System Architecture : Separate functional groups (Field call stations / Loudspeakers)
 03. Zone Station : Area-wise
 04. Master Control : One station (1)- coordinating Zone Stations.
 05. Zone call discipline : Between Zones & Master station
 06. Master call discipline : All Zone stations
 07. Alarm siren : From MCS on Zone basis/plant basis
 08. Override : From MCS for broadcast.
 09. Operating Voltage : 240 Volts 50 Hz AC
 10. Master Control Station : Rack mounted, free standing
 11. Location : Indoor, air-conditioned
 12. Support capability : Expandable to 100 zone stations
 13. Interface required : EPABX & Radio & Existing Intercom Telephone EPABX system (Unit 3& 4).
 14. Input sources : Voice, tones, prerecorded messages, music
 15. System features : Private communication, conference call, PA
 16. System programming : Field Programmable, touch screen
 17. Desk Top Call Station : Desk-top, Indoor, air-conditioned
 - Microphone : Gooseneck(>400mm)

- Enclosure : Plastic ABS
 - Zone selection : Dedicated buttons
 - Emergency features : One touch paging, caller ID, Speed dialling
18. Field Call Station : Hands-free, wall mounted/desk top, dual direct.
- Location : Indoor/Outdoor
 - Mounting : Desk/Wall mounted
 - Protection : Corrosion resistant & pilfer proof.
 - Protection Class : IP65 for Outdoor
 - Body : Heavy duty GRP.
 - Microphone Type : Gooseneck (>400mm).
 - Volume Control : Via keypad.
 - Body : Moulded Polyurethane
 - Operating voltage : 24 V DC.
 - Distance : 2Km (max.).
 - Loudspeaker Output : Yes

The indoor call stations located other than control rooms or RIO rooms shall be atleast IP 54.

5.10.00 Weather Proof Horn Type Speaker (15 Watt)

- 01. Housing : Special Plastic
- 02. Connection : Screw Terminal
- 03. Ingress Protection : IP65
- 04. Weight : Bidder to quote
- 05. Colour : Light
- 06. Mounting : Plastic Bracket/Stainless Bracket
- 07. Rated Power : 15 watt
- 08. Transformer : 100v; 25/14/7. 5/2 watt
- 09. Sound Pressure Level : 110dB
1W,1m
- 10. Sound Pressure Level : 120dB
25W,1m
- 11. Frequency Range : 370Hz to 7000Hz
- 12. Dispersion-6dB- : 140° /40°

1KHz/4KHZ

- | | | |
|---------|---|--|
| 5.11.00 | Indoor Speaker (10 Watt) | <ul style="list-style-type: none"> 13. Operating Temperature : -10°C to 60°C |
| | <ul style="list-style-type: none"> 10. Houshing : Special Plastic 11. Ingress Protection : IP40 12. Weight : Bidder to quote 13. Connection : Clamp 14. Volume Control : Required 15. Rated Power : 6 Watt 16. Transformer : 100v 6/3/. 5watt 17. Sound Pressure Level : 91dB
1W,1m 18. Effective Frequency Range : 100 to 20000Hz | |
| 5.12.00 | Ceiling Mounted Speaker (6 Watt) | <ul style="list-style-type: none"> 01. Housing : Plastic ABS 02. Sound pressure level, power Watts/1m, dB : 103 dB 03. Nett weight, Kg : Bidder to quote 04. Effective frequency range, : 100-15,000 Hz 05. Transformer Power : 0.75, 1.5, 3.0, 6.0, 10
tappings, Watts 06. Input impedance : 13.33k, 6.6k, 3.3k, 1.66k, 1.0k
standard model, Ω 07. Impedance : 8 Ω 08. Operating Temperature : 0°C to +50°C 09. Protection class : IP-40 |
| 5.13.00 | Weatherproof Outdoor Call Station | <ul style="list-style-type: none"> 01. Glass fiber reinforced polyester housing, pilfer proof type |

02. Plug in front unit with all functional parts
03. Dial keypad
04. Call or busy signal by light emitting diodes
05. Noise compensated inbuilt microphone with dynamic compression and PTT operation
06. Microphone sensitivity and volume control
07. Potential free relay point
08. Connector for optional amplifier booster amplifier
09. Direct intercom connections
10. Can be switched to low volume
11. Led indication of incoming call and line busy, prioritized
12. Supply voltage range : 48-60 v dc
13. Max. Quiescent current : 25 mA
14. Max. Operating current : Approx. 125 ma
15. Loud speaker : 15 w
16. Frequency range : 300 hz to 3.4 khz
17. Electrical data booster amplifier - output power : 25 w / 400 ohm
18. Operating temperature : -10° to +60° celcius
19. Protection class : IP-65
20. Area of use : Non hazardous

5.14.00 Indoor Call Station

01. Plastic housing (ABS) with aluminum base plate, pilfer proof type
02. Gooseneck microphone (300mm)
03. Integrated full range speaker, 8 Ω
04. All keys with individual labelling area
05. Call or busy signal by light emitting diodes
06. Noise cancelling goose neck microphone with dynamic compression
07. Microphone sensitivity and loudspeaker vol control
08. Monitoring of microphone function
09. Potential free relay contact

10. Supply voltage range : 48-60 V DC
11. Frequency range : 300 Hz to 7 khz
12. Max. Quiescent current : 50 ma
13. Max. Operating current : 180 ma
14. Amplifier power rating : 1 W
15. Loudspeaker : 5Watt/8Ohm
16. Average speech power : (1 W / 1 m) 86 db
17. Electrical data booster amplifier - output power - 25 W / 400 Ohm
18. Operating Temperature : 0° to +50° C
19. Protection class : IP30 or better (in control room)
20. Humidity non-condensing : 90%

The indoor call stations located other than control rooms or RIO rooms shall be atleast IP 54.

5.15.00 Type of Instruments shall be designated as below:

- a) Type-A: Handset Station complete with or without Handset and amplifier with indoor type enclosure. It shall be suitable for mounting on wall/column with in covered area inside building.
- b) Type B: Call Station with or without Handset and amplifier with outdoor type enclosure. It shall be suitable for mounting on wall/column in open area. The enclosure shall be dust proof, water proof as per industrial standard. It shall be provided with canopy.
- c) Type-C: Desk Top Mounted Handset complete with Handset and amplifier. It shall be suitable for mounting/placing on table with in control rooms.
- d) Type-D: Outdoor type PA Instrument complete with microphone, speaker and amplifier, but without handset. The communication shall be possible thru built in microphone. The enclosure shall be dust proof, flame proof, water proof as per industrial standard. It shall be provided with canopy.
- e) Type-E : Plug in type socket for communication with the help of Portable PA Inst

5.16.00 Acoustic Hood

- 01) Housing - Rot/vandal resistant glass re--enforced polyester /Hot-galvanized sheet steel or stainless steel with 15 watt lamp
- 02) Self colour-yellow, visible during emergency/Paint- Powder Coated
- 03) Luminous yellow green glow in dark condition, lasting up to minimum 10 hours or more

- 04) Sound absorbent- Up to 12 dB(A) when it will be used as Acoustic Hood
- 05) Resistant to chemical spillage/vapours and are fire-retardant and weather proof
- 06) Flashing beacons telephones and sounders can be attached to the hood
- 07) Temperature Range : +60 Deg C to -10 Deg C
- 08) Humidity : Up to 100%
- 09) Weight : 15 Kg or less
- 10) Maximum Load weight : 20 Kg
- 11) Insulation : Rockwool RAF-SE
- 12) Dimension : As per Vendor
- 13) Canopy
 - i) Canopy shall be of weatherproof type. It shall have cover to open from the side.
 - ii) When the canopy cover shall be opened, it shall be in open position and shall have to be closed manually.

5.17.00 Ethernet Switch

- a) The Layer 2 switch, Industrial grade switch and the fiber/copper module should be from the same OEM/Make. The proposed switches should be offered with 1 year replacement warranty for switches.
- b) The minimum technical requirement of switch is given below :
 - i) Layer 2 Switch-Distribution

Layer 2 switch	
Features	Description of Specs
Interface requirements	Adequate no. of ports plus 20 % spare capacity of 10/100/1000 Base T with 4x SFP port . Additional 4x SFP port upgradable to min 4 xSFP+ ports for and SFP ports should work simultaneously without any restriction as per strategic switch placement with fiber environment.
	1 x Out of Band IP based management Port , 1 Console Port, USB Port / External Flash
	Support stacking for up to 8 switches with minimum 30 Gbps stacking. Stacking option should be ready from day 1 .
	Have Redundant Power Supply support and variable speed fan to adjust to varying weather conditions in campus

Design & Performance	Each switch should have minimum 128 Gbps or more with non-blocking architecture and Forwarding rate of 95 Mpps Should be equipped with minimum 1GB RAM and 4 GB flash
	Should have LED indicator for per port status , FAN, PSU and Management Status
	0°C to 50°C operating temperature and 10% to 95% relative humidity
	Hardware and software configuration have for IPv6 from day one
Switching / Routing	Should have 16 K MAC Address, 1 K active Vlans .
	Should support 10 K ARP entries
	802.1D spanning Tree and PVST+, 802.1w, 802.1s , Should have BPDU Guard or equivalent feature on edge port to auto disable port for a configurable time period to if an accidental loop occurs in the network
	Should support aggregating and load balancing of traffic to two or more peer switches within same VLAN
	Should support G.8032 standard based protocol for ring backbone
	Should have Port based VLAN, MAC based VLAN, private vlan and 802.1 AK for dynamic VLAN propagation
	Should have Local, Remote and multisession port mirroring (minimum 4 session)
	Support Standard based protocols for lossless transport of real time data with dynamic QOS reservation.
	Should have 8 Hardware QOS Queues per port
	Should have traffic rate limiting with Configurable bandwidth granularity of 8 KBps
	Should have Link Layer Discovery Protocol (802.1ab) to allow recognition of third party network devices and LLDP MED for auto configuration
	Should have MAC address tracking and notification for mac address addition , delete or movement in the Network
	Should support policy based routing and switching
	Should have basic dynamic routing protocols like RIP from day 1 and be upgradeable to OSPF , PIM , VRRP
Should have Configurable multicast session limit per port	
Security	Local authentication database for RADIUS Authentication for 802.1x login
	Should have MAC security – Lockdown & Limit and MAC address tracking with syslog & snmp notification
	Should have SSH-2, SCP, SFTP for secure management
	Should have dynamic arp inspection , DHCP snooping, Private VLAN, SYN attack protection, GARP protection
	Should have ASIC based traffic flow analysis based on Netflow/ sFlow/ Ipflix
	Should have minimum 1 K ACL entry support and Time Based ACL

Management	Should have scheduled archiving / uploading of configuration and system log to a central server
	Should support inbuilt DHCP server and Client for quick configuration of endpoints and switch
	Telnet server , ssh server, Ping and traceroute over Ipv6
	Should have L2 Traceroute, L2 Ping and Multicast Traceroute
	Web, Console and CLI management
	Dual firmware and configuration rollback
	Should be SDN capable with Openstack support and OpenFlow API support, Should support IEEE P802.1Qaz
	Inbuilt browser based bandwidth monitoring
	Should support Energy Efficient Ethernet 802.3az
Certification	Model should have safety and standards certifications as below : IEC61000-4-6:2008/EN61000-4-6:2009, IEC61000-4-8:2009/EN61000-4-8:2010 , EN55011:2009+A1:2010, EN 55022:2010 Class A, CISPR 22:2008 Class A, CISPR24:2010ClassA, Radiated Immunity 10V/m,80-960MHz, CriteriaA, UL60950-1 2ndEd, CE 2.0 Compliant

Ethernet switches shall be of POE type. Ethernet switches shall be 8/16/24 port depending upon the no. of handsets connected. Canopy to be provided for housing Ethernet switches located in outdoor areas.

ii) Fiber Module Specification:

Wave length: 1310 nm, Single mode support for min 10 Kilometers. Same Make as Ethernet Switch. Data rate min 1 Gbps, Plug and play option , self locking for the ease of maintenance

5.18.00 CAT 6 UTP 4-pair Cable

All cables shall be 4-pair 100 ohms balanced paired cables. They shall be unshielded twisted pair cables (U/UTP) meeting or exceeding the quality and performance requirements for Category 6 cables stipulated in EIA/TIA-568-C-2 standard.

Unshielded twisted pair cabling system, TIA / EIA 568-C-2 addendum Category 6A Cabling system	
Networks Supported	Support for Fast Ethernet and Gigabit Ethernet, 10G, IEEE 802.3/5/12, Voice, ISDN, ATM 52 & 622 Mbps, Broadband, TP=PMD and ITU V.21 and X.11
Warranty	25-year Performance warranty; Warranty to cover Bandwidth of the specified and installed cabling system.
Performance characteristics to be provided along with bid	Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR for 4 Connector channel.
Site Certification	Site certification to be done by OEM certified installer for 25 years and certificate to be issued from OEM.

The important parameters of Cat 6 shall be as under but not be limited to the following.

- a. 23 AWG Annealed bare solid copper, CAT-6 U/UTP Cable, Channel optimized to 500 Mhz or more.
- b. It shall meet EIA/TIA 568-C.2 Category 6 specifications, UL Listed. Cat 6 U/UTP Solution Zero bit error rate ETL report need to submit. Cat 6 4 Connector Channel Performance ETL Certificate need to be submit to validate the cable channel performance..
- c. The Worst Case Cable Skew shall be 50 nsec/100 meters
- d. The Characteristic Impedence shall be $100 \pm 6 \Omega$ @ 1-500 Mhz
- e. The Conductor Diameter shall be 0.65 mm (nominal)
- f. The Insulation shall be polyethylene
- g. The cable shall support for Fast Ethernet and Gigabit Ethernet,10G, IEEE 802.3/5/12, Voice, ISDN, ATM 52 & 622 Mbps, Broadband, TP=PMD and ITU V.21 and X.11
- h. The DC Resistance shall be Max: 75 Ohms/1000m
- i. The Solid Cable should be compliance to RoHS.
- j. The Cable should be Sheath Fire retardant PVC Compound (FRPVC) Flame Rating : 60 deg. C As per UL 1685 CM
- k. PAIRS Colour code: Blue / White-Blue, Orange / White-Orange Green / White-Green, Brown / White – Brown
- l. The Outer Sheath PVC compound Thickness Diameter shall be 1.45 mm (nominal) Outer diameter 9 mm (nominal)
- m. The Mutual Capacitance shall be 45pF/mtr
- n. The Standard length shall be 305 Mtrs (1000 ft.)

5.19.00 Single Mode Fiber Optic Cable

The specification of Single Mode Fiber optic Cable-Armoured shall be as per clause no. 15.00.00 of this specification

5.19.01 Cat6 Patch Cord

- a. Patch cords shall be of multi strand copper cable with UL Listed.
- b. With Matching colored snag-less, elastomer polyolefin boot
- c. Terminals with gold contacts, 50 micron" gold over nickel
- d. Patch cord has a characteristic impedance of 100 ± 3 Ohms
- e. Patch cord has extra long boot to maintain the bend radius.
- f. Assembled with short body RJ45 50u gold plate to minimized untwist pair length. ·
- g. Designed for high speed transmission ·
- h. Improved PS -NEXT, ELFEXT and Return Loss performance. ·
- i. Back-ward-compatibility with all current Cat.5 products and applications.
- j. Material : ROHS compliant

5.19.02 Network Rack

- i) The network equipment like switch, fiber distribution frame/LIU, twisted pair patch panel, etc. Shall be housed in network racks of suitable capacity in some designated room.
- ii) The usable size of network rack shall be not less than 6U and 9U. All the rack sizes shall be decided by the Bidder considering the quantity of switch, fiber and copper patch panel, space for NAS server, inter equipment spacing as well as 20% spare space etc.
- iii) The network rack shall have following minimum specification in addition to the required accessories like basic frame, side panels, top and bottom cover, leveling legs, doors etc to ensure completeness of the enclosure –

- 01. Basic Structure : Cabinet should be as per DIN 41494 standards, Basic structure of CRCA Steel (CRCA Should be "IS 513 Gr D" standard) in a welded Rigid construction frame with top, bottom and side frame at least 1.2 mm thickness., It should be able to take load of 40 Kg
- 02. Front Door : Front Glass toughened and tinted, with easy detachable hinges. Glass Door with lock – should be easily removable type.
- 03. Side Panel : Fixed Side Panel with top & bottom vented for easy air flow.
- 04. Space : Height - 9U overall height : 485.1mm;
Usable Height : 406.1mm
Height - 6U overall height : 341.75mm;
Usable Height : 272.75mm
Width – It should be 600mmW and 19"
Depth – It should be 500mm
- 05. Wall Mounting : Provision for easy wall mounting should be there with appropriate anchor fasteners
- 06. Heat Management : Rack must be provided with one fan directly mounted on the roof top as an exhaust from the cabinet. Fan should be of AC 230V with flow volume of at least 90CFM
- 07. Standard : Rack should conform to DIN41494 standard
- 08. Cable Management : Rack should be provided with cable management accessories.1U Cable

- manager
09. Powder Coating : Thickness Powder Coating of 80 to 100 Microns with scratch resistance properties.
10. Power Management : To avoid corrosion & rusting : Rack to be powder coated with Nano ceramic pre-treatment process using a zirconium coat, Rack should have PDU, 19", 6 nos octagonal sockets of 5/15 Amp with Indicator, 16Amp MCB
11. Manufacturers Details : 1. Manufacturer should have ISO 9001-2000 & 14001-2004 Certifications, Certificate needed to be submitted. . Process of Manufacturing of rack should have ROHS complied
12. Interior installation : 19" rack, rail system, power management with socket strips, cable management, earthing stud, cooling fan system, adjustable equipment spacing, server placement arrangement.

5.20.00 Cable (Over ground) [Twisted pair, Copper]

01. Conductor : Annealed, tinned, electrolytic grade
02. Conductor insulation : PVC
03. Conductor cross section : 1.5 sqmm.
04. Pair screen : Poly Myler tape
05. Overall screen : Poly Myler tape
06. Drain wire : Tinned copper
07. Sheath : PVC
08. Armour : GI Wire
09. Overall insulation : PE/PVC, FRLS & Anti-rhodent treated
10. Usage : Area subdistribution

Also, refer clause no. 17.00.00 of this specification for cables technical details

6.00.00 ERECTION & COMMISSIONING

Bidder's scope of work shall include the erection and commissioning of the entire system offered. Bidder shall include all erection materials, consumables etc for the purpose. Bidder shall arrange all erection tools, tackle and calibration instruments.

6.01.00 Inclusion in Erection Supply & Works

6.01.01 Supply of erection hardware with all accessories as specified herein.

- a) Erection of equipment with all erection material & accessories
- b) Cabling works as specified.
- c) Pre-commissioning activity, loop checking, calibration & testing
- d) Provide supervision of all above activities.
- e) Supply of consumables
- f) Supply of erection/commissioning spares.
- g) Providing all necessary Tools & Tackle
- h) Painting with anticorrosive paint wherever required.
- i) Commissioning.

6.02.00 Scope of Erection Service

- 01. Keep calibration records.
- 02. Maintaining proper documentation & handing over to Owner.
- 03. Create defect records and insurance claim documentation.

6.03.00 Technical Specification Of Erection Hardware

- a) This section provides the general technical requirements for the erection hardware to be supplied under this package.
- b) All erection materials shall be of good quality and conform to the operating environment of the plant.

6.03.01 Rigid Steel Conduit

This shall meet the technical requirements as per clause no. 16.00.00 of the specification

6.03.02 Flexible Conduit

This shall meet the technical requirements as per clause no. 16.00.00 of the specification

6.03.03 Special Fittings

This shall meet the technical requirements as per clause no. 16.00.00 of the specification

6.03.04 Cable Glands

This shall meet the technical requirements as per clause no. 16.00.00 of the specification

6.03.05 Earthing Wire

This shall meet the technical requirements as per relevant standard & as per specification

6.04.00 General Guidelines & Practice for Erection

Erection procedure shall follow sound engineering practice throughout and shall not cause hindrance to the activities of other Bidders at the work site. The sequence of work activities shall follow logical sequence and shall be based on work-front availability.

6.04.01 Panels & Cubicles

This shall meet the technical requirements as per clause no. 18.00.00 of the specification

6.04.02 Cabling Works (Overground)

This shall meet the technical requirements as per relevant standard & as per specification

6.04.03 Conduiting Works

This shall meet the technical requirements as per relevant standard & as per specification

6.04.04 Cabling Works (Underground)

This shall meet the technical requirements as per relevant standard & as per specification

6.04.05 Earthing

This shall meet the technical requirements as per relevant standard & as per specification

6.04.06 PA system shall comprise following separate zones:

- a) Zone-I for Unit #5
- b) Zone-II Common area
- c) Zone-III for CHP Area

Number of nodes (ethernet switches) decided during detailed engineering shall be connected in ring for Zone-I & Zone-II (depending upon location of handsets) to ensure a reliable and fast network. Handsets shall be connected in star fashion for Zone-II (depending upon location of handsets) and Zone III (in certain cases where distances between handsets is more).

Zone-I & Zone-II will be connected to New IP controller in main plant.

Zone-III shall be connected to existing IP controller of CHP area.



7.00.00 DOCUMENTATION

- 7.00.01 Details of documentation to be supplied as part of the System shall be submitted to Owner for approval prior to execution of the contract.
- 7.00.02 Each documentation deliverable shall be an integral part of Bidder's Project schedule and shall be identified by date for delivery.
- 7.00.03 All documentation shall be in the English language.
- 7.00.04 The following data shall be shown on all documents and/or drawings :
- Name of Bidder / Bidder
 - Correct and complete designation of the document
 - Exact indication of the scale employed
 - Revision Index and type of revision
 - Name of the site.
- 7.00.05 Bidder shall supply final approved sets of documentation in hard copy and soft copies on CD
- 7.00.06 Bidder shall provide the signature and seal on the each and every pages of this specification along with their offer for the confirmation to all the clauses. Along with submit deviation/clarification list if any in given format.
- 7.00.07 Final Documentation shall be assembled as per Owner's instructions for collation of Dossiers.
- 7.00.08 Following sections detail the minimum set of documentation that shall be supplied with the System.
- 7.01.00 Engineering Design Documentation
- 7.01.01 Bidder will produce drawings of complete system to be submitted to Owner for approval, indicating upon each the following :
- Overall dimensional drawing of system cabinet, console and its accessories.
 - Block diagram of system offered with a brief write-up on operation including hook-up arrangement with existing system.
 - Data sheets.
 - Bill of Materials.
 - Typical general arrangement drawings of various handset and speaker stations.
 - Schematic diagram of each type of station.
 - Mounting details.

- Cable connection diagram for various type of stations, clearly indicating cable size, number of pairs/cores etc.
- Total power consumption details.
- Heat load details of panel equipments.
- Technical leaflets on each piece of equipment viz handset, speaker etc.

7.01.02 The Systems Design Manual shall contain all relevant information pertaining to the design and operation of the delivered equipment.

7.01.03 This is intended to provide Owner with an understanding of the operational and design parameters of the equipment and to resolve System operational problems.

7.01.04 This documentation shall typically include the following items, presented in a Systems Design Manual:

- Equipment design calculations and selection basis.
- Equipment construction and assembly drawings.
- Parts list and drawings with manufacturer's identification codes.
- Systems connection diagrams.
- Accessories list and drawings with manufacturer's identification codes.

7.02.00 Operation & Maintenance Drawings and Documentation

7.02.01 The O&M Drawings and Documentation shall typically include the following items:

- Assembly drawings.
- Parts list and drawings with manufacturer's identification codes.
- Accessories list and drawings with manufacturer's identification codes.
- O&M schedules.
- Maintenance guidelines including lapping instructions.
- Troubleshooting guides.

7.02.02 The O&M manuals shall be submitted in the form of handy, hard bound books which can be easily handled and transported to site.

7.03.00 Drawing/ Document Submission Requirements

7.03.01 Bid shall contain at least the following documents:

Sl. No.	Document Type
01.	Supply Document list
02.	Supply program

Sl. No.	Document Type
03.	Data sheets
04.	Technical specifications and relevant drawings
05.	Start-up, Mandatory and Recommended spare parts
06.	List of Tools and Tackle
07.	Proposed System schematic diagram.
08.	Write up on architecture and operation of proposed system
09.	BILL OF MATERIALS with make and model no. of equipment
10.	Power requirement. (capacity of FCBC and SMF battery)
11.	Quality Control Plan

7.03.02 Following documents shall be submitted after award of contract :

Sl. No.	Document Type
01.	Supply Document List
02.	Supply Program
03.	Data Sheets
04.	System Architecture Drawing
05.	Constructive equipment drawings (PA Controller, Call Station and accessories dimensional dwgs)
06.	Technical Specifications (catalogues, assembly and erection specifications)
	Details of Panel and Installation
	Erection /Installation Drawing
	Equipment Layout Drawing in buildings / locations
	Wiring Diagram of Panel
	Cable Route Layout Drawing
	Power Distribution Scheme Diagram
	Cable schedule
07.	Test certificates
08.	Compliance certificates
09.	Quality Control Plan
10.	Test procedures

Sl. No.	Document Type
11.	Start-up , Recommended and mandatory spare parts List
12.	Tools and tackle & consumable list
13.	Operation and maintenance manuals
14.	Final vesion of all drawings and documents furnished with the Bid.

7.04.00 As-Built Drawings

Upon completion of the final acceptance of the System by Owner, all construction drawings shall be updated by Bidder to an as-built status to reflect the equipment and System configurations as actually installed.

8.00.00 TESTING

8.01.00 Factory Acceptance Test (FAT)

8.01.01 Factory Acceptance Test procedure shall be prepared by Bidder alongwith Quality Assurance Plan. The document shall be subject to Owner's approval.

8.01.02 All System equipment shall be tested in the factory prior to clearance for shipping. The FAT shall include individual equipment tests under fully assembled condition.

8.01.03 The FAT shall demonstrate adherence that the equipment meets the design standards and functional compliance.

8.01.04 One (1) month prior to the FAT, Bidder shall submit a test procedure to Owner for approval. . Duration of FAT at manufaturere's works shall be of adequate duration to complete the procedure to the satisfaction of the Inspecting Agency.

8.01.05 Owner's representative may, at Owner's sole discretion, attend the FAT. In this event, Bidder shall ensure all tests are carried out in the presence of Owner's personnel. If Owner declines to attend the FAT, Bidder shall carry out these tests and submit the results to Owner for review.

8.01.06 Factory Acceptance Tests (FATs) shall be documented with the results obtained and the success or failure of the test. The test results shall be submitted to Owner prior to clearance of the FAT and authority by Owner is given to ship.

8.02.00 Commissioning

8.02.01 Bidder is responsible for delivering a fully functional equipment that meets all the requirements of the Specification and applicable standards.

8.02.02 The Commissioning processes will demonstrate the above to Owner, before handing over of the System.

- 8.02.03 System Commissioning shall comprise of a number of different activities culminating in the acceptance of the operational System by Owner. These activities are detailed in the following sections.
- 8.02.04 Bidder shall provide all necessary test equipment required to carry out the Commissioning and acceptance testing.
- 8.03.00 Site Acceptance Test (SAT)
- 8.03.01 Site acceptance test shall be performed by Bidder to verify the full operational functionality of the System.
- 8.03.02 Four weeks prior to the SAT Bidder shall submit a test procedure to Owner for approval.
- 8.03.03 All SAT tests shall be documented with the results obtained and their success or failure. These test results shall be submitted to Owner prior to clearance of the SAT and proceeding to the final performance tests.
- 9.00.00 MAINTENANCE REQUIREMENTS**
- 9.01.00 Maintenance Philosophy
- 9.01.01 Owner's maintenance philosophy is to undertake first line field repair by modular replacement. The module shall then be returned to the supplier, who shall either repair it or replace it during the warranty period.
- 10.00.00 CLEANING, PROTECTION AND PAINTING**
- 10.00.01 All equipment shall be shipped in properly cleaned condition. All the equipment shall be thoroughly cleaned to remove mill scales, rust etc. and properly painted with anti rust primer, where applicable
- 10.00.02 Some of the equipment and accessories, after arrival at site, are likely to be in storage for long periods before they are taken up for erection. Bidder may provide adequate protection for preventing damage due to corrosion, dust / dirt ingress, ageing etc.
- 10.00.03 Plugs shall be provided at cable entry holes/adapters to avoid entry of dust and foreign particles. Paper cap will not be acceptable.
- 11.00.00 IDENTIFICATION, MARKING, PACKING AND STORING**
- 11.00.01 Each equipment shall be individually packed, tagged and protected.
- 11.00.02 Inscription on equipment (labels) shall be in English.
- 11.00.03 Packing must be such to protect all goods from possible impacts and foreign matters; moreover, it must limit the influence of both the climate and the environment, and be suitable for the kind of shipping provided for.

11.00.04 In packing the equipment and accessories, all necessary precautions will have to be taken to avoid any damage during transport and delivery.

11.00.05 All items supplied shall be packed for long term storage under the climatic conditions prevailing at the site. Small items shall be packed in sealed transparent plastic bags with desiccator packs as necessary. Each item shall be clearly marked with its description, purpose and plant designation code as applicable. When more than one item is packed in a single case a general description of the contents is to be shown on the outside of each case and a detailed list enclosed. All cases and other packages must be suitably marked and numbered for identification purposes.

12.00.00 SHIPMENT

12.00.01 Bidder shall be responsible for ensuring that all equipment are carefully and/or suitably packed for shipment, so that they arrive at site in good condition and remain so during storage at site. Before despatch, all exposed surface shall be protected by applying anti rust primer (two coats) and suitable cover shall be provided for the equipment to be supplied.

12.00.02 Bidder will be responsible for all damages due to improper preparation of the goods for shipment

13.00.00 QUALITY ASSURANCE PLAN Refer BHEL QAP no. PE-QP-999-557-E001 REV 03.

13.00.01 Equipment supplied under this specification shall have assured quality and workmanship.

13.00.02 Bidder shall complete the Quality Control Plan with the information pertaining to him, in particular with the reference of the documents to be used.

13.00.03 The QCP completed by Bidder shall be submitted to employer for approval. The QAP matrix furnished hereunder is for guidance only .

13.00.04 Bidder shall carry out all the checks, tests and inspections required to verify the compliance of the supply with the specification requirements at his own expenses.

13.00.05 If not specified otherwise in Contract, Bidder shall notify Owner, 10 (ten) complete working days in advance, that the equipment is ready for inspection. This notification shall include the following information :

- Bidder's Name/ address/ telephone and fax numbers
- Job / Subject, Purchase order number;
- Type / Serial No. / Tag No. / Model No.;
- List of parts to be tested;
- Type of inspection/test.....phase no.....of QCP no.....rev.....;
- Owner attendance;
- Place and date of the inspection;
- Quantity of available items;

- Expected duration;
- Bidder's reference person (name, phone, fax)

In case the inspection is performed without due notification, repetition of those tests may be requested at Bidder's expenses.

13.00.06 Owner and/or testing body's inspector shall have free access to Bidder's works both during manufacturing and tests & trials.

13.00.07 Bidder shall stand guarantee for perfect operation of the equipment during the period specified in the warranty.

13.00.08 Regardless of the results of the tests performed in Bidder's works, the final test will be performed at the plant, under actual operating conditions.

Bidder shall therefore undertake to replace, free of charge and within shortest time possible, all material which, in operating conditions, shall fail to comply with contractual requirements.

13.00.09 Bidder shall arrange the inspection and tests in easily accessible location and in properly illuminated shop to carry out the inspection in proper way.

Bidder shall, if called for, produce the necessary technical documents (drawings, specifications etc.) and copies of the codes or procedures applied to the execution of inspections and/or tests.

Owner reserves the right to reject the inspections and tests which fail to fulfil the above conditions.

13.00.10 Bidder shall perform inspections and tests in full compliance with industrial safety rules, to safeguard his own personnel as well as Owner's/ Consultant's Inspectors.

13.00.11 Bidder shall be responsible for the performance of the tests and shall :

- a) provide qualified and specially skilled personnel
- b) provide calibrated instruments with relevant certification

13.00.12 For Type or Special tests, Bidder shall indicate the location for carrying out the tests (Bidder's works or any recognized laboratory).

In case Owner is expected to give approval on the basis of certifications concerning similar previous supplies, Bidder shall submit for approval to Owner the documentation demonstrating the compliance between the supply and the certified model.

13.00.13 If during the execution or at the end of the supply, any non-conformances are noted, Bidder shall implement and adequately document all the corrective actions necessary to restore the contractually required conditions. The documentation related to the corrective actions shall be included in the final certification report. If the non-conformance compromises the functional or safety feature of the equipment or specific interface elements, the supplier shall inform

employer in advance in writing on the corrective actions he intend to implement. Employer has the right to reject (totally or partially) the proposed actions if considered inadequate or insufficient and Bidder may be asked for more adequate actions. The failure to communicate such non-conformances will be considered fraudulent intention.

13.00.14 During manufacture Bidder shall make available, the certificates concerning the inspections and tests performed. At the end, Bidder shall provide the certificates required for components for which a QCP has been developed. These certificates shall be kept in dossiers and shall comprise the documents concerning manufacturing, inspections and tests performed on the component and on its parts. The dossier shall be organised as follows:

- Cover sheet containing:
- Bidder's Name;
- Job and order number;
- Identification (model no. & serial no.) and short description of the supplied component;
- Date and Bidder's signature;
- List of content;
- QCP
- Certificates of materials, inspections and tests listed in the QCP;
- Non-conformance report (if any);
- Final Inspection Report.

All the pages shall be numbered.

13.00.15 The supply shall be considered completed if :

- the documents presented to Owner have been approved;
- the materials are in compliance with the specification; and related certificates are available and acceptable;
- the necessary qualification certificates are available and acceptable;
- the components have been inspected, examined and tested as required and related certificates are available and acceptable;
- the non-conformances have been documented and accepted by Owner;
- the components are clean, protected and identified;
- the necessary instructions for protection, handling or storage are available;
- the Final Inspection Report has been submitted.

13.00.16 Bidder shall prepare a QCP for each component or group of similar components.

on sheets 1 and 2 of enclosure-A Bidder must indicate his identifying data and those concerning the order and the component for which the QCP is referred to;

on sheet 3 of enclosure-A Bidder shall indicate the materials, parts and processes to be inspected, checked and tested and related tests and inspections to be executed.

Other types of forms may be accepted only if they contain the same information of Bidder.

13.00.17 The QCP prepared by Bidder shall be submitted to Owner for approval at least 15 days before the start of the related activities. Bidder shall be authorised to proceed if the QCP has been approved.

13.00.18 General requirements for inspection shall be as per the following guidelines.

a) Non Destructive Tests (Not Applicable)

b) Tests

- The materials, manufacturing and finished components shall be inspected, controlled and tested as defined in this paragraph in compliance with standard codes and technical specification that shall be subject Owner's approval.

c) Visual Inspections

The PA Controller and speakers, call stations etc. shall be subjected to the following visual inspections and checking:

- Check of the supply (quantities, accessories, markings dimensions / examinations in compliance with relevant drawings);

14.00.00 System Cabinet

- a) The electronic modules located within operator's terminal shall be of completely enclosed type for protection from dust and / or mechanical damage.
- b) All electronic cards and modules located in electronic cubicles in Control Equipment Rooms shall be neatly arranged in sub-racks. Each racks shall have redundant power supply modules catering to the cards mounted in the sub-racks.
- c) Separate cabinets shall be provided for each functional group and data acquisition sub-system.
- d) The packaging density of panels shall be such that the temperature rise within the panels shall never exceed 10°C above ambient even under worst operating conditions. Redundant Cooling fans shall be provided.
- e) The modules shall be arranged logically and sequentially in the sub-racks. Modules associated with a closed loop / open loop controller viz. input cards, output cards etc. shall be housed together with the corresponding controller in the same cabinet.
- f) If after housing a controller with associated cards in a sub rack 25 % or less card slots are left vacant, the same shall not be used to accommodate any card related to any other system.
- g) Adjacent slots to dissipative cards shall be left vacant for proper cooling air circulation within the panels.
- h) In each subrack 10% spare module slots shall be provided to accommodate spare modules for future modification.

- i) In case cards related to a particular controller spill over beyond one sub rack, the remaining cards shall be placed to the next sub rack with at least 4 blank slots in between the cards related to other systems. Vacant slots shall preferably be covered with blank plates.
- j) Cards, in a sub rack, shall be uniformly grouped, type-wise and functionality wise.
- k) The system hardware should be designed to immune against radio frequency & electromagnetic interference.
- l) Cabinet temperature monitoring and monitoring of each individual power supply (at downstream) for each panel shall be done.

15.00.00 OPTICAL FIBER CABLE

15.00.01 This specification defines the minimum general requirements for the Design, manufacture, supply, inspection, installation, testing & commissioning of optical fiber cables and accessories, such as fiber distribution (patch) panels, adapters, connectors, joint boxes, pigtailed and other components, as required to complete the system. Bidder shall consider all related activities, such as cable stripping, cable entry in boxes and panels, cable fiber splicing/fusion, cable performance testing and other services, to achieve a properly documented and operational cable network. all Fibre Optic cables shall be Single Mode type.

15.00.02 Fiber Optic Cables shall be installed on cable tray, duct bank, cable trench installation as necessary. For outdoor applications the cable shall be armoured with Poly Ethylene sheathing. In all cases cable shall be routed through suitable grade HDPE permanently lubricated protection pipe as per IS 4984, IS 12235 & TEC.G/CDS-08 /01of suitable size @ 53% fill factor. Permanent route marking in FRP (Fibre Reinforced Plastic) material shall be provided at intervals not exceeding 5 meters for all FO cables layed outdoor buried under the ground.

15.00.03 The Optical Fiber core shall be of ultra pure fused silica glass coated with UV-cured acrylate suitable to withstand temperature of about 80°C (continuous).

- 15.00.04 Fiber optic cable shall be of loose tube design. Typically, fibers shall be housed in-groups of 6 (minimum) within gel-filled buffer tubes to protect against ingress of moisture and vibration. The tubes shall be manufactured with industry standard material like Poly-Butylenes Terathylate (PBT). They shall be colored for easy identification. Buffer tubes shall be approachable with industry standard tools and practices. The buffer tubes shall be stranded around the Central Strength Member utilizing Reverse Oscillating Lay (ROL). Blank fillers shall be used as necessary to maintain circular cable structure. The fiber optic cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end.
- 15.00.05 The central strength member of the cable shall be Fiberglass Reinforced Plastic (FRP) or other material with equivalent mechanical strength to provide both tensile and anti buckling strength to the cable.
- 15.00.06 In addition to central strength member, additional strengthening substance like aramid yarns shall be helically applied over the cable core to provide additional tensile strength to the cable.
- 15.00.07 The cable shall be of dual jacket & armoured. Inner sheath consists of a medium density polyethylene (MDPE) jacket extruded over the cable core. Two highly visible ripcords are placed under the jacket to aid in sheath removal. A co-polymer coated steel tape is corrugated and wrapped around the inner jacket to provide additional cable compression strength and rodent protection. The armor is covered with an outer black FRLS MDPE jacket. A ripcord is also placed underneath the armor for easy outer jacket removal.
- 15.00.08 Minimum bending radius shall be equal or more to 15 D (D= Diameter). A continuous strength member shall be provided for the entire length of the cables. Every tube and fiber shall be colour coded to provide easy identification. The outer sheath shall be marked to show fiber type and cable classification at suitable intervals.
- 15.00.09 The entire length of each cable shall be marked with the following items:
- Manufacturer's Name
 - Month and year of manufacturing
 - Coded description of the cable based on Telcordia's (Bellcore) SR-2014 Suggested Optical Cable Code (SOCC).
 - Sheath Identification Number
 - Sequential Length Marking in meter
 - A Telephone Handset symbol to distinguish communication from power cable as per NESC section –35 G.
- 15.00.10 Fiber optic cable shall provide a long life expectancy of minimum 25 years and shall meet the industrial standard of operation at temperature of 55⁰ C

and humidity to 100% without degradation to optical or mechanical performance.

15.00.11 Optical fiber used in the plant shall generally conform to the following specification.

SPECIFICATION FOR G.652 MONOMODE FIBER

ATTRIBUTES		VALUE
1.	Cladding Diameter	125 $\mu\text{m} \pm 1.0 \mu\text{m}$
2.	Cladding non-circularity	$\leq 1.0\%$
3.	Attenuation Coefficient at (a) 1290 nm to 1340 nm (b) 1525 nm to 1575 nm	< 0.36 dB/km < 0.25 dB/km
4.	Chromatic Dispersion Coefficient at (a) 310 nm (b) 1550 nm	< 3.5 ps/nm.km < 18 ps/nm
5.	Polarization Mode Dispersion (PMD)	$\leq 0.5 \text{ ps}/\sqrt{\text{km}}$
6.	Mode Field Diameter at (a) 1310 nm (b) 1550 nm	9.2 $\pm 0.4 \mu\text{m}$ 10.50 $\pm 1.0 \mu\text{m}$
7.	Mode Field Concentricity Error	$\leq 0.5 \mu\text{m}$
8.	Proof Test	$\geq 1\%$
9.	Fiber Curl (ROC)	$\geq 4.0 \text{ m}$
10.	Macro-bend Test on Fiber at 1550 nm	$\leq 0.1 \text{ dB}$

15.01.00 Cable Assembly

15.01.01 Optical Fiber Environmental Splice Enclosure

Optical fiber environmental splice joint enclosures shall be re-enterable and rack / wall mountable. The interior splice case shall be equipped to mechanically accommodate single-mode optical fibers connected by the fusion method. Splice case shall be equipped to organize the splice trays and the required service loops of buffered incoming optical fibers and outgoing 'pigtails' in such a way that allows each completed splice and associated optical fiber to be maintained in an unstrained configuration. Splice enclosure shall be dust and weather proof.

15.01.02 Fiber Optic Distribution Patch Panel

Fiber optic distribution panels shall be provided as required. The fiber optic distribution panels shall be of a standard wall mounted sheet metal enclosure type. Fiber optic distribution panels shall be equipped to secure optical fiber patch cables and pigtails to prevent damage during all operation and maintenance functions. In general splice enclosure are envisaged. However, If no optical fiber splice enclosures are implemented, than the fiber optic distribution panels shall be equipped with splice trays for storage and protection of fusion splice connections of single-mode fiber optic cable and pigtails. Each fiber optic distribution panel shall be fully equipped with 'SC' type bulk head connector sleeves or equivalent. Unused sleeve ports shall be equipped with reusable caps to prevent the intrusion of dust.

15.01.03 Pigtail and Patch Cord

All pigtails shall be factory SC-connectorized, and satisfy specified performance for optical links. All unused pigtails (including spares) shall be terminated with the connector to a bulkhead connector sleeve, protected by a reusable cap on the opposite sleeve port, to prevent the intrusion of foreign material or dust. All necessary connectorized pigtails shall be provided in the lengths required.

15.01.04 Fiber Optic Tool Kit

Fiber Optic Splicer, Terminator And Tool Kit Box

Bidder shall provide new unused tools comprise of Splicer and Fusion Jointer and tool kit comprise of cutter, stripper, polishing tool, handheld microscope, heat shrinkable sleeve, scissor, knife etc. as required for maintenance and commissioning.

15.01.05 Tests

Following minimum test as per any approved standards shall be carried out on the cables

- a. Attenuation And Dispersion Characteristics Tests
- b. Proof Tests
- c. Macro-Bend Resistance Test
- d. Mechanical Tests
- e. Low And High Temperature Cable Bend Test
- f. Impact Resistance Test
- g. Compressive Strength Test
- h. Tensile Strength Test
- i. Cable Twist Test
- j. Cable Cyclic Flexing Test
- k. Environmental Characteristics Test
- l. Temperature Cycling Test

- m. Color Permanence Test Cable Aging Test
 - n. Water Penetration Test
 - o. Lightning Test
 - p. Routine Test / Sample Test
- Site Test (Like Continuity & Attenuation)

16.00.00 ERECTION HARDWARE

This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument.

16.01.00 ELECTRICAL ACCESSORIES

Electrical conduit and associated materials shall conform to the requirements of the articles which follow :

a) Rigid Steel Conduit

- i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.
- ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.
- iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.
- iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.

b) Flexible Conduit

- i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.
- ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.

c) Special Fittings

- i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.
- ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

16.01.01

Junction Box

- 01. Type of Enclosure : Dust tight & weatherproof conforming to IP 65
- 02. Material : Fibreglass reinforced polyester material,
4mm
- 03. Type of Cover : Solid Hinged Door with steel handle and IP
lock door handle, self-locking with common key,
- 04. Paint : 631 IS 5 Epoxy Powder Coated
- 05. Mounting : Surface
- 06. Cable Entry : 3 mm (min) Gland plate
- 07. Gasket : Neoprene provided with cage clamp type terminal blocks
- 08. Grounding : Brass earth lug with green screw head
External-2 nos , Internal-1no.M6.
- 09. Number of Drain Holes : Two at bottom capped.
- 10. Identification : Label for JB and Tags for cable
- 11. Accessories : a) Rail mounted cage clamp type screwless
terminals with markers
b) Cable gland
c) Ferrules
d) Canopy at top

16.01.02

Cable Gland

- 01. Type : Double compression
- 02. Entry Thread : NPT
- 03. Material : Brass
- 04. Finish : Cadmium Plated.
- 05. Protection : IP 65 or better

06. Accessories : Neoprene gasket, locknuts, reducers etc.

16.01.03 Cable Tray

01. Material : Mild steel

02. Thickness : not less than 2.0 mm

03. Finish : Hot dip galvanized

04. Perforation : As per MFR standard.

05. Cover : Suitable for tray

06. Height of the cable tray : 100 mm for 450mm and above width.
(width cannot be less than 100 mm)

16.02.00 The PA system cables will be laid in already routed cable trays in different areas of power plant for power & signal cables. Power and signal cable shall run in separate tray.

However, cables of PA system will be laid in HDPE pipe wherever cable trays are not available.

Civil works like foundations and cable trenches are excluded from the scope of bidder

16.03.00 DOCUMENTATION

16.03.01 DOCUMENTS TO BE FURNISHED WITH THE BID

a) Brief System Description.

b) Signed and stamped copy of compliance sheet

c) Catalogues of various equipments

16,03.02 After placement of order, documents shall be submitted for BHEL & customer's approval.

16.03.03 Drawings/documents shall be submitted through Document Management System (DMS).

17.00.00 INSTRUMENTATION CABLE

17.01.01 The thickness of outer sheath shall be as per the guidelines given in VDE 0816. Thickness of outer sheath shall not be less than 1.8 mm in any case. Allowable tolerance of overall diameter of the cables shall be ± 2 mm max. over the declared value in technical data sheets. The variation in diameter and the ovality at any cross section shall not be more than 1.0 mm.

17.01.02 The Cables shall be supplied in non returnable standard seasoned drums. The drum length shall be 1000m ($\pm 5\%$) up to & including 8 pairs and 500 m ($\pm 5\%$) above 8 pairs. Drum shall be anti rodent, anti termite and smooth finish. Both ends of cable shall be capped by means of non hygroscopic sealing material.

17.01.03 Durable marking shall be provided on the outer sheath of the cable at intervals not exceeding 5 metres. Marking shall include Manufacturer's name, Year of manufacture, Voltage grade, Type of cables (Conductor size & no. of pairs /type of compensating /extension cable, Analog or Binary), Insulation material, FRLS etc. Sequential length marking shall also be provided at every metre interval on outer sheath of cable.

17.01.04 All the instrumentation cables i.e. twisted and shielded multipair cables, compensating cables, pre fabricated cables etc. shall be flame retardant low smoke and low halogen (FRLSH) type.

17.02.01 INSTRUMENTATION MULTI PAIRED SIGNAL CABLE

01. Conductor type : Multi-stranded annealed tinned high conductivity copper
02. Conductor size : ~~0.5 / 1.0 / 1.5 Sq.mm (as required)~~
03. Conductor resistance : ~~39 Ω /Km / 18 Ω /Km / 12 Ω /Km~~
04. Conductor Insulation : Extruded PVC meeting the requirements of VDE 0207 Part 4 compound Y I3. Insulation thickness for individual core shall be between ~~0.28 and 0.35 mm for 0.5 mm² cables, 0.5 to 0.6 mm for 1.0 mm² cables and 0.8 to 0.9 for 1.5 mm² cable.~~
05. Voltage Grade : 225 V (peak value)
06. Twisting : Twin twisted with lay of 50 mm (max)
07. Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape.
08. Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 μ m (min.) for individual pair screen and 60 μ m (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be

applied with minimum overlap of 25%.
Metallic side of the screen shall be in
contact with drain wire.

Analog signals - Individual pair & overall
shield.

Binary signals - overall shield.

09. Drain wire : Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm). Separate drain wire for individual pair shield (wherever applicable) as well as overall shield.
10. Inner Sheath : Extruded PVC (compound YM1) as per VDE 0207 Part 5 (anti rodent, anti termite & moisture resistant properties) and shall be of flame retardant low smoke (FRLS) type
11. Fillers : Non metallic flame & moisture retardant
12. Armouring : GI wire / strip
13. Outer Sheath : Extruded PVC (compound YM1) as per VDE 0207 Part 5 and shall be of flame retardant low smoke low halogen (FRLSH) type
14. Temperature Range : 70°C (continuous) except for high temperature resistant Teflon insulated cables which shall be suitable for continuous operation at 205°C
15. Sheath colour : Inner- Black and Outer- Sky Blue
16. Tests on outer sheath : a) Oxygen Index: Min.29% at room temp. (ASTMD-2863)
b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I
c) Temp Index : Min 250° C (ASTMD-2863)
d) Smoke Density Rating :Max.60% (ASTMD-2843).
e) Complete cable assembly shall pass Swedish Chimney Test- as per SEN-4241475 AND Flammability Test as per IEEE-383.

~~f) Halogen Content Measurement as per
ICEA T-33-655 (Permissible limit for
halogen shall not be more than 0.2%)~~

17. High voltage test
- a) Core to core - 1.5 KV for 1 min.
 - b) Core to screen - 1.0 KV for 1 min.
 - c) Screen to Armour – 1.0 KV for 1 min
18. Rodent & Termite repulsion test Presence of lead shall be confirmed
19. Colour of core insulation for Instrumentation Cable

PAIR	CORE	COLOR
1st	1st	Blue
1st	2nd	Red
2nd	1st	Gray
2nd	2nd	Yellow
3rd	1st	Green
3rd	2nd	Brown
4th	1st	White
4th	2nd	Black

Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit. Band marking on individual core shall be provided at regular intervals not exceeding 50 mm.

TABLE- 1
CABLE PARAMETERS

SL. NO.	PARAMETER / TYPE	TYPE – G, I
01.	Mutual Capacitance at 0.8 kHz (max.)	100 nF/Km.
02.	Conductor Resistance (max.)	24.6 ohm/km (loop)
03.	Insulation Resistance (minimum)	100 M ohm/km
04.	Cross-talk figure at 0.8 kHz (minimum)	60 dB
05.	Characteristic Impedance (maximum) at 1 kHz	230 ohm
06.	Attenuation at 1 kHz (maximum)	1.2 dB/Km

11.02.05 Identification of the cores & pairs shall be done with suitable colour coding & band marking as well as by numbering of cores/pairs as per VDE: 0815. The details of colour coding etc. shall be as approved by Owner during detailed stage. Also refer TABLE – 2 for description of various type of cables. —

18.00.00 Panels & cubicles

18.00.01 CABINETS / ENCLOSURE / PANELS

01. Material of construction : Cold rolled steel sheet
02. Thickness of Sheet :
 - a) 3.0 mm for faces supporting instruments / terminals. Mounting plate shall also be 3.0 mm.
 - b) 2.0 mm for other sides inclusive of top.
03. Construction : Welded throughout as per (metallic parts) approved National Standards.
04. Panel height : 2300 mm maximum
05. i) Corners : 7 mm inner radius
ii) Dimensional Tolerances :
 - a) In height & length - 3 mm
 - b) In height between adjacent sections - 2 mm.
 - c) Total for a group - 6 mm
06. Doors : Double, recessed, turned back edges. Doors shall have 4 point IP Lock
 - i) Thickness of Sheet : 2 mm

- ii) Hinges : Stainless steel
- iii) Door latches : Three point type
- iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure.
- v) Opening of the doors : Outward. Door swing shall be Min. 110-120 Degree
- vi) Louvers : With removable wire mesh to ensure dust and vermin proof.
- 07. Color of interior : Brilliant white (Approval shall be accorded by owner during detail engineering)
- 08. Colour external : RAL 7032
(Approval shall be accorded by Owner during engineering)
- 09. Painting : Epoxy powder coated or better. Minimum Paint thickness shall be 80-100 microns
- 10. Gland plates : Removable 4 mm thick (bottom)
- 11. Cable entry : Bottom
- 12. Hardware :
 - a) Anti vibration pad- 15 mm
 - b) Predrilled base channel ISMC - 100 or equivalent for all sides.
 - c) Lifting hook / Eye bolt
 - d) Drawing pocket
 - e) Door switch, lamps, thermostat, heaters and fans
- 13. Enclosure Protection : As per environment condition of the area of installation.

19.00.00 LAPTOP SPECIFICATION

The Laptop shall meet the following minimum requirements:

- Intel Core – i7 Processor with 3.46 GHz, 4 MB L2 cache, 1066MHz
- 15" HD LED anti glare Screen with wide angle viewing.
- 1 TB 7200 rpm HDD with shock absorber.
- 4 GB 800 MHz DDR3 SDRAM
- 1024 MB Graphic Accelerator
- 1 x windows 7 pro 64 bit or latest & proven version of Windows OS with Multimedia
- Slim type DVD-RW/DVDROM combo drive.
- Internal 10/100/1000Mbps Ethernet card
- IEEE 802.11B connectivity port
- Optical mouse
- 4 Nos. USB 3.0/2.0 ports & Wireless INTERNET & blue tooth interface
- 1 No. HDMI Port
- Minimum 8 hrs battery backup.
- Recovery software tools.
- Sound cards
- Internal speakers
- Licensed version of MS Windows latest, MS-Office Professional, Microsoft Visual Studio, Adobe Acrobat, antivirusMcAfee or equivalent, etc.
- Application engineering & HMI software - to suit project specific requirement.

20.00.00 MINI UPS SPECIFICATION (Below 3kVA)

01. Type : Packaged Unit, Solid-state SCR/ power Transistor & Microprocessor controlled.
02. Duty : Continious
03. Enclosure : Sheet steel, IP-42
04. Transformer : Ferro-resonant
05. Inverter : Solid state pulse width modulated
06. Inverter Capacity : To be decided by the bidder on load calculation. 25% extra capacity margin to be considered.
07. Control : Microprocessor based.
08. Battery : 220 Volt, Ni-Cd vented type, pocket plate high discharge battery of adequate capacity to meet the requirement of UPS, generally confirming to IS-10918
09. Total harmonic distortion : < 2%
10. Harmonic attenuation : 400%
11. Line regulation : Better than $\pm 5\%$
12. Load regulation : Better than $\pm 3\%$
13. Spike attenuation : 3000 : 1
14. Power factor : Self correcting > 0.95
15. Metering display : Frequency, Battery, input, output voltage & % load
16. Status display : ON, on battery, low battery, self diagnostic malfunction alarm with SPDT potential free contacts rated at 230 VAC, 5A for each alarm.
17. Output
 - a) Voltage : 240 V A.C, 50 Hz, 1-phase +/- 1.0%
 - b) Frequency : 50 Hz(+/- 0.5%)
 - c) Load Power factor : 0.8%
 - d) Wave form : Sinewave

18. Input
 - a) Voltage : 180 V to 270 V A.C
 - b) Frequency : 45 to 60 Hz
 - c) Power Factor : 0.92
19. Battery back-up capacity : 60 Minutes at full load
20. Charger : Built-in
21. Static switch : Built-in
22. Quantity : As required
23. Rating / Capacity : 125% of System powering capacity
(Sizing in bidder's scope)

TECHNICAL SPECIFICATION OF POWER CABLE

S.NO.	PARTICULARS	DETAILS
		LT POWER CABLES
1	REFERENCE STANDARD	IS: 7098 -PART -1
2	SYSTEM	415 V AC , 240 V AC AND 220V DC
3	VOLTAGE GRADE	1.1 KV
4	CONDUCTOR	
4.1	MATERIAL	STRANDED HIGH CONDUCTIVITY ANNEALED PLAIN COPPER CLASS 2
4.2	REFERENCE STANDARD	IS 8130
4.3	SHAPE	CIRCULAR/ SHAPED
4.4	MINIMUM SIZE	COPPER- 2.5 SQ. MM.
4.5	MAXIMUM CONDUCTOR TEMPERATURE WHEN CARRYING CONTINUOUSLY CURRENT	90°C
4.6	MAXIMUM CONDUCTOR TEMPERATURE AT THE TERMINATION OF SHORT CIRCUIT CURRENT	250°C
5	NO. OF CORES	3C
6	INSULATION	EXTRUDED XLPE
6.1	REFERENCE STANDARD	IS: 7098 -PART -1
7	CORE IDENTIFICATION	BY COLOR CODING AS PER IS: 7098 -PART -1
8	INNER SHEATH	EXTRUDED PVC, TYPE ST-2 FOR MULTI CORE CABLES ONLY SINGLE CORE CABLE SHALL HAVE NO INNER SHEATH
8.1	REFERENCE STANDARD	IS: 5831 & IS-7098 PART-I
9	ARMOUR	SINGLE CORE - ALUMINIUM ROUND WIRE, NON MAGNETIC H4 GRADE MULTICORE CABLES - GS ROUND WIRE
9.1	REFERENCE STANDARD	IS:3975 & IS 7098 PART I
10	OUTER SHEATH	EXTRUDED FRLSH PVC TYPE ST2, IMPROVED FIRE PERFORMANCE CATEGORY C2
10.1	REFERENCE STANDARD	IS: 5831 & IS-7098 PART-I
11	MARKING	(i) MANUFACTURER'S NAME AND/OR TRADE MARK, VOLTAGE GRADE, YEAR OF MANUFACTURE, TYPE OF INSULATION, NO. OF CORE AND SIZE OF CABLE, FRLSH, IS NUMBER, - AT EVERY 1M (BY EMBOSSING) (ii) PROGRESSIVE SEQUENTIAL MARKING OF LENGTH OF CABLE IN METERS- AT EVERY 1M (BY PRINTING)
12	CABLE DRUMS	
12.1	TYPE OF DRUM	WOODEN (HEAVY CONSTRUCTION) AS PER IS 10418
12.2	STANDARD DRUM LENGTH	500M FOR LARGER SIZES / 1000M FOR SMALLER SIZES (±) 5%
12.6	PARTICULAR INFORMATION ON DRUM	THE CABLE DRUMS SHALL CARRY THE FOLLOWING DETAILS IN PRINTED FORM: A) MANUFACTURER'S NAME OR TRADE MAKE B) TYPE OF CABLE & VOLTAGE GRADE C) YEAR OF MANUFACTURE D) TYPE OF INSULATION E) NO. OF CORE AND SIZES OF CABLES F) CABLE CODE G) LENGTH OF CABLE ON DRUM H) NO. OF LENGTH ON DRUM IF MORE THAN ONE I) DIRECTION OF ROTATION BY ARROW J) APPROX GROSS MASS K) IS NUMBER AND ISI MARK

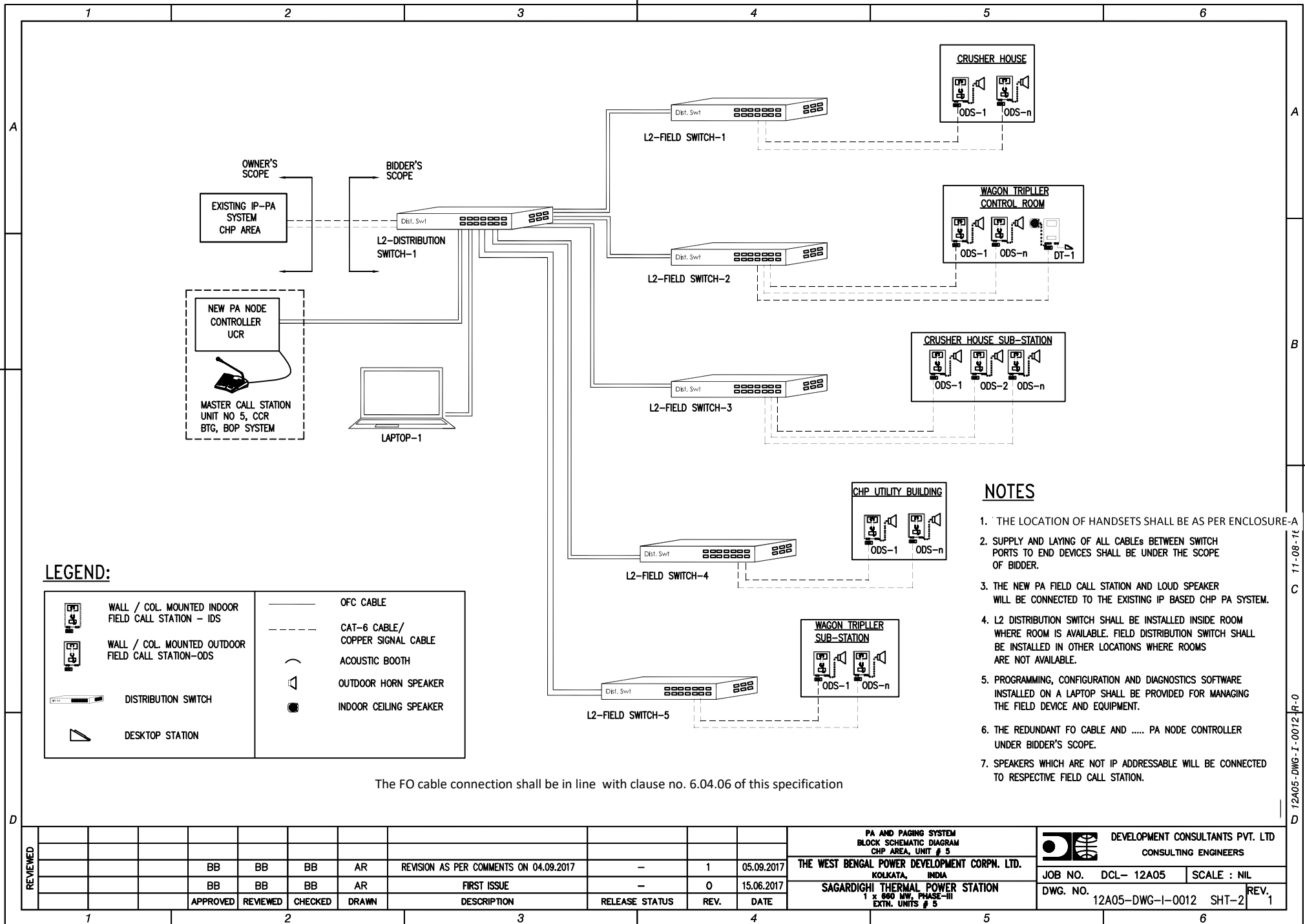
Sagardighi Thermal Power Project 1x660 MW Unit No. 5, Phase - III
ENCLOSURE-A

TENTATIVE EQUIPMENT TYPE & LOCATION OF PUBLIC ADDRESS SYSTEM									
SI No.	DESCRIPTION OF LOCATION	Master Control Station / Zone Station	FCS TYPE- A	FCS TYPE- B	FCS TYPE- C	FALSE CEILING TYPE SPEAKER	CONE TYPE INDOOR SPEAKER	INDUSTRIAL OUTDOORS PEAKER	ACOUSTIC HOOD
I Zone-I									
1	Power House Building Unit#5 (Location of each duringn detailed engg.)	1	2	4	4	4	4	4	4
2	BFP			2				2	2
3	Boiler Area Unit#5 (Location of each duringn detailed engg)								16
	Boiler Switchgear room at 28m			2				2	
	Boiler cable Vault at 24m			2				2	
	Boiler Platform Elv 24m			2				2	
	Boiler Platform Elv 35.3m			2				2	
	Boiler Platform Elv 48.5m			2				2	
	Boiler Platform Elv 60.17m			2				2	
	Boiler Platform Elv 75.3m			2				2	
	Boiler Platform Elv 85.2 m			2				2	
4	ESP Area Unit#5			2				2	
5	ESP Control Room and Substation		1		2	2	1		
6	Mill Bay Area , Unit # 5			2				2	2
7	FD/PA/ID Fan Area, Unit # 5			2				2	2
8	Vaccum Pump House		1	1			1	1	1
9	Vaccum Pump House RIO Room				1	1			
10	AHP Unit # 5		1	2			1	2	
11	FGD Control Room Control Room				2	2			
12	FGD Area			1				1	
13	Conveying Air Compressor (AHP) VACCUM CUM COMPRESSOR House			1				1	
14	Intrument Air Compressor (AHP) BELOW BCN36A/36B		1				1		
15	Centralised Fire Control Room (CWPH)				1	1			
16	FAE tower			1				1	
II Zone-II Control Room (CW PMP House)									
1	CPU Regeneration Building	1		1				1	
2	CPU Control Room				2	2			
3	Cooling Water Treatment Plant		1				1		
4	CW ACW Pump House Area			2				2	1
5	Switchyard			2				2	
6	DG BUILDING			1				1	
7	Chlorination Unit			2	1	1		2	
8	CWBD RO Plant			2	2	2	2	2	
9	Absorber Tower			3				3	
10	CW/ACW Pump Control room				2		2		
11	MRS Compressor House			1				1	
12	Ammonia Unloading area			1				1	

CHP AREAS UNDER UNIT#5

SI No.	DESCRIPTION OF LOCATION	Master Control Station / Zone Station	FCS TYPE-A	FCS TYPE-B	FCS TYPE-C	FALSE CEILING TYPESPEAKER	CONE TYPE INDOORSPEAKER	INDUSTRIAL OUTDOORSPEAKER	ACOUSTIC HOOD
Zone-III									
1	CHP MCC-2 Control room				1	2			
2	Transfer Point in CHP								
a	TP-20			1				1	
b	TP-20A			1				1	
c	TP-21			1				1	
d	TP-22			1				1	
e	TP-23			1				1	
f	TP-25			1				1	
g	TP-26			1				1	
h	TP-27			1				1	
i	TP-28			1				1	
j	WT COMLEX BCN#29A/B area (-26mtr)			1				1	
3	CHP Crusher house			4				4	4
4	Wagon Tippler Area			2				3	
5	Wagon Tripler Apron Feeder area			1			1		
6	Wagon Tripler switchgear Room (CHP MCC-1)			1			1		
7	CHP utility building			1			1		
8	Bunker Floor-1 Area			2				2	
	Bunker Floor-2 Area			2				2	
9	Transformer Yard (Near CHP MCC-2)			1				1	
10	Bunker Switchgear Room (CHP MCC-3)			1			2		
11	Other CHP Areas								
a	Pent House			1				1	

ANNEXURE-I : BLOCK DIAGRAM FOR CHP AREA(TYPICAL)



REVISED	1	2	3	4	5	6
		BB	BB	BB	AR	REVISION AS PER COMMENTS ON 04.09.2017
		BB	BB	BB	AR	FIRST ISSUE
		APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION
						RELEASE STATUS
						REV.
						DATE

PA AND PAGING SYSTEM BLOCK SCHEMATIC DIAGRAM CHP AREA, UNIT # 5		DEVELOPMENT CONSULTANTS PVT. LTD CONSULTING ENGINEERS	
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD. KOLKATA, INDIA		JOB NO. DCL- 12A05	SCALE : NIL
SAGARDIGHI THERMAL POWER STATION 1 x 660 MW, PHASE-III EXTN. UNITS # 5		DWG. NO. 12A05-DWG-I-0012	SHT-2
		REV. 1	

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ERECTION AND COMMISSIONING

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	ERECTION TESTING & PRE-COMMISSIONING PRACTICES – GENERAL
2.00.00	SPECIFIC ERECTION PRACTICES AND GUIDELINE
3.00.00	CONSUMABLE, TOOLS AND TACKLE, CALIBRATION AND TEST INSTRUMENTS AND ERECTION MATERIALS
4.00.00	INSTRUMENT CALIBRATION/CHECKING AT SITE PRIOR TO ERECTION
5.00.00	EXAMINATIONS AFTER INSTALLATION
6.00.00	PROTECTION DURING MANUFACTURE, TRANSPORTATION AND STORAGE BEFORE ERECTION
7.00.00	QUALITY ASSURANCE SERVICES
8.00.00	INSPECTION AND TESTING

ERECTION AND COMMISSIONING

1.00.00 ERECTION TESTING & PRE-COMMISSIONING PRACTICES - GENERAL

1.00.01 This part of the specification is intended to provide a general guideline for the procedures to be followed for the erection, testing and commissioning of various Control & Instrumentation Systems, field instrumentation, final control elements and accessories.

1.00.02 Omission of any specific reference to any method, parts, accessories or material required for proper and efficient execution of the work shall not in any way relieve the Contractor from his responsibilities of providing such facilities and performing the successful erection, testing and commissioning.

1.01.00 Equipment, Materials & Services to be provided by Contractor

1.01.01 Contractor shall follow the stipulations of the contract enumerated elsewhere in the specification regarding Equipment, Materials & Services to be provided under this specification and shall include but not limited to the following:

- a) Shop testing and Factory Acceptance Test.
- b) Pre-calibration of instruments at site and maintaining record of the same.
- c) Pre-assembly at site, as required.
- d) Erection of items.
- e) Cleaning / flushing (as required), pre-commissioning checking to ensure correctness of erection.
- f) In-situ calibration, testing, loop checking etc. of instruments and accessories, as required and maintaining record of the same.
- g) Cleaning up of instruments, accessories and worksite during and after erection.
- h) Powering on and Commissioning of all the instruments and equipment and systems.

1.02.00 Site Acceptance Test

1.02.01 General

- a) The work under Control & Instrumentation shall include activities like placement of equipment on foundation/ support, leveling and alignment, grouting on foundation, other miscellaneous civil work such as dressing / chipping of foundation / surfaces and also assembly and

pre-assembly, minor rectification, welding, cutting, site adjustments and all other incidental activities, as applicable.

- b) Contractor shall arrange all testing, erection and commissioning tools and tackle like hydraulic jacks, precision levels including micro level, dial and other gauges, surface plates, straight edges, vacuum cleaners, blowers, pumps and other equipment / implements necessary for hydro testing, compressed air testing, calibration and all other necessary tests as may be required for timely and efficient execution of the Contract.
- c) Bidder shall furnish a detailed erection micro-plan consistent with the overall project schedule and keeping in view the various site facilities and constraints encountered during various phases of work.

2.00.00 SPECIFIC ERECTION PRACTICES AND GUIDELINES

The specification provides the general guidelines to be followed for the warehousing, handling, testing, erection, pre commissioning checks and commissioning of various types of instruments and accessories.

- a) The guidelines provided shall not be deemed as an effort to describe the entire work involved or to identify the steps and sequence to be adhered to in the erection of specific work items.
- b) The basic intent is to establish a sound engineering practice to be adopted throughout.
- c) Equipment manufacturers' recommendation, where available, shall prevail over the guidelines furnished in this section and in case of any contradiction between the stipulations.
- d) For special instruments viz. analyzers etc., the specification furnished are of general nature only and manufacturer's recommendation shall be strictly followed as guideline for erection and commissioning.
- e) The specification shall not be treated as comprehensive. Any activity, not specifically mentioned but felt essential or advisable from good engineering consideration shall be performed.

2.01.00 Field Instruments

Guidelines provided herein shall be adhered to while erecting an instrument or accessory in the plant beyond control room areas.

- a) Care should be taken to avoid damage to the instruments during handling and transportation. Special care shall be taken while handling breakable, spillable, fragile and delicate items.
- b) Before erection, all instruments shall be subjected to calibration and other functional checks at Contractor's site laboratory. The instruments shall be uncrated and unpacked with utmost care and as

per instructions furnished on the respective packages, using appropriate tools and implements.

- c) All instruments, jigs, tools and tackle for the purpose of performing the tests shall be arranged by Contractor.
- d) All instruments shall be tagged with engraved aluminum / stainless steel tag plates and shall be secured to the instrument with metallic wire fasteners, during the test.
- e) For instruments found acceptable and conforming to the declared performance parameters of the manufacturer, the test report shall be prepared.
- f) Minor repairs and adjustments of the instruments shall be performed by Contractor. Once the defective instrument has been successfully repaired, it shall again be subjected to calibration and functional checks, as indicated above.
- g) A record of such repairs and adjustments shall be systematically maintained by Contractor.
- h) For instruments where the extent of damage is such that the same cannot be repaired at site, a failure report shall be generated by Contractor, enumerating the nature of fault/ damage. Cases where the damages are only superficial and which does not affect the appearance and performance of the instrument/s, the decision as to whether such instruments are fit for erection shall solely lie with Owner.
- i) In no case, erection work shall be taken-up in areas where heavy equipment movement is foreseen, major welding activity is under progress, heavy structural items are being erected or any other major activity is being carried out or is anticipated, which may cause damage to the erected instrument or its support.
- j) If any erected instrument or its accessories are found to be vulnerable to damage or to be fouling/interfering with progress of other activities in the area, same shall be dismantled/removed. During re-erection of such instruments, all the necessary steps as indicated in the specification for the erection of the instrument shall be carried out afresh.
- k) After erection, the instruments shall be covered with transparent polyethylene sheets to protect from unauthorized handling.
- l) Colored PVC adhesive tapes shall be put on the polyethylene cover to indicate various stages of activities. Red tape shall indicate erection under progress. Yellow tape shall indicate completeness of erection. Blue tape shall imply approval of erection and Green tape shall signify the commissioning of the instrument. Adhesive paper tapes shall be fixed on the respective tapes to inscribe the dates of completion of activities.

- m) Location of field instruments shall be consistent with tapping points on pipes and equipment.
- n) No field mounted instrument shall be installed in such a manner that it depends on rigidity of the impulse piping or the electrical connection to it for support.
- o) Handrails shall not be used for mounting or supporting instruments.
- p) The place where the instrument is to be installed must be easily accessible from nearest floor / platform level and there must have enough clear space to allow maintenance work and lay-down.
- q) The installed position must be such as not to cause any inconvenience to repair, removal, observation, inspection and maintenance of the installed equipment and other items nearby.
- r) The nearby high temperature equipment or process piping shall not give rise to any injurious effect to instruments.
- s) There will be no safety valve or effluent drain point which may cause injurious effect near the instrument. In general, no instrument shall be erected in areas prone to vibration.
- t) Instruments which are outside the building or shed and are not located within transmitter rack shall be provided with protective cover or canopy to provide effective protection against dust, rain, sun etc. The cover shall be provided immediately after mounting the instrument.
- u) All clamps, supports, stands etc. required for installation and erection of instruments and their accessories, shall be painted.
- v) No field mounted instruments shall be installed without simultaneously taking up impulse line work connected with the instrument.
- w) Proper precaution is to be to protect his installations, instruments, accessories, devices etc. by isolation/removal from possible damages during flashing, pressure testing of main pipe lines, air headers, vessels, equipments etc.
- x) Wherever practicable the height of the instrument from its working floor/ platform shall be between 1000-1400 mm. The illumination at the locations where instruments are located shall be adequate so that the scales can be read unassisted.
- y) Sub-trays, where required, shall be erected for proper routing of the cables and tubes and no cable shall be laid unsupported.
- z) The indicating meters shall be oriented properly so that the scale can be read unassisted and unobstructed from the approach floor / platform.

2.03.00 Local Panels, Racks, Cubicles, Gauge Boards Enclosures and Structures

Local racks, panels, gauge boards, cubicles shall be installed at specified locations. Work shall also include fabrication and installation of gauge boards, stands, mounting brackets and frames, drain headers etc. with associated painting and civil work.

- a) Contractor shall erect panels / cubicles / enclosures etc. only after ensuring availability of work front.
- b) The panels shall be issued from warehouse or storage yard on the same day when the actual erection is performed.
- c) Panel, once uncrated, must be installed on the same day.
- d) Panels supplied in packed condition, will be properly slinged for lifting. When lifting unpacked panels eye-bolts shall be used. Unpacking should be done at store or installation site only.
- e) During slinging or lifting of the panel, care shall be taken not to damage the structure or any instrument/equipment mounted on the panel.
- f) Panels shall be slowly lowered on its foundations and shall not be subjected on unnecessary jerk or bounce.
- g) Prior to the installation of panels the foundation shall be inspected for presence of foreign matters and existence of possible defects or damage. Positions, shape and dimensions of the foundation shall be

verified against corresponding drawing. Pockets for grouting shall normally be on the concrete base. Contractor shall arrange anchor bolts or grouting spikes and grout the same in the pocket.

- h) Accurate center lines and auxiliary lines shall be marked-off with due consideration of proper alignment and level. Base channel of panel shall be dismantled from the panel and shall be positioned and set by grouted anchor bolts. Before fixing the bolts, the panels must be properly aligned and plumbed. Only brass shims may be used for leveling of the panels. Leveling of panel should be done by the help of spirit level or similar device.
- i) Contractor shall arrange to provide suitable protective coverings for the panels since unpacking and after erection to avoid any damage due to movement of men and materials in the vicinity.
- j) Retouching work of painted surface of panels shall be carried out wherever required.
- k) During installation of panels and panel instruments the panels must be kept in perfectly clean condition.
- l) All panels shall be suitably earthed as per guidelines furnished in the specification.
- m) Only construction power shall be utilized during erection of panels. Under no circumstances power lines shall be tapped-off from the panels.

2.03.01 Junction Boxes and Pull Boxes

Contractor's scope of erection of junction boxes shall include mounting of junction boxes in appropriate locations indicated in the drawings, fabrication of necessary supports, pedestals, brackets, frameworks etc., for erection and final painting of the structures and the junction boxes.

- a) Junction boxes and pull boxes shall be provided for multi-pair / multi-core cables and compensating cables.
- b) Junction boxes shall be provided either with un-drilled removable gland plates or with knock-outs. Before installation gland plates shall be drilled/knock-outs shall be removed based on the cable schedule.
- c) The junction boxes shall be fixed to the nearest available structures as far as possible. In certain cases, special pedestals may have to be fabricated and grouted/bolted to nearest available structure.
- d) Before installation, junction boxes may have to be assembled by fixing terminal blocks, mounting rail etc. Any other connected job shall be a part of the junction box installation.

- e) Unused knock-outs in the junction boxes shall be left plugged to prevent dust and moisture entry.
- f) All necessary nuts, bolts, screws, foundation bolts etc. for mounting the junction boxes and their supporting structure shall be supplied by Contractor.
- g) Identification tags for the cables shall be provided both inside and outside the junction boxes close to the glanding point.
- h) Junction box mounting shall include the fabrication of steel supporting structures as well as other connected jobs.
- i) Contractor shall arrange to repaint junction box if the paint is damaged due to improper handling. Wherever required, Contractor shall arrange to perform retouching of paint on the junction boxes. Proper identification numbers shall be labeled on the junction boxes for ease of identification.
- j) After erection, junction boxes shall be covered with polyethylene sheets.
- k) Ideally the height of junction boxes shall be 1000-1400 mm from the

2.04.00 Cabling and Interconnection

Cabling and interconnection activity shall include cabling work between local switches, resistance temperature detectors, transmitters, converters, limit switches, smart positioners, torque switches, solenoid valves etc. up to local junction boxes; thermocouples up to local thermostatic junction boxes, temperature transmitters or control room panels from local junction boxes / local panels / transmitter racks / instruments to termination cabinets / panels / electronic cabinets in control room / control equipment room ; command and feedback signals from MCC / Switch Gear room to termination cabinets / panels / electronic cabinets in control room / control equipment room; inter-cabling between various cabinets in control room / control equipment room ;earthing of all panels / racks / cabinets / junction boxes etc, up to ground lug / riser with appropriate cable; special cabling between sensing devices to converter cabinets and cabling work of prefabricated and hiway cables. Cabling work shall normally imply pulling, laying, marking, splicing, glanding, dressing, ferruling, crimping and termination of cables at both ends with associated conduit and sub-tray work; followed by testing of cables.

- a) Single and multi pair/core cable shall be laid on trays or in conduits. Cable shall be neatly laid with proper dressing and adequately fixed.
- b) Cable shall enter in the enclosures through cable glands.
- c) All the cable runs shall be properly identified by easily readable printed permanent tag plate fastened to the cable with steel wires.

provided at both field ends and panel ends and at a maximum of 20 meter intervals in straight length. Tags shall be provided in all bends and both sides of the barrier walls as well as at both terminal ends.

- d) In the cable spreader room, cables shall be clamped rigidly below the panel entry. If required, vertical cable tray shall be provided in case where the horizontal cable tray is more than 1 Meter below the respective Panel bottom.
- e) Cables laid near the main Steam Piping and other high temperature steam pipings shall be protected through proper insulation arrangements against damage due to continuous exposure to high temperature.
- f) Bend trays with suitable roller arrangements shall be used for cross over of cables from one section to other in perpendicular direction.
- g) Spare cable runs shall be kept coiled inside the enclosures with the ends suitably protected and cables properly identified.
- h) In case of single piece straight multipair/core cable run, no joint in the cable shall be provided in between.
- i) All Control and Instrumentation Cables shall be laid maximum upto 2 layers for horizontal cable trays and in single layer for vertical trays.
- j) Cable glands and other openings in the junction boxes shall be properly sealed by means of sealing compound to make them thoroughly dust and moisture proof.
- k) The cables laid, shall not be subjected to excessive tension so as to cause damage to the conductors.
- l) At bends where excessive spatial stress may concentrate or where danger exists of damaging the insulation, extreme care shall be taken while laying the cables, to avoid any possible damage.
- m) All cable shall be tested for continuity and insulation before and after installation as per the latest Indian Electricity Rules. Test for continuity shall be done by a circuit tester. Insulation resistance test shall be done with a 500V megger. The measured insulation resistance shall be more than 50 meg. Ohms between conductors and one conductor to ground.
- n) All cable shall run through conduits up to local junction box / nearest sub-tray.
- o) All cable shields shall be individually terminated and jumpered together at the terminal blocks. Earthing of the shields shall, however, be performed at the control panel end.
- p) All cable shall be laid only along the route specified in the cable schedule.

- q) If at any time during progress of work, trays are found inadequate to accommodate the assigned cable, Contractor shall discontinue laying of the cable until the problem is rectified.
- r) Cable conducting AC and DC signals shall be segregated. Compensating cables shall not be mixed with cables carrying milliampere signals. The signal cables and power cables shall not be in the same conduit, tray or junction box. In general, a minimum clearance of 1500 mm shall be maintained between noise generating equipment like large motors, generators, transformers etc. and signal/control cables. The minimum distances to be maintained between the instrumentation signal cables and any AC power cables running in parallel are as follows :

Maximum Circuit Voltage	Separation (mm)
240 V AC	250
415 V AC	300
3.3 KV / 11 KV	600 / 900

- s) All cable shall be carefully laid or pulled in trays so that neither cable nor the trays are damaged. Cable shall be cut sufficiently long to conform to the contour of the trays, especially for vertical inside bends. All excessive slack shall be removed from the cable so that the cables lie parallel to the sides of the trays.
- t) The cable shall be tied to the trays with G.I./Aluminum or self-locking cable grip strip at not more than 2 meter intervals for horizontal runs and at not more than 1 meter intervals for vertical runs. All cable shall be strapped individually.
- u) Pulling of cable shall be done with manila rope or nylon rope.
- v) Only the type of lubricants recommended by cable manufacturer shall be used.
- w) Before pulling cable from the drum, the drum shall be visually inspected for protruding nails, fastenings or other objects which may damage the cable. Such articles shall be removed before pulling of the cable. Continuity and I.R. test shall also be performed.
- x) Contractor shall perform a thorough visual inspection for flows, breaks, cracks and abrasions in the cable sheath during pulling.
- y) Cable damaged in any way during installation shall be replaced.
- z) The pulling tension of any cable shall not exceed the maximum tension recommended by the cable manufacturer.
- aa) To avoid insulation damage from excessive sidewall pressure at bends in conduit runs, the pulling tension in Kilograms shall not exceed 1.5 times the radius of bend in centimeters.

- bb) For cable without metallic shielding or armor and cable with metallic tape shielding, the cable bend radius shall be in accordance with the requirements of IPCEA standards. For cable with metallic wire shielding or metallic armor the bend radius shall not be less than 8 times the overall diameter of the cable.
- cc) All spare conductors of a multipair/core cable shall be left at their maximum lengths for possible future replacements of any other conductors in the cable. Each spare conductor shall be identified and neatly coiled separately and then taped to the conductors being used.
- dd) All exposed conductor surfaces shall be taped with all-weather vinyl plastic electrical tape.

2.04.01 Instrumentation Twisted Pair Cables

Cabling in this category shall include cabling between local switches, resistance temperature detectors, transmitters, local converter, smart positioner, limit/torque switches, solenoid valves etc. up to local junction box by means of single or multipair armoured / unarmored cables up to local junction boxes and from local junction boxes to panels/cabinets in Control Room/Control Equipment Room etc. and interconnection between various panels/cabinets .

- a) Contractor's scope of work shall include conduit and sub-tray work from all field instruments to junction boxes, pulling, laying, glanding, dressing, sleeving ferruling, crimping and termination at both ends.
- b) Contractor should take special care regarding wastage of cables while splicing.

2.04.03 Prefabricated Cables

Cabling work shall include laying and terminating prefabricated cables between different panels.

- a) All necessary special glands, grommets of nylon or rubber etc. shall be supplied and erected.
- b) Prefab cables shall run through cable spreader room on trays. Vertical riser trays, to support the vertical run of cables from the main trays in cable spreader room to the panel glanding areas shall be supplied and erected.
- c) All the cable runs shall be properly identified by engraved aluminum tag plates fastened to the cable at not more than 10 meter intervals by steel wires.
- d) Cables laid shall not be subjected to excessive tension so as to cause damage to the conductors or plugs.
- e) In cases where the connecting heads/plugs may be supplied loose, Contractor, after laying the cable, shall solder cable cores and screen ends to connector pins/ plug-in crimped ends of the cable to the connector plug socket/crimp-in special connectors for coupling the cable to the plug socket/wire wrap the ends to connector pins, as the case may be. Contractor shall ensure properness of end connection before embarking upon the termination.
- f) All necessary modifications, rework, splitting etc. of the gland plates to accommodate prefab cables, their glands/ grommets shall be performed.
- g) Prefab cables shall be routed through special glands/ grommets as recommended by the manufacturer.

2.04.04 Special Cables

The category of special cables shall include the cabling work related to the data highways, flue gas and water analysis system, vibration monitoring system etc. where proprietary cables are supplied as part of instrument & for

the transmission of low level voltage signals or other signals susceptible to noise interference.

- a) Special cables shall not be laid through trays carrying signals having voltage level of more than 60 volts AC/DC. As far as practicable special cables shall be laid through conduits.
- b) Minimum separation to be maintained between special cables and other cables shall be as indicated in the specification, unless specified otherwise by the supplier of the cable/ instrument.
- c) All necessary connectors, lugs, sleeves, conductor markers/ferrules etc. for termination of special cables shall be supplied by Contractor .
- d) Special cables shall not run unsupported for more than 1 meter.
- e) Special cables shall run un-spliced for each individual run. Junctions, loops, bends and long vertical falls shall be avoided to the extent possible.
- f) Tools recommended by the cable/instrument supplier shall only be used for splicing, connecting and terminating special cables.
- g) Where teeing, tapping, looping or branching are required for special or co-axial cables; only the equipment, tools and tackle recommended by the manufacturer shall be used.

2.04.05 Conduits

Flexible and rigid conduits shall be used for connecting instruments to the junction boxes or nearest trays/sub-trays. The activities shall include threading, plumbing, routing, supporting, connecting to cabinets; cleaning, sealing grounding painting and other related activities, as required.

- a) Where threads are required to be formed they shall be cut and cleaned before conduit reaming.
- b) Ends of all conduits shall be reamed to remove all burrs and rough edges.
- c) Cutting oil shall be used for threading operation and the dies shall be kept sharp.
- d) Rigid conduits shall be installed in exposed runs either parallel or perpendicular to dominating surface, with right angle turns made of symmetrical bends only.
- e) Conduit shall not be installed on the outside face of exposed columns but shall be routed on the web or on the inside of the flange of column.
- f) Metal conduits shall be joined by threaded conduit couplings.

- g) A run of conduit shall not contain more than the equivalent of four quarter bends including those immediately at the outlets or fittings of cabinets.
- h) Precautions shall be taken to prevent accumulation of water, dirt, concrete, foreign material etc. in the conduit.
- i) Bending radius of the rigid conduits shall not be less than six times the internal diameter of the conduits.
- j) Rigid conduits shall be regularly clamped at intervals of not more than 600 mm.
- k) Flexible conduits shall be installed in conduit runs across expansion joints.
- l) All screwed joints shall be properly sealed with sealing compound to make them thoroughly water proof.
- m) Loop shall be provided in the flexible conduit while joining with rigid conduit, enclosure or detector. Flexible conduit shall not be kept under tension.
- n) Flexible conduits shall essentially be used for connecting instruments or equipment subjected to vibration, expansion or thermal movement. In all such cases adequate loop lengths shall be provided to allow free movement at the connected points.
- o) Not more than 40% of conduit area shall be taken up by cables.

2.04.07 Earthing

Contractor's scope of work shall include the earthing of all instruments/equipment, enclosures and other metallic parts and objects. Necessary wires, lugs, sleeves, markers/ferrules etc. shall be supplied. In addition to the general guidelines given below, Contractor shall remain responsible to follow the instrument/equipment manufacturer's grounding recommendation.

- a) Screens of all screened cables between field instruments to local junction box shall be terminated to individual terminal blocks. The other end of the screen shall be left disconnected and taped with adhesive vinyl tape. All screen terminal blocks at JB end shall be shorted with shorting links. The screen of multipair cables to cabinets shall be connected to the screen terminal block in JB and the other end to be grounded at panel end only.

- b) Compensating cable screens shall be terminated at independent terminal blocks in control panel end only. This terminal block shall, however, be wired up to insulated screen bus bar integral to the panel.
- c) All junction boxes, stands, stanchions, local panels, cubicles etc., must be connected to the nearest riser of electrical earth mat by SWG 10 MS galvanized steel wire.
- d) All control panels, desks, consoles, cubicles, cabinets etc. must be physically earthed with the electrical ground mat inside the control room area.
- e) All electrical ground terminals of local instruments shall be individually terminated up to local junction box by one core of the signal cable and these terminal blocks shall be shorted by links. The common earth point then may be led to local earth point by SWG 10 galvanized steel wire.
- f) All local panel and central panel instruments shall be grounded to the common ground bus available inside the panel. Normally the grounding wires will be available as wired-up inside the panels. Wherever grounding wires are not available inside the panel, the same shall be provided by Contractor.
- g) For terminating grounding wires only ring-tongue type lugs shall be used.

Regarding the earthing requirement of power supplies and electronic equipment, manufacturer's recommendation shall be strictly adhered to. The earthing cables shall be carefully sized not to exceed the specified earth impedance. Separate salt pit earth and earth risers shall be created as required.

3.00.00 CONSUMABLE, TOOLS AND TACKLE, CALIBRATION AND TEST, INSTRUMENTS AND ERECTION MATERIALS

The purpose of this section is to outline, in general, the minimum necessary equipment / tools & tackle and consumable that may be required for erection work. The list hereunder is only meant to be a guideline and Contractor shall be responsible to arrange for supply any other equipments/ tools & tackle or consumable that may be required for satisfactory completion of the job.

- a) Erection consumables shall include but not be limited to the following :
 - i) Polythene sheets for covering field instruments and panels.
 - ii) Grease of approved quality.
 - iii) Colored adhesive PVC tapes.

- iv) Gaskets and washers of various size and types as required.
 - v) Paints of approved quality and shade.
 - vi) Brass shims/foils for levelling of panels
 - vii) Welding electrodes, Oxygen, Acetylene and Argon Cylinders.
 - viii) Dry seal type thread sealant.
 - ix) Insulated PVC/Vinyl adhesive tapes, sleeves etc.,
 - x) Cable markers and clamps (G.I. or Aluminum)
 - xi) Hacksaw
 - xii) Cleaning solvent, petrol, rustolene, kerosene etc.
 - xiii) Gland sealing compound
 - xiv) 2 mm thick Aluminum Sheets
 - xv) Twisted galvanized steel wire
 - xvi) Cutting oil
 - xvii) Teflon tape
 - xviii) Liquid soap, Jute
 - xix) Solder and flux
 - xx) Nuts, bolts, screws and gaskets as required
 - xxi) Perforated G.I./aluminum tray (if required)
- b) Necessary tools & tackle/equipment that may be required for erection/ installation/testing shall be provided.

The items listed below are indicative in nature and any other tools & tackle/equipment that may be required shall be arranged by Contractor.

- i) Hydraulic Test Jack (0-400 Kg/Sq. mm) [2 sets at least]
- ii) Continuity Tester and 500V Megger
- iii) Engraving machine
- iv) Sheet punching machine
- v) Hand drill with bits of various sizes

- vi) Welding kit (2 sets at least).
 - vii) Thread cutter (with different sizes of die)
 - viii) Test pressure gauges for hydraulic testing
 - ix) Wire wrapping tool and soldering iron
 - x) Materials for scaffolding
 - xi) Materials for rigging
 - xii) Sets of wrenches, spanners, Allen keys, screw drivers and other tools for wiring and impulse piping work.
 - xiii) Crimping tool, splicing tool
 - xiv) Pipe bending jig
 - xv) High speed cutting emery wheel
 - xvi) Sheet bending machine
 - xvii) Multimeter
 - xviii) Air compressor and spray painting gun
 - xix) Air filter regulators
 - xx) Slide caliper/screw gauge
 - xxi) Tube cutter
 - xxii) Tube bender
 - xxiii) Hacksaw
- c) Necessary tools & tackle, jig, instruments/equipments that may be required for loop checking, calibrating and commissioning of all supervisory and modulating control loops, binary system, annunciation system and calibration/checking of all field instruments, receiver instruments etc. as detailed in this specification shall be arranged.

The items listed below are indicative in nature. Any other items that may be required shall also be arranged by Contractor at his own cost

- i) Precision calibration standard mercury manometers of accuracy $\pm 0.02\%$ of full scale.
- ii) Portable pneumatic calibrators of accuracy $\pm 0.1\%$ of full scale.
- iii) Sub-standard test gauges of accuracy $\pm 0.1\%$ of full scale.

- iv) Dead weight testers of accuracy $\pm 0.05\%$ of measured pressure.
 - v) Hydraulic gauge testers of accuracy of ± 0.1 of measured pressure.
 - vi) D.C. potentiometers of accuracy $\pm 0.1\%$
 - vii) Wheatstone bridge of accuracy $\pm 0.1\%$
 - viii) Decade Resistance Boxes of accuracy $\pm 0.1\%$.
 - ix) Multimeters of accuracy $\pm 2\%$
 - x) Temperature Bath
 - xi) Line testers
 - xii) Telephone sets with battery
 - xiii) Oscilloscope (Dual trace, 75 Hz)
 - xiv) Signal generator
 - xv) mV generator
 - xvi) Bench top power supply (0-30 VDC, 10A) - 4 nos. at least
 - xvii) Special testing/calibration kit for electronic panel mounted receiver instruments e.g. indicators, recorders etc.
 - xviii) Metal film resistor (100 Ohms, 250 Ohms, 62.5 Ohms of 0.1% tolerance).
 - xix) Rules generator, logic probes and other digital test instruments
 - xx) Stop watch
 - xxi) Variac (0-260 VAC continuous output)
 - xxii) Solder suckers and IC extractors.
 - xxiii) Multifunction calibrators.
 - xxiv) RTD / Thermocouple Calibrator.
 - xxv) Electronic transmitter Calibrator.
 - xxvi) Continuity Tester.
 - xxvii) Electronic Meggar.
- d) This section grossly summarizes the different items to be supplied by Contractor for completion of activities specified. The detailed job-wise requirement shall be guided by final engineering drawings and various clauses of the technical specification :
- i) Conductor markers/Ferrules, lugs, connectors as required for cabling and terminations.
 - ii) Glands and grommets for cable entry.
 - iii) Straps, nylon rope fasteners for cable support and dressing.
 - iv) Bends, tees, unions, crosses, plugs, caps and other fittings for impulse and drain pipe work.

- v) Compression fittings, adapters ferrules etc. for SS tubing.
- vi) G.I. tees, unions, elbows, reducer, screwed brass needle valves.
- vii) Perforated G.I./Aluminum subtrays (50, 100, 150 mm) for cabling and tubing work.
- viii) 1/2 & 3/4" rigid and flexible conduit fittings
- ix) Terminal blocks (1.5 Sq.mm).

Contractor shall include all structural steel items.

4.00.00 INSTRUMENT CALIBRATION / CHECKING AT SITE PRIOR TO ERECTION

The general guidelines for calibration and functional checking of instruments and accessories are as given below :

- a) For calibration and functional checking of different types of instruments, check lists shall be prepared. The results and observations of checks and tests shall be recorded in appropriate forms.
- b) Qualified and experienced engineers, supervisors and skilled technicians shall be deployed for calibration and functional checking of instruments.
- c) Only precision testing instruments of certified accuracy specially made for testing particular make/type of instruments shall be used for calibration and functional checking of instruments.
- d) Physical checking of the instruments shall be carried out to find out any possible damage to the instruments.
- e) Instruments requiring calibration shall be calibrated, in general, throughout the instrument range at five check points viz. 0%, 25%, 50%, 75% & 100% of span, both upscale run and downscale run. The error between theoretical and calibration figures thus obtained at each check point shall not exceed the instrument manufacturer's stated figures. If the error exceeds the limits specified by the manufacturer, the instruments shall be adjusted to achieve calibration accuracy within the specified limits.
- f) Regarding the calibration and functional checking of special instruments, the instruction of the manufacturer shall be followed.

5.00.00 EXAMINATIONS AFTER INSTALLATION

5.00.01 On completion of erection of the equipment and before start-up, each item of the equipment shall be thoroughly cleaned and inspected by Contractor for correctness and completeness of installation and acceptability for start-up, leading to initial pre-commissioning tests at Site. The list of pre commissioning tests to be performed shall be as mutually agreed and included in Contractor's quality assurance program.

5.00.02 Contractor's commissioning / start-up engineers shall be responsible for carrying out all the pre-commissioning tests. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the complete equipment shall be placed on Initial Operation during which period the complete equipment shall be operated integral with sub-systems and supporting equipments.

5.00.03 All insulated conductors furnished and installed shall be electrically tested after installation.

5.00.04 All circuits shall be tested complete except for connections at equipment end.

6.00.00 PROTECTION DURING MANUFACTURE, TRANSPORTATION AND STORAGE BEFORE ERECTION

This section provides special precautions, protection & care to be taken for delicate electronic items and supplements the general guidelines provided in the specification.

6.01.00 Protection

- a) All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or non-metallic protecting device. Ends of valves and conduit shall be sealed with suitable devices to protect them from damage. The parts which are likely to get rusted due to exposure to weather, should be properly treated and protected in a suitable manner.
- b) All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. The surfaces that are to be finish painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer.
- c) Special high temperature primer shall be used on surfaces exposed to temperature higher than 95°C.

6.01.01 Protective Guards

Suitable guards shall be provided for protection of personnel and delicate instrument. All such guards shall be designed for easy installation and removal for maintenance.

6.02.00 Storing

6.02.01 Stored equipment and materials shall be adequately supported and protected to prevent damage.

6.02.02 Stored equipment and materials shall not be allowed to contact the ground in ware houses that do not have dry concrete or suspended floors, material and equipment shall be stored on platforms or shoring.

6.02.03 Strip heaters and similar heating devices shall be energized immediately upon placement of the equipment in storage.

6.02.04 Mechanical dehydrators provided in control panels shall be maintained in operation from the date of receipt of equipment.

6.03.00 Defects

6.03.01 All defects in erection shall be corrected. The dismantling and reassembly to remove defective parts, replace parts, or make adjustments shall be included as a part of the work.

6.03.02 The removal of control and instrument equipment in order to allow bench calibration, if required, and the reinstallation of said equipment after calibration shall also be included as a part of the work under these specifications.

7.00.00 QUALITY ASSURANCE SERVICES

This section outlines, in general terms, the inspection, testing and QA/QC procedures to be adhered to with suitable check-points for Owner's intervention for Control & Instrumentation items. The general conditions outlined elsewhere in the specification over and above. The special requirements furnished below.

7.01.00 Quality Assurance Program

7.01.01 To ensure that the equipment and services of Control & Instrumentation items under the scope of this Contract, whether manufactured or assembled within Contractor's works or at his Sub-contractor's premises or at the site or at any other place of work, are in accordance with the specification, Contractor shall adapt suitable quality assurance program to ensure proper quality and workmanship at all points. A quality assurance program of Contractor for Control & Instrumentation items shall generally cover the following :

- a) Organization structure for the management and implementation of proposed quality assurance program.
- b) Documentation control system.
- c) Qualification and experience data of his key personnel.
- d) The procedure for Purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of materials purchased etc.
- e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly controls.
- f) Control of non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and field activities.
- h) Control of calibration and testing of control, measuring and testing instruments/systems.
- i) System for indication and appraisal of inspection status.
- j) System for quality audits.
- k) System for handling, storage and delivery.
- l) Item/System-wise QA/QC and inspection flow charts clearly identifying the check-points of three types

- Where in-house checks will be performed
 - Where in-house test reports will be submitted for Owner's approval
 - Where Owner's inspection is necessary
- m) System for authorizing release of manufactured product.
- n) System for maintenance of records, and
- o) A quality plan detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component furnished.

7.02.00 Quality Assurance Documentation

7.02.01 Contractor shall be required to submit the following Quality Assurance Documents well ahead of dispatch of the equipment :

- a) All non-destructive calibration, testing , examination procedures and repair procedure actually used during fabrication.
- b) The inspection plan with verification, inspection plan check points, verification sketches (if used) and methods used to verify that the inspection were performed satisfactorily.
- c) Factory test results for testing required as per applicable codes and standards.

7.02.02 Owner shall have access to the works of Contractor and Sub-contractor at all times for the purpose of carrying out system audits, conducting quality surveillance, witnessing of tests and inspections etc.

7.02.03 Owner or his authorized representative may periodically check the work and Contractor's method of operation to assure that quality control practices are being followed. At the time of Owner's visit, all quality documentation pertaining to test, qualifications, inspections etc., shall, upon request, be made readily available.

7.02.04 All reports of tests and inspections as per Quality Control Practices and Quality Plans shall be made available to Owner on demand.

7.02.05 Contractor shall prepare quality plan in two sections, one for quality control at shop and the other for quality control at site.

7.02.06 Testing/inspection procedures as detailed herein gives a basic program to be followed and is in no way comprehensive or complete. Any other inspection stages not mentioned in these clauses but required as per Contractor's quality assurance program shall included. Any tests necessary from operation, safety and reliability point of view shall also be included.

7.02.07 These procedures shall include all checks/tests conducted at site for preservation, pre-assembly, alignment, positioning of equipment, foundation

preparation, grouting, welding/bolting, heat treatment, non-destructive examination, hydraulic test, performance tests, etc.

7.03.00 Shop Test

7.03.01 Shop tests shall include all tests to be carried out at Contractor's works, at works of his sub-contractor and at works where material used for production of the equipment is manufactured.

7.03.02 Individual components, instruments and devices furnished in accordance with specification shall be shop tested by manufacturer prior to shipment. The tests and test certificates shall be in accordance with the agreed QA program.

7.03.03 Such tests shall include electrical, mechanical, performance and hydraulic tests in accordance with relevant standards called for in the specifications to ensure that the plant being supplied fulfills the requirement of the specifications. Equipment not covered by any approved standards shall be tested in accordance with Contractor's quality control program.

7.03.04 All material shall be of tested quality, supported with duly correlated test certificates and wherever called upon by the Indian Boilers Regulations or by the design code, the test pieces shall be prepared and tested as per such regulation/code.

7.04.00 Site Test

7.04.01 Site tests shall include but not be limited to calibration, pre-commissioning trials, start-up trials, trial operation and performance guarantee test.

7.04.02 Contractor shall provide all required test equipment and simulation devices of reputed make, of required accuracy class and recently calibrated by some appropriate authority.

8.00.00 INSPECTION AND TESTING

8.00.01 General Requirements

- a) Equipment furnished under this specification shall be subject to test by quality assurance personnel of Contractor and Owner during manufacture, erection and on completion at specific agreed hold points.
- b) Contractor shall conduct all necessary shop and site tests and maintain proper records to fully meet the following requirements.
- c) Demonstrate to Owner's satisfaction that each equipment/sub-system fully meet all functional, parametric and other requirement of this specification and Owner's approved drawings/documents under all operating regimes.
- d) All applicable requirements of latest revised edition of I.S.A. Recommended practice MC-55.1 - 1982/ANSI MC 8.1-1975 regarding hardware testing of Digital process computers shall be fully met.

- e) All applicable tests shall be performed in accordance with the latest revisions of pertinent codes of ANSI, ISA and other applicable codes and standards. For equipment not covered by these codes, Bidder shall apply his standard shop and site testing procedures subject to Owner's approval.
- f) Contractor shall prepare detailed shop and site "Draft Quality Assurance Program" to fully meet the requirements of this specification. The document shall cover the following :
 - Quality assurance and testing procedures from component inspection stage up to final acceptance test at site.
 - Formats for recording calibration/test results.
 - Formats for test reports.
 - Specifications of test equipment proposed to be used for shop and site tests.
- g) The above "**Draft Quality Assurance Program**" shall be reviewed by Owner. The "**Quality Assurance Program**" as approved by Owner shall be used for conducting all shop and site tests.
- h) Additionally all standard quality assurance procedures of Contractor shall also be followed to ensure proper quality of equipment and compliance with specification requirements.

8.00.02 Shop Tests

- a) Contractor shall maintain proper records duly signed by authorized quality assurance personnel regarding all stage inspections, tests on individual equipment/sub-system/systems which are conducted by Contractor as per his standard procedure as well as those conducted to meet the requirements of his specification and Owner's approved "Quality Assurance Program". These records shall be made available to Owner during Acceptance Test.
- b) Contractor shall provide a complete factory test report of the system hardware and software.

8.01.00 Functional And Pre Acceptance Test

The authorized quality assurance personnel of Contractor shall conduct all tests as per the requirements of approved quality assurance program and fully satisfy compliance with specification requirements by all equipment / sub-systems and the system as a whole before sending notification for Acceptance test to Owner. Contractor shall maintain accurate records for all pre-acceptance test which shall be properly documented and duly certified documents shall be furnished to Owner at least one month prior to Factory Acceptance Test.

8.01.01 Input-output wiring check (for system cabinets, relay cabinets etc.)

- a) Contractor shall conduct a point by point wiring continuity check to every input and output and verify that the wiring connections agree with documentation. The test shall be performed by connecting a controlled signal to each input point in sequence. One point at a time, the wiring of all outputs shall be checked.
- b) Upon completion of point wiring checkout, Contractor shall conduct a system operational test employing static signals over the range of input signal. Appropriate static signals simulating each input shall be applied, scanned, processed, printed etc. as directed by the program. Signal strength shall be varied in order to check alarm functions and output fidelity. Simulation shall include testing of all specified system functions and operation. All calculations and conversions shall be verified against pre-calculated results.
- c) Calibration of outputs shall be individually tested for the quality and range over the period of not less than ten days (i.e. 240 hours) after completion of debugging, in order to confirm system stability and accuracy and to detect faulty programming, operation and components.

8.01.02 Special Tests for Solid State Equipment

All solid state equipment shall be subjected to Burn-in and Elevated temperature test and surge protection test :

- a) Surge protection test shall be conducted on all fully equipped system panels as per IEC information 255-4 Class-II. The equipment shall be designed to successfully withstand, without damage to component and/or wiring.
- b) Burn-in & Elevated Temperature Test

All solid state equipment shall be tested for a minimum of 168 hours continuously under power and simulated load prior to shipment.
- c) Acceptance Criteria for Burn-in and Elevated Temperature Test :
 - i) Functional test to be performed before and after Burn-in + ET Test.
 - ii) At no point of time the average temperature rise inside the cabinet shall be 10°C more than the ambient temperature.

8.01.05 Notification for Acceptance Test at Shop

- a) Owner, his duly authorized representative and/or an outside inspection agency acting on behalf of Owner shall have access at all reasonable times to inspect and examine the material and workmanship of the works during its manufacture of erection and if part of the works is being manufactured or assembled on other premises or works.
- b) Contractor shall give Owner/Inspector written notice of any material being ready for testing.
- c) Owner or Inspector shall within fifteen (15) days from the date of inspections, as notified by Contractor give notice in writing to Contractor of any objection to any drawings and if any equipment and proposed workmanship which in his opinion is not in accordance with the Contract. Contractor's shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objection or shall inform in writing to Owner/Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.
- d) The completion of these tests or the issue of the certificate shall not bind Owner to accept the equipment should it, on further tests after erection, be found not to comply with the Contract.
- e) The inspection by Owner and issue of inspection certificate thereon shall in no way limit the liabilities and responsibilities of Contractor in respect of the agreed quality assurance program forming a part of the Contract.
- f) Contractor shall furnish copies of the following as implemented documents as prior to Acceptance Tests, failing which, Owner may withhold program for Acceptance Tests :
 - i) System configuration drawings
 - ii) Copies of all as-built drawings
 - iii) Final approved copies of all drawings/documents.
 - iv) All off-line diagnostic program listings
 - v) Off-line diagnostic manuals
 - vi) Dump of individual and complete data base
 - vii) Detailed main and bulk memory maps
 - viii) Final Design Specification Volumes
 - ix) Test data to verify all calculations
 - x) All console operation manuals

- xi) Procedures of generating graphic displays, data base, logs, structuring/tuning of controllers etc.
- xii) Test procedures, copies of approved data sheets and relevant pages of approved QAP for field instruments & control actuators.
- xiii) All test reports for all types of tests carried out by Contractor.

8.01.06 Acceptance Test

8.01.06.1 The Acceptance Test shall include all reasonable exercises which the combination of equipment and software can be expected to perform. The test shall include but not be limited to, the following :

- a) Demonstration of the proper function of all hardware.
- b) Demonstration of required spare system capacity and all other parametric requirements of this specification.
- c) Demonstration of all man/machine functions.
- d) Demonstration of the proper functioning of all software.
- e) Demonstration of all diagnostic features.
- f) Point by point exercising of each input and output.
- g) Thorough exercising of each device, including the processor/ CPUs, Peripherals etc.

8.01.06.2 The Acceptance Tests shall also include the following Tests :

- a) Simulation of Inputs - to verify conversion accuracies, scan rates, operator functions, corrections of calculations.
- b) Operational Tests - to verify that the system performs all required functions and meets the specification requirements with respect to "free" processor time, spare memory requirements, loop response time and other parametric requirements.
- c) Diagnostics Test - to test working and bulk memory locations, instruction complements, functioning of outputs and peripheral devices, functioning of system check modules, etc.
- d) Power-consumption test - to verify KW consumption.
- e) Power failure test - to observe the consequences of a total power failure.
- f) Accuracy and Repeatability Test - accuracy and repeatability for analog inputs shall be demonstrated by statistical analysis using the point values read every scan cycle for a consecutive 8 hours period for a total of 10 percent of all analog inputs. The specified noise rejection capabilities shall be demonstrated using the same test and

analysis, by the application of at least 135V RMS common mode and 25V RMS differential mode to the same inputs. The noise rejection test shall be a second 8 hours test. Inputs to be used will be randomly selected by Owner prior to the test.

- g) Functions - All system functions shall be tested to demonstrate that they are in accordance with the specification.
- h) Format - All printouts and CRT display formats shall be checked to demonstrate that they are in accordance with the specification.
- i) Calculations - All calculations shall be tested to demonstrate that they are in accordance with the specification and I/O schedule. Contractor shall prepare all test cases for calculations (three for each calculation at low, mid and upper ranges of inputs) and submit them for Owner's review in accordance with contract schedule. Test cases shall include performance calculations, flow and level calculations.
- j) Demonstration of the manual and auto switch over from main to standby Bus/Controllers.

8.01.06.4 The results of all Acceptance Tests shall be properly documented by Contractor and submitted to Owner.

8.01.06.5 Upon successful completion of Acceptance Test, Owner will provide Bidder with a written authorization for shipment of the system equipment to the project site.

8.02.00 On Site Tests

- a) On-site test shall include all tests to be carried out by Contractor at site upon receipt of equipment. These shall include but not be limited

to inspection of equipment, preliminary on-site checks and tests, pre-commissioning trials, start-up tests, trial operation, performance and guarantee test, availability test etc. as per the requirements of clause 4.00.00 and other applicable clauses of this specification.

- b) Contractor shall perform the site tests in accordance with the requirements of these specifications and Owner's approved "**Quality Assurance Program**".
- c) Contractor shall maintain all test records in Owner's approved formats. These shall be countersigned by the authorized quality assurance personnel of Contractor supervising these works.

8.02.01 Preliminary On-Site Inspection And Tests

After field installation and before equipment energization and connection of field inputs, Contractor shall inspect all equipment and shall check wiring and cable to assure correctness of connections and power equipment installation. After these checks, Contractor's representative shall power the system and perform standard diagnostic tests on all system modules and equipment to assure that the system is working. The field inputs and outputs will then be connected by Contractor.


8.02.02 Start-up


- a) On completion of erection of the equipment and before start-up, each item of the equipment shall be thoroughly cleaned and inspected for correctness and completeness of the installation and acceptability for start-up, leading to initial pre-commissioning tests at site. The list of pre-commissioning tests to be performed shall be as Owner's approved "Quality Assurance Program".
- b) On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the complete equipment shall be operated integrally with sub-systems and supporting equipment as a complete system.


8.04.08 Criteria for Handing-over of Control & Instrumentation System

- a) Contractor shall apply in writing to Owner for handing over of the complete Control & Instrumentation System after successful demonstration of tests as specified up to "Availability Guarantee Test".
- b) Owner shall take over charge of the C&I system subject to fulfillment of the conditions enumerated hereunder :
 - i) All site check-list prepared by Owner are fruitfully attended by Contractor and certified by Owner.
 - ii) All Operation/Instruction manuals are updated to incorporate changes made up to Availability Test Run.
 - iii) All drawings/sketches are submitted as per Contract, on as-built basis.

- ~~iv) All Close loop controls, Binary & Sequential controls should be working on auto and all interlocks are demonstrated to be functional.~~
- v) All equipments and system supplied by Bidder are in working condition.
- vi) All short supply items, as per Contract, are refurbished by Contractor.
- vii) The above conditions are in addition to fulfillment of any/all other contractual obligations of Contractor towards Owner. Partial handing-over of systems/equipments shall not be permissible, except if desired so by Owner in special cases.

		MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS			QUALITY PLAN				SPEC. NO. :			DATE:				
									CUSTOMER :			QP NO.: PE-QP-999-557-E001 REV 03			DATE:	
					PROJECT:			PO NO.:			DATE:					
					ITEM: IP BASED PUBLIC ADDRESS SYSTEM				SECTION:			SHEET 1 OF 3				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS			
					M	C/N				M	C	N				
1	2	3	4	5	6		7	8	9	10			11			
1.0	SERVER (CONTROLLER)	1. AESTHETIC	MA	VISUAL	100%	100%	APPD. DWG.	APPD. DWG. INSP. REPT.	INSP. REPT.	P	W	W	*BHEL witness voltage level at minimum 5 points randomly.			
		2. MECHANICAL	MA	DIMENSION	100%	100%	APPD. DWG.	APPD. DWG. INSP. REPT.	INSP. REPT.	P	W	W				
		3 SHEET THICKNESS	MA	DIMENSION	100%	100%	APPD. DWG.	APPD. DWG.	INSP. REPT.	P	W	W				
		4. ELECTRICAL -Rated input voltage -Rated output voltage	MA	ELECTRICAL	100%	*	APPD. TP	APPD. TP	INSP. REPT.	P	W	W				
	ELECTRONIC MODULE	5. Burn in test at 50 °C for 48 hours in energised condition.	MA	ELECTRICAL	100%	-	APPD. TP	APPD. TP	INSP. REPT.	P	V	V				
2.0	MASTER CONTROL STATION (MCS)	1. AESTHETIC	MA	VISUAL	100%	100%	APPD. DWG.	APPD. DWG. INSP. REPT.	INSP. REPT.	P	W	W				
		2. MECHANICAL	MA	DIMENSION	100%	100%	APPD. DWG.	APPD. DWG. INSP. REPT.	INSP. REPT.	P	W	W				
		3 THICKNESS	MA	DIMENSION	100%	100%	APPD. DWG.	APPD. DWG.	INSP. REPT.	P	W	W				
		4. ELECTRICAL -Input sensitivity at 1KHz -THD at 1 KHz. -Frequency Response -Signal to Noise Ratio	MA	ELECTRICAL	100%	100%	APPD. TP APPD. DATASHEET	APPD. TP APPD. DATASHEET	INSP. REPT.	P	W	W				
	ELECTRONIC MODULE	5. Burn in test at 50 °C for 48 hours in energised condition.	MA	ELECTRICAL	100%	-	APPD. TP	APPD. TP	INSP. REPT.	P	V	V				
BHEL				BIDDER/ SUPPLIER				FOR CUSTOMER REVIEW & APPROVAL								
ENGINEERING			QUALITY			Sign & Date		Doc No.		Sign & Date						
Sign & Date		Name	Sign & Date		Name	Seal				Sign & Date		Name	Seal			
Prepared by:			Checked by:							Reviewed by:						
Reviewed by:			Reviewed by:													

 MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS		QUALITY PLAN						SPEC. NO :			DATE:		
		CUSTOMER :						QP NO.: PE-QP-999-557-E001 REV 03			DATE:		
		PROJECT:						PO NO.:			DATE:		
		ITEM: IP BASED PUBLIC ADDRESS SYSTEM						SECTION:			SHEET 2 OF 3		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
1	2	3	4	5	6		7	8	9	10			11
3.0	CONE TYPE SPEAKER, HORN LOUD SPEAKER	1. AESTHETIC	MA	VISUAL	100%	*	APPD. DWG.	APPD. DWG. INSP. REPT.	INSP. REPT.	P	W	W	*BHEL witness on 5% sample (min 5) selected at random of each type per Lot.
		2. MECHANICAL	MA	DIM.	100%	*	APPD. DWG.	APPD. DWG.	INSP. REPT.	P	W	W	
		3 THICKNESS	MA	DIMENSION	100%	*	APPD. DWG.	APPD. DWG.	INSP. REPT.	P	W	W	
		4. ELECTRICAL -DC Resistance	MA	ELECTRICAL	100%	*	IS 9302 Part IV APPD. TP	APPD. DATA SHEET APPD. TP	INSP. REPT.	P	W	W	
4.0	FIELD CALL STATION, PORTABLE STATION, DESKTOP STATION & FLUSH MOUNTED STATION (AS APPLICABLE)	1. AESTHETIC	MA	VISUAL	100%	*	APPD. DWG.	APPD. DWG. INSP. REPT.	INSP. REPT.	P	W	W	*BHEL witness on 5% sample (min 5) selected at random of each type per Lot.
		2. MECHANICAL	MA	DIM.	100%	*	APPD. DWG.	APPD. DWG. INSP. REPT.	INSP. REPT.	P	W	W	
		3 THICKNESS	MA	DIMENSION	100%		APPD. DWG.	APPD. DWG.	INSP. REPT.	P	W	W	
		4. ELECTRICAL -THD at 1 KHz. -Frequency Response -Signal to Noise Ratio -Input impd. at 1 KHz	MA	ELECTRICAL	100%	*	APPD. DATASHEET APPD. TP	APPD. DATA SHEET APPD. TP	INSP. REPT.	P	W	W	
5.0	EXTENSION AMPLIFIER	1. AESTHETIC	MA	VISUAL	100%	*	APPD. DWG.	APPD. DWG. INSP. REPT.	INSP. REPT.	P	W	W	*BHEL witness on 10% sample (min 3) selected at random.
		2. MECHANICAL	MA	DIMENSION	100%	*	APPD. DWG.	APPD. DWG. INSP. REPT.	INSP. REPT.	P	W	W	
		3 THICKNESS	MA	DIMENSION	100%		APPD. DWG.	APPD. DWG.	INSP. REPT.	P	W	W	
		4. ELECTRICAL -Input sensitivity at 1KHz -Rated output power -THD at 1 KHz -Frequency Response -Signal to Noise Ratio -Input impd. at 1 KHz -IR & HV Test	MA	ELECTRICAL	100%	*	IS(9302) Part II APPD. TP	APPD. DATA SHEET APPD. TP	INSP. REPT.	P	W	W	
BHEL				BIDDER/ SUPPLIER				FOR CUSTOMER REVIEW & APPROVAL					
ENGINEERING			QUALITY			Sign & Date		Doc No:					
Sign & Date	Name		Sign & Date	Name	Seal				Sign & Date	Name	Seal		
Prepared by:		Checked by:							Reviewed by:				
Reviewed by:		Reviewed by:							Approved by:				

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN			SPEC. NO. :	DATE:
		CUSTOMER :			QP NO.: PE-QP-999-557-E001 REV 03	DATE:
		PROJECT:			PO NO.:	DATE:
		ITEM: IP BASED PUBLIC ADDRESS SYSTEM			SECTION:	SHEET 3 OF 3

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
					6	C/N				9	M	C		N
6.0	POWER DISTRIBUTION BOX, LOUD SPEAKER JB, POWER JB, SIGNAL JB, MAIN DISTRIBUTION FRAME (MDF), SUB DISTRIBUTION FRAME (SDF), SOCKET BOX FOR PORTABLE STATION	1. AESTHETIC 2. MECHANICAL 3 THICKNESS 4. HV / IR	MA MA MA MA	VISUAL DIM. DIMENSION ELECTRICAL	100% 100% 100% 100%	* * * *	APPD. DWG. APPD. DWG. APPD. DWG. APPD. DWG. APPD. TP	APPD. DWG. APPD. DWG. APPD. DWG. APPD. DATA SHEET APPD. TP	INSP. REPT. INSP. REPT. INSP. REPT. INSP. REPT.	P P P P	W W W W	W W W W	*BHEL witness on 5% (min1) sample selected at random of each type per Lot.	
7.0	WEATHER PROTECTING CANOPY& SOUND PROTECTING HOOD	1. AESTHETIC 2. MECHANICAL 3 THICKNESS	MA MA MA	VISUAL DIM. DIMENSION	100% 100% 100%	* * *	APPD. DWG. APPD. DWG. APPD. DWG.	APPD. DWG. APPD. DWG. APPD. DWG.	INSP. REPT. INSP. REPT. INSP. REPT.	P P P	W W W	W W W	*BHEL witness on 3% sample (min 3) selected at random of each type per Lot.	
8.0	INTEGRATED TESTING ON PA SYSTEM	FUNCTION -Party call -Paging call -Busy tone -Alert tone	MA	VISUAL	100%	*	APPD. TP	APPD. TP	INSP. REPT.	P	W	W	*BHEL to witness on 5 no. of stations or min 5% connected to central exchange.	
9.0	TYPE TEST	As per Annexure A	MA	ELECTRICAL /FUNCTIONAL	SAMPLE	*	Reference standard as per annexure A	Reference standard as per annexure A	REPORT	P	W	W	*Refer note below	
10.0	CABLES MAKE , MODEL & TYPE ROUTINE TEST FUNCTIONAL TEST	1. AESTHETIC 2. ELECTRICAL 2. ELECTRICAL	MA MA MA	VISUAL TC ELECTRICAL	100% 100% SAMPLE	* * *	APPD. DWG. TC APPD. TDS	APPD. DWG. TC INSP. REPT.	INSP. REPT. TC INSP. REPT.	P P P	W W W	W V W		

NOTE: CONDUCTION OF TYPE TEST/ SUBMISSION OF AVAILABLE VALID TYPE TEST REPORTS ON PA SYSTEM EQUIPMENT SHALL BE AS PER SPECIFICATION.

LEGENDS:
 *RECORDS, IDENTIFIED WITH "TICK"(✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
 ** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, C: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, N: CUSTOMER,
 P: PERFORM, W: WITNESS, V: VERIFICATION, AS APPROPRIATE
 MA: MAJOR, MI: MINOR, CR: CRITICAL

BHEL				BIDDER/ SUPPLIER				FOR CUSTOMER REVIEW & APPROVAL							
ENGINEERING		QUALITY		Sign & Date		Seal		Doc No.		Sign & Date		Name		Seal	
Prepared by:	Sign & Date	Name	Checked by:	Sign & Date	Name					Reviewed by:					
Reviewed by:			Reviewed by:							Approved by:					

LIST OF TYPE TEST FOR PUBLIC ADDRESS SYSTEM

S No	Equipment	Type test description	Referred standard	Test to be specifically conducted (Yes/No)	BHEL/Customer's approval Req. on test certificate (Yes/No)
1	Central Exchange	• High frequency radiated magnetic field test	IEC 61000-4-3	NO	YES
		• Electrostatic discharge test	IEC 61000-4-2		
		• Susceptibility test	IEC 61000-4-6		
		• Vibration test	IEC 60068-2-6		
		• Dry heat & damp heat test	IEC 60068-2-2 & IEC 60068-2-30		
		• Surge protection test	IEC 61000-4-5		
2	Field call stations, Junction box, power distribution box, Central Exchange, Master Control station, Desktop station, Flush mounted station, MDF/MB (if not integrated in central exchange)	DOP test (dust test & water test)	Relevant IS / IEC	NO	YES
3	Cone type speaker	Sound pressure level (SPL) before & after DOP test (dust test & water test)	Relevant IS / IEC	NO	YES
4	Horn type speaker	• Sound pressure level (SPL) before & after DOP test (dust test & water test)	Relevant IS / IEC	NO	YES
		• Frequency response test	IS: 9302 Part- IV		
		• Sound pressure level (SPL) test			
		• Impedance test			
		• Dry heat & damp heat test			
5	Field Call station	• Dry heat & damp heat test	IEC 60068-2-2 & IEC 60068-2-30	NO	YES
		• Vibration test	IEC 60068-2-6		
		• Electrostatic discharge test	IEC 61000-4-2		
		• Electromagnetic immunity test	As per relevant standard		
		• Surge protection test	IEC 61000-4-5		
		• RF immunity test	As per relevant standard		
6	Amplifier	• Frequency response test • Power output test • Signal to noise ratio test • Distortion test	Relevant IS / IEC	NO	YES
7	Flameproof handset station, flameproof horn type speaker, flameproof junction box (if applicable)	Type test as per relevant IS for flameproof properties	Relevant IS	NO	YES

ANNEXURE-III

PA SYSTEM-PACKING SPECIFICATION

1. Packing procedure shall conform to the following.
 - i) The equipment shall be properly packed before dispatch. The packing shall be capable of performing all necessary functions like prevention of damage to the contents, sufficient to support frequent handling and lengthy period of site storage in adverse weather condition are required. Workmanship and material used shall be of high standards meeting the technical requirement.
 - ii) The equipment shall be wrapped in weather proof packing using polythene sheets/ air bubble sheets/ thermocol sheets and then secured in Carton boxes / wooden packing cases. Further, carton boxes/ packing cases of smaller item shall be clubbed & packed finally in wooden box. Suitable cushioning material like rubberised coir shall be provided in the gap between items and casing.
 - iii) Wood for wooden packing cases/ crates shall be fir, chir, silver oak (gravilea robusta), (Normally wood for Wooden crates will be pinewood, fir, chir, silver oak without any bends, cracks and splits.)
 - iv) Central Exchange / MDF / SDF / PDB etc. shall be secured by fixing base plate/ frame with the help of bolt and nuts, etc. to bottom frame of the wooden packing cases/ crates.
 - v) Detailed case wise packing list in water proof envelope shall be inserted in each package together with equipment/material. One copy of 'Detailed Packing List' shall be fastened outside of the package in waterproof envelope
2. Specification for the sea worthy packing, if enclosed, for the export jobs shall form part of the specification.

Note: In case Manufacturer has a different packing standard which is equivalent or better same to be submitted for approval during contract stage.

ANNEXURE-A

PROJECT : 1X660 MW WBPDCS SAGARDIGHI EXTN UNIT V
PACKAGE : PA SYSTEM (IP BASED)
DESCRIPTION : DELIVERY TERM

1. Delivery Schedule :

- a. **Supply including quantity variation :** Delivery completion for supply shall be 205 days from the PO date.
- b. **E&C : 180** days from Front Clearance. For E&C, front shall be made available at least before 3 months from completion date.

Notes :

- a. Supplier to start manufacturing/supply only after getting the applicable engineering Drgs. /docs approved from BHEL/End Customer.
- b. Drawings /documents submission/re-submission schedule shall be as indicated in technical specification which shall be used for progress monitoring purpose and required course correction, if any.
- c. The delivery date specified is for completion of the deliveries. Deliveries to start progressively so as to meet the completion schedule.
- d. The delivery conditions specified are for contractual purposes. However, to meet project requirement, BHEL may ask for early deliveries without any compensation thereof.

2. **Validity of contract (PO rates, terms and conditions) :** Vendor has to make supply of goods/services as per the delivery time mentioned above. However, due to unavoidable circumstances if delay happens in providing inputs/ clearances (inputs, Engineering approvals, deputing inspector for inspection, issuance of MDCC and any hold imposed owing to site issues etc.) for which delivery time extension is admissible as per point no.3, in such situation it shall be obligatory at vendor part to execute the contract at PO rates, terms and conditions where inputs/ clearances has been accorded within validity of contract. Validity period for various activities shall be as defined below or as mentioned in the NIT.

2.1 Validity of the contract for supply including quantity variation.

- Contract shall be valid for 730 days from the PO date. However, delay at vendor's end (if any) shall be added to the validity period and contract validity shall get extended by the delay period at vendor's end.

For example: Original Delivery period for supply : 205 (in days)

Delay at vendor's end : B (in days beyond "205" days)

Contract validity : 730 + B (in days)

- 2.2 **Validity of contract for Services (E&C, Performance Guarantee PG test, Handing Over etc.) :** Validity of contract for Services shall be till completion of contractual obligations w.r.t. Services.

Notes :

- a. B is the Vendor delay days beyond original contractual delivery period for supply /extended delivery period owing to time taken by BHEL at point no. 2 above.
- b. Supply including quantity variation applicable in the contract released/ cleared for manufacturing within contractual validity period, to be supplied by vendor/supplier at PO rates, terms and conditions.

- c. Execution of the contract quantities released beyond contract validity period shall be decided on mutual consent basis at PO rates, terms and conditions.

3. Delivery Extension: Extension of contractual delivery time :

Delivery time mentioned in the NIT includes Engineering completion time (time for drawing/document submission/resubmission by the vendor and review/approval of the same by the BHEL/End customer), manufacturing, inspection, Packing and dispatch time. Due diligence is to be observed by the vendor to ensure timely completion of engineering and supply.

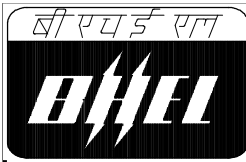
During the execution of the contract, time loss occurred owing to the reason attributable to BHEL besides force majeure shall be considered for delivery time extension to the vendor as given below: -

- i. Any Delay in providing comments/ approval on Primary drawing/documents beyond the stipulated time as specified in NIT.
- ii. Time Loss in approval of the drawing/document as a result of increase in the iteration not attributable to the vendor (i.e. resubmission owing to end customer comments) as certified by BHEL. Time extension equivalent to the resubmission time noted in the tech. spec and consequential increase in the approval time in lieu of increase in iteration shall be applicable. However, for incomplete re- submission time loss shall be in vendor account.
- iii. Delay in providing engineering input/material by BHEL.
- iv. Delay in deputing inspector for inspection and delay in release of MDCC in line with GCC/ GEM ATC terms.
- v. Any hold put by BHEL for whatever reasons during execution of contract (within contract validity period), time extension equivalent to hold period shall be admissible. However, in the event hold period continues for more than 30 days then, an additional fifteen days for the purposes of mobilization and demobilization of resources shall also be admissible.

Note : Extension in delivery period if any with or without imposition of LD shall be considered after detailed delay analysis based on provisions given above. However, no delay analysis will be applicable if supply is completed within delivery schedule as specified in Purchase order.

Delivery Schedule (Supply + E&C)

Sl.no	Package name	1st Vendor Sub (Days)	1st Bhel comment (Days)	2nd Vendor Sub (Days)	2nd Bhel and Customer comment/appr oval (Days)	Total Engg Time (Days)	Manufacturing Time (Days) including inspection, MDCC and despatch	Main Supply/ Delivery days from PO(For Unit- 1, Unit 2 and common area)	E&C from Front clearance	Validity of contract for main supply including of subsequent units (if applicable)- Considering 1st/2nd Unit.	Remarks
								"A" Days		"C" Days	
1	PA SYSTEM	21	8	8	18	55	150	205	180	730	E&C by supplier : For E&C, front shall be made available at least before 3 months from completion date.



**TECHNICAL SPECIFICATION FOR
IP BASED PA SYSTEM
1X660 MW SAGARDIGHI TPP UNIT#5**

SPECIFICATION NO. PE-TS-445-557-E001
REVISION 0
SHEET 1 OF 1

DRAWINGS & DOCUMENTS SCHEDULE

Documents shall be submitted after placement of order for BHEL & customer's approval as per the schedule specified below:

<i>BHEL Drawing No.</i>	<i>Drawing Title</i>	<i>Vendor Sub (Days)*</i>	<i>Bhel comment (Days)</i>	<i>Vendor Sub (Days)#</i>	<i>Bhel and Customer comment/a pproval (Days)</i>	<i>Total Engg Time (Days)</i>
Primary Documents						
PE-V0-445-557-E009	GA OF FLUSH MOUNTED STATION	21	8	8	18	55
PE-V0-445-557-E018	GA OF CONE TYPE SPEAKER (FLAME PROOF)	21	8	8	18	55
PE-V0-445-557-E024	TECHNICAL DATA SHEET OF FIBRE OPTICAL CABLE	21	8	8	18	55
PE-V0-445-557-E001	PA SYSTEM - TDS	21	8	8	18	55
PE-V0-445-557-E020	GA OF SOCKET FOR PORTABLE HAND SET	21	8	8	18	55
PE-V0-445-557-E011	GA OF EXTENSION AMPLIFIER	21	8	8	18	55
PE-V0-445-557-E013	GA OF PORTABLE HAND SET	21	8	8	18	55
PE-V0-445-557-E017	GA OF HORN TYPE SPEAKER (FLAME PROOF)	21	8	8	18	55
PE-V0-445-557-E005	GA OF MAIN DISTRIBUTION FRAME (MDF) / MAIN JUNCTION BOX(MJB)	21	8	8	18	55
PE-V0-445-557-E021	GA OF ETHERNET SWITCH	21	8	8	18	55
PE-V0-445-557-E014	GA OF HORN TYPE SPEAKER	21	8	8	18	55
PE-V0-445-557-E007	GA OF MISCELLANEOUS ITEMS FOR PA SYSTEM	21	8	8	18	55
PE-V0-445-557-E010	GA OF ACCOUSTIC HOOD / BOOTH	21	8	8	18	55
PE-V0-445-557-E004	GA OF FIELD STATION	21	8	8	18	55

PE-V0-445-557-E901	QUALITY PLAN FOR PA SYSTEM	21	8	8	18	55
PE-V0-445-557-E008	GA OF CENTRAL EXCHANGE FOR CHP AREA	21	8	8	18	55
PE-V0-445-557-E016	GA OF POWER JUNCTION BOX	21	8	8	18	55
PE-V0-445-557-E003	GA OF DESKTOP/ MASTER CONTROL STATION	21	8	8	18	55
PE-V0-445-557-E029	TYPE TEST PROCEDURE FOR PA SYSTEM	21	8	8	18	55
PE-V0-445-557-E002	GA OF CENTRAL EXCHANGE	21	8	8	18	55
PE-V0-445-557-E012	GA OF CANOPY	21	8	8	18	55
PE-V0-445-557-E006	GA OF SUB DISTRIBUTION FRAME (SDF) / SIGNAL LINE BOOSTER (SLB)	21	8	8	18	55
PE-V0-445-557-E019	GA OF POWER JUNCTION BOX (FLAME PROOF)	21	8	8	18	55
PE-V0-445-557-E015	GA OF CONE TYPE SPEAKER	21	8	8	18	55
PE-V0-445-557-E023	TECHNICAL DATA SHEET OF ETHERNET SWITCH	21	8	8	18	55
Secondary Documents						
PE-V0-445-557-E031	BILL OF MATERIAL	21	8	8	18	55
PE-V0-445-557-E030	TYPE TEST REPORT FOR PA SYSTEM	21	8	8	18	55
PE-V0-445-557-E027	CABLE SCHEDULE FOR PA SYSTEM	21	8	8	18	55
PE-V0-445-557-E025	O & M MANUAL FOR PA SYSTEM	21	8	8	18	55
PE-V0-445-302-E156	BILL OF MATERIAL	21	8	8	18	55
PE-V0-445-557-E028	CABLE INTERCONNECTION FOR PA SYSTEM	21	8	8	18	55
PE-V0-445-557-E026	BLOCK DIAGRAM FOR PA SYSTEM	21	8	8	18	55
NOTES:						
a)*1st submission within indicated days from date of purchase order.						
b) # Submission (within indicated days) after incorporating all BHEL comments.						
c) Primary documents shall be considered for Delay analysis.						
Notes:						
1. Vendor shall submit the dates for drawing/document submission/BHEL comments/ resubmission after approval of documents.						
2. In BOM each of the item to be uniquely identified with item code no. or item Sl. No. Supplier to ensure that all the items which will find separate mention in the packing list are covered in detailed BOM. Supplier to give following undertaking in BOM: " The BOM provided here completes the scope (in content and intent) of material supply under PO no. ---- dtd ----- Any additional material which may become necessary for the intended application of supplied item/package will be supplied free of cost in most reasonable time."						



PRE - QUALIFYING REQUIREMENTS

ENQUIRY NO:

PROJECT:

SAGARDIGHI UNIT V

PACKAGE:

PA SYSTEM

CRITERIA FOR EVALUATION - FINANCIAL :

Average annual financial turnover during the last Three Financial Years should not be less than
Rs.Sixty Five Lakh only

Amount (in Rs.)
65,00,000.00

Notes:-

a) The bidder has to submit financial accounts (audited, if applicable comprising of Audit report, Balance Sheet, Profit & Loss A/c Statement and Notes/Schedules pertaining to Turnover/Sales/Revenue), for last three years (or from the date of incorporation, whichever is less) as on tender due date to review the above criteria. In case the incorporation of vendor is less than 3 years, average annual financial turnover shall be calculated based on available information as below:-

i) If the accounts are available for ≤ 1 Financial Year, the Average Annual Turnover shall be calculated based on available information divided by 1 (One).

ii) If the accounts are available for >1 but ≤ 2 Financial Years, the Average Annual Turnover shall be calculated based on available information divided by 2 (Two).

iii) If the accounts are available for >2 but ≤ 3 Financial Years, the Average Annual Turnover shall be calculated based on available information divided by 3 (Three).

b) Foreign bidder is to submit a latest report from reputed third party business rating agency like Dun & Bradstreet, Credit reform etc. in addition to the documents mentioned at point (a) above for review of above criteria.

c) Other Income shall not be considered for arriving at Annual Turnover/Sales. For evaluation purpose, turnover figure excluding taxes shall be considered.

d) For evaluation of foreign bidder, exchange rate (TT selling rate of SBI) as on scheduled date of tender opening (Part-I bid in case of two part bid) shall be considered.

ANNEXURE I
1 X 660 MW WBPDCS SAGARDIGHI EXTN UNIT V

GeM BID NO. -----, Dt:- --

Letter head of Company

Ref.....

Date.....

To,
Bharat Heavy Electricals Limited
PEM, PPEI Building, Plot No 25,
Sector -16A, Noida (U.P)-201301

Subject: - Certification regarding local content

Dear Sir,

We hereby certify that items offered by us of ----- for **1 X 660 MW WBPDCS SAGARDIGHI EXTN UNIT V** meets the requirement of minimum local content in line with clause no. -- of NIT and the Public Procurement (Preference to Make in India), Order 2017 dated-15.06.2017, 28.05.2018, 29.05.2019, 04.06.2020 & 16.09.2020. The Percentage (%) of Local content is%.

We further confirm that details of location at which the local value addition is made will be our registered works at ----- (address of the works)

Yours very truly

----- (authorized signatory of company)

----- (firm name)

authorized signatory
of company

1 X 660 MW WBPDCS SAGARDIGHI EXTN UNIT V

GeM BID NO. -....., Dt:-

ANNEXURE -II (INSTRUCTIONS TO PACKING LIST)

For faster verification of bills, successful bidder to submit detailed Bill of Material (BOM) at the time of drawings/ documents submission after placement of PO. Each item of the BOM to be uniquely identified with item code no. or item Sl. No. Supplier to ensure that all items which will find separate mention in the packing list are covered in this detailed BOM.

Supplier to also give the following undertaking in the BOM:

“The BOM provided herewith completes the scope (in content and intent) of material supply under PO No. Dated Any additional material which may become necessary for the intended application of the supplied items/package will be supplied free of cost in most reasonable time.

Packing List must indicate:

- a) Packing size
- b) Gross weight and net weight of each package
- c) Contents of the package with cross reference to BOM item code no. / Sl. No.
- d) Quantity of each items separately.

The packing list must cover all the BOM items.

Supplier to give following undertaking in the packing list:

The Packing list provided herewith is as per BOM approved under PO No. ----

ANNEXURE III
1 X 660 MW WBPDC SAGARDIGHI EXTN UNIT V

GeM BID NO. -....., Dt:-

Letter head of Company

Ref.....

Date.....

To,
Bharat Heavy Electricals Limited
PEM, PPEI Building, Plot No 25,
Sector -16A, Noida (U.P)-201301

Subject: - Certification regarding Land Border

Dear Sir,

I have read the clause regarding restrictions of procurement from a bidder of a country which shares a land border with India. I hereby certify that M/s (Organization name) is not from such a country and is eligible to be considered.

Note :- Bidder is requested to furnish the above undertaking on company letterhead from the highest competent authority at your end (i.e Owner, partner, CMD, Director, company secretariat etc.).

Yours very truly

..... (authorized signatory of company)

..... (firm name)

authorized signatory
of company

INTEGRITY PACT**Between**

Bharat Heavy Electricals Ltd. (BHEL), a company registered under the Companies Act 1956 and having its registered office at "BHEL House", Siri Fort, New Delhi - 110049 (India) hereinafter referred to as "The Principal", which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the ONE PART

and

_____, (description of the party along with address), hereinafter referred to as "The Bidder/ Contractor" which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the OTHER PART

Preamble

The Principal intends to award, under laid-down organizational procedures, contract/s for _____

_____ (hereinafter referred to as "Contract"). The Principal values full compliance with all relevant laws of the land, rules and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder(s)/ Contractor(s).

In order to achieve these goals, the Principal will appoint panel of Independent External Monitor(s) (IEMs), who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1- Commitments of the Principal

- 1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles: -
 - 1.1.1 No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.
 - 1.1.2 The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential/ additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.
 - 1.1.3 The Principal will exclude from the process all known prejudiced persons.
- 1.2 If the Principal obtains information on the conduct of any of its employees which is a penal offence under the Indian Penal Code 1860 and Prevention of Corruption Act 1988 or any other statutory penal enactment, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions.

Section 2 - Commitments of the Bidder(s)/ Contractor(s)

- 2.1 The Bidder(s)/ Contractor(s) commit himself to take all measures necessary to prevent corruption. The Bidder(s)/ Contractor(s) commits himself to observe the following principles during participation in the tender process and during the contract execution.

- 2.1.1 The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to the Principal or to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material, immaterial or any other benefit which he/ she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.
- 2.1.2 The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any illegal or undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.
- 2.1.3 The Bidder(s)/ Contractor(s) will not commit any penal offence under the relevant Indian Penal Code (IPC) and Prevention of Corruption Act; further the Bidder(s)/ Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.
- 2.1.4 Foreign Bidder(s)/ Contractor(s) shall disclose the name and address of agents and representatives in India and Indian Bidder(s)/ Contractor(s) to disclose their foreign principals or associates. The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.
- 2.2 The Bidder(s)/ Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.
- 2.3 The Bidder(s)/ Contractor(s) shall not approach the Courts while representing the matters to IEMs and shall await their decision in the matter.

Section 3 - Disqualification from tender process and exclusion from future contracts

If the Bidder(s)/ Contractor(s), before award or during execution has committed a transgression through a violation of Section 2 above, or acts in any other manner such as to put his reliability or credibility in question, the Principal is entitled to disqualify the Bidder(s)/ Contractor(s) from the tender process, terminate the contract, if already awarded, exclude from future business dealings and/ or take action as per the separate "Guidelines on Banning of Business dealings with Suppliers/ Contractors", framed by the Principal.

Section 4 - Compensation for Damages

- 4.1 If the Principal has disqualified the Bidder (s) from the tender process before award / order acceptance according to Section 3, the Principal is entitled to demand and recover the damages equivalent to Earnest Money Deposit/ Bid Security.
- 4.2 If the Principal is entitled to terminate the Contract according to Section 3, or terminates the Contract in application of Section 3 above, the Bidder(s)/ Contractor (s) transgression through a violation of Section 2 above shall be construed breach of contract and the Principal shall be entitled to demand and recover from the Contractor an amount equal to 5% of the contract value or the amount equivalent to Security Deposit/ Performance Bank Guarantee, whichever is higher, as damages, in addition to and without prejudice to its right to demand and recover compensation for any other loss or damages specified elsewhere in the contract.

Section 5 - Previous Transgression

- 5.1 The Bidder declares that no previous transgressions occurred in the last 3 (three) years with any other company in any country conforming to the anti-corruption approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.
- 5.2 If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason or action can be taken as per the separate "Guidelines on Banning of Business dealings with Suppliers/ Contractors", framed by the Principal.

Section 6 - Equal treatment of all Bidder (s)/ Contractor (s) / Sub-contractor (s)

- 6.1 The Principal will enter into Integrity Pacts with identical conditions as this Integrity Pact with all Bidders and Contractors.
- 6.2 In case of Sub-contracting, the Principal Contractor shall take the responsibility of the adoption of Integrity Pact by the Sub-contractor(s) and ensure that all Sub-contractors also sign the Integrity Pact.
- 6.3 The Principal will disqualify from the tender process all Bidders who do not sign this Integrity Pact or violate its provisions.

Section 7 - Criminal Charges against violating Bidders/ Contractors /Subcontractors

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Vigilance Office.

Section 8 -Independent External Monitor(s)

- 8.1 The Principal appoints competent and credible panel of Independent External Monitor (s) (IEMs) for this Integrity Pact. The task of the IEMs is to review independently and objectively, whether and to what extent the parties comply with the obligations under this Integrity Pact.
- 8.2 The IEMs are not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD, BHEL.
- 8.3 The IEMs shall be provided access to all documents/ records pertaining to the Contract, for which a complaint or issue is raised before them as and when warranted. However, the documents/records/information having National Security implications and those documents which have been classified as Secret/Top Secret are not to be disclosed.
- 8.4 The Principal will provide to the IEMs sufficient information about all meetings among the parties related to the Contract provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the IEMs the option to participate in such meetings.

- 8.5 The advisory role of IEMs is envisaged as that of a friend, philosopher and guide. The advice of IEMs would not be legally binding and it is restricted to resolving issues raised by a Bidder regarding any aspect of the tender which allegedly restricts competition or bias towards some Bidders. At the same time, it must be understood that IEMs are not consultants to the Management. Their role is independent in nature and the advice once tendered would not be subject to review at the request of the organization.
- 8.6 For ensuring the desired transparency and objectivity in dealing with the complaints arising out of any tendering process or during execution of Contract, the matter should be examined by the full panel of IEMs jointly, who would look into the records, conduct an investigation, and submit their joint recommendations to the Management.
- 8.7 The IEMs would examine all complaints received by them and give their recommendations/ views to the CMD, BHEL at the earliest. They may also send their report directly to the CVO, in case of suspicion of serious irregularities requiring legal/ administrative action. Only in case of very serious issue having a specific, verifiable Vigilance angle, the matter should be reported directly to the Commission. IEMs will tender their advice on the complaints within 30 days.
- 8.8 The CMD, BHEL shall decide the compensation to be paid to the IEMs and its terms and conditions.
- 8.9 IEMs should examine the process integrity, they are not expected to concern themselves with fixing of responsibility of officers. Complaints alleging mala fide on the part of any officer of the Principal should be looked into by the CVO of the Principal.
- 8.10 If the IEMs have reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant Indian Penal Code / Prevention of Corruption Act, and the CMD, BHEL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the IEMs may also transmit this information directly to the Central Vigilance Commissioner, Government of India.
- 8.11 After award of work, the IEMs shall look into any issue relating to execution of Contract, if specifically raised before them. As an illustrative example, if a Contractor who has been awarded the Contract, during the execution of Contract, raises issue of delayed payment etc. before the IEMs, the same shall be examined by the panel of IEMs. Issues like warranty/ guarantee etc. shall be outside the purview of IEMs.
- 8.12 However, the IEMs may suggest systemic improvements to the management of the Principal, if considered necessary, to bring about transparency, equity and fairness in the system of procurement.
- 8.13 The word 'Monitor' would include both singular and plural.

Section 9 - Pact Duration

- 9.1 This Integrity Pact shall be operative from the date this Integrity Pact is signed by both the parties till the final completion of contract for successful Bidder, and for all other Bidders 6 months after the Contract has been awarded. Any violation of the same would entail disqualification of the bidders and exclusion from future business dealings.
- 9.2 If any claim is made/ lodged during currency of this Integrity Pact, the same shall be binding and continue to be valid despite the lapse of this Pact as specified above, unless it is discharged/ determined by the CMD, BHEL.

Section 10 - Other Provisions

- 10.1 This Integrity Pact is subject to Indian Laws and exclusive jurisdiction shall be of the competent Courts as indicated in the Tender or Contract, as the case may be.
- 10.2 Changes and supplements as well as termination notices need to be made in writing.
- 10.3 If the Bidder(s)/ Contractor(s) is a partnership or a consortium or a joint venture, this Integrity Pact shall be signed by all partners of the partnership or joint venture or all consortium members.
- 10.4 Should one or several provisions of this Integrity Pact turn out to be invalid, the remainder of this Integrity Pact remains valid. In this case, the parties will strive to come to an agreement to their original intentions.
- 10.5 Only those bidders / contractors who have entered into this Integrity Pact with the Principal would be competent to participate in the bidding. In other words, entering into this Integrity Pact would be a preliminary qualification.
- 10.6 In the event of any dispute between the Principal and Bidder(s)/ Contractor(s) relating to the Contract, in case, both the parties are agreeable, they may try to settle dispute through Mediation before the panel of IEMs in a time bound manner. In case, the dispute remains unresolved even *after mediation by the panel of IEMs, either party may take further action as the terms & conditions* of the Contract. The fees/expenses on dispute resolution through mediation shall be shared by both the parties. Further, the mediation proceedings shall be confidential in nature and the parties shall keep confidential all matters relating to the mediation proceedings including any settlement agreement arrived at between the parties as outcome of mediation. Any views expressed, suggestions, admissions or proposals etc. made by either party in the course of mediation shall not be relied upon or introduced as evidence in any further arbitral or judicial proceedings, whether or not such proceedings relate to the dispute that is the subject of mediation proceedings. Neither of the parties shall present IEMs as witness in any Alternative Dispute Resolution or judicial proceedings in respect of the dispute that was subject of mediation.

For &

Ashish
आशीष कुमार गुप्ता
प्रबंधक (पीजी-1)
बी.एच.ई.एल./पी.ई.एम. नोएडा

For & On behalf of the Bidder/ Contractor
(Office Seal)

Place

Date

Witness:

Ashutosh Sharma
आशुतोष शर्मा / Ashutosh Sharma
एन प्रसन्न (पीजी-1)/Dy. Manager (P.G-1)
भारत हेवी इलेक्ट्रिकल्स लिमिटेड / Bharat Heavy Electricals L.
पावर सेक्टर-प्रियोजनता अभियांत्रिकी प्रबंधन
Power Sector-Project Engineering Management
पीजीईएमई बिल्डिंग, एच.आर.डी.आई. एवं ईएसआई कॉम्प्लेक्स
PPEI Bldg, H.R.D.I. & ESI Complex,
प्लॉट नं. 25, सेक्टर 18 ए, नोएडा - 201301
Plot No. 25, Sec. 18 A, Noida - 201301

Witness: _____
(Name & Address) _____