INDRADHANUSH GAS GRID LIMITED

(Joint Venture of IOCL, ONGC, GAIL, OIL and NRL)

GUWAHATI, ASSAM

BID DOCUMENT

FOR

SCADA & APPS SYSTEM FOR PIPELINE SECTIONS (1-2-3-4-5-6-7-8-9-10-11-12-13-14) UNDER NORTH EAST GAS GRID PIPELINE PROJECT PH-I, II & III OF M/s IGGL

OPEN DOMESTIC COMPETITIVE BIDDING

Tender no.: 05/51/23VC/IGGL/094-R

VOLUME – II OF II

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PREPARED AND ISSUED BY

MECON LIMITED

(A Govt. of India Undertaking)

Delhi, India

INDRADHANUSH GAS GRID LIMITED

NATURAL GAS PIPELINE PROJECT
FOR
NORTH EAST GAS GRID PIPELINE

BID DOCUMENT

FOR

SCADA AND APPS SYSTEM (PHASE I, II, III)

DOMESTIC COMPETITIVE BIDDING
E-Tender no. :
BID Doc No. : 05/51/23VC/IGGL/094

VOLUME – II OF II

PREPARED AND ISSUED BY

MECON LIMITED
(A Govt. of India Undertaking)
MECON Limited, 13th & 15th Floor,
North Tower, SCOPE MINAR,
Laxmi Nagar District Centre, Delhi-110092 (India)

INDEX

VOLUME–II OF II

BID DOC. NO.: 05/51/23VC/IGGL/094 PHASE I, II, III

A. VENDOR DATA REQUIREMENT

B. VENDOR DRAWING/ DATA APPROVAL PROCEDURE

C. VENDOR DRAWING/ DOCUMENT SUBMISSION SCHEDULE

D. MATERIAL REQUISITION

E. PARTICULAR JOB SPECIFICATION FOR RTU FOR CENTRALISED SCADA SYSTEM (PJS No.: MEC/05/E5/T/23VC/PJS-094)

Annexure to PJS

0	03.08.2022	ISSUED FOR BID	Aditya	Ratnadeep	Pankaj
Revision	**Date**	**Description**	**Prepared by**	**Checked by**	**Approved by**

INDRADHANUSH GAS GRID LIMITED

NATURAL GAS PIPELINE PROJECT
FOR
NORTH EAST GAS GRID PIPELINE FOR IGGL
(PH-I, PH-II, PH-III)

MR No.: MEC/05/E5/T/23VC/MR-094 R
BID Doc No. : 05/51/23VC/IGGL/094 R

MATERIAL REQUISITION
FOR
SCADA AND APPS SYSTEM
(PH-I, PH-II, PH-III)

PREPARED AND ISSUED BY

MECON LIMITED
(A Govt. of India Undertaking)

MECON Limited, 13th & 15th Floor,
North Tower, SCOPE MINAR,
Laxmi Nagar District Centre, Delhi-110092 (India)

MATERIAL REQUISITION

1	03.08.2022	ISSUED FOR BID	Arvind	Ratnadeep	Pankaj Shrivastava
Revision	**Date**	**Description**	**Prepared by**	**Checked by**	**Approved by**

ITEM : SCADA AND APPS SYSTEM (PH – I, PH-II, PH-III)
PART A (PH-I,PH-II) AND PART B (PH-III)
PROJECT : NORTH EAST GAS GRID PIPELINE PROJECT FOR IGGL
MR NO. : MEC/05/E5/T/23VC/IGGL/094 R
CLIENT : INDRADHANUSH GAS GRID LIMITED (IGGL)

FOR PART -A (PH-I, PH -II)

Sr. No.	D E S C R I P T I O N	Unit	Assam	AP	Tripura	Nagaland	Mizoram	Meghalya	Total Quantity
T	The Scope of work for IP based SCADA & APPS system shall be (but not limited to) Project Management, Design, Engineering, Procurement of Materials, fabrications/ manufacturing, Inspection & Factory Acceptance Testing at works, Supply, Packaging, Shipping, Insurance, Port Handling, Custom Clearance, Inland Transportation to site, Storage & Safety, Installation along with necessary software, installation material, cables, connectors, RTU panels, erection of foundation support channel on trench for panel erection, cable trays, test instruments / equipments, Site Acceptance testing & Integration, Test Run, Pre-commissioning activity, Commissioning, Integration with Telecom System, APPS System, Leak Detection System & local IEDs, Training, technical support, Warranty, Mandatory spares & commissioning spares, Documentation for IP based Supervisory Control & Data Acquisition (SCADA) System with Remote work station & Remote Telemetry Unit, APPS System and shall be executed on turnkey indivisible works contract basis as per details scope of work, Technical Specification, Job specification PJS No. MEC/05/E5/T/23VC/ PJS-094 and other documents provided in the tender. Locations suggested are tentative and will be finalised during detailed engineering.								
T.S.A	**Supply:** Supply with all work define above								

T.S.A.1	**MAIN EQUIPMENT**								
T.S.A.1.1	System Design, Engineering & Supply of SCADA and APPS System at Main Master Station (MMS) consisting all Hardware, fully wired Server Rack, necessary accessories, furniture etc as defined in Scope of work in the Job specification No MEC/05/E5/T/23VC/PJS94, Technical Specifications & other documents provided in the tender. (Tentatively at Guwahati)	Set	01	00	00	00	00	00	01
T.S.A.1.2	System Design, Engineering & Supply of SCADA & APPS System at Backup Master Station (BMS) consisting all Hardware, fully wired Server Rack, necessary accessories, furniture etc (for complete scope including Part A and Part B) as defined in Scope of work in the Job specification No MEC/05/E5/T /23VC/ PJS-094, Technical Specifications and other documents provided in the tender. (Tentatively at DT, Silchar and RT, Numaligarh)	Sets	02	00	00	00	00	00	02
T.S.A.1.3	System Design, Engineering & Supply of SCADA Engineering work station cum Operator Work Station (desktop mounted), necessary accessories consisting of all Hardware, (for complete scope including Part A and Part B) as defined in Scope of work in the Job specification PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender. (Tentatively at MMS and BMS locations)	Sets	09	00	00	00	00	00	09
T.S.A.1.4	System Design, Engineering & Supply of Redundant Remote work station (desktop mounted), necessary accessories consisting of all Hardware, as defined in Scope of work in the Job specification PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.	Sets	01	01	02	01	01	01	07
T.S.A.1.5	System Design, Engineering & Supply of APPS Client work	Sets	03	00	00	00	00	00	03

	station (desktop mounted), necessary accessories consisting of all Hardware, as defined in Scope of work in the Job specification PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.								
T.S.A.1.6	System Design, Engineering & Supply of Portable Programmable Diagnostic Unit (PDT) , necessary accessories consisting of all Hardware, Licensed software(OS, RTU programming software etc) as defined in Scope of work in the Job specification PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.	Sets	03	00	00	00	00	00	03
T.S.A.2	Remote terminal units (RTU) with accessories, fully wired rack of size 2115 H (2000 + 15 + 100) as per the Technical Specification of RTU - Annexure I to PJS, & Job specification PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.								
T.S.A.2.1	**For SV Stations (with 2 nos. Spare in Assam and 1 no. spare in tripura)**	Sets	29	01	13	00	06	06	55
T.S.A.2.2	**For SV cum DT Stations**	Sets	03	00	00	00	00	00	03
T.S.A.2.3	**For DT/ RT Stations (with 1 no. Spare in Assam)**	Sets	05	01	05	01	01	01	14
T.S.A.2.4	**For IP Station and IP cum DT station**	Sets	04	00	00	00	00	01	05
T.S.A.2.4	RTU test unit (test jig) with each type of RTU cards, power supply, CPU, communication, serial, AI,DI,AO,DO cards for simulating RTU test environment (to be mounted in fully wired rack of 2115 mm(2000+15+100) x 800 mm x 800 mm) as per PJS MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.	Sets	03	00	00	00	00	00	03
T.S.A.3	**SOFTWARE**								
T.S.A.3.1	Operating System Software,	Sets	03	00	00	00	00	00	03

	SCADA server software, SQL Server software, HMI software/ Engineering Work Station Software, SCADA EWS software, APPS server software, APPS EWS software, History Server Software, Web Server Software, OPC server software, GPS Server Software etc as finally configured on the system readable storage media shall be provided. Licenses for operating system, SCADA server software, SQL Server software, HMI software, Engineering Work Station Software, APPS server software, APPS EWS software, History Server Software, Web Server Software, OPC server software, GPS Server Software etc shall be provided for complete SCADA System each at MMS and BMS location. All software with License have to be provided for the complete scope (including Part A and Part B) as defined in Scope of work in the Job specification No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender. Each Set shall consist of all the required software of complete SCADA system for 1 station.								
T.S.A.3.2	Operating System Software, SCADA RWS software, etc as finally configured on the system readable storage media shall be provided. Licenses for operating system, SCADA RWS software etc shall be provided for complete SCADA RWS at RWS location. All software with License have to be provided as defined in Scope of work in the Job specification No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender. Each Set shall consist of all the required software of complete SCADA RWS system for 1 station.	Sets	01	01	02	01	01	01	07
T.S.A.4	**Mandatory Spares:**								
T.S.A.4.1	Supply of loose Mandatory Spares (For RTU only - 10% of all type of Installed cards,	Lot	01	01	01	01	01	01	06

	convertors, power supply/ converters, termination boards, OEM cables between cards and termination boards, backplanes, relays, RTU chassis etc accounted & calculated considering for total quantities of RTU only), during calculation of mandatory spares as defined in Particular Job Specification, PJS No. MEC/05/E5/T/23VC/ PJS-094 (Bill of Material has to be provided along with offer, any fraction quantity should be round off to nearest number in higher side). Unit rate for Mandatory spares with cards details, part no., make etc. shall be given separately with the offer & price part.								
T.S.A.5	Industrial standard Tool kit for equipments with leather bag	Sets	03	00	00	00	00	00	03
T.S.A.6	**Test equipments as per specification -**								
T.S.A.6.1	Portable Power Source cum Calibrator (Current & Voltage) as per specification	Set	03	00	00	00	00	00	03
T.S.A.62	4 ½ Digit Multi-meter as per specification	Nos.	03	00	00	00	00	00	03
T.S.A.6.3	Protocol Analyser as per the specification defines in the Job specification PJS No. MEC/05/E5/T/23VC/ PJS-094	Set	03	00	00	00	00	00	03
T.S.A.7	Extended Warranty **per month** (The extended warranty of the SCADA system (MS, BMS, RWS) including all RTUs and APPS system shall be as per tender). (Note 7)	Month	24	24	24	24	24	24	144
T.A.E	**SERVICE AND SITE WORK** Installation, Testing & commissioning, Training, Interfacing with Instrumentation, Telecommunication, Electrical, CP system, APPS system, any other work as defined for SCADA & APPS system, work for the hook-up of RTU to SCADA server, (including all supply and erection of all installation materials, accessories,								

	connectors, all types of cables (Signal cable, power cable, Control Cable, Earthing cable (all cable FRLS Armoured), FRPVC Armoured Ethernet Cable, Armoured OFC cable (if required)), Perforated GI cable tray for laying of supplied cable, panel base frames, civil foundation etc complete in all respect as required and per PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.								
T.E.A..1	**MAIN EQUIPMENT**								
T.E.A.1.1	All Site work as define above at respective stations for complete SCADA & APPS System with all Hardware & Software for Main Master Station (MMS) (including all the servers and workstation) as per the Job Specifications PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.	Lot	01	00	00	00	00	00	01
T.E.A.1.2	All Site work as define above at respective stations for complete SCADA & APPS System with all Hardware & Software for Backup Master Station (BMS) (including the servers and workstation) as per the Job Specifications PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.	Lot	02	00	00	00	00	00	02
T.E.A.1.3	All Site work as define above at respective stations for complete SCADA RWS System with all Hardware & Software for RWS Location as per the Job Specifications PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.	Lot	01	01	02	01	01	01	07
T.E.A.1.4	All Site work as define above at respective stations for complete APPS Client Workstation with all Hardware & Software as per the Job Specifications PJS No. MEC/05/E5/T/23VC/ PJS-094,	Lot	03	00	00	00	00	00	03

	Technical Specifications and other documents provided in the tender.								
T.E.A.2	All Site work as define above at respective stations for complete RTUs with SCADA system Interface with all Hardware & Software as per TS of RTU and Job Specifications PJS No. (including the redundant server and workstation) as per the Job Specifications PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.								
T.E.A.2.1	**For SV Stations**	Lot	28	01	12	00	06	06	53
T.E.A.2.2	**For SV cum DT Stations**	Lot	03	00	00	00	00	00	03
T.E.A.2.3	**For DT/ RT Stations**	Lot	04	01	05	01	01	01	13
T.E.A.2.4	**For IP Station and IP cum DT station**	Lot	04	00	00	00	00	01	05
T.E.A.3	Training (as defined in PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender at OEM works / OEM testing facilities) for SCADA and APPS system before the final acceptance of the SCADA and APPS system by the Client as per the Job Specifications PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender. (04 engineers for 05 man days each).	Lot	01	01	01	01	01	01	06
T.E.A.5	All inclusive per month rates for maintaining store at site (State wise / regions wise for the supplied material and free issue materials of respective state / regions). (Note 8)	Months	24	24	24	24	24	24	144
T.P.A.W	**Post warranty maintenance contract (PWMC) – comprehensive for complete SCADA & APPS system and RTU (as provided under Part A- all supplied items)** as defined in the Particular Job specification / bid document for complete telecom system **for 5 years** after completion of main warranty / extended warranty complete in all respect as define in the	Lot	01	01	01	01	01	01	06

	particular Job specification. Payment will be made on quarterly basis. (Note -9)								

FOR PART B (Ph-III)

Sr. No.	D E S C R I P T I O N	Unit	Nagaland	Manipur	West Bengal	Sikkim	Total Quantity
T	The Scope of work for IP based SCADA & APPS system shall be (but not limited to) (for both Part A and Part B) Project Management, Design, Engineering, Procurement of Materials, fabrications/ manufacturing, Inspection & Factory Acceptance Testing at works, Supply, Packaging, Shipping, Insurance, Port Handling, Custom Clearance, Inland Transportation to site, Storage & Safety, Installation along with necessary software, installation material, cables, connectors, panels, erection of foundation support channel on trench for panel erection, cable trays, test instruments / equipments, Site Acceptance testing & Integration, Test Run, Pre-commissioning activity, Commissioning, Integration with Telecom System, APPS System, Leak Detection System & local IEDs, Training, technical support, Warranty, Mandatory spares & commissioning spares, Documentation for IP based Supervisory Control & Data Acquisition (SCADA) System with Remote work station & Remote Telemetry Unit , APPS system and shall be executed on turnkey indivisible works contract basis as per details scope of work, Technical Specification, Job specification PJS No. MEC/05/E5/T/23VC/ PJS-094 and other documents provided in the tender. Locations suggested are tentative and will be finalised during detailed engineering.						
T.S.B	**Supply:** Supply with all work define above						
T.S.B.1	System Design, Engineering & Supply of Redundant Remote work station (desktop mounted), necessary accessories consisting of all Hardware, as defined in Scope of work in the Job specification PJS No.	Sets	00	01	00	01	02

	MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.						
T.S.B.2	Remote terminal units (RTU) with accessories, fully wired rack of size 2115 H (2000 + 15 + 100) as per the Technical Specification of RTU - Annexure I to PJS, & Job specification PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.						
T.S.B.2.1	**For SV Stations (with 1 no. Spare in WB)**	Sets	06	04	07	02	19
T.S.B.2.2	**For DT/ RT Stations**	Sets	00	01	01	01	03
T.S.B.2.3	**For IP Station**	Sets	00	01	01	00	02
T.S.B.3	**SOFTWARE**						
T.S.B.3.1	Operating System Software, SCADA RWS software, APPS module for phase – III pipelines etc as finally configured on the system readable storage media shall be provided. Licenses for operating system, SCADA RWS software etc shall be provided for complete SCADA RWS at RWS location. All software with License have to be provided as defined in Scope of work in the Job specification No. MEC/05/E5/T/ 23VC/PJS-094, Technical Specifications and other documents provided in the tender. Each Set shall consist of all the required software of complete SCADA RWS system for each station.	Sets	00	01	00	01	02
T.S.B.4	**Mandatory Spares:**						
T.S.B.4.1	Supply of loose Mandatory Spares (For RTU only - 10% of all type of Installed cards, convertors, power supply/ converters, termination boards, OEM cables between cards and termination boards, backplanes, relays, RTU chassis etc accounted & calculated considering for total quantities of RTU only), during calculation of mandatory spares as defined in Particular Job Specification, PJS No. MEC/05/E5/T/23VC/ PJS-094 (Bill of Material has to be provided along with offer, any fraction quantity should be round off to nearest number in higher side). Unit rate for Mandatory spares with cards details, part no., make etc. shall be given separately with	Lot	01	01	01	01	04

	the offer & price part.						
T.S.B.5	Extended Warranty **per month** (The extended warranty of the SCADA system (MS, BMS, RWS) including all RTUs and APPS system shall be as per tender). (Note 7)	Month	24	24	24	24	96
T.B.E	**SERVICE AND SITE WORK** Installation, Testing & commissioning, Training, Interfacing with Instrumentation, Telecommunication, Electrical, CP system, APPS system, any other work as defined for SCADA system, work for the hook-up of RTU to SCADA server, (including all supply and erection of all installation materials, accessories, connectors, all types of cables (Signal cable, power cable, Control Cable, Earthing cable (all cable FRLS Armoured), FRPVC Armoured Ethernet Cable, Armoured OFC cable (if required)), Perforated GI cable tray for laying of supplied cable, panel base frames, civil foundation etc complete in all respect as required and per PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.						
T.E.B.1	All Site work as define above at respective stations for complete SCADA RWS System with all Hardware & Software for RWS Location as per the Job Specifications, APPS for Phase -III pipeline section as per PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.	Lot	00	01	00	01	02
T.E.B.2	All Site work as define above at respective stations for complete RTUs with SCADA system Interface with all Hardware & Software as per TS of RTU and Job Specifications PJS No. (including the redundant server and workstation) as per the Job Specifications PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender.						
T.E.B.2.1	**For SV Stations**	Lot	06	04	06	02	18
T.E.B.2.2	**For DT/ RT Stations**	Lot	00	01	01	01	03

T.E.B.2.3	**For IP Station and IP cum DT station**	Lot	00	01	01	00	02
T.E.B.3	Training (as defined in PJS No. MEC/05/E5/T/23VC/ PJS-094, Technical Specifications and other documents provided in the tender at OEM works / OEM testing facilities) for SCADA and APPS system before the final acceptance of the SCADA and APPS system by the Client as per the Job Specifications PJS No. MEC/05/E5/T/23VC/PJS-094, Technical Specifications and other documents provided in the tender. (04 engineers for 05 man days each).	Lot	01	01	01	01	04
T.E.B.5	All inclusive per month rates for maintaining store at site (State wise / regions wise for the supplied material and free issue materials of respective state / regions). (Note 8)	Month	24	24	24	24	96
T.P.B.W	**Post warranty maintenance contract (PWMC) – comprehensive for complete supplied system under Part B & RWS, RTU, APPS Modules etc)** as defined in the Particular Job specification / bid document for complete telecom system **for 5 years** after completion of main warranty / extended warranty complete in all respect as define in the particular Job specification. Payment will be made on quarterly basis. (Note 9)	Lot	01	01	01	01	04

NOTES:

1. Bidder shall quote for all the items of Part A & Part B. Bid offer will be evaluated package wise i.e. combine for Part A & Part B. All the items /sub-items of Part A & Part B will be considered for evaluation purpose. Order will be awarded to lowest priced bidder for both Part A and Part B as completion of total work as a TURNKEY work responsibility.

2. Bidder has to note that the Time schedule shall be as define in the tender; supply and site work shall be executed as per the written intimation from client/PMC.

3. Inspection of the various Items of each LOT as per time schedule shall be executed as per the time schedule (CDD) and as defined in the Particular Job specification. The RTU, RWS will be tested with PC based Server & SCADA software if supply requested without MMS/ BMS equipment / software. For the Inspection (by client/ PMC) any provision / facilities as required shall be arrange by the bidder at the time of Inspection and FAT at OEM's work / SCADA OEM works. Details and procedure of Inspection will be finalised with successful bidder during detailed engineering stage.

4. Each lot Commissioning spare as required will be part of the offer and shall be available at the time of commissioning.

5. Details of Mandatory spares with part no., make etc. shall be given separately with the offer & enclosed with techno-commercial documents.
6. The quantity and location of the stations may change due to any change in site location/ requirements; bidder shall to take prior approval for procurement and erection.

7. The Main warranty of the complete SCADA & APPS system(for both Part A and Part B) of the complete supplied system including all SCADA system, APPS system, RTUs, RWS (all supplied system including mandatory spares), test instruments, PDT etc. will be 24 months from the date of completion as defined in completion schedule. In case any works not completed till 24 months from FOA (due to delay not attributed to bidder); Extended warranty will start for all the supplied / commissioned system so that the main warranty is intact for 24 months from the date of completion as defined in completion schedule. In case of delay from bidder side; extended warranty will start only after adjusting the delay part of bidder. All materials will be considered in custody of bidder with applicable conditions of warranty till handing over of the system to Client

   The Extended warranty shall be applicable for the complete scope of supply including mandatory spares and Test equipments. The extended warranty per month rate will be used to allow the contractor to provide and intact the main warranty for the delayed commissioning & handing over of system not attributed to contractor, so that the Main warranty (i.e. 24 months) is made available on successful completion of trial run/ acceptance of system by owner / handing over of system. After the completion of trial run/ acceptance of system by owner / handing over of the complete system to the Client, Main warranty of the System (for 24 months) shall start.

   In case of delayed supply attributable to bidder extended warranty will start after adding delayed period of last supply to completion schedule for which cost of warranty/extended warranty is to be borne by bidder.

   Start of extended warranty per month is to be intimated by the bidder and will be confirmed by the client / PMC. The Extended warranty rates shall be for the complete scope of supply including mandatory spares and Test equipments.

   Payments will be made monthly/quarterly as per SOR rate quoted by the bidder and will continue till hand over of the system. The Extended warranty rates shall be for complete scope of supply including mandatory spares and Test equipment and to be billed as per SOR. Refer respective Clause for Warranty in Particular Job specification of the tender.

8. Bidder has to complete the work as per the schedule. Bidder shall maintain store (for Both Part A and Part B) in each state at site for storage of all the supplied materials in each state. Payment for the store shall be claimed by the bidder as per the quoted rates after receipt of material at store, from date of receipt of material at store to the date till which the materials are stored in the store. The store has to be maintained for each state /region of pipeline and billed as per the requirements. Insurance of all materials in the store is included in scope of the bidder and cost of the same shall be covered in the quoted price. Safety and security of store shall be the responsibility of bidder and is included in scope of the bidder. Bidder shall be responsible for all the supplied material till handing over of the material to Client.

9. Post warranty maintenance contract (comprehensive) as define in the bid (for Both Part A and Part B) shall be provided by original equipment supplier along with bidder for **05 years of periods** as defined in the tender for complete scope of supply. PWMC work will start after completion of Main warranty at same time for both Part A & Part B. However, in case of any delay in any Part, warranty & PWMC may start separately for Part A & Part B as per rate quoted and as per the decision of EIC. At the time of FOA; order for supply and site services shall be placed, however client will placed separate order for Post Warranty Maintenance as per terms & condition of the contract on or before 3 months of completion of main warranty.

10. Operation & maintenance OEM suggestive spares (for 2 years) required after PWMC, each module, with complete list, part no, unit rate shall be provided at the time of bid. The validity of rates shall

be upto contractual period including PWMC from date of commissioning / acceptance of complete work (i.e. 7 year – 2 year warranty + 5 year PWMC). Refer PJS for details

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VENDOR DATA REQUIREMENTS

The table hereunder specifies the quantities and the nature of the documents to be submitted by the Vendor to the Client / Consultant for Approval / Record.

Any document, even when preliminary, shall be binding and therefore duly identified and signed by the Vendor. It shall bear the Project reference, the PO no. and the document identification number.

THE DOCUMENTS ARE FULLY PART OF THE SUPPLY WHICH SHALL BE COMPLETE ONLY IF AND WHEN THE DOCUMENTS COMPLYING FULLY WITH THE MATERIAL REQUISITION REQUIREMENTS ARE RECEIVED BY THE CLIENT / CONSULTANT.

Sl. No.	Documents and Data	Quotes	Certified information required after Purchase Order			
			Soft Copy	Printed Matter	Date needed	Date Promised
1	Functional design Specification for SCADA and APPS system	1	4	4	12 weeks	-
2	Bill of Material	1	4	4	12 weeks	-
3	List of Commissioning Spares	1	4	4	12 weeks	-
4	List of Mandatory Spares	1	4	4	12 weeks	-
5	Detailed system architecture for SCADA and APPS system including details of various interfaces, signal protocols etc.	-	4	4	12 weeks	-
6	RTU Specification, internal Layout including mounting arrangement, interconnection, individual Cabinet wiring diagram (including server cabinet)	1	4	4	12 weeks	-
7	I/O point database	-	4	4	12 weeks	-
8	User guides, maintenance & configuration manuals for all supplied equipments / Test instruments/ Spares/ subsystems.	-	4	4	-	W/S
9	RTU-IED interface manuals including manuals of special tools used for interfacing IEDs	-	4	4	-	W/S
10	Quality Assurance Plan	1	4	4	12 weeks	-
11	FAT Procedure	-	4	4	12 weeks	-
12	SAT Procedure	-	4	4	16 weeks	-
13	Test Run Procedure	-	4	4	16weeks	-

14	IP address & protocol structure at each station	-	4	4	12 weeks	-
15	Station wise power consumption calculations of each system	-	4	4	12 weeks	-
16	List of special Tools & Tackles	-	-	-	-	-
17	Project execution schedule	-	4	4	6 weeks	-
18	As Built I/O Details	-	After completion			-

Notes:

1. Fold all drawing to 210mm x 297mm.
2. Vendor to provide all printed matter and the soft copy to MECON LIMITED.
3. Legends:
   A/C= As completed, W/S= With Shipment, W= Weeks
4. Final technical document file shall be supplied in hard copy as indicated and in electronic format (.pdf Acrobat files) on two (2 Nos.) CD-ROM.
5. All these documents shall be submitted along with dispatch of the system to site.
6. FAT procedure documents must include clause wise reference of tender specification for its compliance. This document shall be prepared in consultation with owner / owner's representative.
7. The documents / information required with offer sheets to be furnished otherwise the offer shall be liable for rejection.
8. During detail engineering stage, 3 sets of printed matter and 2 soft copies shall be submitted till the final approval of documents/drawings. After approval 4 sets has to BE submitted.
9. As Built documents: 6 sets Printed Matter, 6 sets Soft Copy.

MECON Limited	**Vendor Drawing/ Document Submission Schedule**		
Client/ Project :	**Vendor's Name :**	**Contact Person (Name/ Tel/ Fax/ email) :**	**Status Date:**
Item Description : **SCADA System**	**PR No.:** **Date of LOI:**	**Review Status Code:** 1. APPROVED - No Comments 2. APPROVED AS NOTED - Proceed with manufacture/ fabrication as per commented document. Revised document required. 3. NOT APPROVED Document does not conform to basic requirements as marked. Resubmit for Review. R: Retained for Reference V: Void	
Doc No. MEC-S-05-E5-094-F01, Rev 0	**PO No.:** **Date of PO:**		
Department :	**Contact Person:**		

S. No.	Drawings / Documents as per MECON Vendor Data Requirement	Vendor Drg/ Doc No. Title	Category Review(R) / Records(I)	Schedule Date of 1st Submission (Rev. 0)	Anticipated (Ant) Date of submission by vendor Actual (Act) Date of submission by vendor Date of Return (Rew) by MECON Review Status (Code)	Rev. 0	Rev. 1	Rev. 2		Form Electronic (E)/ Print (P)	Remarks
					Ant						
					Act						
					Rew						
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VENDOR DRAWING/ DATA APPROVAL PROCEDURE

SCADA SYSTEM FOR NATURAL GAS PIPELINE PROJECT FOR NORTH EAST GAS GRID PIPELINE

BID DOC. NO.: 05/51/23VC/IGGL/094

1. Vendor must take care of the following while submitting drawings and documents for review as indicated in Vendor Data Requirements enclosed.

   A blank space measuring 75mm W x 40mm H shall be provided on all vendor drawings for marking review codes etc. by MECON LIMITED.

   The review of vendor drawings shall be done as applicable under the following review codes:

   a) Review Code Approved : Approved

   b) Review Code Approved As Noted: Proceed with manufacture/ fabrication as per commented drawings. Revised drawing required.

   c) Review Code Not Approved: Document does not conform to basic requirements as marked. Resubmit it for review.

2. Review of the vendor drawings by MECON would be only to check compatibility with basic design and concepts and would in no way absolve the manufacturer/ fabricator of his responsibility to meet applicable codes, specification and statutory rules/ regulations.

3. For drawings/ documents indicated as FOR INFORMATION in the Vendor Data Requirement, Vendor must mark FOR INFORMATION ONLY on the submitted drawings/ documents.

INDRADHANUSH GAS GRID LIMITED

NATURAL GAS PIPELINE PROJECT
FOR
NORTH EAST GAS GRID PIPELINE

PARTICULAR JOB SPECIFICATION (PJS)
FOR
CENTRALISED SCADA SYSTEM

PJS No.: MEC/05/E5/T/23VC/PJS-094

PREPARED AND ISSUED BY

MECON LIMITED
(A Govt. of India Undertaking)

MECON Limited, 13th & 15th Floor,
North Tower, SCOPE MINAR,
Laxmi Nagar District Centre, Delhi-110092 (India)

TABLE OF CONTENTS

1.0 INTRODUCTION

2.0 BRIEF PROJECT DETAILS

3.0 DEFINITIONS

4.0 CODES AND STANDARDS

5.0 ABBREVIATIONS

6.0 UNITS OF MEASUREMENT

7.0 BRIEF SCOPE OF SUPPLY & WORKS FOR SCADA SYSTEM

8.0 DETAILED SCOPE OF SCADA SYSTEM

9.0 GENERAL TECHNICAL REQUIREMENTS

1.0 INTRODUCTION:

a) The purpose of this specification is to define the outline requirement of Centralized SCADA System for IGGL's NATURAL GAS PIPELINE PROJECT FOR NORTH EAST GAS GRID including all Dispatch Terminals/ Receiving Terminals, Sectionalising Valve (SV) stations, Intermediate Pigging stations used for NG transporting services.

b) In case of any conflict between the specifications, enclosed data sheets, enclosed attachments, related codes and standards, the same shall be informed at the bid stage, after award of contract change will not be permitted.

c) In the event of any conflict between this specification, data sheets, BOQ, TS, related standards, codes etc. after award of contract, stringent among all the data shall be followed without any implication and no extra payment shall be made towards the same.

d) Vendor shall be responsible for selection of the correct system to meet the purchaser's specifications at the time of bid. In case of any modification / change in selected equipment model at a later date to meet the Purchaser's Specifications, the same shall be done by the vendor without any price and delivery implications.

2.0 BRIEF PROJECT DETAIL

a. The Hydrocarbon vision 2030 for North East India (vision document), released by MoP&NG proposes detailed plan for Natural gas infrastructure development in North-East. The states covered in the vision document include Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura.

b. M/s Indradhanush Gas Grid Limited (IGGL), a Joint Venture of IGGL, ONGC, IGGL, OIL and NRL, is in the process of implementing the North East Gas Grid (NEGG) with a vision to connect all the eight (08) north eastern state capitals and major consumption centers in the region. The NEGG will be connected to National gas grid at Guwahati through Barauni-Guwahati pipeline.

c. The scope of work shall include: design, engineering, procurements of material, fabrication/assembly, shop painting, shop testing, packaging, loading, dispatch to site, unloading, storage, unpacking, handling at site, erection, site testing, site painting, flushing, commissioning and performance of guarantee tests for the SCADA System items. The term SCADA system wherever mentioned shall include RTUs of all stations (DT, RT, SV. IP) , SCADA Server, History Server, GPS Server (only at MMS location), OPC Server, Web Server, APPS Server, SCADA EWS, SCADA RWS, APPS EWS at different locations, all requisite software for servers and work stations, all requisite hardware and other materials as required for complete commissioning of entire SCADA system as per the specification.

d. The tentative station wise I/O's are indicated in tender. The major IED (Intelligent Electronic

Devices) to be connected with the RTU's are PLC system of respective stations, cathodic protection panel, UPS panel, Battery chargers panel of Solar Power Supply, Grid power supply Panel

3.0 DEFINITIONS

The following definitions shall apply for the SCADA tender:
a) PURCHASER/ OWNER: Indradhanush Gas Grid Limited (IGGL)
b) CONSULTANT/ PMC : MECON Limited
c) VENDOR/ BIDDER/ TENDERER : Individual or organization entering into agreement with Purchaser to perform services or work and/ or to supply materials specified in Purchase Document.
d) PURCHASE DOCUMENT: All the written materials, in addition to the Specifications, Data sheets and Drawings which describe the contract terms and conditions, delivery requirements and instructions and any other information/ instructions required by the vendor to perform the specified services and/ or to supply the specified materials.

4.0 CODES AND STANDARDS

The SCADA system shall be designed in accordance with the basic laws, codes, rules and standards that are mandatory by law. The latest edition of all the codes and standards applicable shall be followed. If there is conflict between these standards that may exist, in such case the most stringent requirements shall be applicable.

i) Laws, Codes & Rules as mandatory under the legislation of India, among others, but not limited to and due attention shall be paid to the following.
   • OISD: Oil Industry Safety Directorate
   • PNGRB: The Petroleum & Natural Gas Regulatory Board
   • MOE&F - Ministry of Environment & Forest guidelines
   • MB Lal Committee Recommendations accepted by Ministry
   • ITU SCADA Standardization Sector (ITU-T) • Bureau of Indian Standards (BIS)
   • Petroleum Rules
   • ANSI
   • ASME
   • ASTM
   • IEC/IEEE
   • Indian Standard (IS)
   • ISA
   • ISO
   • PESO
   • API RP 551, API RP 552, API RP 554, API 555, API RP 520, API RP 521, API RP 526, API RP 527, API 6D, API 6FA, API 607, BP RP 30-1, BP RP 30-2, BP RP 30- 4, BP RP 30-5, BP RP 30-7, BP RP 32-1, BP RP 44-1, BP 6739, BP 6883, BP 5308, BP 5345, BP 5839, BP 6121, BP 1042, EN 50014, EN 50018, EN 50019, IEC 60529, IEC 60079, IEC 61000-5-7, IEC 60331, IEC 60332, IEC 60751, IEC 61131, IEC 61508, IEC 60801, IEC 60534-1, IEC 61511, IP Part 15, ISA 75.01, ISA 84.01, ISA RP 55.1, ISA 5.3, ISA 71.01, ISA 71.02, ISA 71.03, ISA 82.02.01, IEEE

712, IEEE Std 446, IEEE Std 472, IEEE Std 488.1, IEEE Std 802.3, IEEE Std 488.2, ISO-5167, NFPA, EIA RS 232C, EIA RS 485

The specifications and data sheets as a minimum shall be in compliance with the latest edition of the above mentioned standards. The Order of precedence applying for use of the Codes, Standards, Specifications and Statutory requirements for this project is as follows:

• Statutory Requirements;

• International Codes & Standards;

• Project Documents; In the event of an inconsistency, conflict or discrepancy between any of the Standards, Specifications and Statutory requirements, the most stringent and safest requirement applicable to the project will prevail to the extent of the inconsistency, conflict or discrepancy. Any inconsistencies, critical to the design, shall be brought to the attention of the EPMC CONSULTANT / OWNER for resolution. The OWNER's clarification shall be final.

i) The "Good Engineering Practice" commonly used by the worldwide Oil Industry.

5.0 ABBREVIATIONS

- ASME American Society of Mechanical
- DT Dispatch Terminal
- IPS Intermediate Pigging Station
- RT Receiving Terminal
- SV Sectionalizing Valve Station
- AV Actuated Valve
- OISD Oil Industry Safety directorate
- PLC Programmable Logic Controller
- SCADA Supervisory Control and Data Acquisition
- RWS Remote Work Station
- EWS Engineering Work Station
- IP Internet Protocol/ Ingress Protection
- Ex-Proof Explosion Proof
- OFC Optical Fibre Cable
- SCMH Standard Meter Cube Per Hour
- ACMH Actual Meter Cube Per Hour

6.0 Units of Measurement

- Volumetric Flow Rate : m3 /hr
- Mass Flow Rate : kg/ hr
- Mass : kg
- Noise : dB(A)
- Power : kW
- Pressure(gauge) : Kg/cm2 (g)
- Pressure(absolute) : Kg/cm2 (a)
- Temperature : ^{o}C
- Density : Kg/m3
- Viscosity : cP
- Velocity : m/s

- Measured Volume : ACMH
- Standard Volume : SCMH
- Dimension : mm/m
- Area : m^2

7.0 BRIEF SCOPE OF SUPPLY & WORKS FOR SCADA SYSTEM:

7.1. To ensure effective and reliable Control, Management and Supervision of pipeline, the pipeline is envisaged to be monitored and controlled from centralized SCADA system's proposed Main Master Station (MMS), at Guwahati, Back-up Master Station (BMS) -1 at Numaligarh and Back-up Master Station (BMS) -2 at Sichar. MMS, BMS-1 & BMS-2 shall be in hot synchronized configuration.

7.2. For smooth monitoring & control of pipeline facilities with SCADA system, new RTUs have been envisaged and the same will be interfaced with SCADA system.

7.3. All the software provided by the bidder shall be licensed in name of IGGL and shall be perpetual. Paper License/ Softkeys shall be provided for each license. Dongle shall not be acceptable.

7.4. Routers , Switches shall be provided with all the desired license as required and as mentioned in the datasheet of Routers and Switches.

7.5. SCADA System shall be open architecture design, to monitor & control the process equipment and parameters of pipeline. The architecture shall mainly consists of following -

i. Redundant Main Master station (MMS) at Guwahati
ii. Back-up Master Station -1 (BMS-1) at Numaligarh
iii. Back-up Master station -2 (BMS-2) at Sichar
iv. OPC Server each at MMS, BMS-1 and BMS-2 locations
v. History Server each at MMS, BMS-1 and BMS-2 locations
vi. APPS (including Leak Detection) Server (including RTM and PM modules) each at MMS, BMS -1and BMS-2 locations
vii. APPS Server for Trainer module each at MMS, BMS -1and BMS-2 locations
viii. APPS (including Leak Detection) Work station each at MMS, BMS -1and BMS-2 locations
ix. Web Server (including Email server, SMS server functionality) at MMS location
x. 20 Nos. Web Client Licenses web server
xi. SCADA Engineering cum Operator Work Station, 3 nos. each at MMS, BMS -1and BMS-2 locations
xii. GPRS/ GSM server each at MMS, BMS -1and BMS-2 locations for GPRS/ GSM communication
xiii. GPS NTP/ PTP clock each at MMS, BMS -1and BMS-2 locations
xiv. AI/ ML server each at MMS, BMS -1and BMS-2 locations
xv. AI/ ML workstation each at MMS, BMS -1and BMS-2 locations
xvi. SCADA Redundant Remote Work Station at each major Receiving stations
xvii. RTU at each remote operated station of the piepline

xviii. 75” large display each at MMS, BMS -1and BMS-2 locations
xix. Dual channel GPRS MODEM for each RTU
xx. Routers and switches each at MMS, BMS -1and BMS-2 locations as per the tender requirement
xxi. Any item not mentioned above but required to meet the complete functionality of the system as per the tender requirements

7.6. The web server should be able to display graphics through web.

7.7. All the Power, signal, control, MODBUS and Ethernet cables required shall be FRLS armoured cables as per the specification provided. CAT-7 Cable shall be FRPVC armoured cable.

7.8. The Vendor shall provide the required programming for the interface to the APPS server. It is the responsibility of the vendor for complete seamless integration of the SCADA server with the APPS Server

7.9. The centralized server of SCADA shall poll the RTUs through high speed links. The communication between MMS/ BMS-1/ BMS-2 and RTUs will be through DNP 3.0(TCP/IP) or any combination thereof.

7.10. All RTUs shall communicate through DNP 3.0 (TCP/IP) with all the SCADA servers (MMS, BMS-1 and BMS-2). New RTUs as envisaged shall be procured & commissioned.

7.11. Bidder shall offer their own make of RTU. If bidder is not a manufacturer of RTU or bidder cannot offer their own make of RTU, then bidder shall offer RTU strictly from the following OEM –

- M/s Yokogawa
- M/s Schneider
- M/s ABB / Hitachi
- M/s ECIL

7.12. Static IP has to be taken by bidder at each MMS, BMS-1 and BMS-2 locations, as per the requirement. Separate dedicated routers shall be provided at each MMS, BMS-1 and BMS-2 locations for static IP. All the works and services required for static IP is included in scope of the bidder. Also, all the works as required for bumpless integration and smooth operation GPRS system including GPRS server is included in scope of the bidder.

7.13. The SCADA system communicates to the individual IP addressed RTU through any of the following two communication channels –

- Over Dedicated Telecom channel of IGGL with OFC Backbone
- On third party GPRS communication network through dual SIM-MODEM.

7.14. The space for installation of SCADA system shall be provided by IGGL.

7.15. It shall be the responsibility of the SCADA vendor for coordination with mechanical, civil, electrical and other contractors for all the works related to SCADA.

7.16. 25% spare ports shall be provided in each supplied router and switch for future purpose.

7.17. All equipment shall be capable of operating for the specified environmental conditions. All equipment unless otherwise specified, shall be electronic type.

7.18. The design and installation shall be generally in accordance with international recommended practices and other applicable standards like ASI, IBR etc. All standards, code of practice shall be of the latest edition.

7.19. Surge Protection Devices to be provided extensively for AC/DC at input and output. Surge Protection System shall also be provided at the earth circuits and field communication links.

7.20. Any number of changes/ modification/ addition/ deletion in Graphics, Logics, Reports etc. as required by IGGL/ MECON for any number of times and at any stage of project (including during warranty, PWMC) shall be carried out by the bidder as per the instructions of IGGL/ MECON without any cost implication to IGGL/ MECON.

7.21. Interfacing of any number of field devices, IEDs, DRS, MRS etc. with SCADA system at any stage of project (including during warranty, PWMC) is included in scope of bidder without any cost implication to IGGL/ MECON.

7.22. Tubular lugs shall be used for cable termination.

7.23. The tender is MR based and line items are only for billing purpose. Bidder to consider the tender requirements and quote accordingly in available line item. Any item required as per the tender but line item is not considered for the same, it shall be provided by the bidder and all cost of the same shall be included in the quoted price of available line items. Rest Tender Conditions prevail.

8.0 DETAILED SCOPE OF SCADA SYSTEM:

8.1 The successful bidder shall undertake full responsibility on turnkey basis for providing a complete and evolutionary state of the art SCADA System with Open architecture, meeting the objectives, functional and specific requirements described in the tender. The successful bidder shall also take full responsibility on turnkey basis for providing a complete and evolutionary state of the art servers meeting the objectives, functional and specific requirements described in the tender.

8.2 The Scope of work for IP based SCADA system shall be (but not limited to) Project Management, Design, Engineering, Procurement of Materials, fabrications/ manufacturing, Inspection & Factory Acceptance Testing at works, Supply, Packaging, Shipping, Insurance, Port Handling, Custom Clearance, Inland Transportation to site, Storage & Safety, Installation along with necessary software, installation material, cables, connectors, RTU panels, all hardware, software as defined in the tender, erection of foundation support for erection, cable trays, test instruments / equipments,

Site Acceptance testing & Integration, Test Run, Pre-commissioning activity, Commissioning, Integration with IEDs, Training, technical support, Warranty, Mandatory spares & commissioning spares, Documentation for IP based Supervisory Control & Data Acquisition (SCADA) System and shall be executed on turnkey indivisible works contract basis as per details scope of work, Technical Specification & Job specification PJS No. MEC/05/E5/T/23VC/PJS-094. Locations suggested are tentative and will be finalized during detailed engineering.

8.3 The SCADA system at MMS, Guwahati shall comprise of the following (but not limited to)-

i. Rack Mounted Redundant MMS SCADA Server including the DBMS server
ii. Integrated Tape based Backup System along with Drive (LTO 9) (with tapes - 2 nos for Data and 1 no for cleaning) with each SCADA Server / SAN based storage with separate SAN management controller and software
iii. Rack Mounted History server
iv. Rack Mounted OPC UA Server
v. Rack mounted APPS (including leak detection) Server (including RTM and PM modules)
vi. Rack Mounted APPS Server for Trainer module
vii. Rack Mounted AI/ ML server
viii. Rack Mounted GPRS/ GSM server
ix. Console mounted Web Server (with 20 numbers web client license)
x. Console mounted SCADA EWS cum OWS (3 Nos.)
xi. Console mounted APPS Work station
xii. Console mounted AI/ ML Work station
xiii. OPC Client workstation
xiv. Redundant Routers for Web Server, GPRS server
xv. Redundant Routers for SCADA system
xvi. Redundant Switches for SCADA system
xvii. GPS NTP/ PTP Server with redundant clock module and antenna
xviii. 19" KVM Monitor with integrated keyboard and Mouse for each server rack
xix. Server Racks – Server Racks shall be provided as per following philosophy –
- Redundant MMS SCADA server, History Server, LTO drives, Routers, Switches, KVM Monitor shall be mounted in One Server Panel
- OPC UA server, APPS server, AI/ ML Server, GPRS/ GSM server, KVM Monitor, GPS NTP/ PTP clock shall be mounted in One Server Panel
- However, if the above mentioned items cannot be accommodated in specified server racks, then additional server racks shall be provided without any cost implication to IGGL/ MECON.
- The actual number of server racks shall be finalized during detail engineering

xx. RTU with dual port GRPS MODEM with fully wired fee standing Panel
xxi. RTU Test Jig Unit with dual port GRPS MODEM and fully wired fee standing Panel
xxii. CRCA Consoles for Mounting PC and Monitor. One no. Console shall be provided for each console mounted computer. Also, 20% spare consoles shall be provided.
xxiii. A3+ A4 printer with CRCA printer Table
xxiv. Chair for each console.
xxv. Software for the Complete SCADA system
xxvi. Firewall for the complete SCADA system including individual sub-systems, lease line
xxvii. Power Distribution Cabinet for the complete SCADA system

xxviii. Mandatory spares
xxix. All cables as required
xxx. 75" Large LED UHD 4K display
xxxi. Any other item not mentioned here but required to meet the complete functionality of the complete system as per the tender requirement.

If separate OPC server hardware is not required as per bidder's design , then the OPC server hardware shall not be provided by the bidder. The same shall be decided during detail engineering. The OPC server shall be designed to communicate with at least 5 devices with scalability feature. Accordingly the OPC server and workstations shall be provided. It shall be possible to scale up the server by adding device licenses to include more device communication in future without requirement of any hardware upgrade.

The redundant SCADA LAN shall be configured at IPv6 addressing scheme. The same shall be able to communicate with Telecom network which shall function at IPv4 addressing scheme. Necessary devices for interfacing, as required, shall be provided by the bidder and is included in scope of the bidder. However, if due to technical and interfacing reasons, IPv6 addressing scheme cannot be configured, only then bidder shall configure SCADA LAN at IPv4. The same shall be finalized during detail engineering.

19" KVM Monitor with integrated keyboard and mouse shall be provided for each server rack to connect all the servers installed in that rack.

For all the items for which separate SOR line item is not available, cost of it shall be included in the available line item of SCADA system of MMS station.

8.4 The SCADA system at BMS-1, Numaligarh shall comprise of the following (but not limited to)-

i. Rack Mounted BMS-1 SCADA Server including the DBMS server
ii. Integrated Tape based Backup System along with Drive (LTO 7) (with tapes - 2 nos for Data and 1 no for cleaning) with each SCADA Server
iii. Rack Mounted History server
iv. Rack Mounted OPC UA Server
v. Rack mounted APPS (including leak detection) Server (including RTM and PM modules)
vi. Rack Mounted APPS Server for Trainer module
vii. Rack Mounted AI/ ML server
viii. Rack Mounted GPRS/ GSM server
ix. Console mounted SCADA EWS cum OWS (3 Nos.)
x. Console mounted APPS Work station
xi. Console mounted OPC Client workstation
xii. Console mounted AI/ ML Work station
xiii. Redundant Routers for GPRS server
xiv. Redundant Routers for SCADA System
xv. Redundant Switches for SCADA system
xvi. GPS NTP/ PTP Server with redundant clock module and antenna
xvii. 19" KVM Monitor with integrated keyboard and Mouse for each server rack
xviii. Server Racks – Server Racks shall be provided as per following philosophy –

- Redundant BMS-1 SCADA server, History Server, LTO drives, Routers, Switches, KVM Monitor shall be mounted in One Server Panel
- OPC UA server, APPS server, AI/ ML Server, GPRS/ GSM server, KVM Monitor, GPS NTP/ PTP clock shall be mounted in One Server Panel
- However, if the above mentioned items cannot be accommodated in specified server racks, then additional server racks shall be provided without any cost implication to IGGL/ MECON.
- The actual number of server racks shall be finalized during detail engineering

xix. RTU with dual port GRPS MODEM with fully wired fee standing Panel
xx. RTU Test Jig Unit with fully wired fee standing Panel
xxi. CRCA Consoles for Mounting PC and Monitor. One no. Console shall be provided for each console mounted computer. Also, 20% spare consoles shall be provided.
xxii. A3+ A4 printer with CRCA printer Table
xxiii. Chair for each Work station
xxiv. Software for the Complete SCADA system
xxv. Firewall for the complete SCADA system including individual sub-systems, lease line
xxvi. Power Distribution Cabinet for the complete SCADA system
xxvii. Mandatory spares
xxviii. All cables as required
xxix. 75" Large LED UHD 4K display
xxx. Any other item not mentioned here but required to meet the complete functionality of the complete system as per the tender requirement.

If separate OPC server hardware is not required as per bidder's design , then the OPC server hardware shall not be provided by the bidder. The same shall be decided during detail engineering. The OPC server shall be designed to communicate with at least 5 devices with scalability feature. Accordingly the OPC server and workstations shall be provided. It shall be possible to scale up the server by adding device licenses to include more device communication in future without requirement of any hardware upgrade.

19" KVM Monitor with integrated keyboard and mouse shall be provided for each server rack to connect all the servers installed in that rack.

The redundant SCADA LAN shall be configured at IPv6 addressing scheme. The same shall be able to communicate with Telecom network which shall function at IPv4 addressing scheme. Necessary devices for interfacing, as required, shall be provided by the bidder and is included in scope of the bidder. However, if due to technical and interfacing reasons, IPv6 addressing scheme cannot be configured, only then bidder shall configure SCADA LAN at IPv4. The same shall be finalized during detail engineering.

For all the items for which separate SOR line item is not available, cost of it shall be included in the available line item of SCADA system of BMS station.

8.5 The SCADA system at BMS-2, Sichar shall comprise of the following (but not limited to)-

i. Rack Mounted BMS-2 SCADA Server including the DBMS server
ii. Integrated Tape based Backup System along with Drive (LTO 7) (with tapes - 2 nos for Data and 1 no for cleaning) with each SCADA Server
iii. Rack Mounted History server

iv. Rack Mounted OPC UA Server
v. Rack mounted APPS (including leak detection) Server (including RTM and PM modules)
vi. Rack Mounted APPS Server for Trainer module
vii. Rack Mounted AI/ ML server
viii. Rack Mounted GPRS/ GSM server
ix. Console mounted SCADA EWS cum OWS (3 Nos.)
x. Console mounted APPS Work station
xi. Console mounted AI/ ML Work station
xii. Redundant Routers for GPRS server
xiii. Redundant Routers for SCADA system
xiv. Redundant Switches for SCADA system
xv. GPS NTP/ PTP Server with redundant clock module and antenna
xvi. 19" KVM Monitor with integrated keyboard and Mouse for each server panel
xvii. Server Racks – Server Racks shall be provided as per following philosophy –
- Redundant BMS-2 SCADA server, History Server, LTO drives, Routers, Switches, KVM Monitor shall be mounted in One Server Panel
- OPC UA server, APPS server, AI/ ML Server, GPRS/ GSM server, KVM Monitor, GPS NTP/ PTP clock shall be mounted in One Server Panel
- However, if the above mentioned items cannot be accommodated in specified server racks, then additional server racks shall be provided without any cost implication to IGGL/ MECON.
- The actual number of server racks shall be finalized during detail engineering

xviii. RTU with dual port GRPS MODEM with fully wired fee standing Panel
xix. Consoles for Mounting PC and Monitor. One no. Console shall be provided for each console mounted computer. Also, 20% spare consoles shall be provided.
xx. A3+ A4 printer with printer Table
xxi. Chair for each Work station
xxii. Software for the Complete SCADA system
xxiii. Firewall for the complete SCADA system including individual sub-systems, lease line
xxiv. Power Distribution Cabinet for the complete SCADA system
xxv. Mandatory spares
xxvi. All cables as required
xxvii. 75" Large LED UHD 4K display
xxviii. Any other item not mentioned here but required to meet the complete functionality of the complete system as per the tender requirement.

If separate OPC server hardware is not required as per bidder's design , then the OPC server hardware shall not be provided by the bidder. The same shall be decided during detail engineering. The OPC server shall be designed to communicate with at least 5 devices with scalability feature. Accordingly the OPC server and workstations shall be provided. It shall be possible to scale up the server by adding device licenses to include more device communication in future without requirement of any hardware upgrade.

19" KVM Monitor with integrated keyboard and mouse shall be provided for each server rack to connect all the servers installed in that rack.

The redundant SCADA LAN shall be configured at IPv6 addressing scheme. The same shall be able to communicate with Telecom network which shall function at IPv4 addressing scheme. Necessary devices for interfacing, as required, shall be provided by the bidder and is included in scope of the bidder. However, if due to technical and interfacing reasons, IPv6 addressing scheme cannot be configured, only then bidder shall configure SCADA LAN at IPv4. The same shall be finalized during detail engineering.

For all the items for which separate SOR line item is not available, cost of it shall be included in the available line item of SCADA system of BMS station.

The complete software has to be provided for all supplied servers and work stations.

Following softwares (as a minimum, but not limited to) shall be provided –

1. Operating System Software for Servers
2. Operating System Software for Work Stations
3. SCADA programming software
4. DBMS software
5. Web Server Software, E-mail and SMS server software
6. OPC UA server and client software
7. AI/ ML software
8. SCADA EWS cum OWS Software
9. SCADA RWS Software
10. APPS (including Leak detection) Software
11. Requisite software to meet the GPS server functionality, History server functionality, Web Server Functionality, OPC UA server functionality
12. Office Suite software
13. Adobe Acrobat pro software
14. Antivirus Software
15. Any other software not mentioned here but required to meet the complete functionality of the system.

If any additional software is required, the same shall be provided as per the instruction of IGGL/ MECON without any cost implication to IGGL/ MECON. The list of softwares shall be finalised during detail engineering.

8.6 The SCADA system at each RWS locations shall comprise of the following (but not limited to)-

- 2 Nos. of Remote Work Station (RWS)
- Routers for SCADA system
- Redundant Switches for SCADA system
- Firewall for SCADA and lease line

The redundant SCADA LAN for RWS shall be configured at IPv6 addressing scheme. The same shall be able to communicate with Telecom network which shall function at IPv4 addressing scheme. Necessary devices for interfacing, as required, shall be provided by the bidder and is included in scope of the bidder.

Following softwares (as a minimum, but not limited to) shall be provided –

1. Operating System Software for Work Stations
2. SCADA EWS Software
3. Office Suite software
4. Adobe Acrobat pro software
5. Antivirus Software
6. Any other software not mentioned here but required to meet the complete functionality of the system.

If any additional software is required, the same shall be provided as per the instruction of Client/PMC. The list of softwares shall be finalised during detail engineering

8.7 All the servers shall be both ODBC & OPC compliance. SCADA Servers of MMS, BMS-1 and BMS-2 shall be loaded with OPC software (OPC UA and DA) (both OPC client and OPC server interface).

8.8 SCADA servers at MMS, BMS-1, BMS-2 shall have hot standby server which will take over the failed server automatically with smooth changeover within 5 minutes automatically without any loss of data and functionality

8.9 The SCADA software licensor shall take the responsibility of the following as a minimum for successful execution of the SCADA system:

a) Participation in system engineering, system integration, factory acceptance testing of the complete SCADA system, commissioning and site acceptance of the complete system.

b) Vetting of FDS and all Design & Engineering Documents.

c) To provide technical support, supply of licensed SCADA software, upgradation of software license version on migration to new hardware etc in line with conditions of the tender.

d) Ensuring QA / QC programs of the project conforming to standards of SCADA software licensor.

8.10 Smooth interfacing is the responsibility of the bidder.

8.11 Selection of power cables shall be done as per the following methodology –

i. For Current consumption upto 3 A – 1.5 sq mm
ii. For Current consumption 3 A to 5 A – 2.5 sq mm
iii. For Current consumption 5 A to 10 A – 6 sq mm
iv. For Current consumption 10 A to 15 A – 10 sq mm
v. For Current consumption 16 A to 25 A – 16 sq mm

All cables shall be copper cables.

8.12 SCADA MMS, BMS-1 and BMS-2 shall poll all RTUs on dedicated channels in either direction. If both the servers at MMS & BMS-1 fail, then BMS-2 server will take over automatically. All the SCADA servers shall be synchronized once the failed SCADA server is restored again.

8.13 All RTUs shall communicate with SCADA system over OFC/ (GPRS/ GSM) MODEM. If OFC connectivity is available, it shall communicate through OFC , else it shall communicate through GRPS/ GSM MODEM. The SIM card for the MODEM shall be provided by the bidder. The SIM card shall be operated by the bidder till the end of warranty period and then handed over to IGGL for operation. All the cost of SIM card, its operational charge till warranty period etc. as required shall be included by bidder in the quoted price and no additional payment shall be made to bidder. The GPRS/ GSM network shall be secured. Preferably, APN network shall be set-up for GPRS/ GSM communication, however same shall be finalised during detail engineering. Bidder shall propose the best available option to ensure high availability of network.

8.14 Bidder shall be responsible for the complete end to end connections for GPRS/ GSM connectivity for RTU communication through MODEM. All the devices required for complete GPRS/ GSM connectivity for RTU communication with SCADA over GPRS/ GSM is shall be provided by the bidder and is included in scope of the bidder. All the works required for complete GPRS/ GSM connectivity for RTU communication with SCADA over GPRS/ GSM, including liasioning works with third party for obtaining GPRS/ GMS connectivity is included in scope of the bidder. All the cost of the operation of entire network till the end of warranty period is included in scope of the bidder.

8.15 Switches and Routers shall be provided of commercial grade with all the required license.

8.16 The SCADA system shall interface with third party systems of client such as SAP system, pipeline GIS/ MIS, CCTV system etc. Bidder shall display the pipeline route in the SCADA with static/ dynamic features (as per the data available from GIS/ MIS). All the modules required in SCADA system shall be provided by bidder. Third party interfaces shall be through a published API (Application Program Interface). All the API required to be developed in SCADA is included in scope of bidder.

8.17 All the RTUs shall be connected to the MMS. The RTUs shall be connected to each BMS as per the following philosophy –

- 50% of all RTUs shall be connected to BMS-1
- 50% of all RTUs shall be connected to BMS-2

However, same shall be finalised during detail engineering. It shall be possible to connect complete 100% RTU to each BMS without any cost implication to IGGL/ MECON.

The quantity and segregation of RTUs which need be connected to each BMS shall be finalised during detail engineering. However, it may be possible that all the RTUs shall be connected to each server (BMS-1, BMS-2) without any segregation. Bidder shall design and provide the system accordingly.

8.18 A3+A4 printer shall be provided for printing of reports.

SCADA Servers -

8.19 The SCADA servers shall be MMS, BMS-1, BMS-2. Minimum 16 CPU cores CPU (2* octa core) shall be provided for each SCADA server.

8.20 The SCADA server database shall store the SCADA data for 3 months and thereafter it shall archive it to the history server.

History Server with Historian Storage-

8.21 Separate History server with Historian Storage shall be provided for MMS, BMS-1 and BMS-2 to facilitate the history archiving of the SCADA database. However, all the history servers shall be synchronized such that there shall be no discrepancy or loss of data stored in either of the History Server.

8.22 Minimum 8 Cores CPU shall be provided for the History Server along with the Historian Storage. However, the actual number of core requirement shall be decided based on the OEM recommendation if higher number of CPU cores is required, same shall be provided.

8.23 The History server along with the Historian Storage shall be designed to store the SCADA data for 7 years. Accordingly, the historian storage shall be sized.

8.24 Additional removable external storage (shall be provided as per OISD and PNGRB) and fire safe cabinet shall be provided along with the History server for storage of the data. The additional storage shall be provided to store the data of 1 year which will be stored in the fire safe cabinet.

OPC UA server-

8.25 For interfacing the SCADA data with third party software, the OPC UA server shall be provided for each MMS, BMS-1 and BMS-2.

8.26 Minimum 8 cores shall be provided for the OPC UA server However, the actual number of core requirement shall be decided based on the OEM recommendation and if higher number of CPU cores is required, same shall be provided.

Web server-

8.27 For display of SCADA screens over web browser, web server is envisaged to be provided. E-mail and SMS functionality shall be provided in the web server itself. 20 nos. web client license shall be provided with web server.

8.28 Minimum 8 cores shall be provided for the Web server However, the actual number of core requirement shall be decided based on the OEM recommendation if higher number of CPU cores is required, same shall be provided.

8.29 Web server shall be installed on PC console. Separate redundant 4-port routers shall be provided for web server which shall be installed in console.

GSM/ GPRS server-

8.30 For connectivity of RTUs over GSM/ GRPS, separate GSM/ GRPS server shall be provided each at MMS, BMS-1 and BMS-2 stations.

8.31 Minimum 8 cores shall be provided for the GSM/ GRPS server. However, the actual number of core requirement shall be decided based on the OEM recommendation if higher number of CPU cores is required, same shall be provided.

8.32 Separate redundant 8-port routers shall be provided for GSM/ GRPS server which shall be installed with GSM/ GRPS server.

GPS **Server-**

8.33 For Synchronization of data and system of the Complete SCADA system, GNSS based GPS cum NTP server with antenna shall be provided.

8.34 The GPS server shall be installed at MMS, BMS-1 & BMS-2 locations and shall synchronize the complete network using the redundant GPS clock.

SCADA EWS cum OWS

8.35 3 Nos. SCADA Engineering Work station (EWS) cum Operator Work station shall be provided for development / engineering activities related to database, graphics, reports etc. All database, graphics, reports etc shall be downloaded from MMS/BMS to SCADA EWS .

8.36 The SCADA EWS and HMI shall also be hosted on the Host Machine. All the functions of SCADA HMI shall also be available at SCADA Engineering Work Station.

8.37 Minimum 8 cores shall be provided for each SCADA EWS cum OWS. However, the actual number of core requirement shall be decided based on the OEM recommendation if higher number of CPU cores is required, same shall be provided.

AI/ML Server and Workstation

8.38 For Analytical handling and machine learning features, separate AI/ ML server with client work station shall be provided.

8.39 Minimum 8 cores shall be provided for each server and workstation. However, the actual number of core requirement shall be decided based on the OEM recommendation, if higher number of CPU cores is required, same shall be provided.

APPS Server

8.40 1 No. APPS server (with leak detection feature) shall be provided.

8.41 Minimum 8 cores shall be provided for APPS Server. However, the actual number of core requirement shall be decided based on the OEM recommendation, if higher number of CPU cores is required, same shall be provided.

APPS Workstation

8.42 1 No. APPS workstation (with leak detection feature) shall be provided.

8.43 Minimum 8 cores shall be provided for APPS workstation. However, the actual number of core requirement shall be decided based on the OEM recommendation, if higher number of CPU cores is required , same shall be provided.

8.44 **75" LED UHD 4K Display**

8.45 75" large LED UHD 4K Display with all required accessories shall be provided as per the specifications provided in the tender. Necessary interface (hardware and software) and accessories as required for the connection shall be provided by the bidder without any extra cost.

Printer-

8.46 2 Nos. A3 size + A4 size colour laserjet network printer is envisaged at MMS, BMS-1, BMS-2 locations for printing of reports, alarms etc. for the SCADA system.

8.47 The SCADA system at each remote operated location shall comprise of the following (but not limited to) -

- RTU at with Fully Wired free standing Rack (2000(H)+100mm base channel +15mm AVP * 800(W)* 800(D))
- Dual channel GPRS MODEM
- All software for complete supplied system
- All cable as required
- Mandatory Spares

8.48 All the RTUs of a particular GA shall communicate with MMS, BMS-1 and BMS-2.

8.49 2 Numbers Rodent Repellers shall be provided in the SCADA Control Room at Numaligarh, Guwahati, Sichar and same is included in scope of the bidder without any additional cost.

8.50 The database in SCADA servers shall be real time base with management system to fast access to support the data processing functions & other time critical data bases. The database shall be transparent to the user such that all the attributes of tag/point cab be accessible from any workstation.

8.51 It shall have below facilities -

a) System & database configuration.

b) Data acquisitions from the RTUs

c) Generation & management of real-time database

d) Generation & management of historical data for trending & archival.

e) Category wise alarm handling, including storage, display & printout.

f) Generation, storage presentation of Mimic diagrams with dynamic information on HMI monitor.

g) Display management for alarm, alerts, mimic, analogue& digital value, trend & graphs.

h) Report generation & printout. The format of report, type of report and number of reports shall be as per requirement. It shall be a continuous evolving process with changes required to be done at any stage of project as per the requirement of Client/ PMC.

i) Data logging at periodic intervals, on operator requests & automatically on occurrence of an event.

j) Transmission of control commands & configuration of parameters to outstations.

k) Redundancy, failover & recovery mechanism.

l) GPS time synchronization of various SCADA servers, RTU's & HMIs with GPS time server.

8.52 Following software as a minimum, but not limited to, shall be provided for the SCADA system-

i. Operating system Software for Each server and Workstation- The Operating system software with license for each server and work station shall be either windows or UNIX based as per the requirement of the SCADA OEM.
ii. Application Software- Suitable application software with license for accessing .pdf, .doc, .xls files and equivalent is envisaged and shall be provided by the vendor based on the operating system software.
iii. Anti-virus Software - Suitable Anti-virus software with license shall be provided by the vendor based on the operating system software.
iv. Firewall - Suitable firewall software with license shall be provided by the vendor based on the operating system software for complete SCADA system, sub-systems etc. as finalized during detail engineering.
v. SCADA server software – the SCADA server software shall be provided for each SCADA server (MMS, BMS-1, BWS-2). The SCADA server software license envisaged is for 30000 data points for each server (plus 50 % spare shall be provided in each server). The SCADA server software shall be expandable in the future without any limitations. Also, if any upgrade is released by the vendor for the software within warranty or PWMC period, the software shall be upgradable without any changes in hardware and same shall be upgraded by the bidder without any cost implication to IGGL/ MECON.
vi. DBMS software- Suitable licensed DBM software shall be provided in each SCADA servers for database management.
vii. OPC UA and DA server and client Software - Suitable licensed OPC UA and DA server and client software shall be provided.
viii. SCADA EWS cum OWS software - Suitable licensed SCADA EWS cum OWS software shall be provided.
ix. SCADA RWS Software - Suitable licensed SCADA RWS cum HMI software shall be provided.
x. Adobe Acrobat Pro Software
xi. AI/ ML Software - Suitable licensed AI/ ML Software shall be provided for all the AI/ ML server and workstation machines.
xii. Requisite software to meet the GPS server functionality, History server functionality, Web Server Functionality, OPC server functionality
xiii. All required software to meet the E-mail and SMS facility at each E-mail and SMS server
xiv. All required software to meet the Router and Switch functionality
xv. Any specific software not mentioned above but required to meet the functionality of the complete SCADA system shall also be included in scope of the vendor.

All the licenses shall be perpetual and taken in name of IGGL. Softkeys for all licenses shall be

provided. Dongle Keys shall not be acceptable

If any additional software is required, the same shall be provided as per the instruction of Client/PMC. The list of softwares shall be finalised during detail engineering.

8.53 All the software shall be licensed software. Soft licenses shall be provided for the software. Dongle Keys shall be avoided and shall not be acceptable.

8.54 The SCADA software with main SCADA data base shall be SCADA server resident and the OS shall support real-time operation.

8.55 The vendor shall install all the software provided on respective computers.

8.56 The Vendor shall register all software licenses and documentation that came with the computers in the name of the owner and turn them over to the owner

8.57 The SCADA software licensor shall take the responsibility of the following as a minimum for successful execution of the SCADA system:

a) Participation in system engineering, system integration, factory acceptance testing of the complete SCADA system, commissioning and site acceptance of the complete system.

b) Vetting of FDS and all Design & Engineering Documents.

c) To provide technical support, supply of licensed SCADA software, upgradation of software license version on migration to new hardware etc in line with conditions of the tender.

d) Ensuring QA / QC programs of the project conforming to standards of SCADA software licensor.

8.58 Smooth interfacing is the responsibility of the bidder.

8.59 The Commissioning spares are in Bidder's scope & Bidder will take back these commissioning spares after commissioning if not used. List has to be provided along with bid.

8.60 All the Power, signal, control, MODBUS and Ethernet cables required shall be FRLS armoured cables as per the specification provided and conforming to IS 1554. CAT-6/ CAT-7 Cable shall be FRPVC armoured cable.

8.61 MMS shall have complete database including real-time integrated alarm/event management summary for overall operations management & control of entire pipeline network.

8.62 BMS shall have facility for polling respective RTUs and shall start polling of RTUS in case MMS SCADA system goes down completely

8.63 Backup Server is also envisaged at the Centralized location to periodically store the Back-up of the SCADA

8.64 If any number of the IO points (including the RTU MODBUS ports) mentioned in the IO list is not used for its intended purpose, the same shall be utilized by Client for other purpose as deemed necessary by Client and shall be finalized during detailed engineering/ document approval process. In such case, supply of all cables, cable trays , other hardware as required to integrate the other IOs with respective RTU shall be included in the scope of the bidder without any extra cost / time implication to Client.

8.65 The system will be based on the concept of Open system Interconnect (OSI) architecture maximising the use of international standard interfaces.

8.66 SCADA system shall fully support MIS/ GIS interfaces. Third party interfaces shall be through a published API (Application Program Interface). All the APIs required to be developed in SCADA is included in scope of bidder.

8.67 The SCADA system has to be integrated with Client's SAP system. All the necessary interface for the same shall be developed by the SCADA vendor. All work required for successful integration including supply and installation of all hardware and software shall be included in the scope of the bidder without any additional cost.

8.68 Minimum two different redundant fast Ethernet LAN networks are envisaged for the complete SCADA system. However, actual number of redundant LAN networks shall be as per the bidder's design and same shall be finalised during detail engineering. Firewall shall be provided for each LAN network as per the specifications provided elsewhere in the tender.

8.69 Suitable firewall and Anti virus shall be provided by the SCADA vendor for security purpose.

8.70 Cyber security features as per API 1164 shall be implemented by the SCADA vendor for data security and integrity purpose.

8.71 In addition, following Cyber Security features shall be provided in SCADA and RTU-

The proposed SCADA and RTU by the vendor shall have the following cyber security features from the outset. Any licensed software or license required to meet the following cyber security features shall be provided by the vendor with the SCADA and RTU –

a) DNP3 with level-4
b) DNP3 (SAv5)
c) DNP3 Data encryption
d) RTU should be capable to bulk AO (writing): SCADA – RTU on DNP protocol, RTU To IED on Modbus. The RTU shall be able to write Analog data to different devices over serial communication to several IED connected to RTU simultaneously.
e) User access control

f) Password complexity
g) Role Based Access Control
h) In-built VPN function (only for SCADA and RTU MODEM)
i) Integrated firewall
j) Patch management (The frequency of patches as provided by OEM shall also be indicated)
k) Support Network access control (Authentication) IEEE 802.1X
l) Support Application access control (Authentication) DNP3 Secure Authentication in firmware
m) Should be able to restrict Master IP

8.72 **TIME SYNCHRONIZATION - SCADA MACHINES AND RTUs:**

GPS time server shall be installed at MMS, BMS-1 and BMS-2. As long as MMS and BMS are interconnected, GPS server at MMS shall be used as primary clock to synchronize time of all SCADA machines at MMS, BMS-1 and BMS-2 locations within 2 seconds. RTUs shall be time synchronized by the respective active server within 2 seconds. In case of MMS failure or isolation of BMS from MMS, each respective BMS shall synchronise the RTUs connected to it. BMS shall synchronize with MMS on restoration of the link.

8.73 **AL/ ML features –**

8.70.1 AI/ ML based analytics system shall be provided with the SCADA system for advanced monitoring, control, customer satisfaction, process optimization and maintenance of the pipeline and associated assets.

8.70.2 The AI/ ML system shall take the required data from SCADA system, station PLC system or any other system as required. All hardware and software required for data gathering is included in scope of the bidder. In case of failure of data communication, the system shall generate suitable alarms to alert the operator about the same.

8.70.3 The AI/ ML system shall continuously utilize the data from SCADA historian to re-calibrate the system, minimize the errors , decrease uncertainty, improve the performance and system output.

8.70.4 The AI/ ML based system shall use the historical data to facilitate the operation team for quick decision making.

8.70.5 The AI/ ML system shall be designed and customized by the bidder to meet the functionalities as defined in the tender.

8.70.6 Bidder shall design and select the required algorithm to be used to meet the system requirement.

8.70.7 It shall be the responsibility of the bidder to gather all the required data for AI/ ML system. Client/ PMC shall support the bidder in collection of data wherever possible.

8.70.8 The AI/ ML system shall be integrated with SCADA and all critical alarms of AI/ ML system shall be communicated to SCADA. The list of such alarms shall be finalized during detail engineering.

8.70.9 The AI/ ML system provided by the bidder shall be reliable and competent to execute the functionalities as per the requirement.

8.70.10 The AI/ ML system provided by the bidder shall be scalable in future without the requirement to replace the software. Any upgrade required in software for scalability shall be provided by bidder without any cost implication to Client/ PMC.

8.70.11 The AI/ ML system shall have built-in calculation and engineering unit conversion capability.

8.70.12 The AI/ ML system shall be capable to handle large amount of data and shall utilize big data analytics, machine learning analytics models.

8.70.13 The AI/ ML system shall be able to detect impending issues, inefficient energy usage and improvement opportunities.

8.70.14 The AI/ ML system shall recommend actions, record learning, analyze failures, reports & diagnostics.

8.70.15 The AI/ ML system shall generate/ identify KPIs for various performance metrics over various time horizons.

8.70.16 Bidder shall propose the AI/ ML system as per their design considering the best practices and latest trends followed in hydrocarbon industry. However, the system shall be customized and provided as finalized during detail engineering. The requirements finalized during detail engineering shall be implemented by the bidder without any cost implication to IGGL/ MECON.

8.70.17 The AI/ ML based system shall provide the following features –

i) Gas consumption and supplier details , daily, consumer/ supplier wise , sector wise
ii) Prediction for today and future gas consumption for each customer/ supplier.
iii) Incase of difference in supply and consumption , it shall provide alarm and details for difference.
iv) Pipeline indexing (0-100)
v) Dashboard for major activities
vi) Repository and trend shall be generated for daily, monthly, yearly, 5 years etc for various parameters
vii) Analysis of Gas losses

8.70.18 All the modules shall be factory configured package with facility of site customization and fine tuning at site based on monitored machine historical & engineering data.

8.70.19 The system shall automatically capture process and equipment conditions that represent normal operation and calculate alert limits for abnormal conditions based on this baseline data.

8.70.20 The system shall keep and utilize the historical data of atleast 7 years to optimize the outputs. Separate hard disks and server as required to keep the historical data shall be provided by the bidder.

8.70.21 System shall provide the ability to export current values and historical data to Excel

8.70.22 Events such as alerts shall audibly notify an operator.

8.70.23 Events shall be stored in event history and be available for operator viewing. Event history shall be based on a commercially available SQL database.

8.70.24 The system shall support a multi-user environment. Any Users shall have the ability to view the health, displays and settings for any asset in the system, however, only assigned users shall receive alert notifications for those assets or have access to the alert limits, baseline data and configuration settings for that asset.

8.70.25 The application should be scalable to include other equipment asset types for site-wide and/organization-wide basis

8.70.26 The system shall be In-house expert system to analyze data and support Decision making.

8.70.27 Bidder to note that the requirements specified for AI/ ML system are minimum. Bidder shall design the AI/ ML system in accordance with the latest industry trends and latest available technology to provide best possible solution.

8.70.28 Minimum 6 months of operating data shall be considered for commissioning of AI/ ML system.

8.74 **Screens & Screen Displays**

- All screens shall be in English. Screens shall include (but not limited to) the following:
  a) Graphical status display for all inputs. The process graphics shall mimic the Piping Instrumentation Diagrams. Pumps, compressors, etc. shall be red if off and green if on. Valves shall be red if closed, green if open, and yellow if in travel. All analog values shall be displayed with units near their location on the process graphics. The piping colors shall be different for different product piping and fire water piping.
  b) Equipment and instruments shall blink on the HMI screen if any of their associated alarms or warnings is true. Controls and controllers shall show if they are in manual or local mode.
  c) There shall be overview displays for the entire pipeline and for each station. These displays shall show the status of all major equipment. The overview display for the entire pipeline shall show all charge pumps, mainline pumps, and pump suction and discharge valves. Product tank levels, all pressures, flows, and densities shall also be shown. This display may encompass both monitors if necessary for clarity.
  d) Equipment/instrument tags shall be shown via a “tooltip” or static text.

e) There shall be a comprehensive communication status screen and an electrical system status screen. The electrical system status screen shall show volts, amps, and kW as read from the power monitors. The HMI shall read the power monitors directly.
f) Permissive and interlocks. The user shall be able to select any piece of equipment and display all permissive and interlock status information required for running said piece of equipment.
g) Set points and alarm limits. All analog, alarm, and interlock set points shall be operator adjustable. A dedicated set points screen is required.
h) Trending. All analog input and output values and set points shall be logged and trended. All override commands shall be logged and trended. All pump (on/off) and valve (open/close) status shall be logged and trended. The data log files used by the trending routine shall store a minimum of 90 days' worth of data. Any other Digital points (DI or DO) logged and trended as per requirement of the operator and shall be operator adjustable.
i) The data log shall be organized so that relevant data can be viewed simultaneously in the Trend object.
j) Each analog value shall have its own trend screen. Clicking on the analog value will pop up the trend screen for the selected analog value.
k) Navigation. A portion of each screen shall be dedicated to navigation keys. These keys shall include all overview displays, the alarm screen, set points screen, and other screens the developer deems relevant. The Project details, time and date shall be displayed in this section. In addition, the users shall be able to log in, log out, and change their passwords from the navigation area
l) In addition to the above, the screens and graphics as required during detail engineering and project execution shall be developed and modified by the bidder without any cost implication to the owner.

8.75 **Alarms**

a) All controller outputs shall have an associated failure alarm. All analog inputs shall have high and low alarms available. A standard dedicated alarm screen shall be configured and available to the operator.
b) Alarm history shall be provided. An operator shall be able access alarms that have occurred during the previous 90 days.
c) An alarm banner listing the latest unacknowledged alarm shall appear on one of the monitors at all times.
d) All alarms shall print to the printers. It shall also be possible to save the alarms either in Spreadsheet format or *.pdf form.
e) Alarms shall be assigned one of three priorities: critical, warning, or advisory.
f) All alarms will be generated at the SCADA.
g) The operator will be able to silence, acknowledge, and reset alarms. The silence button shall be a 'hot-key' on the keyboard (i.e. F11). To acknowledge an alarm, the operator shall be required to go to the alarms screen. There, the operator shall be able to acknowledge one or all alarms. Each station shall have a separate alarm reset button. The HMI will only reset alarms at its station.
h) Visibility controls shall be used to turn off other station resets. A screen shall be available to set up where an HMI is located.

8.76 **Tag Name**

- Each tag name shall follow the standard name convention.

8.77 **Commands**

i) The operator shall be able to initiate and halt all sequences required in the sequence of operations.
j) The operator shall be able to advance all sequences manually if the sequences stall in mid-sequence.
k) The operator shall have full override control in semi-automatic mode. In semi-automatic mode, all interlocks shall be bypassed. This function shall be password protected.
l) All commands initiating equipment action shall require two mouse clicks to initiate the desired action. For example, to start a pump, it is necessary first to click on the pump. This will enable a popup box, and the operator can then start the pump.
m) In addition to the above, all the requirements during detail engineering and project execution shall be developed and modified by the bidder without any cost implication to the owner.

8.78 **Reports**

- A shift reports detailing all pumps run times and flow accumulators shall automatically generate at shift's end. The report shall be sent to the report printer when requested by the operator. Previous reports can also be accessed.
- In addition to the above, all the reports required during detail engineering and project execution shall be developed and modified by the bidder without any cost implication to the owner

8.79 **Security**

- HMI security will be configured with multiple levels of security. An adjustable inactivity timeout setting shall be used to prevent unauthorized control actions when the current logged in operator is not present. This timeout will log out the currently logged in operator after the timeout period. The vendor shall provide for the capabilities in the table below:

Capabilities Default	**Station**	**Operator**	**Pipeline Operator**	**Operations Engineer**	**Manager**
View Screens	X	X	X	X	X
Acknowledge Alarms		X	X	X	X
Reset Alarms - Local		X	X	X	X
Reset Alarms - All Stations			X	X	X
Issue Start/Stop commands – Local Open/Close		X	X	X	X
Issue Start/Stop commands - All StationsOpen/Close			X	X	X
Change Auto/Manual				X	X
Change Alarm Set points				X	X
Disable Alarms				X	X
Bypass Interlocks				X	X
Change FTO/FTC Presets				X	X

Add users, change passwords				X	X

- In addition to the above, all the requirements during detail engineering and project execution shall be developed and modified by the bidder without any cost implication to the owner

8.80 **RTU test Jig Unit**

A Test Jig RTU is envisaged at Centralized location. The RTU test Jig unit shall have following features-

a) The Test Jig should be able to simulate all types of RTU provided.
b) The RTU test jig unit shall be similar to the RTUs supplied and shall consist of single Processor module for each type of RTU, power supply module, 1 no. of IO card of each type and of each type of RTU, 1 No. communication card of each type, redundant DNP module and any other module supplied with the RTU
c) The dimension of RTU Test Jig panel shall be same as the free standing RTU panel (2115(H)*800(W)*800(D))
d) The front side of the RTU Test Jig panel shall consist of Lamps for each channel of DI card, Toggle Switches for each channel of DO card, Potentiometer for each channel of AI card and Analog Display for each channel of AO card. These systems are envisaged for testing purpose.

8.81 **DESIGN & ENGINEERING OF SCADA SYSTEM:**

The vendor shall be fully responsible for detailed engineering and design of the complete system to meet the following as detailed in the tender document as a minimum:

a. System Functional requirement : Scope of Work of the tender document.
b. SCADA System Specifications including system sizing, fail-over & restoration mechanism
c. Integration of RTUs with MMS, BMS & EMS of SCADA system
d. Interfacing with Web Server, History Server, GPS Server, OPC Server

Vendor shall submit Functional Design Specifications (FDS) covering the design, engineering, methodology of implementation etc of the SCADA system for approval.

8.82 **SUPPLY OF SCADA SYSTEM:**

The vendor shall supply of all the items / equipments including softwares, SCADA equipment racks, installation materials (e.g. cables, cable glands, conduits for laying the cable, connectors, ferrules, etc.) required to implement the SCADA system complete in all respects as per the tender requirement in line with Schedule of Rates, General Technical Requirements & SCADA System Specifications.

The bidder shall provide the duly filled SCADA System Technical (SST) form given and shall furnish the technical specifications / brochures of all offered systems as part of the technical bid document.

All the work has to be completed as define in the completion schedule.

8.83 **TRANSPORATION AND STORAGE OF SCADA SYSTEM:**

The vendor shall carryout the transportation and storage of the supplied SCADA system and associated items including but not limited to the following:

a) Transportation, insurance, loading, unloading of equipment and all other components from locations of manufacturing/supply to the locations of storage for the sites of installation.
b) Transportation, insurance, loading, unloading of equipment and all other components from locations of storage for the sites of installation to the location of installation.
c) The Storage of all the supplied item is included in scope of the bidder. The store shall be selected in each state.
d) Selecting and finalising the storage location for ALL the components supplied by the bidder. The selected location of storage for the sites of installation shall be informed to Client/PMC and the storage location shall be finalised after approval of the same from the Client/ PMC. The location of storage shall be preferably near to the installation site.
e) Storage during transit, transit insurance & storage/ warehousing as required.
f) Statutory clearances including clearances of customs, excise, entry tax and others, as required for all the supplied items.

8.84 **INSTALLATION OF SCADA SYSTEM AT SITES:**

The vendor shall carry out the installation & Commissioning of SCADA system which shall include but not limited to following:

a. Installation of SCADA equipments including network devices, modems etc following standard installation procedure.
b. All the Servers at MMS & BMS locations shall be installed in racks supplied by the vendor.
c. Interfacing of SCADA equipments with telecom equipments as defined
d. Configuration of SCADA equipments including network devices, modems etc at all locations.
e. Laying & routing of cables through conduits, glanding, termination of cables, dressing and ferruling for all the cables.
f. Providing earthing to SCADA equipments at all locations by extending the earth conductor of suitable dimension from earth pit to the equipment rack.

8.85 **INTEGRATION WITH RTUs & OTHER SYSTEMS:**

The vendor shall carry out the integration of SCADA system with the following for its successful implementation:

a. Integration of RTUs as defined in tender document
b. Interfacing with Web Server , GPS server, History Server, OPC Server and Leak Detection

Server

The complete requirement as contained in the Bid Document shall meet bid, its objectives, functional, specific requirements describe in the specification, taking care of complete P&ID requirement, operation & control philosophy. The specification shall be read in conjunction with scope of work, specification, drawings, documents and other requirements indicated in the tender documents.

It shall be the responsibility of the bidder for complete integration of all the systems with RTU and SCADA such that all the desired signals of each system is available in SCADA. Coordination for interfacing (including obtaining relevant details) with Instrumentation vendor , IED vendor, CP system & Electrical contractor, directly or through client for any disputes shall be the responsibility of the bidder.

8.86 **PROJECT MANAGEMENT SERVICES (PMS):**

The vendor shall provide project management services (PMS) to meet the quality objectives and for the timely completion of the project successfully.

8.87 **FACILITY MANAGEMENT SERVICES (FMS):**

The vendor shall provide FMS services at each location during the warranty period for normal and trouble free operation of the system as define tender document.

8.88 **PROJECT REQUIREMENTS:**

The Bidder shall undertake full responsibility for providing a complete and evolutionary state of the art SCADA System by using IP technology with Open architecture meeting the objectives, functional and specific requirements describe in the specification.

The main Scope of work of SCADA system (Internet Protocal - IP based) as define above and the complete requirement as contained in the Bid Document shall be executed on turnkey indivisible works contract basis.

The material to be delivered and works performed shall be to meet the technical specifications and the requirements detailed in the Bid package.

8.89 **GENERAL CONTROL AND FAILOVER PHILOSOPHY:**

a) The pipeline will be controlled by the SCADA operators of Main Master station (MMS) , Backup Master Station-1 (BMS-1) and Backup Master Station-2 (BMS-2). Local instrumentation system at various locations shall be communicated with SCADA system to allow remote monitoring and control from MMS, BMS-1 and BMS-2. The MMS, BMS-1, BMS-2, SCADA EWS, Web Server, History Server, GPS Server, OPC UA Server etc. , shall have dual redundant Ethernet LAN, distributed open system architecture having redundant processor, power supply and storage devices.

b) The system will be based on the concept of Open system Interconnect (OSI) architecture maximising the use of international standard interfaces. Each functional server will be redundant and connected to both systems LAN's in a hot standby configuration.

c) The SCADA system communicates to individually IP addressed RTU /Device on dedicated OFC network. **Backup communication link between MMS/BMS will be achieved by Independent leased link provided by the independent service provider (under IGGL's scope). Necessary WAN router and terminal server as required for interfacing is included the bidder's scope.**

d) Engineering Work Station (EWS) shall be provided at MMS location which shall be interfaced with MMS through high speed dedicated Ethernet data channels. All the work station shall remain connected to MMS in normal condition, they shall get connected to BMS in case MMS is not in operation. The location / quantity may be changed as per the requirements during detailed engineering.

e) The SCADA system shall be reliable, field proven and evolutionary state of the art. The RTUs shall be provided for remote monitoring and control as per the requirements.

f) Each RTU shall have Serial ports as per the requirement for communication to other IEDs. The requirements of internal communications between the RTU CPU module and RTU I/O modules is to be taken care separately while designing and sizing of RTU. The details of configuration of each port will be provided in detailed engineering.

g) Communication protocol between MMS/BMS-1/ BMS-2 and RTUs shall confirm to OSI Communication model. It shall be DNP 3.0 (TCP/IP) and it will be standard protocol for all the station communications.

h) SCADA Vendor shall ensure that the all servers and workstation makes/models meet the system loading requirements specified in the tender. In case additional hardware / software is required or the SCADA hardware are to be upgraded to meet the tender requirement, the same shall be done by the SCADA vendor, at any stage of project implementation for fulfilling the system performance requirements, without any price and time schedule implications.

i) SCADA Vendor shall ensure the completeness of the system to meet the complete requirements of this tender as part of their responsibility and any change / modifications required for the same during detailed engineering to meet the requirements of the tender shall be done by the SCADA Vendor without any delivery & cost implications to the Client

j) The SCADA Vendor shall carry out the activities related to SCADA project management, system design, engineering, integration, training & testing fully by themselves and the remaining activities may be sub-contracted to any other agency having experience in erection, cabling, installation of the SCADA system.

k) In the tender, the terms Owner, Purchaser, Company and Client been used synonymously. The terms Contract document, Contract specifications, tender specification have been used synonymously. The terms SCADA Vendor, Contractor, Bidder have been used synonymously.

l) The SCADA System technical details (including selection in respect of protocol, SCADA HMI standards, Input/output points as per RTU card, RTU engineering feature etc.) to be implemented for SCADA system shall be furnished by the bidder duly filled in and signed as part of the bid.

m) The offered SCADA system shall meet the requirements of Open architecture in the following manner:

- The offered SCADA shall meet the requirements of interoperability, portability and scalability as per the following international standards, with their latest version:

(i) The SCADA software with main SCADA data base shall be SCADA server resident and the OS shall support real-time operation.

(ii) The networking shall support OSI/TCP/IP/DNP 3.0 network connectivity.

(iii) The LAN shall meet IEEE 802.3 standards.

(iv) The SCADA database management system shall support database access through SQL.

(v) The SCADA system shall be Web enabled.

(vi) All the servers shall be both ODBC & OPC compliance.

n) All the hardware to be supplied as part of the contract shall be manufactured utilizing good engineering practices. The SCADA servers shall meet the system loading requirements specified in the tender

o) Hardware supplied should be of latest model and should not be phased out / become obsolete before commissioning of the system. If the system gets phased out before commissioning then bidder has to replaced phased out hardware with new latest hardware having higher/better configurations.

p) The Bidder shall give an undertaking in line with PMR form enclosed as Annexure VI that system support for maintenance, up gradation and enhancement/expansion of the offered system shall be available for 05 years from the expiry of the Warranty period.

q) Bidder shall furnish all documentation, drawings, and other information required Operation and Maintenance Manuals, Handbook of inventory of all the equipment supplied and installed. Documentation shall also include SCADA application specific documents, Database

documents, HMI documents, Web Server documents, compiler related documents, etc. covering all the hardware and software aspects of entire supplied system.

r) SCADA vendor must coordinate with Instrumentation / Telecommunication / Electrical / CP system contractor / vendor during installation & commissioning for proper integration.

s) The electrical works associated with the installation and commissioning of the equipments, earthing of equipments at all sites, powering of equipments at all sites, termination of cables as required shall be the responsibility of the bidder. Supply and laying of Power Cables from Electrical panel to respective RTU Panel, Server Panel, RWS etc cables as required shall be the responsibility of the bidder.

t) Supply and laying of cables & connectors from each IED to RTU is in bidder's scope.

u) Supply and laying of cables & connectors from Local Station PLC to RTU, Local Control Panel/ TIC panel to RTU & interconnection between SCADA equipments and interfacing of SCADA equipments with Telecom system is in bidder's scope.

v) Glanding, ferruling, termination of cabling at RTU end, Server end, work station end and respective end at PLC, Electrical Panel, IEDs or any other interfacing device shall be bidder's responsibility.

w) Training of Client's personnel (in the operation, maintenance, system internals and expansion/modification) of the installed SCADA system is in bidder's scope. Training shall be provided both at SCADA Vendor's manufacturing works and at Site locations after commissioning of the SCADA system. The Man-days for the training shall be decided during detail engineering.

x) System Warranty including all services and spares for operation and maintenance of the system.

y) IEDs communication protocol details will be provided by Client during detail engineering.

z) Any hardware required for communication between MMS/BMS-1/BMS-2 and remote sites / IEDs (e.g. switch, serial to TCP/IP converter, TCP/IP to serial converter etc.) shall be provided by SCADA Vendor if required at site. Also, the cables and connectors to connect the terminal server port with modem/DCU/serial to TCP/IP converter will be provided by SCADA vendor.

aa) At MMS, BMS-1 and BMS-2 locations, the SCADA servers, web server, History Server, OPC Server, GPS Server, router and switches etc shall be mounted in racks. The racks have to be provided by the SCADA vendor.

bb) The power supply for the SCADA system at all locations shall be provided at a single point to the bidder for the bidder's supplied system. Laying of power cables, PDB and distribution to individual equipments is in the scope of SCADA vendor.

cc) All Scope regarding cables (all power, signal and control cables shall be FRLS armoured, all serial & LAN CAT cables shall be FRPVC Armoured), cable trays, hot and cold loop testing, cable glands and interconnection of cabling and accessories including cable routing

between different cabinets/ equipments is included in bidder's scope. The supply of cable includes the supply of Gland as required at both ends of the cable.

dd) All the above ground armoured cable shall be laid in the GI cable tray with cover. The GI cable tray shall be Hot Dip Galvanised with minimum 2.5mm thickness. Supply and installation of GI cable tray with cover as per the site requirement is included in scope of the bidder.

ee) All equipment, cable glands etc. used in hazardous area shall be certified explosion proof suitable for use in hazardous area Zone 1, Gr IIA/B as per IEC 60079.

ff) Scope regarding cables glands and interconnection of cabling and accessories including cable routing between the following cabinets/ equipments are as follows:

Sl. No.	Type of Cabling	Location	From	To	Scope of SCADA Vendor (as applicable)
1.	Serial Interface cables (RS 485/Ethernet)	RTU locations	RTUs.	IEDs , MODEM at RTU locations	Complete interfacing requirements including supply connectors at IED end, modem end, and RS 485 / Ethernet connection intrinsically safe box (ISB) ends.
2.	Power cables	MMS/BMS-1/BMS-2/ RTU locations	UPS	RTU, Server Racks, Other items supplied by bidder	Supply of all cable including laying, routing, Glanding, termination, ferruling, dressing, hot and cold loop testing etc. at both ends.
3.	Telecom Interface Cable	MMS/BMS-1/BMS-2/ RTU locations	Telecom panel / router / switch/ MODEM	Ethernet port of RTU / Servers	Supply of all cable including laying, routing, Glanding, termination, ferruling, dressing, hot and cold loop testing etc. at both ends.
4.	Ethernet Interface Cable	MMS/BMS-1/BMS-2/ RTU locations	Switch/ Router/ RTU	Each Server, Work station, Video Wall, client existing LAN, Field device	Supply of all cable including laying, routing, Glanding, termination, ferruling, dressing, hot and cold loop testing etc. at both ends.
6.	Power Cables	RTU location	Solar system supplied by other contractor	RTU provided by bidder	Supply of all cable including laying, routing, Glanding, termination, ferruling, dressing, hot and cold loop testing etc. at both ends.

Necessary tray, Glands, other erection accessories as required has to be supplied and installed and is included in scope of the bidder.

The Cable tray shall be GI cable tray of minimum 2.5 mm thickness. The size of the cable tray shall be as per the requirement. 20% spare space shall be provided in each cable tray. All the cables in control room shall be laid in the GI cable tray. At each location, all above ground cables shall be laid GI cable tray.

20% spare core shall be available in cable and same shall be considered in cable design for each type of cable supplied by bidder. For power cables, the cables shall be sized for 20% additional current consumption considering maximum current consumption of each system supplied by the bidder.

For Connection to the UPS, Client shall provide the Incomer Raw Power Supply at a single point in its MCC/ PMCC/ Other Electrical Panel. It shall be the responsibility of the bidder to supply and lay all required cable for UPS connection till the point of connection provided by client.

The Panels shall be installed in the equipment room. Video wall, consoles, etc. shall be installed in the control room. The UPS and battery shall be installed in their respective rooms. The SCADA room layout is attached with the tender document. Bidder shall refer the attached SCADA room layout to determine the length of cables required.

Selection of power cables with copper core shall be done as per the following methodology –

vi. For Current consumption upto 3 A – 1.5 sq mm
vii. For Current consumption 3 A to 5 A – 2.5 sq mm
viii. For Current consumption 5 A to 10 A – 6 sq mm
ix. For Current consumption 10 A to 15 A – 10 sq mm
x. For Current consumption 16 A to 25 A – 16 sq mm

8.90 BATTERY LIMIT WITH OTHER CONTRACTORS

SI. No.	Item	Scope of other contactor	Scope of RTU (as applicable)
1.	Cathodic Protection (CP)		Supply & laying of cable for hardwired signals from CP TR Unit panel to RTU, Supply & laying of cable for serial communication from CP panel to RTU; including glanding, termination, ferruling, dressing, hot and cold loop testing etc. both end
2.	Fire & Gas Detection System		Supply & laying of cable for hardwired signals from Fire & Gas panel to RTU, Supply & laying of cable for serial communication from Fire & Gas

			panel to RTU; including glanding, termination, ferruling, dressing, hot and cold loop testing etc. both end
3.	Field Devices (including hardwired signals, IED serial cables etc)	Supply & laying of cable from each Field Device to RTU panel including glanding, termination, ferruling, dressing etc. at field device end	glanding, termination, ferruling, dressing, hot and cold loop testing etc. of laid cable at RTU end.
6.	Solar System	Supply of solar system & provision for Modbus/Ethernet in Solar system for interfacing with RTU	Supply of power cable, communication cable with connectors at both ends from Solar charge controller to RTU including Laying, glanding, termination, ferruling, dressing, hot and cold loop testing etc. at both ends.
7.	UPS Panel/ Other IEDs		Supply of communication cable with connectors at both ends from UPS Panel/ other IEDs to RTU including Laying, glanding, termination, ferruling, dressing , hot and cold loop testing etc. at both ends.
8.	MODEM		Supply of all cables for interfacing of RTU with MODEM

Note:

1. Distance between CP /Solar/ UPS Panel and RTU Panel to be considered as 30 meters. However, these distances shall be firmed up during detail engineering.
2. RTU vendor has to supply & lay the cable tray, supply & erection of foundation channel on trench/ false flooring provided by client as required.
3. All the serial cables shall be laid in the conduits from various panels to RTU.
4. Cables for servers / HMI / work stations (all type and must be armored).
5. The sizing of cables (including number of cores/ pairs in each cable) shall be done by bidder including all the I/Os provided in I/O list as well as the spare I/Os. Each spare channel of each type of I/O shall be terminated till the terminal block of each RTU.

gg) Vendor shall note that inspection might be done by Client / PMC Personnel at Vendor's shop (Original equipment manufacturer/ System integrator). For this inspection, labour, consumables, equipment and utilities as required shall be in vendor's scope or as defined elsewhere in the tender documents.

hh) System warranty including all services and spares, consumables for operation and maintenance of the system.

ii) Bidder shall provide the following information along with their offer:
   i. Compliance to complete scope of work.
   ii. FDS documents of SCADA System
   iii. Details of all special equipments.
   iv. Utility requirements including Power consumption. The offer shall indicate the power requirement for Uninterrupted Power Supply (UPS), Non-UPS and DC power clearly indicating the locations for each. (Furnished the details in PUCR form – Annexure XV)
   v. Estimated heat load for the equipment located in control room.
   vi. Sub vendor list.
   vii. Special Installation Standards (Typical)
   viii. List of deviations, if any, from MR / PR's specifications clause number wise with reasons thereof, wherever applicable.
   ix. Mandatory spares for RTU accessories & other items shall be provided separately for any additional requirement.

hh. Bidder's offer, catalogues, drawings, instrument manuals etc. shall be in English.

ii. Bidder shall quote for two years operational spares (with unit price) for the complete system package offered in price schedule.

jj. The person deputed for supervision of erection and testing shall be competent for execute the work independently.

kk. Portable Programmable Diagnostic Unit (PDT) shall be provided as per the specification with Latest configuration. The specification provided is indicative only and PDT has to be provided as per the latest configuration available at the time of ordering of PDT and the configuration shall be higher/better than the specification provided in the tender.

8.91 **Mandatory requirements for centralized SCADA for RTU**

In addition to the requirements as define in the technical specification of RTU (Provided in the tender as Technical Specification of RTU); following has to be considered while designing the RTU and integration with centralized SCADA of client. In case of any conflict; the requirement of client will prevail.

i. The RTU vendor shall inform client about product discontinuation one year in advance so that client can procure the spares of the RTUs to maintain it for its remaining useful life.

ii. All the alarms, events and command history shall be stored in RTU memory with date and time stamp on FIFO basis. Minimum 5000 alarms and events and 200 commands shall be stored in RTU memory which shall be non-volatile and accordingly the RTU memory shall be provided.
iii. In addition to above, RTU should have event logging and buffering feature. In case of communication loss, RTU shall store the events in the buffer and transmit to Master Station on restoration of link.
iv. RTU should have calculation features in it for defining RTU resident calculation points.
v. RTU should have surge/lightening protection for power supply & communication channel. Surge protector shall be provided for all input supply / communication (MODBUS/Ethernet/ DNP) port apart from the inbuilt surge protection available on RTU.
vi. Test jig RTUs with configuration with one card of each type to be supplied and installed with required power and communication cabling and made online with SCADA system
vii. RTU shall be interfaced with Centralized SCADA system without using any interfacing Device / Protocol convertor between SCADA server and RTU

8.92 **Communication related aspects for RTU**

i. RTU shall have dual Ethernet ports (configurable independently) for DNP 3.0 (TCP/IP) communication (IEC protocol if mentioned shall be ignored) with SCADA.
ii. Both the communication port should support Class 0 and Class 1, 2, 3 polling from SCADA independently.
iii. The ports (Ethernet) available on CPU of RTU may be utilized for communication with SCADA Servers. However, there shall be separate serial card(s) for interfacing with IEDs.
iv. Serial ports available at serial card should be independently and individually configurable at all respect.
v. It shall be possible to do configure / write IED interface in RTU for which necessary software tool shall be supplied.
vi. For communication with IEDs through serial ports, the RTU shall support 16-bit, 32-bit, signed, unsigned, integer and floating point data type.
vii. In case RTU software installation in PC or server requires additional software like Dot NET / Java etc, it should be declared and provided.
viii. RTU configuration and diagnostic tool should be able to connect to RTU remotely over TCP/IP even during polling from SCADA Server on same TCP/IP.
ix. RTU configurator and diagnostic tool should have suitable software authentication like username and password.
x. RTU configuration and diagnostic tool should have provision to warm restart of RTU.

8.93 **I/O points and RTU card related aspects**

i. The Digital Output should also be configured for pulse duration. No separate program or logic will be acceptable at RTU end.
ii. RTU should have separate CPU card and Power card.
iii. On RTU restart/ power failure, RTU shall reset the output circuit, shall not generate false control signal and cancel all pending control signal.

iv. DI and DO card of the RTU should have minimum 16 IO points. AI card of the RTU should have minimum 8 IO points. The AO and serial card should have minimum 4 IO points / port. However minimum point may further be deliberated considering the sizing of the RTU and availability.
v. All the field / IED Paramaters should be configurable at the RTU end.
vi. For each channel of AI, AO, DI and DO card, fused TBs of suitable rating has to be provided for termination of incoming cables from field/TIC panel. Loop/ Common fuse TB must not be provided and the same shall not be acceptable
vii. Each AI shall be wired in Sink mode configuration. However, if source mode configuration is required, the same will be decided during detail engineering
viii. Active Analog barriers have to be provided for each channel of AO card in the RTU panels
ix. Each RTU should have 25% spare I/O points and additional 25% spare slots of total installed serial and I/O cards slots.
x. RTU should be internally wired between IO cards and terminal blocks for all the IO points in all the IO cards in the RTU.
xi. The terminal blocks to be mounted either on front or back or both but not on sides.

8.94 **Aspects related to RTU configuration and diagnostics**

i. Licensed RTU configuration software for each type of RTU (along with software CD) loaded on all PDT and all Work stations (as envisaged) shall be supplied. RTU configuration software licenses shall be preferred in software (software key) form instead of hardware (dongle).
ii. The PDTs shall be handed over to Client before start of RTU commissioning activities and are not to be used by RTU vendor for commissioning activities.
iii. RTU configurator / diagnostic software shall have the following provision:
    a. Index of all I/O along with present real time field data to be available in diagnostic software table/window.
        I. All RTU cards, serial ports and communications channels health points are to be configured in RTU and DNP/IEC index of same are to be reflected in I/O list and all serial ports should be independently configurable.
        II. Error detection/control feature to ensure data integrity.
iv. RTU should have the utility for configuration and diagnostics through remote and local.
v. RTU should have diagnostic provision without uploading / downloading RTU configuration to PC/laptop.
vi. The RTU should have diagnostic feature for hardwired IOs, DNP/IEC and IED communication.
vii. RTU should be internally wired between IO cards and terminal blocks for all the IO points in all the IO cards in the RTU.
viii. The RTU panel shall be designed for 24V DC operation. Accordingly, all the Lights and fans in the RTU panel shall be provided for 24V DC operation
ix. The RTU back pane, CPU, IO cards and any other device susceptible to 230V AC discharge shall be installed insulated from the panel body through proper insulators

8.95 **Site Services**

i. Configuration of RTU for all I/O points including calculation points and IED points.
ii. Offline testing of field signals using PDT from RTU to field including IEDs
iii. Powering on of RTU and making it online with SCADA system.

iv. Online testing of all field signals from SCADA system in association with SCADA vendor. RTU vendor shall maintain sufficient no of commissioning spares during installation and commissioning activities. RTU vendor shall not use mandatory spares supplied as part of contract.
v. All the tools, tackles and test equipments required for installation and commissioning shall be arranged by RTU vendor.

9.0 GENERAL TECHNICAL REQUIREMENTS:

i) **REFERENCES**

Codes and Standards

The following standards shall be considered part of this specification insofar as they give definitions, describe requirements and provide tests that the equipment supplied shall meet. The Standards used shall be the latest revision in force, including any addenda, supplements or revisions thereto.

International Standards

API

• API 1113	Developing a Pipeline Supervisory Control Centre
• API 1130	Computational Pipeline Monitoring

ANSI

• ANSI/NFPA 75	Standard for the Protection of Electronic Computer Data Processing Equipment

NEMA

• NEMA ICS	General Standards for Industrial Control and Systems
• NEMA ICS 2-230	Components for Solid-state Logic Systems
• NEMA ICS 3-304	Programmable Controllers
• NEEMA ICS-6	Enclosures for Industrial Controls and Systems

IEC

• IEC 61131	Programmable Controllers- ALL PARTS
• IEC 60870-5-101	Telecontrol equipment and systems – Part 5 – 101: Transmission Protocols – Companion standard for basic telecontrol tasks

ISA

• ISA S5.1	Instrumentation symbols and identification
• ISA S5.2	Binary Logic Diagrams for Process operation
• ISA- 5.3 – 1983	Graphic symbols for Distributed Control/ Shared Display

Instrumentation, Logic, and Computer systems

- ISA S5.4 Instrument loop Diagrams
- ISA-5.5-1985 Graphic Symbols for Process Displays
- ISA S18.1 Alarm annunciation sequence and specification
- ISA-50.02 Fieldbus Standard for use in Industrial Control Systems Part : 2 Physical Layer Specification and Service Definition
- ISA RP55.1 Hardware testing of digital process computers
- ISA-RP60.3-1985 Human Engineering for Control centres
- ISA S71.04 Environmental conditions for process measurement and control System: Airborne contaminants
- ISA S72.1 LAN Industrial data highway
- EWICS-1998 Guidelines for the use of Programmable Logic Controllers in Safety – Related Systems
- EWICS-1997 Guidelines for Achieving Safety in Distributed Systems

Indian Standards

- IS 732-1989 Code of Practice for Electrical Wiring installations
- IS 3034-1993 Fire Safety of Industrial Buildings: Electrical, Generating and Distribution Stations- Code of Practice
- IS 3043 Code of Practice for Earthing
- IS 5887-1916 Classification of Maximum Surface temperatures of Electrical Equipment for use in explosive Atmospheres

Other Standards

- IEEE 472 Guide for surge Withstand Capability
- IEEE C37.1 Automatic and Supervisory Station Control and Data Acquisition
- IEEE 730 Software Quality Assurance Plan
- IEEE 830 Software Requirement Specification
- IEEE 802.3 Standard CSMA/CD Media Access Control (Ethernet)
- IEEE 829 Software Test Documentation
- ANSI MC8.1 Recommended Practice Hardware Testing of Digital Process computers
- ITU V.23 Modern VF Interference
- ITU V.24 DCE/DTE Interface
- BS 5345: Part 4:1977 UK Code of Practice for Intrinsic Safety
- BS 5501: Part 6:1977 Intrinsic Safety 'e'
- BS 1259: 1958 Intrinsic Safety Standard
- EIA-232 Interface between Data terminal equipment & data communication equipment employing serial binary data interchange
- EIA-422 Electrical characteristics of balanced voltage digital interface ckts
- EIA-485 Electrical Characteristic of generators and Receivers for use in Balanced Digital Multipoint Systems
- ISO/9001/02/03 Quality system for Design/Production and Installations/ Final Inspection and testing

- MIL-STD-461B Radio Frequency and Electro-magnetic Interference.

Abbreviations

AMS	Alarm Management System
CP	Cathodic Protection
DCS	Distributed Control System
DHCP	Dynamic Host Configuration Protocol
EPAX	Electronic Private Automatic Exchange
ESD	Emergency Shut Down
FIFO	First In First Out
FMC	Field Marshalling Cabinet
GIS	Geographical Information System
GPS	Global Positioning System
IS	Intrinsically Safe
LAN	Local Area Network
MMS	Main Master Station
BMS	Backup Master Station
RWS	Remote Work Station
HMI	Human Machine Interface
MOV	Motor Operated Valve
MTBF	Mean Time between Failures
MTTR	Mean Time To Power
OPC	OLE for Process Control
P&ID	Piping and Instrument Diagram
PLC	Programmable logic Controller
RAID	Redundant Array of Independent Disks
RTU	Remote Terminal/ Telemetry Unit
SCADA	Supervisory Control and Data Acquisition Unit
SCSI	Small Computer System Interface
TSS	Training Simulation System

UPS Uninterruptible Power Supply

WAN Wide Area Network

9.1 GENERAL SITE INFORMATION:

All the equipment supplied under this contract shall be suitable for continuous operation under the environmental conditions prevailing at site. It shall be suitable for operation under the following site conditions:

Sand & Dust :

With a built up of dust on operational surface to a level such as may occur because of imperfections in the sealing of equipment, housing and conditions prevailing in sub-tropical dust conditions and pipeline installations.

Tropicalisation :

The equipment shall be fully tropicalised

Shock & vibration :

The equipment shall withstand transportation and handling by air, sea and road under packed condition confirming to standards, confirming to MIL 810 B specification or commercial equivalent.

The equipment shall also be resistant to termite, fungus, rodents and salty environments.

9.2 ENVIRONMENTAL SPECIFICATION OF EQUIPMENT TO BE SUPPLIED

All the equipment of SCADA system servers shall operate satisfactorily in controlled/ uncontrolled environment under the following conditions.

FOR	TEMPERATURE	HUMIDITY
Operation	0 to 35°C	20 to 80 % RH
Storage & transportation	0 to +60 °C	5 to 95 % RH

All the RTUs shall be designed for storage and operation under the non air conditioned environment with the limits given below-

FOR	TEMPERATURE	HUMIDITY
Operation	0 to 55°C	10 to 95 % RH
Storage & transportation	0 to +70 °C	5 to 95 % RH

All SCADA equipment cabinet and power supply, distribution cabinet structures to be supplied shall be constructed to allow free air flow to dissipate heat generated. Construction shall be such that ventilation grills will not be obstructed when equipment is mounted in its installed position. Manufacturer shall calculate the heat dissipation and where the calculations prove necessity, and then air flow ventilation shall be assisted by integral low power silent running air extraction fans. Inlet ventilation grills shall be fitted with dust filters.

All equipment to be supplied shall withstand international standards of vibration for industrial application.

9.3 POWER SUPPLY

The power supply for each equipment of the SCADA system shall be provided by the bidder. All the equipments of the SCADA system have to be powered through Power provided by client at each station. Any power supply converter/ hardware etc required to achieve the desired voltage level of SCADA equipments shall be supplied by the bidder. All the works required for providing power to SCADA system is in scope of bidder. Only power connection at a single point shall be provided by Client.

SCADA vendor shall furnish power consumption details with detailed break-up for each subsystem/equipments including inrush current and its duration during detailed engineering.

Power Supply Level -

Sl No	Location	Power Source	Power supply	Max. Allowable load (Watts)
1	MMS, BMS-1, BMS-2 Servers	UPS (Grid)	240C AV	6000 W
2	RTU locations	UPS (Grid)/ Solar	24V DC	150 W
3	RWS locations	UPS (Grid)	240V AC	400 W
5	RTU Test Jig Unit	UPS (Grid)	24V DC	150 W

For any other desired voltage, Reliable and rugged redundant SMPS power supply shall be supplied with equipment to generate isolated and stable voltage levels required for equipment operation.

9.4 SURGE PROTECTION, TRANSIT SUPPRESSORS, RFI FILTERS

All the equipment shall be designed with built-in safety to protect against the effects of monitor induced high voltages, effects of surges, transients (RF)

Each RTU, Each Server Rack should have surge/lightening protection for power supply & communication channel. Surge protector shall be provided for all input supply / communication apart from the inbuilt surge which is available on RTU

Surge protection device for the power and communication shall be considered of both internal and external type confirming to IEC or UL standards. Surge Protection devices shall be provided as per following philosophy-

- For all incomer power supply to each panel (UPS , Solar, Non-UPS)
- For Each MODBUS communication Channel
- Power supply feeder to WAN routers, firewall router
- GPS antenna cable
- For each LAN connection of RTU
- For each LAN connection from SCADA system to system not supplied by bidder.

9.5 EARTHING

Each supplied RTU cabinet, Server cabinet / rack in the MMS /BMS locations shall be provided with earthing lugs with their frames. All these lugs/ strips shall be properly secured to the electrical earthing bus.

Earthing of the SCADA equipment is in scope of bidder. Separate earthing shall be provided for AC and DC systems . Bidder shall extend the copper earth strip from earth pit upto the RTU panel / server panel.

All the system ground of various cards and equipments, shields of instrument cables shall be connected to system ground bus which is electrically isolated from the ac mains earthing bus. The equipment shall provide separate earthing strip for the same. The system ground bus shall be connected to independent ground buses through insulated wires.

I. SCADA vendor shall note that for new RTUs, separate earthing shall be provided for:-

a) System grounding (Earth resistance less than 1 ohm)

b) Frame and AC mains grounding (Earth resistance less than 5 ohm)

Accordingly the RTUs shall provide separate earthing strips as mentioned above and SCADA vendor shall also take care of onwards earthing connections from equipment to earthing strips.

II. Following guideline shall be considered while doing the earthing work:

a) Panel metalwork- electrical AC mains supply earth – 2 off M10 brass studs per panel section. These brass studs shall be fitted with vibration proof nuts and washers.

b) Instrument “Clean” earth – electrically insulated copper bus bar 75 mm2 minimum separated from the panel metalwork by 25mm minimum. 2 off M10 brass earth studs to be provided at each end of the bars with associated shake proof nuts and washers.

c) An intrinsically earth bar similar in construction to the instrumentation clean bar shall be installed. This bar shall comply entirely with the requirements of IS 3043. The bar shall incorporate a removable section to facilitate earth continuity testing.

III. On intrinsically safe circuits the following shall be considered:

- Unused cores of the multicare cables nominated as spares shall be terminated to earth via dummy barriers. All other unused cores shall be taken directly to the I.S. earth bar.
- The earth connection via dual shake proof screws or clamps.
- Brass studs shall be incorporated on the I.S. earth bar for connection of dual I.S. earth cables.
- The I.S. earthing system shall be labeled “Safety earth-Do not disconnect”.

Similarly unused cores of Non- I.S. field cables and system cables shall be terminated and connected to the instrumentation “clean” earth. A minimum of 30 % spare capacity shall be provided within system cables and ELCO connectors.

9.6 ELECTROMAGNETIC COMPATIBILITY - EMC

- The equipment shall be efficiently screened against EMI, RFI and conductive interference and shall not interfere with other equipment in the vicinity or installed in the same building.
- The equipment shall be required to meet one of relevant EMC standards (IEC, MIL, VDE, BS, IEEE etc.)

9.7 SYSTEM AVAILABILITY REQUIREMENTS

- The SCADA vendor shall ensure the system availability shall be 99.99 %
- The SCADA vendor shall ensure that the MTTR of RTU as 8 hrs and MMS, BMS equipments as 2 hrs.
- System Design covering future expansion takes calculation of availability in to account

9.8 INSTALLATION MATERIALS

- All installation materials such as all types of cables, data cables, cable trays, relays, connectors, switches, MCBs, frames, supports, lugs, ferrules, sleeves, structural steel, SS cable tags, fuses, terminations, TBs, distribution boxes and other items required but not mentioned herein shall be provided by the SCADA vendor. The structural steel shall be from reputed manufacturers such as SAIL, TATA Steel, Jindal Steel.
- SCADA vendor to note that detailed scope of cables including power cables with other accessories for interfacing with different equipments shall be supplied by the vendor.
- Necessary erection accessories, cabling between the LED monitor and the EWS unit is in the bidder's scope."

- The quality of materials used shall be of the highest order and shall conform to the international standards and safety standards as per relevant hazardous area classification.

- **Civil works**

    - All civil works required for installation of the SCADA equipments shall be carried out by the bidder.

9.9 SAFETY REQUIREMENTS

- It is the intent of the Client that operational hazards be reduced to a minimum. The SCADA vendor shall use sound engineering judgment to complete an installation that will perform the required function without compromising this aim.
- All controls shall be in fail-safe mode. a fail safe mode is defined as if a plant equipment or system fails, it shall be safe to the system
- Provision shall be made to isolate all incoming signals to a cabinet before gaining access to cabinet internals. Shrouding terminal with warning labels shall be provided with these terminal being segregated from other incoming terminals.
- SCADA vendor must ensure that the equipments will not be damaged due to blackouts / burnouts.
- SCADA vendor shall provide the start up procedure of the system. Further SCADA vendor to indicate steps to be taken for fail safe operations of the system under following criterion

    A) power failure
    B) voltage variation more that ± 10%
    C) frequency variation more than ± 3%
    D) air conditioning failure

9.10 FINISH

- All the frame and the steel work of the cabinets shall be degreased then phosphate treated or coated with primer followed by at least two undercoats and a final coat of matte finished enamel paint of SHADE RAL 7035. The finished of the equipments shall be of the finest quality and capable of long and unattended service. The inside of the cabinets shall be painted SHADE RAL 7035.

- All the SCADA Cabinet / racks and RTU cabinets shall have ‘Nameplates’ correlating with the Project details, type and location of the cabinet. In addition, all the SCADA Cabinet / racks and RTU cabinets shall have ‘Tag plates’ correlating with the type and location of the cabinet.

9.11 CALIBRATION

- The calibration procedure along with periodicity required for ensuring the accuracy of test instruments supplied under this contract shall be taken care by the SCADA vendor. The SCADA

vendor shall supply calibration charts from independent test laboratory for all input/output subsystems, during the warranty period.

9.12 ELECTRICAL WORKS

For MMS / BMS, RTU locations, ELECTRICAL work shall consist of:

a) Providing PDB/ dedicated feeder and interconnecting cabling from power supply unit in electrical control room to SCADA / RTU room & all equipments supplied by bidder

b) Providing interconnecting cabling with telecommunication system along with cable routing and dressing.

c) All the cable work including earthing up to the panel from the dedicated earthing point, system grounding for the supplied equipments.

d) Any temporary electrical works associated with the erection & commissioning of the system

e) Testing and certification of all the electrical works within the scope.

f) All power cabling (including supply of cables, glanding, ferruling, termination etc.) from the power distribution cabinet to the SCADA equipment shall be carried out by SCADA vendor

9.13 SPARES:

- The SCADA vendor shall cover the various categories of spares included corresponding activity / services as listed below as part of Lump sum price:
- Commissioning spares including consumables as part of commissioning activities
- The consumable shall be adequate and complete and shall include as a minimum paper, print heads, cartridges, disks, taps etc. as required for the printers at workstation etc.
- Contractor shall guarantee the 'OWNER' in writing from the Original Equipment Manufacturer regarding the supply of spares over a period of ten (10) years from the date of acceptance of system.
- Spare parts shall be quoted as per the Bill of Materials and SOR. In case any of the equipment supplied by the Contractor is scrapped by the manufacturer or its production is discontinued owing to any reason whatsoever, the Contractor shall submit, before twelve (12) months of such an eventuality, an offer for life-time spares of the equipment. Such quotation shall remain valid for a period of 180 days from the date of submission of the offer to the Owner.
- The decision as to repair/ replacement of the faulty component/ module/ part/ sub-assembly shall be that of the Owner and Contractor shall be bound by it. The procedure for repair or replacement of spare parts for the warranty period shall be worked out with the Contractor at a later date

- The mandatory spares (as per SOR) shall be supplied as per the contract. These spares can't be used during commissioning.

1. Mandatory spares for RTU:

Supply of loose Mandatory spare shall include 10% (with minimum of 1 no.) of all type of Installed cards, convertors, power supply/converters, termination boards, OEM cables between cards and termination boards, backplanes, relays etc accounted & calculated considering total quantities of RTU and SCADA statewise(as per MR). **In case total installed cards/items are 1 or 2 then only one spare card/item shall be provided. Bill of material of fully wired RTU and SCADA system (with spare calculation) must be furnished along with offer. (Bill of Material has to be provided along with offer, any fraction quantity should be round off to nearest number in higher side).**

(a) CPU cards
(b) Power Supply cards
(c) AI Cards with pre-fab cables
(d) DI Cards pre-fab cables
(e) AO Cards pre-fab cables
(f) DO Cards with relay and relay board, pre-fab cables
(g) DNP Communication card
(h) MODBUS Communication Card with pre-fab cables
(i) Network Switches and routers
(j) OEM Termination CABLES
(k) Termination board
(l) Back pane & RTU chassis
(m) Surge protection device of each type
(n) Power supply sockets
(o) Pre-fab Ethernet cable of minimum 5 mtrs length
(p) LTO drives
(q) MCBs, TBs
(r) Any item required but not specified above
(s) Barriers, Isolators of each type
(t) 100% spare for consumables such as fuse, lamps etc. shall be provided

- Calculation of the 10% spares shall be made for each type of Cards on the basis of total number of cards supplied against all RTUs statewise wise for each state. Any fraction number so calculated shall be taken as the next whole number. For example the quantity of 0.3 shall be taken as quantity 1, a quantity of 2.1 shall be taken as quantity 3.

- Unit rate for Mandatory spares with cards details, part no., make etc. shall be given separately with the offer & price part.

- Vendor has to note that mandatory spares, supplied to CLIENT, shall not be available to them as part of commissioning spares.

- For spares Vendor shall provide the address, contact person, fax and telephone numbers of the manufacturer for spare parts. The vendor shall warrant that spare part for the system would be available for minimum of 10 years after warranty period from the date of system commissioning. After this period if the vendor discontinues the production of the spare parts, then he shall give at least 12 months notice prior to such discontinuation so that Owner may order the requirements of spares in one lot.

- The Vendor shall provide unit price of each Spare Module card, which shall be valid for the procurement of the spares for operation and maintenance in subsequent years as & when requested or during detailed engineering.

2. COMMISSIONING SPARES:

- The commissioning spares shall be arranged by the vendor to cater to the needs/requirement during installation, commissioning, site acceptance testing, trial run and warranty period. These spares will be the part of the tender. These spares shall be readily available with the vendor. If the spares not used they may be retained by the vendor for maintenance. Providing Commissioning spares including consumables as part of commissioning activities.

- Vendor must ensure availability commissioning spares as a minimum at site not less 2 nos of CPU, 2 nos of each I/o cards (AI, AO, DI, and DO) for each type of RTU, one no of each type of communication card and one no. of each type of router.

- These commissioning spares are different from Mandatory spares and vendor shall not use mandatory spares as commissioning spares. Vendor shall provide a list of commissioning spares (with Serial & Part number for each system, sub-system) at the time of offer and it will be part of main offer.

9.14 TEST Equipments:

- SCADA vendor shall supply test equipments and tools for testing and calibration of all the equipments as per SOR.

- Diagnostics software for RTU, SCADA Server and RWS shall be supplied along with necessary documentation and accessories. All the supplied software should be licensed to Client.

- Portable Programmable Diagnostic Test Unit (PDT Unit) shall be supplied with latest configuration. The PDT shall be latest Intel Pentium with active matrix display and fully configured and loaded with all the RTU configurations and diagnostic software. All the necessary cables and connectors shall be supplied with the PDTs.

i. MINIMUM SPEC FOR PORTABLE PROGRAMMABLE DIAGNOSTIC TEST UNIT (PDT UNIT):

Portable Programmable Diagnostic Test Unit (PDT Unit) shall be supplied with latest configuration. The PDT shall be latest Intel Pentium with active matrix display and fully configured and loaded with all the RTU configurations and diagnostic software. All the necessary cables and connectors shall be supplied with the PDTs.

MINIMUM SPEC FOR PORTABLE PROGRAMMABLE DIAGNOSTIC TEST UNIT (PDT UNIT):

The hardware shall be provided from proven sources (hand held service terminal equipment of Manufacture / Laptop computer from LENOVO /HP/DELL/HCL/TOSHIBA/SAMSUNG/SONI/GETAC)

It shall be possible to use the PDT both locally and remotely to manage each component of SCADA system. All necessary software for the same shall be provided by the bidder in PDT. All software shall be licensed and perpetual. Softkeys shall be provided for license. Dongle shall not be acceptable. Provision for local accessibility of each equipment shall be provided along with all hardware /cable etc available at each station.

The PDT shall be provided as per the latest configuration available during procurement. Following minimum specification is listed out for reference purpose, however, latest configuration higher to the one mentioned below has to be supplied (For any discrepancy / conflict with specification, higher specification will prevail):
* information to be provided by the bidder at the time of offer:

Make and Model	**:**	Any Rugged Industrial Laptop manufacturer
Operating System	**:**	**Latest** Microsoft Windows with Recovery Media and OS Media and Key along with downgrade rights to previous version
Processor	**:**	Min Intel Core i7 9th-Generation or later
Memory	**:**	Min. 8GB DDR4 SDRAM, Expandable upto 16GB
Hard Drive	**:**	Min. 1TB HDD SSD
Optical Drive	**:**	External / Internal/ DVD +/- RW
Display	**:**	14 inch Widescreen with resolution 1366X768 or better.
Mouse	**:**	Touch Pad
Ports	**:**	2 number of USB 3.0.and additionally Min 1 no of USB 2.0 or 3.0. Min 1 no of HDMI for external Audio & Video Min 1 no of VGA port Min 1 no of Bluetooth Min 1 no of Microphone in/Headphone jack One Serial (RS232) port onboard or through converter SD Memory Card Reader
Ethernet	**:**	2 nos of Integrated Gigabit Ethernet with RJ-45 interface (10/100/1000 Mbps)
Integrated Wireless LAN	**:**	Dual Band Wireless LAN 802.11 a/g/n or b/g/n
Weight	**:**	Less than 3 KG inclusive of battery, Pls. specify
Carry case	**:**	OEM Executive Carry Case
Power Adapter	**:**	240V AC adapter with Cable (Indian style)
Battery	**:**	Internal minimum 45 W Hr, 5 hours battery back-up

Anti-virus	:	Latest Antivirus with license for virus definition free update till 5 years, Latest MS Office suite, latest Adobe Acrobat pro
Operating Temperature	**:**	0 to 50 Deg C
Ruggedness	**:**	MIL-STD 810G (Vibration, Altitude, Drop, Shock, Thermal, Humidity).

All the above specs will be verified through OEM spec sheet of the model offered. The OEM spec sheet shall be submitted along with the offer.

RTU configurator/diagnostic software shall have the following provision:

i. DNP index of all I/O along with hardware details and present value in single table/window.
ii. All RTU cards, serial ports and communications channels health points are to be configured in RTU and DNP index of same are to be reflected in I/O list and all serial ports should be independently configurable.
iii. Error detection/control feature to ensure data integrity.

ii. Portable Power Source cum Calibrator (Voltage & Current):

Portable Power Source cum Calibrator (Voltage & Current) for simulating signal source and measurements function for current (min 4-20 m Amp) & voltage (1-5 Volt).

The calibrator shall be operable on RTU power supply Voltage level (Both 24 V and 230 V AC). The calibrator shall be self contained and complete in all respects with power supply (230V AC chargeable adapter), cards termination/ connectors, interconnecting signal and power cables and connectors with carrying case. Calibration certificates shall be included

iii. 4 ½ Digit Multi-meters:

4 ½ Digit Multimeter with built-in signal level meters and with carrying case [to measure accurately and serve the function of measurements of DC voltage, AC voltage (True – RMS), resistance, conductance, frequency Test leads, probe holder, alligator clips, batteries, user manual and calibration certificate shall be included]. Preferred Make shall be Tektronix, Fluke, Agilent Technologies, and Falcon.

iv. **Protocol analyser**:

Protocol analyser shall be supplied with necessary software to diagnose and troubleshooting in networks. The analyser should be able to monitor (line and buffer), simulate different industry related protocol and shall provide detailed timing, raw data and messaging information for serial, and Ethernet networks. The analyser shall have provision to monitor, diagnose and simulate minimum modbus (serial/IP), DNP (serial / IP) protocols. Communication setting in the analyser shall be user defined and can be set by the user. The analyser shall be provision to be configured both as master or slave.

RTU test unit (Test Jig, make shall be from the RTU supplied) with each type of RTU cards,

power supply, CPU, communication, serial, AI, DI, AO, DO cards for simulating RTU test environment. The test jig RTU shall be multidrop in the SCADA network.

9.15 DOCUMENTATION

- The language used in all correspondence, documentation, literature, drawings, markings etc., shall be English.
- SCADA vendor shall furnish all relevant technical manuals, literature and other technical data as required at the various stages of the project indicated in tender.
- All the drawings and documents shall be verified by the SCADA vendor before presenting the same for Client review.
- All these documentation shall be furnished in hard cover loose ring folders in A4 size (210mm x 297 mm).
- All SCADA documents shall also be supplied in "SOFT COPY" form.
- SCADA engineering documents (FAT, SCADA engineering manual, SCADA user's manual, HMI document, engineering will be submitted for review/approval/records.
- The contract document would be the Purchase order (after award of contract) and the same shall have higher precedence than all approved project documents.
- Prior to submitting the following documents for Client's review/ records, the SCADA vendor shall review, duly sign & stamp all the documents and ensure compliance to the requirements of the contract.
- **FOLLOWING DOCUMENTATION TO BE SUPPLIED WITH EACH SET OF OFFER (AS A MINIMUM):**

a) Technical manuals for each equipment covering full technical specifications, principle of operation, design features, test and monitoring facilities, generated performance data, power consumption, heat dissipation, dimensional and mounting details, power and signal connections, block diagrams, descriptive operation, procedure and facilities of panel metering etc.

b) Installation manual mentioning material requirement, installation procedure and commissioning.

c) System Description.

d) System configuration diagram.

e) Equipment interconnection configuration.

f) Details of modules & cards offered with each equipment.

g) Layout of equipment and space requirements.

h) Equipment schedule for various stations attended/ unattended.

i) Operator interface and control functions

j) MTBF and MTTR figures for each equipment.

k) Load calculation of power supply requirement for Station Control systems offered for each station.

l) Manpower set up for a) design and engineering management, b) procurement management, c) construction management and d) commissioning management.

m) Authorization certificates from OEM

- Also, the contractor shall submit the following certificates/details along-with each set of offer:

i) Make/ Model/ Type of equipment
ii) Various test certificates for the tests undergone by the equipment
iii) Customers list of last 3 years for similar equipment with P.O Ref. No. and contact person's details.

3.0.1 After the award of work, the following documents for the complete system shall be supplied for review and approval:

Sl. No.	Time Frame	Documents to be submitted
1	Final Documentation to be submitted within 3 months from date of issuance of Letter of Acceptance/ Site Clearance	• Functional Design Specifications for RTUs (considering existing and new RTUs) • Functional Design Specification of SCADA system • Interface details • Other documents as per approved DCI. • HMI Graphic Screens
2	Documentation to be submitted within 6 months from date of issuance of Letter of Acceptance/ Site Clearance	• Factory Acceptance Test procedures for RTU, SCADA, • Site Acceptance Test procedures, training course ware. • Other Documents as per approved DCI.
3	After Acceptance of the System	• 06 copies of as-built documentation (station wise) to be submitted immediately after final acceptance of the integrated system.

9.16 FUNCTIONAL DESIGN SPECIFICATIONS (FDS)

SCADA vendor has to note that the SCADA system tender completely covers the operational and functional requirements of the SCADA system for Client's pipeline and associated network. The requirement of SCADA FDS shall be to focus on the implementation aspects of these requirements.

FDS shall be custom defined for this project and include the implementation aspects of tender requirements in the following sections.

FDS shall cover SCADA implementation aspects [Complete details of systems configuration, MMS, BMS, SCADA EWS, Web server, GPS server, History Server, OPC Server, SCADA EWS philosophy, Redundancy and backup aspects (system failovers & fail backs), alarms management & HMI philosophy, covering implementation aspects of tender requirements, Interfacing, Integration and communication aspects between various subsystems including with Telecom system, communication protocol interfacing with Flow computers, GC, CP Panel and other IEDs, description of SCADA/ third party software interface, system resource sizing basis and performance parameters covering CPU, Hard disk and main memory utilisation, memory mapping, system timeouts, computers switchover timings, Display updates, Display Call-ups, poll time calculations etc.]

Functional Design Document which shall comprise but not limited to the following:

i) All sub-vendor items for main & auxiliary equipment. (Datasheets with Tender Vs offered spec tables)
ii) Technical literature with installation procedures, operation and maintenance manual of all items
iii) System parameters
iv) System design
v) Equipment layout drawings inside the buildings for each site
vi) Installation drawings with overall dimensions and necessary free spaces
vii) Operator console layout for each site
viii) Patch Panel Schedule.
ix) DNP 3.0 Database
x) Equipment schedule at each site
xi) AFC drawings, signal list, control philosophy, logics, graphics
xii) Interface details with various 3rd party devices
xiii) Supervisory configuration, Alarm list operator interface etc.
xiv) Electrical wiring diagrams of the system (feeding circuits, inter-connection between the different equipment and control desk) and earthing details
xv) Cable schedules, loop drawings, termination schedules etc.
xvi) Connectivity details between SCADA servers, client machines and RTUs etc.
xvii) Connectivity details of fire alarm, detection and protection system in Infrastructure
xviii) racks and connectivity / integration with SCADA system.
xix) Test procedures at factory and site, training course ware.

06 copies (or as decided during detail engineering) of as-built documentation (station wise) to be submitted immediately after final acceptance of the integrated system.
Any other data, document not specifically mentioned but required for the satisfactory operation and maintenance of the system shall be forwarded.

03 sets of Operation & Maintenance manuals of all systems and sub-systems supplied (which shall

be decided during FDS) shall be submitted at PLHO, Noida. The document shall be divided into two sections as a minimum:

Preventive maintenance procedures

Trouble shooting procedure including failure analysis:

The section on repairs shall provide exhaustive information on repairs including but not limited to removal, reinsertion of components and cards, repair and adjustments, tuning, calibration, tools required for a particular operation, test points, etc. It shall also contain:

a. Diagnostics of the equipment
b. Test set ups
c. Test parameters and their values on each PCB
d. Soft copy of the above shall be submitted on a CD ROM

SOFTWARE DOCUMENTATION

This will cover system software, programming language, utilities and will include reference manuals, operating manuals, and programming manuals. The software documentation shall provide description of functions of each program, input/ output details, details logic include Macro and Micro flow charts and cross reference systems relating flow charts to coding.

I. All manuals necessary to develop software should also be provided.

II. All software tools and other utilities, which are required to build the system.

III. System Point database for all stations / RTUs / Scrapper Stations / Remote Stations etc.

IV. Man Machine Interface (MMI) documents for all station.

V. Loop schematics, Interlocks, layout drawings, interconnection drawings, grounding details, installation and mounting details, drawings, and cable schedule.

VI. Operating philosophy.

VII. System parameter and Engineering manuals.

VIII. User maintenance guides for all equipment.

IX. Software documentation manuals

X. Factory Acceptance Test (FAT) documents.

XI. Site Acceptance Test (SAT) documents.

Full design specification shall be submitted after the design and drawings are approved.

All necessary details shall be reflected in the drawing submitted for approval so as to avoid delay. Further on approval based on data sufficiency, facts and figures submitted by the Contractor shall not relieve the Contractor of the responsibility of ensuring design completeness if any insufficiency/ suppression of information is detected at any stage by the owner. On such happening the owner shall have the right to cancel the extent of subjected work completed and order for resubmission of drawings, data sheets for approval.

THE DELAY SHALL BE ACCOUNTED ON THE PART OF THE CONTRACTOR. NO COMPENSATION IN TIME/ VALUE OF WORK SHALL BE ALLOWED BY THE OWNER IN SUCH CASES.

A valid / approved soft copy (editable) of the above shall be essentially submitted on a CD ROM / DVD

a) Human Machine Interface (HMI) Document

The HMI documents shall be generated for SCADA systems covering all the displays, graphics and reports, in color printouts ensuring proper view ability and legibility. The coloring scheme for various displays taking care of the colors for the titles/ headings/ sub-headings, background color, static text, dynamic values, pipeline, Sectionalizing Valves and other equipments etc. shall be highlighted in the dedicated section of the HMI document. Necessary input for process related graphics shall be taken from P &ID, I/o point data base etc.

b). SCADA Signals database document

SCADA vendor is required to incorporate the complete requirements of signals for SCADA system taking the inputs from the Respective plant PLCs, Local Control Panels/ TIC Panels, field instruments, other panels etc. The information like engineering units, ranges, alarm limits, set points, and digital contact configuration shall be taken care of by SCADA vendor during detailed engineering.

All the calculated, server resident points and system status related points are also to be included in this document.

c). SCADA Master Control Room Layouts

This Document cover control room layouts for MMS, BMS, EMS, History Server, Web Server, OPC server, GPS Server, MMS, BMS locations, SCADA EWS, RTU (SCADA vendor shall be responsible for making the complete control room layout. Bidder shall note that at MMS locations, Panels and the workstations shall be in one room designated Control Room (CR). SCADA vendor shall appropriately design the layout for SCADA equipment.)

d). DRAWINGS:

Engineering drawings / documents –

i) This document shall be submitted covering the LAN interconnection diagrams, arrangement of SCADA equipments in racks and their interconnections at MMS/ BMS/EMS, interconnections of SCADA equipments, wiring details related to power distribution.

ii) This document shall cover arrangement mounting arrangement of RTU, cable schedule, Termination & Wiring diagrams, grounding schemes/ diagrams at new RTU locations.

Construction drawings / documents:-

Documents such as Mounting arrangement of each cabinet, cable schedule, termination & wiring diagrams, grounding schemes / diagrams has to be submitted by the vendor.

e). Power Consumption and Utilisations Report (PUCR)

SCADA vendor shall furnish power consumption details with detailed break-up for each subsystem/equipments including inrush current and its duration during detailed engineering.

f). Factory Acceptance Test (FAT) Plans and Procedure Documents:

FAT document for SCADA systems shall contain test sections to test all the aspects of SCADA System as covered in Tender, FDS and HMI documents.

g). Site Acceptance Test (SAT) Plans and Procedure Documents

SAT document for SCADA systems shall contain test sections to test all the aspects of integrated SCADA System. Test run & procedure documents has to be submitted.

Separate SAT shall be conducted for SCADA system and RTU system as per the installation and commissioning time period defined for SCADA system and RTU system..

SAT of each RTU may be conducted independently as per the direction of EIC.

All changes in the SCADA database, graphics, reports, logic changes during site commissioning phase as required by the client EIC shall be treated as part of the scope of SCADA vendor. SCADA vendor shall carry out all changes as required as per the direction of EIC. Also, if any change in SCADA database, graphics, reports, logic changes is required during SAT of RTU (after the SAT of SCADA),it shall also be treated as part of the scope of SCADA vendor and SCADA vendor shall carry out all changes as required as per the direction of EIC.

h). SCADA Documentation

SCADA documentation covering engineering manuals, user manuals, installation, operation & maintenance manuals for all the supplied software, hardware and equipments, C/C++ Complier manuals, API manual, Oracle interface manual as applicable.

i). OTHER DOCUMENTATION

Bill of Material, Quality assurance plan, Billing procedure, Installation & Test procedure, Site execution plan.

One Hardcopy and Four softcopies at MMS and BMS locations shall be submitted for the following documents:

FDS , Point Database, HMI , Engineering Manual , SCADA System User's Manual , Engineering Drawings and Cable connections, FAT , SAT, Billing Procedure etc.

j) Configuration Manuals

Documentation shall be provided which describes fully all of the following:

• The method of configuring both hardware and software;
• The method of installing SCADA OS and SCADA Software;
• The method of modifying existing configuration;
• The method of testing and tuning a configured system;
• The method of creating and modifying operator interface displays including graphics, trend displays, reports and data logs;
• The method of taking SCADA system backup and restoration.
• The method for creating, modifying and scheduling of applications programs, including full details on the editor, compiler program and linker.
• The 'as commissioned' configuration for each equipment item including communication and SCADA system equipment.
• The method of adding a RTU in the system.

Documentation shall also be provided which includes a detailed description of all of the function blocks included in the system. Such documentation shall include a comprehensive technical description of the theory of operation of each function block including equations and diagrams together with all other necessary information to give a complete understanding of the functional facilities. The descriptions shall integrate both the hardware and software component parts of the respective functions.

k) Manuals

At least 30 days prior to the FAT, the proposed Operating and Maintenance Manuals and Final Drawings shall be submitted for review by the Owner.

l) As-Built Manuals

The operating and maintenance manuals and drawings shall be updated with changes made to the equipment, configuration, and parameters or operating procedures during the installation and commissioning. As-Built Operating and Maintenance Manuals shall be supplied prior to taking the Final Acceptance of the System.

Station wise As-Built documentation shall be provided by the Vendor within one month of completion of test run, covering the following as a minimum:

- Bill of Material along with serial nos
- Equipment rack layout
- Rack layout in the room
- Cabling and interfacing details
- Equipment configuration details
- Final SCADA database, graphics, reports
- Copy of SAT report
- Bandwidth / data traffic for various telecom links among MMS, BMS, locations and RWS locations.

9.17 SCADA software and hardware manuals

Engineering manuals, user manuals, installation, operation & maintenance manuals for all the supplied software, hardware and equipments.

9.18 System Backup & Restoration manual

Vendor shall provide in detail the procedure for taking backup & for restoration of various systems / sub-systems at all locations.

The hardcopies and softcopies of various final documents shall be supplied as per following:

- One hardcopies and Four softcopies (on media) of all documents at MMS and BMS

- SCADA Vendor shall take care of project specific customization for SCADA system for meeting the project specific functionalities.

a. The review of documents by Client however does not absolve the SCADA vendor of his responsibilities to satisfy the requirements of contract document and install & commission the SCADA system accordingly. SCADA vendor is required to make necessary rectification in the SCADA system to meet the requirements of the contract document at any stage of system implementation, without any implication of cost and schedule to the Client.

b. It is SCADA vendor's responsibility to incorporate all the comments of the Client in one revision itself. SCADA vendor shall be responsible for incorporation of comments (comments not

incorporated in the revised document without prior bringing to the notice of the Client for acceptance) in the SCADA system at any stage of the system implementation, without any implication of cost and schedule to the Client.

c. SCADA Vendor shall take care of the complete requirements of designing, generation and implementation of SCADA displays for monitoring & control, SCADA reports, SCADA alarms/ events, SCADA trending taking care of the requirements outlined in this specification for SCADA implementation.

d. SCADA vendor shall furnish the point wise response to Client's comments indicating the document section/clause/page no. reference where the same has been included in the revised document. The body of the document and corresponding pages will show the revision bars only at the places where the revision has been carried out. Client is required to check the revised document w.r.t. these changes only, while considering that rest of the document has remained unchanged.

9.19 TRAINING

- Vendor shall provide training to technical, operator & maintenance personnel of the company in India before final acceptance of the system. Company will bear the expenditure pertaining to air ticket, daily allowance, hotel expenditure and local conveyance for company's personnel for attending the training.

- Training **FOR THE OFFERED SYSTEM SHALL BE OFFERED AS UNDER:**

a) **Training at principal's works:** This course shall be mainly devoted to SCADA, RTU hardware & software including real time executive, hardware maintenance, ladder logic, block programming, network architecture, codes of compliance, diagnostics of each system and sub -system. This training course shall also include instructions on structures and operation commands of real time executives, use of system utility programmes to create, compile or assemble source programmes and to load into the system for execution. The training course shall cover adding RTU, generation and modification of HMIs & point data base, integration of new devices with the system etc. The duration of this course shall be 5 days for 2 batches of 10 persons per batch at principal's works .

b) **Training at Owners Site:** A separate training programme in shall be conducted for IGGL operating personnel on SCADA functionality, features, alarm management and alarm handling, significance of alarms (various parameters required), navigation between different screens, etc. The training shall be for operating personnel and shall be conducted at Owner's site. The training shall not affect the operating system. Any hardware / software required for the training purpose shall be made available by the Contractor. '

This course shall be conducted at owner's site and include familiarisation of complete system in respect to actual operation of equipment under normal and abnormal operating conditions such as failure of certain modes of operation (degraded mode), tripping of power supplies, malfunctioning of any system or sub-system etc. The content of course is to be framed in such a way that operators are fully aware of

capabilities and facilities of offered system. The duration of above programme shall be minimum 5 days for 2 batches of 15 persons per batch.

- For above training modules, the Contractor shall provide all required training materials, faculty, shop floor exposure etc. at his cost including cost of boarding & lodging & travelling of the Owner's persons deputed to the training.

- For training purpose:

a) Contractor shall provide comprehensive documentation, course material, manuals, CD ROMs, literature etc., as required for proper training of personnel at his own cost. After the completion of course, all such materials shall become the property of the owner. Contractor shall update the course material/ manuals in case there are any changes owing to revisions/ modifications in equipment/ system specifications.

b) Contractor shall also prescribe minimum basic technical qualifications of personnel to be trained. Contractor shall send complete training programme including details of such course, duration, subject matter, a short resume of the subject etc., 45 (forty five) days prior to the start of the training. The owner reserves the right to suggest any additions/ deletions in the programme, which shall be incorporated by the contractor at no additional cost

- It is the responsibility of the vendor to deploy competent and technically verse personnel to impart training to client's personnel. The vendor's person shall be able to provide complete training on the SCADA system to client's personnel and shall be able to resolve the queries of the client's personnel. .

- The course shall be designed to train the trainees in all aspects of System engineering, equipment operation and functional details, theory of operation of equipments, troubleshooting and familiarization with the equipments at card level, the operation of equipments and system including testing of equipments/sub-assembly, preventive breakdown, trouble shooting and normal maintenance activities. All equipment used for training shall be identical to those supplied for site installation.

- If the vendor's deployed person are not competent or the components used during training are different than the one supplied in the project during the training period, the client reserves the right to cancel the training and reschedule the complete training period with the competent vendor's representatives.

- Vendor shall provide comprehensive documentation, course material, manuals, literature etc. as required for proper training of personnel at his own cost. Consolidated and comprehensive documentation shall be available to each participant. After the completion of course, all such materials shall become the property of the OWNER. Vendor shall update the course material & manuals in case there are any changes owing to revision/modifications in equipment/system specifications.

- The training shall be completed before the final acceptance of the SCADA system by the CLIENT.

SCADA Engineer's / System manager's Training

The depth of the training required shall be adequate enough to enable Client to (but not limited to):

a) Operate & maintain the system
b) Add new Zonal servers
d) Add new RTUs and change media of communication between Server and RTU/IED
e) Addition of new low speed channels and LAN for RTU polling.
f) Generation and modification of HMIs (graphics && reports) and Point database
g) Integration of new IEDs like PLCs , flow computers with the system
h) System internals
i) Integration with 3rd party software using OPC.
j) Back ups and other jobs related to SCADA system house keeping
k) Loading of system software on new machine.
l) Operation, management and configuration of SCADA system.
m) Loading of system software on SCADA system.
n) Back-up and restore of SCADA system.
o) Complete operational and functional detail of SCADA.

The training will be conducted by engineer of SCADA software licensor.

Operator/SCADA end user's Training

Vendor shall train COMPANY"s pipeline operation and maintenance engineers for SCADA system after test run at locations (as decided by client). The training topic should cover the overall operation of the SCADA system for Pipeline operation and control.

Company will bear the expenditure pertaining to air ticket, daily allowance, hotel accommodation and local conveyance for Company"s personnel for attending the training.

I. General

The Bidder shall provide a comprehensive training program for the Owner's engineering, maintenance and operations staff. The Bidder shall provide for approval, a training program that shall provide the required standard of operational expertise needed to operate and maintain the installation.

The training shall be specific to the SCADA system installation, not general in nature and includes:

• The provision of site lectures
• Comprehensive explanatory and guidance notes
• Visual and audio aids
• Practical hands on training

The material used to provide the training (slides, notes, etc) shall remain the property of the Owner following completion of the training courses.

The personnel offered by the Bidder shall be suitably experienced and qualified and be sufficient in number to ensure that the Owner's staff are effectively and comprehensively trained.

II. Programming and Configuration

System programming and configuration training shall be provided to engineers.

Training shall be provided at the Bidder's premises prior to dispatch of equipment to site, and shall include:

- System software installation, version upgrade and configuration
- Logic configuration
- Database design
- Graphics and display configuration
- Reporting
- Applications programming
- Trouble shooting and Maintenance

III. SCADA Training

Owner personnel shall be trained in each aspects of the system required for day-to-day and emergency operations.

Training courses shall be given for

- Operators,
- Application and system programmers,
- Hardware Engineers.

IV. ENGINEERS/SYSTEM MANAGER TRAINING

SCADA vendor shall train Client's engineers for SCADA system. The depth of the training required shall be adequate enough to enable the Client to (but not limited to):

a) Operate & maintain the system

b) Add new RTUs and change media of communication between MMS/BMS / EMS and RTU

c) Generation and modification of HMIs (graphics && reports) and Point database

d) Integration of new IEDs with the system

e) System internals

f) Integration with 3rd party software using OPC / APIs

g) Back ups and other jobs related to SCADA system house keeping

h) Loading of system software on new machine.

i) Interfacing with GMS Software & Application software.

j) Configuration of RTU.

V. OPERATOR/SCADA SYSTEM USER'S TRAINING

SCADA vendor shall train client's pipeline operation and maintenance engineers on operation of the system and for company's SCADA engineers on internals and maintenance of the supplied system as define in MR.

SCADA vendor to note that all programming languages, commands, display languages etc. for the entire SCADA system shall be in ENGLISH language only.

Latest anti-virus software shall be provided by the SCADA vendor for all the Servers and HMI workstations and it shall be updated by the SCADA vendor (as and when required) during warranty periods.

9.20 TRIAL RUN:

i. Upon successful completion of the SAT, vendor shall keep the all the supplied equipment & facilities commissioned for 30 days for 'TRIAL RUN' to monitor them for 30 days.

ii. The trial run of each system (SCADA and APPS System at Centralized location, each type of RTU) shall be carried out independent from each other. In case of errors/ faildown is observed in any one the system, it shall not effect the trial run of other system.

iii. During this period, vendor shall provide all specialist Engineers & Technicians including experts at all locations, so as to maintain the total log, incidents, failures & for assisting site engineer & for total co-ordination. However, the normal operation and maintenance of the system shall be performed by the personnel of the Owner trained for the purpose.

iv. If during 'Trial run' any defect is noted in the any of the system, the vendor shall rectify, replace the same to the satisfaction of IGGL. The decision to repeat the final test or restart the 'Trial' shall be of IGGL depending upon the severity of the defect.

v. During trial run, if any fault occurs to any equipment of any system, vendor shall identify and rectify the same and provide report, history of all faults to the Owner.

vi. Ideally, during the Trial run, no shutdown of the system due to failure of equipment should happen. A record of all failures shall be kept for each manned/unmanned station and the availability of the system shall be calculated and accordingly, results shall be submitted by the vendor to IGGL.

vii. If the system fails to come up to the guaranteed performance, the Vendor, within a period of thirty (30) days shall take any and all corrective measures and resubmit the system for another 'Trial Run'. All modifications, changes, corrective measures, labour etc. shall be at the cost of the Vendor. In case the date of completion for the second trial run exceeds the time schedule for the project, he shall be liable to pay liquidated damages. If the system fails to reach the guaranteed performance even after the second

trial run, the Owner shall be free to take any action as he deems fit against the Vendor and to bring the system to the guaranteed performance with the help of third party at the expense of the vendor.

9.21 WARRANTY / EXTENDED WARRANTY:

i. Contractor's engineers and technicians, capable of trouble shooting and looking after health of system during the warranty period, shall be made available all through the period.

ii. The warranty shall cover the complete system supplied by the contractor.

iii. The Main warranty of the complete SCADA & APPS system(for both Part A and Part B) of the complete supplied system including all SCADA system, APPS system, RTUs, RWS (all supplied system including mandatory spares), test instruments, PDT etc. will be 24 months from the date of completion as defined in completion schedule

iv. In case any works not completed till 24 months from FOA (due to delay not attributed to bidder); Extended warranty will start for all the supplied / commissioned system so that the main warranty is intact for 24 months from the date of completion as defined in completion schedule. In case of delay from bidder side; extended warranty will start only after adjusting the delay part of bidder. All materials will be considered in custody of bidder with applicable conditions of warranty till handing over of the system to Client.

v. Bidder has to quote Extended Warranty **per month** (along with OEM). All materials will be considered in custody of contractor with applicable conditions of warranty till handing over of the system to Client.

vi. The Extended warranty shall be applicable for the complete scope of supply including mandatory spares and Test equipments. The extended warranty per month rate will be used to allow the contractor to provide and intact the main warranty for the delayed commissioning & handing over of system not attributed to contractor, so that the Main warranty (i.e. 24 months) is made available on successful completion of trial run/ acceptance of system by owner / handing over of system. After the completion of trial run/ acceptance of system by owner / handing over of the complete system to the Client, Main warranty of the System (for 24 months) shall start.

vii. In case of delayed supply attributable to bidder extended warranty will start after adding delayed period of last supply to completion schedule for which cost of warranty/extended warranty is to be borne by bidder.

viii. Start of extended warranty per month is to be intimated by the bidder and will be confirmed by the client / PMC. The Extended warranty rates shall be for the complete scope of supply including mandatory spares and Test equipment.

ix. During the Warranty / Extended Warranty, the vendor shall use his own instrument, spares, man-hour, communication facilities, hardware, software, materials, etc. for the rectification of any problem.

x. Additionally the following shall also apply:

a) During the warranty, the vendor shall use his own instrument, spares, man-hour, communication facilities, hardware, software, materials, etc. for the rectification of any problem.

b) The "turnaround time" for the rectification of the problem shall be minimum. The owner envisages that the system, due to built in redundancies, shall always be operational. The owner shall be within his powers to impose penalty for complete break in communications system for more than the designed specifications. The same shall be discussed on award of work.
(Turnaround time: From the time of placement of first service call to vendor's representative until the system is restored fully to the satisfaction of the Owner.)

c) The vendor shall provide trained engineers and technicians on site during warranty maintenance.

d) The vendor shall ensure the upgradation of SCADA software as per the upgrade released by the SCADA OEM, APPS Software as per the upgrade released by the APPS OEM during the Warranty Period

e) The bidder shall be responsible for proper design, quality, workmanship & maintenance of all equipment, accessories etc. supplied by the bidder including all services, spares and consumables for warranty period, for meeting the functionality and performance requirements of this contract. To fulfil the same, it shall be obligatory on the part of bidder to modify/upgrade, rectify any hardware problems in the system or replace any hardware from the supplied equipments and modify/upgrade, rectify the operating system software, Equipment software, other software, supply the required spares and consumables and attend to the troubleshooting & maintenance of the complete system, free of cost, during start up and on-line operation & maintenance of the system, within the Warranty period. Any modifications/ up gradation or replacement of any hardware & software during warranty shall not affect the performance & functionality of the system. In addition to this bidder will also have to carry out the updation/ change in setting based upon the input received from client or through their own analysis tools. To do corrections/ modifications/ diagnosis from remote, internet connection can be provided by client, if required. The repair work should not however exceed 7 days otherwise warranty period shall be suitably extended.

f) As a part of AMC APPS vendor (OEM person) shall make quarterly preventive visits and min 2 breakdown/call visits in a year.

g) During the quarterly visits the APPS vendor shall check data validation and do fine-tuning of the system in coordination with Client personnel.

h) APPS vendor shall also assist client personnel during mandatory annual testing of leak detection by simulating a leak in mainline and / or station/Valve location. Any fine tuning required during this testing shall be carried out by the APPS vendor. These activities shall be done during planned quarterly visits or as a separate under breakdown/ call visit

i) During the Warranty period, the bidder is required to position one no. resident engineer each at the MMS, BMS-1 and BMS-2 locations for the entire duration of the warranty period. The cost of the resident engineer shall be covered in the quoted price of available SOR items. Resident engineer shall take care of all activities related to maintenance of system supplied by the contractor like SCADA,APPS, RTUs etc. The Contractors' resident engineer will check and service each equipment and its accessories and maintain them in good working condition. Suitable replacement of the posted resident engineer shall be arranged by the bidder in case the posted engineer takes leave. The replacement shall arrive at the location of the posted engineer prior to the leave period of the posted engineer. In case of absence of Resident engineer or non-posting of resident engineer by the bidder, a penalty shall be imposed by IGGL on the bidder. The penalty amount shall be equal to INR 15000 per day of absence of the engineer, applicable for the entire duration of warranty period . The penalty amount shall be deducted from the CPBG submitted

by the bidder. The resident engineer deputed by the bidder shall have atleast 3 years of experience of operation and management of bidder supplied SCADA and APPS system.

j) In addition to the above, bidder shall carry out preventive maintenance, breakdown maintenance and network monitoring of the complete supplied system at all stations. The brief description of works to be carried out for preventive maintenance, breakdown maintenance and network monitoring of the complete system has been mentioned here but the same is tentative and not exhaustive. Any other works, as required, shall be carried out without any cost implication to IGGL/ MECON.

i. Preventive Maintenance:

On half yearly basis, bidder shall submit the preventive maintenance plan. Preventive maintenance shall involve complete checking of SCADA and APPS system including RTUs, inspection of hardware and software, fault prediction, inspection of power supply quality, environmental operating condition checks, major repairs/ replacements, replacement of cards and accessories because of expected ageing failure and detailed reporting, manual cleaning of each card and cabinet filters. Cleaning of Panel is essential requirement of the contract. In addition, following activities are required to be done during preventive maintenance visit at all terminals:

1. Cleaning of all Racks / Systems / sub-system.
2. To ensure working of RTU channels.
3. Taking backup of all systems installed at respective site.
4. To resolve the fault (If any).
5. To ensure routing of all cables are up to date.
6. To update RTU rack chassis layout details (Card details / Slot no. details etc.)
7. Maintenance / checking of other applications.
8. To ensure working of all Ethernet port of each switch and router
9. To ensure working of firewall
10. To ensure working of GPS Clock
11. For updating each installed software and anti-virus as per the latest version/ patch release
12. Checking & cleaning of centralized servers and storage with storage configuration
13. Operational checking of SCADA and RWS system with user authentication
14. Checking & cleaning of edge devices
15. Operational checking of edge device as per configuration
16. Local storage & automatic restoration checking
17. Taking of logs from edge devices
18. Checking auto-backup and synchronization between servers
19. Checking the functionality of AI/ ML system and data updating in AI/ ML system
20. Preparation & submission of preventive maintenance reports as per Formats / availability reports of all equipment

Note:

1. Above indicated list of activities are tentative in nature. Activities shall be carried out as per OEM standard operation & maintenance procedure for each type of equipments installed under SCADA and APPS system package.
2. Detailed procedures for maintenance shall be provided by bidder on successful commissioning of entire SCADA and APPS system.

ii. Breakdown Maintenance:

In the event of any malfunction of the any equipment of SCADA and APPS System (Hardware/software) or data / voice unavailability or any application fault, engineer to carry out preliminary troubleshooting /

diagnosis using server/ other methods. If fault cannot be resolved remotely, Resident Engineer must visit the site within 12 hours of report of failure, with necessary spares. The engineer has to carry out the maintenance of faulty system/ sub-system & it must be brought back online within 24 hours after reporting at site. Any spares if issued from IGGL must be topped up in 15 days. Necessary Breakdown / RCA reports to be generated as per IGGL requirements.

iii. Network Monitoring:

1. Bidder to maintain the existing operating & application software to improve upon performance of the system. Monitoring of total network health including all manageable equipment.

2. Checking of any Major / Minor / Critical alarms. If any Alarm / Fault related to any failure of card / links / equipment, RE will do the necessary fault rectification and will carry out Analysis / Troubleshooting & will decide the future course of action required.

3. Software modification and up gradation, as & when required, shall also be covered under this scope at no extra cost. Any link / cross connection / tunnel creation for any application as per GSPL requirements shall be done by RE.

k) After the successful completion of Trial run & successful performance testing, the PRE WARRANTY COMPLETION CERTIFICATE shall be issued by the COMPANY and there after Warranty phase will start.

l) As soon as the Warranty phase has been successfully completed and the bidder fulfils his obligation, he shall be eligible to apply for COMPLETION CERTIFICATE. The COMPANY shall issue to bidder the COMPLETION CERTIFICATE after receiving an application from bidder after verifying that works have been completed in accordance with the Contract Document.

m) The BIDDER shall warrant that the software are in good working order, is free of viruses, operates and performs properly on the hardware and network infrastructure. During the warranty period the BIDDER shall provide the following support for the software at no extra cost to the company.

- Technical assistance or consultation in order to assist the Company in solving problems encountered in the course of using the software.
- Timely correction of errors/defects in the software and system documentation.
- Provision of new releases of the software and/or documentation which incorporate solutions to all errors and/ or defects encountered in the use of the software or improvements to the software introduced by the BIDDER.
- Any additional support normally provided by the BIDDER to his customers during a warranty period.

n) In case of failure of any equipment, replacement has to be sent immediately within 15 days. It is adviced that Vendor should keep sufficient spare for warranty support in its stores (designated store to be informed during detailed engineering). Bidder shall ensure that the resident engineer deputed by the bidder is competent enough to rectify the faults observed in SCADA and APPS system. However, is a separate service engineer is required to cater to any fault, competent service engineer of bidder shall reach site within 15 days of generation of fault. The resident engineer shall attend to the fault immediately once the

fault is generated and shall notify the IGGL officials incase the fault cannot be resolved by resident engineer and services of separate engineer of bidder is required.

o) Penalty Clause –

- Bidder to note that incase bidder fails to replace the faulty card/equipment within the time limit, after taking over of the faulty part from client, then a penalty of Rs 10000/- per day shall be levied for the days of delay from the expiry of time limit in receipt of replacement item at designated site or as defined in contract.
- Bidder to note that in case bidder delays to deploy service engineer at site within the time limit , then a penalty of Rs 10000/- per day shall be levied for the days of delay from the expiry of time limit. The penalty shall be deducted from the CPBG of the bidder.
- The penalty amount shall be equal to INR 15000 per day of absence of the resident engineer
- In case of failure of carrying out preventive maintenance or Breakdown maintenance or network monitoring activity, penalty equal to the amount of INR 500000 shall be levied for each failure.

If the replacement is not send within specified time then penalty at the rate as define above or as define in contract has to be imposed. In case bidder still not responds then same may be deducted from the CPBG as per the terms and condition of the contract. Also vendor to provide firmware upgrades and configurator software upgrade free of cost to IGGL within warranty/extended warranty period.

System Warranty including all services and spares for operation and maintenance of the system.

Any software modification including changing in logic, graphics, reports etc. as required as per the site in-charge, to incorporate additional facilities including addition of new RTUs (supplied by same party or other contractor), addition of new DRS, addition of New MRS, addition of any other new facility which has to be integrated with SCADA, mapping of new signals in SCADA, APPS, changes in assignment, etc. , should be carried out by the Vendor without any extra cost to IGGL/ MECON during the Warranty Period & PWMC period.

9.22 POST WARRANTY MAINTENANCE CONTRACT(PWMC) – Comprehensive for 5 years (Comprehensive Annual Maintenance Contract (CAMC))

a) The Vendor shall quote for providing post warranty maintenance for 5 years (comprehensive for all supplied equipments) after completion of warranty /extended warranty period and provide technical support for the maintenance of the SCADA and APPS system and associated system / subsystem including any repair / replacement of faulty cards/ equipments.

b) Bidder to note that for evaluation purpose of price bid, the higher of following shall be considered

- THE ACTUAL QUOTED AMC CHARGES EACH YEAR

OR

- 2% (for 1st year), 2.25% (for 2nd year), 2.5% (for 3rd year), 2.75% (for 4th year) & 3% (for 5th year) of the total price quoted (including supplies, services and composite items excluding GST). In case, if bidders quote for the year-wise AMC charges are lower than the minimum percentages specified above, the total shortfall in quoted AMC charges with respect to percentages specified for 1st to 5th year, AMC charges shall be compensated from the total amount of supply, services and composite items proportionately. Thus the value of year wise AMC charges shall be increased to minimum percentages specified and value of all supply, service and composite items shall be decreased proportionately during evaluation and award of work, so that gross quoted price including GST of the bidder remains the same.'

c) The proposal shall include travel, boarding & lodging of service engineer as and when required n case of site visit.

d) The system is to be maintained for a period of 5 (Five) years after expiry of defect liability period. Cost of all spares, equipment, instruments & services, (Preventive & Breakdown) to take care of maintenance, has to be borne by the Contractor during the AMC period. Contractor shall ensure minimum 95% uptime for all equipment covered under Annual Maintenance Contract individually and 99.9% uptime for all redundant items. The clock shall start upon notification from IGGL. In case of uptime less than 95% a deduction of Rs 1000/- per equipment, per day shall be made from the Contractor's bill.

e) Comprehensive Annual Maintenance Contract shall cover all items supplied by the contractor under this contract.

f) 4 Nos. normal visits (once per quarter) per annum for preventive maintenance of all the items under scope of AMC at each station and emergency visits for breakdown maintenance as & when required are included in scope of A.M.C. (Annual Maintenance Contract). If there is a requirement of OEM's Engineer for carrying out specific job during AMC/Defect liability period, then the same shall be arranged by contractor at no extra cost to IGGL. Owner will have the right to reschedule the visits and adjust the total no. of regular visits. In case of non-adherence to preventive maintenance schedule, in addition to non-payment of AMC charges for that quarter a penalty of 10% of total AMC charges for the year will be recovered.

g) The Contractor is also required to position resident engineer at MMS location during the entire CAMC period of 5 years. The cost of the resident engineer shall be included in the quoted price of CAMC for each year. The resident engineer deputed by the bidder shall have atleast 3 years of experience of operation and management of bidder supplied SCADA and APPS system. Resident engineer shall take care of all activities related to maintenance of system supplied by the contractor like SCADA, APPS, RTUs etc. The Contractors' resident engineer will check and service each equipment and its accessories and maintain them in good working condition. Any consumables required for servicing the equipment shall be arranged by the IGGL at no extra cost to Contractor under the AMC.

h) Suitable replacement of the posted resident engineer shall be arranged by the bidder in case the posted engineer takes leave. The replacement shall arrive at the location of the posted engineer prior to the leave period of the posted engineer. In case of absence of Resident engineer or non-posting of resident engineer by the bidder, a penalty shall be imposed by IGGL on the bidder. The penalty amount shall be equal to INR 15000 per day of absence of the engineer, applicable for the entire duration of PWMC.

i) Owner can terminate the annual maintenance contract by giving three months' notice in advance to the Contractor.

j) In the event of any malfunction of the system hardware/ system software, failure of any equipment, vendor will provide technical guidance to IGGL to resolve the issue with available spares. In case the problem is not resolved through remote technical guidance then the vendor should sent experienced service engineer to site within 3 working days (IGGL working days) to the respective site on the receipt of such information from owner and rectify the issue. In case of delay in reporting, 0.25% of quarterly cost of AMC for delay in each working day(IGGL working days) up to a maximum period of one month days shall be deducted as a penalty from the CAMC payment.

k) Owner personnel will work on system day to day basis and wherever possible, owner shall inform the type of failure of hardware/ software to vendor based on diagnostic available with the system. However Vendor shall be fully responsible to attend and rectify the root cause and the failure at the shortest possible time.

l) Vendor shall furnish Bank Guarantee equivalent to the rates quoted for 5 year comprehensive Annual Maintenance Contract. This Bank Guarantee shall be submitted 2 months before the expiry of warranty period

failing which retention money shall stand forfeited. BG for CAMC shall be valid for minimum 62 months or till the end of 5th year AMC whichever is later.

m) Vendor may utilize the spare modules available with owner if necessary and available with owner at site, which is part of mandatory spares supplied with system as per this contract. However the faulty card/equipment needs to be repaired / replaced by the Vendor within a reasonable time (not exceeding 2 months) to maintain bare minimum spares required for the system operation.

n) The vendor shall ensure availability of spares for the SCADA and APPS System for a minimum period of 7 years after warranty period. In the event of non-availability of spares due to fast obsolescence of hardware and software, the vendor shall arrange to upgrade/ replace the equipment's with equivalent or higher hardware and software at no additional cost till end of CAMC period

o) The Vendor must note that all commissioning spares and the spares / consumables during warranty and comprehensive CAMC shall be supplied by the vendor free of cost.

p) Any software modification including changing in logic, graphics, reports etc. as required as per the site in-charge, to incorporate additional facilities including addition of new RTUs (supplied by same party or other contractor), addition of new nodes, addition of new IEDs, addition of any other new facility which has to be integrated with SCADA, mapping of new signals in SCADA, APPS, changes in assignment, etc. , should be carried out by the Vendor without any extra cost to IGGL/ MECON during the Warranty Period & Post Warranty Maintenance Contract period. The activity shall be carried out any number of times as required by IGGL.

q) The vendor shall ensure the upgradation of SCADA software as per the upgrade released by the SCADA OEM, APPS Software as per the upgrade released by the APPS OEM during the Warranty Period & Post Warranty Maintenance Contract period without any extra cost to IGGL/ MECON. If for upgradation of SCADA software and APPS software, upgradadtion of hardware is required by SCADA OEM, then bidder shall upgrade the hardware as per the requirement without any extra cost to IGGL/ MECON during the Warranty Period & Post Warranty Maintenance Contract period.

r) As a part of AMC APPS vendor (OEM person) shall make quarterly preventive visits and min 2 breakdown/call visits in a year.

s) During the quarterly visits the APPS vendor shall check data validation and do fine-tuning of the system in coordination with Client personnel.

t) APPS vendor shall also assist client personnel during mandatory annual testing of leak detection by simulating a leak in mainline and / or station/Valve location. Any fine tuning required during this testing shall be carried out by the APPS vendor. These activities shall be done during planned quarterly visits or as a separate under breakdown/ call visit

u) In addition to the above, bidder shall carry out preventive maintenance, breakdown maintenance and network monitoring of the complete supplied system at all stations. The brief description of works to be carried out for preventive maintenance, breakdown maintenance and network monitoring of the complete system has been mentioned here but the same is tentative and not exhaustive. Any other works, as required, shall be carried out without any cost implication to IGGL/ MECON.

i. Preventive Maintenance:

On half yearly basis, bidder shall submit the preventive maintenance plan. Preventive maintenance shall involve complete checking of SCADA and APPS system including RTUs, inspection of hardware and software, fault prediction, inspection of power supply quality, environmental operating condition checks, major repairs/ replacements, replacement of cards and accessories because of expected ageing failure and detailed reporting, manual cleaning of each card and cabinet filters. Cleaning of Panel is essential requirement of the contract. In addition, following activities are required to be done during preventive maintenance visit at all terminals:

1. Cleaning of all Racks / Systems / sub-system.
2. To ensure working of RTU channels.
3. Taking backup of all systems installed at respective site.

4. To resolve the fault (If any).
5. To ensure routing of all cables are up to date.
6. To update RTU rack chassis layout details (Card details / Slot no. details etc.)
7. Maintenance / checking of other applications.
8. To ensure working of all Ethernet port of each switch and router
9. To ensure working of firewall
10. To ensure working of GPS Clock
11. For updating each installed software and anti-virus as per the latest version/ patch release
12. Checking & cleaning of centralized servers and storage with storage configuration
13. Operational checking of SCADA and RWS system with user authentication
14. Checking & cleaning of edge devices
15. Operational checking of edge device as per configuration
16. Local storage & automatic restoration checking
17. Taking of logs from edge devices
18. Checking auto-backup and synchronization between servers
19. Checking the functionality of AI/ ML system and data updating in AI/ ML system
20. Preparation & submission of preventive maintenance reports as per Formats / availability reports of all equipment

Note:

1. Above indicated list of activities are tentative in nature. Activities shall be carried out as per OEM standard operation & maintenance procedure for each type of equipments installed under SCADA and APPS system package.
2. Detailed procedures for maintenance shall be provided by bidder on successful commissioning of entire SCADA and APPS system.

ii. Breakdown Maintenance:

In the event of any malfunction of the any equipment of SCADA and APPS System (Hardware/software) or data / voice unavailability or any application fault, engineer to carry out preliminary troubleshooting / diagnosis using server/ other methods. If fault cannot be resolved remotely, Resident Engineer must visit the site within 12 hours of report of failure, with necessary spares. The engineer has to carry out the maintenance of faulty system/ sub-system & it must be brought back online within 24 hours after reporting at site. Any spares if issued from IGGL must be topped up in 15 days. Necessary Breakdown / RCA reports to be generated as per IGGL requirements.

iii. Network Monitoring:

1. Bidder to maintain the existing operating & application software to improve upon performance of the system. Monitoring of total network health including all manageable equipment.

2. Checking of any Major / Minor / Critical alarms. If any Alarm / Fault related to any failure of card / links / equipment, RE will do the necessary fault rectification and will carry out Analysis / Troubleshooting & will decide the future course of action required.

v) In case of failure of carrying out preventive maintenance or Breakdown maintenance or network monitoring activity, penalty equal to the amount of INR 500000 shall be levied for each failure.

w) Software modification and up gradation, as & when required, shall also be covered under this scope at no extra cost. Any link / cross connection / tunnel creation for any application as per GSPL requirements shall be done by RE.

x) The service under Post Warranty Maintenance Contract , including repair/replacement of spare parts and services, shall broadly comprise of:

   a. 24 x 7 hr Technical Support for resolving issue /modification / upgradation of the system
   b. Repair/replacement of faulty parts.
   c. Emergency Service

   The bid shall be made lumpsum for 5 years (comprehensive) and the price validity shall be available for the entire period of contract. Payments shall be made quarterly.

y) IGGL may change/upgrade any or multiple modules/equipment as per the business requirement during Warranty / CAMC period. It shall be obligatory on the part of Vendor to provide access to IGGL/ IGGL appointed third Party without diluting the existing Warranty/CAMC and without any cost & time implication. To ensure integrity of existing System and CAMC, modalities of interface of the new equipment/ modules will be mutually decided before implementation. The Software provided shall have ready interface with all the approved makes given in the tender and as such no additional effort is envisaged in replacing any of the equipment/module with the alternate approved make. In such cases, IGGL appointed third Party will have the responsibility of interfacing with the System provided under this tender, however any Site visit required for supervising the interface work will be covered in the preventive maintenance (CAMC period).

z) Vendor shall quote 5 year rate for CAMC . For additional 6th year, CAMC the max amount that Vendor can quote upto 3.25% (for 6th year) of the total price quoted (including supplies, services and composite items excluding GST).
   Quarterly Payments will be made as per the detailed terms & conditions for AMC contracts as mentioned in the Technical Specifications of this tender. Liquidated damages shall be applicable as per the CAMC clause and summarized below

9.23 TECHNICAL SUPPORTS ON WARRANTY / POST WARRANTY

The details of services to be provided under warranty shall include but not limited to the following:

a) **TECHNICAL SUPPORT SERVICE**

Technical Support Services that extends coverage for IGGL after handover of the system. This includes 24 hours x 7 days a week on line support. IGGL shall utilize this service by intimating the Vendor of its unique customer ID in case of any contingency and Vendor in turn provide telephonic support. Depending upon the severity of the issue, engineer shall be sent by Vendor to the site. Vendor shall have service backup facility.

b) **DOCUMENTATION DELIVERY SERVICE**

Under Documentation delivery service Vendor is required to provide engineering practices and Technical Bulletins for updates at free of cost. All the latest software upgrades and updates for complete system are also required to be providing under warranty.

9.24 2 YEARS MANUFACTURER'S RECOMMENDED OPERATION & MAINTENANCE SPARES

Vendor shall attach a list of 2 years operation & maintenance spares along with the unit rates on respective sub vendors letterheads, which would be necessary for next 2 years trouble free operation and maintenance of the system. The Owner shall be free to select the items of spares and the quantity at the time of award of contract or during the execution of the project before completion of warranty/ Extended Warranty. The quantity of spares intended for procurement, is what would be necessary for 02(two) years trouble free maintenance of the system.

The validity of rates shall upto contractual period including PWMC from date of commissioning / acceptance of complete work (i.e. 5 year – 2 warranty and 3 year PWMC)

Spares shall be provided from the same manufacturing facilities/location from where the respective equipment, subsystems are offered. Unit rates for each spares required for operation and maintenance shall be provided.

Vendor shall provide the address, contact person, fax, and telephone number of the manufacturer of the spare parts. The Vendor shall warrant that spare parts for the system would be available for minimum of 10 years after warranty period after system commissioning (taking over). After this period if the Vendor discontinues production of spare parts, then he shall give at least 12 months prior notice to such discontinuation so that Owner may order requirements of spares in one Lot.

9.25 SUBMISSION OF COMPLIANCE REPORT

Vendor shall submit clause by clause compliance to the requirement of specifications with cross reference to the document submitted in the bid. The compliance form has to be submitted. Each of the pages shall be stamped and signed by the authorized representative of the vendor. Any of the clauses neither responded nor appropriately cross referred as per the submitted document shall be treated as Not Complied and liable for rejection.

9.26 CERTIFICATE FOR LOGISTICS SUPPORT

Vendor shall provide backup engineering, maintenance support and spare part supports for a period of ten (10 years) for the RTU being supplied .Logistic support certificates as per format attached with the bid document.

9.27 SITE PREPARATION

This includes all electrical and civil works and site preparation activities as defined for installation and commissioning of the equipments.

9.28 ACCESSORIES / OTHER ASSOCIATED ITEMS

Supply & Installation of necessary equipment, cables trays, cables & accessories to meet the overall system requirements along Pipeline at respective sites, separate earthing & lighting protection of

indoor equipment at respective locations etc. Furniture as required for various systems, sub-systems, equipment etc shall be supplied by the Vendor.

System integration including requisite interfaces and accessories to realize the complete system shall be in bidder's scope.

Any item of goods/services not specifically mentioned, but considered essential for completion of the work in all respects shall be deemed to be included in the scope of work of the successful Vendor. As the work has to be executed as a turnkey responsibility, any erection material required for supply & commissioning has to be provided as per the site requirements.

9.29 QA / QC REQUIREMENTS

The Bidder shall operate a Quality System meeting the requirements of the relevant part of ISO.

Bidder shall provide documents such as plans, procedures, instructions, etc. for the accomplishment of all works covered in this specification to provide the required quality.

Specific adherence to the guidelines set down in ISO series documentation shall be detailed out by the bidder and shall be subject to review and approval by the Company.

Vendor shall submit the quality management system meeting the requirements of ISO 9001 which he proposes to operate while executing the job.

The system documents shall cover Quality Plan for this job, procedures, work instructions, inspection and test plans (ITP) and test results reporting format to provide an approach for achieving the required quality job. The quality system shall be reviewed and approved by the company.

Owner reserves the right to undertake such audit as deemed necessary to assess the effectiveness of the Bidder's quality system.

The vendor shall provide the quality assurance for testing & acceptance of SCADA system as define in tender document and shall include but not limited to the following:

- **Pre-FAT:** Carrying out pre Factory Acceptance Test (pre-FAT) of SCADA system as per the approved FAT procedure and submission to Client/PMC.

- **Factory Acceptance Test (FAT):** On acceptance of pre-FAT report by Client/PMC, vendor shall invite Client/PMC to witness FAT. FAT shall be carried out as per the FAT approved procedure at vendor"s premises in presence of COMPANY or any third party agency appointed by Client/ PMC**.** On successful completion of FAT, dispatch clearance shall be provided to the vendor by Client/PMC.

- **Site Acceptance Test (SAT):** On successful completion of installation and configuration of SCADA equipments and associated systems at site, the SAT shall be conducted as per approved

SAT procedure.

- **Test Run:** After successful completion of SAT, the SCADA system shall be put under Test Run for a minimum period of 30 days following approved procedure.

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		SIGNAL CABLE (MULTI PAIR)	
GENERAL	1	Description	Signal Cable
	2	Type	Twisted, Screened & Armoured
	3	Size (pair)	2 / 4 / 6 / 8 / 10 / 12
	4	Make	As per suggested vendor list
CONDUCTOR	1	Material	Annealed Tinned Electrolytic Copper IS: 8130 '84
	2	Size	1.0 Sq.mm
	3	No. of Strands / Strand size mm	☑ 7
	4	Shape of conductor	Stranded Circular
PRIMARY INSULATION	1	Material	☐ PVC (PVC Type.A - IS:5831'84) ☑ HRPVC (PVC Type.C -IS:5831'84) ☐ FRLS PVC
	2	Type	☑ Extruded ☐ Wrapped
	3	Thickness (nom.) in mm	(Suitable for 1100V as per BS:5308 Part-2)
	4	Colour Scheme	Black & Blue *(Note:2)*
	5	No. of twists (pair)	Min. 10 twists/meter
	6	Insulation Voltage Grade	1100 V
INDIVIDUAL PAIR SHIELD	1	Material	Aluminium Mylar tape – black
	2	Type	Helical
	3	Thickness (nom.) in mm	(Suitable for 1100V as per BS:5308 Part-2)
	4	Overlap	25%.
	5	Coverage	100%.
	6	Drain wire type / Size / No. of strands / Formation	Annealed tinned copper / 0.5 mm² / 7 strands / in contact with the shield
OVERALL SHIELD	1	Material	Aluminium Mylar tape – black
	2	Type	Helical
	3	Thickness (nom.) in mm	(Suitable for 1100V as per BS:5308 Part-2)
	4	Overlap	25%.
	5	Coverage	100%.
	6	Drain wire type / Size / No. of strands / Formation	Annealed tinned copper / 0.5 mm² / 7 strands / in contact with the shield
INNER SHEATH	1	Material	☑ FRLS PVC
	2	Type	☑ Extruded ☐ Wrapped
	3	Thickness (nom.) in mm	(Suitable for 1100V as per BS:5308 Part-2)

	4	Colour Scheme	Black *(Note:2)*
	5	Dia over sheath	*
ARMOUR	1	Material	☑ Single layer Gal. round steel wire ☐ Gal. flat steel strip confirming to IS:3975'79
	2	Size in mm	As per BS:5308 Part-2
	3	Dia over armour	*
OUTER SHEATH	1	Material	☐ PVC (PVC Type.ST1 - IS:5831'84) ☐ HRPVC (PVC Type.ST2 - IS:5831'84) ☑ FRLS PVC
	2	Type	☑ Extruded
	3	Thickness (nom.) in mm	(Suitable for 1100V as per BS:5308 Part-2) Thickness shall vary with no. of pairs as per BS:5308 Part-2
	4	Overall diameter	*
	5	Tolerance on overall diameter	± 2%
	6	Colour Scheme	Light Blue *(Note:2)*
	7	Rip cord	Non-metallic under inner sheath
ELECTRICAL PARAMETERS	1	Conductor Resistance (max)	* at 20 Deg.C
	2	Drain wire resistance with shield	* at 20 Deg.C
	3	Insulation Resistance of cable	* at 20 Deg.C
	4	Mutual capacitance: core-core	* at 1 khz
	5	Mutual capacitance: core-screen	* at 1 khz
	6	Mutual inductance	*
	7	L/R ratio	*
	6	High Voltage Test	*
TEST & INSPECTION	1	General	According to BS:5308 Part-2
	2	Insulation	IS:5831'84 except insulation resistance. Voltage/spark test BS:5308(Part-II)'86
	3	Armour	IS: 3975 '79
	4	Armour galvanisation	IS: 2633
FRLS PROPERTY	1	Oxygen index	Oxygen index of 29 at 27 (± 2) deg C According to ASTM D 2863
	2	Temp. index	According to ASTM D 2863
	3	HCL emission	According to IEC-754-1
	4	Smoke density	According to ASTM D 2843
	5	Flame retardent test	According to IEC-332-Part III cat. A
OTHERS	1	Drum length / No. of drums	*
	2	Total length	*
	3	Meter marking	*

	4	Possible variation in length	±5% for length < 5 km ±2% for length > 5 km

Notes:

1. '*' = Vendor to specify
2. Core identification shall be as per BS:5308 Part-2
3. A durable marking to be provided on the surface of the cable at regular intervals not exceeding 625mm. The marking shall include manufacturer's name, conductor material, size, pairs, insulation material etc. as per BS:5308 Part-2

		CONTROL CABLE (MULTI CORE)	
GENERAL	1	Description	Control Cable
	2	Type	PVC Insulated,Armoured
	3	Size (core)	10 / 12 / 16 / 24 / 36
	4	Make	As per suggested vendor list
CONDUCTOR	1	Material	Annealed Tinned Electrolytic Copper IS: 8130 '84
	2	Size	1.0 Sq.mm
	3	No. of Strands	☑ 7
	4	Shape of conductor	Stranded Circular
PRIMARY INSULATION	1	Material	☐ PVC (PVC Type A - IS:5831'84) ☑HRPVC (PVC Type C -IS:5831'84) ☐ FRLS PVC
	2	Type	☑ Extruded ☐ Wrapped
	3	Thickness (nom.) in mm	(Suitable for 1100V as per BS:5308 Part-2)
	4	Colour Scheme	Black *(Note:2)*
	5	No. of twists (pair)	~ NA ~
	6	Insulation Voltage Grade	1100 V
INDIVIDUAL PAIR SHIELD	1	Material	~ NA ~
	2	Type	~ NA ~
	3	Thickness (nom.) in mm	~ NA ~
	4	Overlap	~ NA ~
	5	Coverage	~ NA ~
	6	Drain wire type / Size / No. of strands / Formation	~ NA ~
OVERALL SHIELD	1	Material	Aluminium Mylar tape – black
	2	Type	Helical
	3	Thickness (nom.) in mm	(Suitable for 1100V as per BS:5308 Part-2)
	4	Overlap	25%.
	5	Coverage	100%.
	6	Drain wire type / Size / No. of strands / Formation	Annealed tinned copper / 0.5 mm² / 7 strands / in contact with the shield
INNER	1	Material	☑ FRLS PVC
	2	Type	☑ Extruded ☐ Wrapped
	3	Thickness (nom.) in mm	(Suitable for 1100V as per BS:5308 Part-2)

	4	Colour Scheme	Black *(Note:2)*
	5	Dia over sheath	*
ARMOUR	1	Material	☑ Single layer Gal. round steel wire (for ≤10C) ☑ Gal. flat steel strip confirming to IS:3975'79
	2	Size in mm	as per BS:5308 Part-2
	3	Dia over armour	*
OUTER SHEATH	1	Material	☑ FRLS PVC
	2	Type	☑ Extruded
	3	Thickness (nom.) in mm	(Suitable for 1100V as per as per BS:5308 Part-2) thickness shall vary with no. of cores, as per BS:5308 Part-2
	4	Overall diameter	*
	5	Tolerance on overall diameter	± 2%
	6	Colour Scheme	Black *(Note:2)*
	7	Rip cord	Non-metallic under inner sheath
ELECTRICAL PARAMETERS	1	Conductor Resistance (max)	* at 20 Deg.C
	2	Drain wire resistance with shield	* at 20 Deg.C
	3	Insulation Resistance of cable	* at 20 Deg.C
	4	Mutual capacitance: core-core	* at 1 khz
	5	Mutual capacitance: core-screen	* at 1 khz
	6	Mutual inductance	*
	7	L/R ratio	*
	6	High Voltage Test	*
TEST & INSPECTION	1	General	According to BS:5308 Part-2
	2	Insulation	IS:5831'84 except insulation resistance. Voltage/spark test BS:5308(Part-II)'86
	3	Armour	IS: 3975 '79
	4	Armour galvanisation	IS: 2633
FRLS PROPERTY	1	Oxygen index	According to ASTM D 2863
	2	Temp. index	According to ASTM D 2863
	3	HCL emission	According to IEC-754-1
	4	Smoke density	According to ASTM D 2843
	5	Flame retardant test	According to IEC-332-Part III cat. A
OTH	1	Drum length / No. of drums	*
	2	Total length	*
	3	Meter marking	*

	4	Possible variation in length	±5% for length < 5 km ±2% for length > 5 km

Notes:

1. '*' = Vendor to specify
2. Core identification shall be as per BS:5308 Part-2
3. A durable marking to be provided on the surface of the cable at regular intervals not exceeding 625mm. The marking shall include manufacturer's name, conductor material, size, pairs, insulation material etc. as per BS:5308 Part-2

		POWER CABLE	
GENERAL	1	Description	Power Cable
	2	Type	Armoured
	3	Size	2C/ 3C
	4	Make	As per suggested vendor list
CONDUCTOR	1	Material	Annealed Bare Electrolytic Copper IS: 8130 '84
	2	Size	4 Sq.mm
	3	No. of Strands / Strand size mm	☑ 7
	4	Shape of conductor	Stranded Circular
PRIMARY INSULATION	1	Material	☑ XLPE
	2	Type	☑ Extruded ☐ Wrapped
	3	Thickness (nom.) in mm	as per BS:5308
	4	Colour Scheme	Black *(Note:2)*
	5	No. of twists (pair)	~ NA ~
	6	Insulation Voltage Grade	110 V
	7	Binder tape	Provided
INDIVIDUAL PAIR SHIELD	1	Material	~ NA ~
	2	Type	~ NA ~
	3	Thickness (nom.) in mm	~ NA ~
	4	Overlap	~ NA ~
	5	Coverage	~ NA ~
	6	Drain wire type / Size / No. of strands / Formation	~ NA ~
OVERALL SHIELD	1	Material	~ NA ~
	2	Type	~ NA ~
	3	Thickness (nom.) in mm	~ NA ~
	4	Overlap	~ NA ~
	5	Coverage	~ NA ~
	6	Drain wire type / Size / No. of strands / Formation	~ NA ~

INNER SHEATH	1	Material	☑ FRLS PVC
	2	Type	☑ Extruded ☐ Wrapped
	3	Thickness (nom.) in mm	Suitable for 1100V as per BS:5308)
	4	Colour Scheme	Black *(Note:2)*
	5	Dia over sheath	*
ARMOUR	1	Material	☑ Single layer Gal. round steel wire ☐ Gal. flat steel strip confirming to IS:3975'79
	2	Size in mm	as per BS:5308
	3	Dia over armour	*
OUTER SHEATH	1	Material	☑ FRLS PVC
	2	Type	☑ Extruded
	3	Thickness (nom.) in mm	(Suitable for 1100V as per as per BS:5308)
	4	Overall diameter	*
	5	Tolerance on overall diameter	± 2%
	6	Colour Scheme	Black *(Note:2)*
	7	Rip cord	Non-metallic under inner sheath
ELECTRICAL PARAMETERS	1	Conductor Resistance (max)	* at 20 Deg.C
	2	Drain wire resistance with shield	* at 20 Deg.C
	3	Insulation Resistance of cable	* at 20 Deg.C
	4	Mutual capacitance: core-core	* at 1 khz
	5	Mutual capacitance: core-screen	* at 1 khz
	6	Mutual inductance	*
	7	L/R ratio	*
	6	High Voltage Test	*
TEST & INSPECTION	1	General	According to as per BS:5308
	2	Insulation	IS:5831'84 except insulation resistance. Voltage/spark test BS:5308(Part-II)'86
	3	Armour	IS: 3975 '79
	4	Armour galvanisation	IS: 2633
FRLS	1	Oxygen index	According to ASTM D 2863
	2	Temp. index	According to ASTM D 2863
	3	HCL emission	According to IEC-754-1
	4	Smoke density	According to ASTM D 2843
	5	Flame retardent test	According to IEC-332-Part III cat. A
HE	1	Drum length / No. of drums	*

	2	Total length	*
	3	Meter marking	*
	4	Possible variation in length	±5% for length < 5 km ±2% for length > 5 km

Notes:

1. '*' = Vendor to specify
2. Core identification shall be as per BS:5308
3. A durable marking to be provided on the surface of the cable at regular intervals not exceeding 625mm. The marking shall include manufacturer's name, conductor material, size, pairs, insulation material etc. as per BS:5308

SCADA Server System SPECIFICATION

S.No	Required Minimum Specifications	Meeting specifications (Yes/ No?)	Remarks/Deviation (If any)
	Rack Optimized SCADA Server		
(a)	Processor		
	• 64-bit Latest Intel xeon x86 processor gold grade scalable processor • Two nos. processor with standard heat sink • Min. 8 core each (total min 16 core) • 24 MB or higher L3 Cache • 2.4 GHz speed		
(b)	Form factor		
	• 1U/ 2U rack-optimized server • Rack-Form factor chassis		
(c)	Memory		
	• 16 GB (2 X8 GB), expandable to 32 GB • Latest DDR4 RAM • 4 DIMM slots • Advanced ECC • Patrol and Demand Scrubbing		
(d)	Hard Disk Drive (HDDs)		
	• Internal disk space with minimum usable 2*1.8 TB in RAID 5+0 to be provided in server for OS, Database Software and application software. • The hard disks must be 2.5-inch SFF SAS or SSD drives with minimum 15K RPM spindle in case of SAS. • Suitable disk management software (if required) including Volume Manager to dynamically manage the logical volumes to be supplied • The drives should be hot swappable.		
(e)	Factory RAID		
	• Support for RAID 0,1, 5 & 6		
(f)	Internal Optical Drive		
	• DVD-ROM Optical Drive		
(g)	RAS Features		
	• Each of the offered servers shall have an inbuilt service processor with system clock. • Redundant, hot swappable power supplies and fans. • Hot-swappable disk.		

(h)	Operating System		
	• As per the OEM requirement		
(i)	Interface and Network Adapter		
	• Minimum Two dual port embedded Broadcom® NetXtreme® II 5709c Gigabit Ethernet NIC or better with failover and load balancing)		
(j)	Ports		
	• Display Port, USB 3.0 (3 Nos.), Audio In/ Out, HDMI • 6 PCIe slots		
(j)	System Management		
	• Remote Management of Server over LAN & WAN with SSL encryption , virtual Media with required license and KVM over IP .On System Management Chipset (through Management Port 3 or latest) • Server management system should be web browser based remote capability. • It should be possible to manage the servers and get information about the health and performance of the server remotely. • Management software should help to update system drivers, systems software/firmware components.		
(k)	Other parameters		
	• The server should be IPv4 and IPv6 Compliant from day one of installation. The system should be TEC / IPv6 Ready logo certified. • The future roadmap of the Servers and CPU needs to be submitted for the next five years from the date of submission of document • Vendor has to ensure from OEM that offered Server shall not be EOSL or EOL in next five year from date of submission of document		
(l)	Support and Services		
	• Upgradation of firmware and patches for OS would be covered in warranty and PWMC period.		

	Rack Optimized History Server, OPC Server, AI/ ML server, Web Server, GPRS Server, APPS server		
(a)	Processor		
	• 64-bit Latest Intel xeon x86 processor gold grade • Min. 8 core • 20 MB or higher L3 Cache • 2.4 GHz speed		
(b)	Form factor		
	• 1U/ 2U rack-optimized server • Rack-Form factor chassis		
(c)	Memory		
	• 16 GB (2 X8 GB), expandable to 32 GB • Latest DDR4 RAM • 4 DIMM slots • Advanced ECC • Patrol and Demand Scrubbing		
(d)	Hard Disk Drive (HDDs)		
	• Internal disk space with minimum usable 2*1.8 TB in RAID 5+0 to be provided in server for OS, Database Software and application software. • The hard disks must be SSD drives • Suitable disk management software (if required) including Volume Manager to dynamically manage the logical volumes to be supplied • The drives should be hot swappable.		
(e)	Factory RAID		
	• Support for RAID 0,1, 5 & 6		
(f)	Internal Optical Drive		
	• DVD-ROM Optical Drive		
(g)	RAS Features		
	• Each of the offered servers shall have an inbuilt service processor with system clock. • Redundant, hot swappable power supplies and fans. • Hot-swappable disk.		
(h)	Operating System		
	• As per the OEM requirement		

(i)	Interface and Network Adapter		
	• Minimum Two dual port embedded Broadcom® NetXtreme® II 5709c Gigabit Ethernet NIC or better with failover and load balancing)		
(j)	Ports		
	• Display Port, USB 3.0 (3 Nos.), Audio In/ Out, HDMI • 6 PCIe slots		
(j)	System Management		
	• Remote Management of Server over LAN & WAN with SSL encryption , virtual Media with required license and KVM over IP .On System Management Chipset (through Management Port 3 or latest) • Server management system should be web browser based remote capability. • It should be possible to manage the servers and get information about the health and performance of the server remotely. • Management software should help to update system drivers, systems software/firmware components.		
(k)	Other parameters		
	• The server should be IPv4 and IPv6 Compliant from day one of installation. The system should be TEC / IPv6 Ready logo certified. • The future roadmap of the Servers and CPU needs to be submitted for the next five years from the date of submission of document • Vendor has to ensure from OEM that offered Server shall not be EOSL or EOL in next five year from date of submission of document		
(l)	Support and Services		
	• Upgradation of firmware and patches for OS would be covered in warranty and PWMC period.		

	Tape Library		
(a)	Capacity		
	• To start with, number of tape drives will be		

	offered to backup 20 TB of data. The online / offline backup will be taken for all these applications (parallel) within 4 hours window. • Tape Library must be offered with Minimum 6 LTO-9 or latest FC tape drives. • Tape Library must be offered with Minimum 80 cartridge slots. • While sizing the drives on their native speed, the vendor must consider maximum 50% efficiency to calculate sustained throughput after allowing tape overhead and error connection. Vendor will submit the complete calculation in terms of Tape Drives and Media Cartridges in the library for 20 TB of data.		
(b)	Tape Drive Architecture		
	• Offered LTO-9 drive in the Library shall conform to the Data rate matching technique for higher reliability. • Tape Drive Architecture in the Library shall conform to the INCITS/T10 SCSI-3 standard or newer standards.		
(c)	Speed		
	• LTO Generation –9 tape drives with native uncompressed speed of Minimum **300 MB** per second or more, capable to write/read in compressed format with hardware compression ratio of Minimum **2.5:1** and upgradeable to next generation of the offered device with backward compatibility must be provided on the tape library.		
(d)	Connectivity		
	• Offered Tape Library shall provide native FC connectivity to SAN switches.		
(e)	Partitioning		
	• Offered tape library shall have flexibility to configure each offered drive into a separate partition. Offered tape libray shall have support for 10partition when fully populated.		
(f)	Encryption device		
	• Offered Library shall be provided with a hardware device like USB key, separate appliance etc. to keep all the encrypted keys in a redundant fashion.		

(g)	Management		
	• Tape Library shall provide web based remote management.		
(h)	Media &Barcode Reader		
	• Tape library should support barcode reader and any license required for the same should be provided. • Minimum 80 numbers of compatible LTO Gen-9 tape media with Minimum capacity of Minimum 15 TB in compressed format and 6 TB in non-compressed format must be provided for on-line accessibility on the tape library. • Minimum 10 number of compatible cleaning LTO. • All cartridges should be provided with barcodes.		
(i)	Other Features		
	• Tape Library shall have GUI Panel • Shall be rack mountable. • The solution should have redundant hot swappable power supplies and cooling fans. Other than this, Vendor must build in maximum redundancy for no single point of failure on tape library solution. Any possible Single point of failures must be mentioned explicitly for the solution. • Tape Library shall be supplied with software which can predict and prevent failures through early warning and shall also suggest the required service action. • Offered Software shall also have the capability to determine when to retire the tape cartridges and what compression ratio is being achieved • Any license to meet features should be provided with solution.		

	Workstations including RWS **Mention Offered Make & Model- …….**		
(a)	Processor		
	• 64 Bit Intel Xeon Processor, Gold grade • Minimum OCTA Core • 24 MB Cache or more • 2.1 GHz speed or more • Chipset - Intel® C621 or latest • ENERGY STAR Qualified Configuration		
(b)	Form factor & chassis		
	• Tower • 650 W Chassis		
(c)	Memory		
	• latest 16 GB (2x8 GB) DDR4 ECC Registered Memory		
(d)	Hard Disk Drive (HDDs)		
	• Internal / external disk space with minimum usable 900 GB in RAID 10 to be provided for OS, Database Software and application software. • The hard disks must be SSD drives. • Suitable disk management software (if required) including Volume Manager to dynamically manage the logical volumes to be supplied		
(e)	Real-time Data Backup		
	• RAID 10 Striped/Mirrored Configuration		
(f)	Internal Optical Drive ,Media Reader & Audio		
	• DVD-ROM Optical Drive • SD Card Reader • Realtek HD ALC221or latest		
(g	Operating System		
	• latest Windows compatible with respective software		
(h	Network Adapter and Other Ports		

	• Two no. of server Ethernet port (10/100/1000Mbps) • Front:1 headset connector; 4 USB 3.1 (1 charging) • Rear:6 USB 3.1 Gen 1; 2 RJ-45 (1 GbE); 1 audio-in; 1 audio-out; 1 PS/2 mouse port; 1 PS/2 keyboard port; 1 serial • Display Out port VGA-1,DVI-D-1, HDMI 1.4-1 (dual display ports shall be provided for SCADA RWS to connect to 75" LED display)		
(i)	Keyboard , Mouse and Monitor		
	• Wireless Business Slim Keyboard and Mouse (with Battery) • One 32 Inch Display Monitor- LED backlight, Anti-glare; In plane switching; Language selection; LED Backlights; On-screen controls; Pivot rotation; Plug and Play; User programmable; Low Haze, Native Resolution- 1920 x 1080 @ 60 Hz, Supported Resolution- 1920 x 1080; 1680 x 1050; 1600 x 900; 1440 x 900; 1280 x 1024; 1280 x 800; 1280 x 720; 1024 x 768, Signal input connectors- 1 VGA; 1 HDMI 1.4,Ports- 3 USB 3.0 (one upstream, two downstream), Dimensions (W X D X H)- 19.22 x 1.7 x 11.55 in		
(j)	Other parameters		
	• The server should be IPv4 and IPv6 Compliant from day one of installation. The system should be IPv6 Ready logo certified. • The future roadmap of the Servers and CPU needs to be submitted for the next five years from the date of submission of document • Vendor has to ensure from OEM that offered Server shall not be E OSL or EOL in next five year from date of submission of document		
(k	Wireless Networking		

	• 802.11 a/b/g/n/ac, Dual band 2x2 with up to 867 Mbps speed; 3x faster than 802.11n, with up to 3x more bandwidth per stream • Dual mode Bluetooth® 4.2 enables BR/EDR-Low Energy devices to act as a Bluetooth® Smart Ready Hub and Bluetooth® Smart peripheral at the time.		
	• PCI Express Card with M.2 WLAN attached • Dual-Band Antenna • USB cable for internal Bluetooth® connection		

Router -

S.No.	Functionality/ Description	Minimum Specifications
1.	Interface Type	• Ethernet interfaces ports – Minimum 4/8 Nos. (100/1000 MBPS/ 10G) or 10G Fiber or a combination configurable as LAN/WAN ports • Min 2- Ports 10Gigabit BASE-T optical • USB port – 01 No. for external storage required.
2.	Memory	• Min. Memory required : 4 GB DRAM • Default flash: internal 4GB.
3.	Features	• Router switching performance (in pps) for 64 byte packet size: Equal or better than 500 Kpps or 750Mbps. • Free version of TFTP server software for uploading / downloading Router configuration to be provided on CD media. • Router should have latest Version of Operating System and Management software. • The router should support authentication: RSA (748/1024/2048 bit), Integrity: MD5, SHA, SHA-256, SHA-384, SHA-512. • The router should support Encryption : DES, 3DES, AES • Router should support encapsulations : Generic routing encapsulation (GRE), Ethernet, 802.1q VLAN, Point-to-Point Protocol (PPP), Multilink Point-to-Point Protocol (MLPPP), High-Level Data Link Control (HDLC). • The Router should have Zone Based Firewall and Intrusion Prevention System features. • Address translation : Network address & port address translation • Should support Layer2 and Layer3 VPN , IP sec and MPLS. • Router should support static Routes, Routing Information Protocol (RIP), RIPv2, OSPFv2, OSPFv3, Border Gateway Protocol (BGP) , BGP4 , Intermediate System-to-Intermediate System (IS-IS) • Should support Multicast routing protocols : IGMP v1/v2/v3, PIM-SM, PIM-SS • Should support other IP Services : ACLs, DHCP, DNS, NAT . • Router should have SSH, SSHv2, NTP and Network monitoring and accounting tool like

S.No.	Functionality/ Description	Minimum Specifications
		SNMP, syslog, netflow or similar . • Deep packet inspection (DPI)
4.	Cables	• Router should be supplied with all power cables (Plugs as per Indian Standards) / console cable / adaptors / CDs etc.
5.	Power Supply	• 230 V AC + 10%

Ethernet Switch

S.No.	Functionality/ Description	Minimum Specifications
1.	Type	High performance Layer 2 Managed Stacked Network Switch.
2.	Ports	No. of Fast Ethernet ports – 48/24/12 port x RJ45 auto-sensing(1Gb/100Mb). However, no. of ports shall be as per tender requirement The capacity shall be specified by the bidder and the same shall be adequate to connect all the devices plus 25% spare capacity. Optical ports are to be supplied along with suitable SFP modules.
3.	Features	• **Traffic-Port Features** Auto-negotiation for speed and flow control Auto MDI/MDIX Port mirroring Flow-based port mirroring Broadcast storm control Optimizations for iSCSI protocol • **Management- & Configuration-Port Attributes** 1 RJ45 console/management port with RS232 signalling 1 Out-of-Band (OOB) Management Port (10/100/1000BASE-T) 1 USB (Type A) port for configuration • **Switch Attributes** Line-rate Layer 2 switching

S.No.	Functionality/ Description	Minimum Specifications
		Switch auditing support • **Power & Cooling Hardware** Internal hot swappable power supply bays: 2 Hot swappable power supplies:1 Power supply redundancy: Required Variable speed fans: Required • Min. 8,000 MAC Addresses Support, Min. 255 VLANs Support, IPV4, IPV6 Compliant • Switching services • L2 switching, Port Aggregation Protocol • 802.1Q (VLAN) • Management • Web, SNMP, Console • Support for Port Mirroring & Remote Monitoring • USB Port / Console File backup • QOS • 802.1 P (Traffic Prioritization)
4.	Security Features	• Port Security • Port Blocking • Access for IP Address • 802.1x Port based network access control • ACLs based on source and destination MAC addresses • Support for Private VLAN / Port Isolation or Equivalent • 802.1D, Spanning-Tree Root Guard • MAC address Locking
5.	Redundancy	Power Supply Redundancy Required (Hot Swappable)
6.	Fabric Capacity	As per the no. of ports
7.	Forwarding rate	Minimum 150 Mpps
8.	CPU Memory	Minimum 1 GB
9.	Flash Memory	Minimum 256 MB
10.	Packet Buffer Memory	Minimum 4MB

S.No.	Functionality/ Description	Minimum Specifications
11.	Details of protocol support	Bidder to specify
12.	Power Consumption	Bidder to specify
13.	Dimensions	Bidder to specify
14.	Weight	Bidder to specify
15.	Operating Temperature	0° to 45° C or better
16.	Storage Temperature	0° to 65° C or better
17.	Relative Humidity (non-condensing)	20% to 90%
18.	Accessories	Shall be supplied with all required cables, connectors and suitable Surge Protection Devices (SPDs) for network cables
		All required cables and connectors, Documentation: Installation guide, Operation & Maintenance Manuals, Installation CDs.
19.	Mounting	19" Rack Mounted

	KVM Switch & Monitor		
	19" Rack Mount Monitor Keyboard Drawer 1U (Combo LCD Console) with 8 P orts KVM Switch along with all power cables/connecting cables compatible with offered Rack mountable servers. Vendor has to ensure from OEM that offered Equipment shall not be EOSL or EOL in next five year from date of submission of document		

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GPS Time server/ clock

Sr. No.	Feature/description	Minimum specifications
General		
1.	Inputs	GPS Antenna input
2.	Outputs	• NTP outputs for NTP Client access through RJ-45 (Min 04 nos) • PTP • RS 232 serial port through 9 pin 'D" connector
3.	Power supply	90V TO 230V AC/DC
4.	Ambient temperature	0 to 50 degree C
5.	Relative humidity	95%
6.	Mounting	19"Rack Mounting
7.	Display	2 x 16 LCD
8.	Clock License	1 No.
9.	Sync	Time server gets/ lock with satellite and sync with the same. Respective clients get updated with the time of GPS server.
GPS ANTENNA		
10.	Type	Helical/other (Suitable for mounting outside the building)
11.	Gain	Over 30 db
12.	Noise figure	Less than 1.5 db
13.	Operating temp	-40º C TO +85º C
14.	Connector	TNC/BNC
15.	Ingress protection	IP66 or better
16.	Cables for Antenna Connection	Minimum 50 meters of cable for connection of antenna with the GPS server is in the vendors scope
17.	Lightning Accessories	Required to be supplied along with the system
GPS RECEIVER		
18.	Receiving Frequency	1575.42 mhz +/- 1 mhz
19.	Tracking code	'L' Band CA code
20.	No. Of Channels	Minimum 8 parallel channel
21.	Timing accuracy	<15 ns with GPS receiver
Client Software		
22.	Client Software	Client software to support all the windows operating system.

MODEM –

S.No.	Functionality/ Description	Minimum Specifications
1.	Type	Industrial Quad-band GSM/3G/4G Modem (Dual SIM) (APN/VPN Enabled)
2.	Mounting	Din-Rail & Wall Mountable
3.	Band Options	Quad-band 850/900/1800/1900 Mhz
4.	Ports	2 x 10/100 Mbit/s, RJ-45 1 x RS-232/RS-485 2 x Mini-SIM slots Any additional port required, Bidder to specify to meet the system requirement.
5.	Features required	To connect to the SCADA Master station over GPRS cloud (2G/3G/4G) in case of failure of GSM connectivity of any one SIM at RTU locations.
6.	Time lapse	Maximum 10 Seconds for connecting to SCADA system in case of failure of OFC link.
7.	GPRS signal fail	System should connect automatically on restoration of GPRS signal after loss of signal. No manual intervention/restart/reset should be required.
8.	SIM HOLDER	Required
9.	Ingress Protection	IP-30
10.	IP requirement	As per bidder's design
11.	Routing	Static Routing, RIP, OSPF, IGMP Proxy
12.	Security feature	Data transmission to be secured to prevent hacking. Vendor to specify security features like encryption of data.
13.	Environmental Conditions	Operating Temperature: -10° to 65°C. Relative Humidity: 90 % Rh none condensing.

14.	Power	Power: 24 V DC without any power adaptors
15.	Software	Necessary licensed software required for programming of the device in CD.
16.	Antenna with cable	1. Suitable for outdoor installation. 2. Cable length of antenna (Min 3meter), Antenna Type and Antenna Gain shall be decided based on site survey report. (Bidder's Scope)

SPD for 1-Phase 230 AC Mains Power Supply

1. Surge protection device for single phase 230 V AC main power supply shall be a wall / surface/rack mountable device for protecting costly electronic equipment from damaging electrical transients and high-energy disturbances.
2. The equipment shall provide all mode protection between Line to Neutral, Line to Ground and Neutral to Ground.
3. The device shall be based on Metal Oxide Varistor (MOV) or Metal Encapsulated Spark Gap technology Or Hybrid Technology for optimized protection of equipment's.
4. The device shall be highly reliable and fully automatic which shall clamp surge voltage without leakage. No operator intervention shall be required for operation of these devices.

S.No.	Functionality/ Description	Minimum Specifications
1.	Indication	LED based indication / mechanical flag about health of the device.
2.	Connection Type	Single Phase 3 wire
3.	Load Current	Unlimited (Parallel connection)
4.	Nominal Surge Current(In)	25 kA (8/20 µs) between L-N & 100 kA between N-PE
5.	Working voltage	240 Volts AC
6.	Response Time	<5 ns
7.	Line Protection	L-N, L-G & N-G

S.No.	Functionality/ Description	Minimum Specifications
8.	Enclosure	IP20
9.	Local Indication	Power ON (& Ground connected) Protection Fault
10.	Indication	LED based indication about health of the device.
11.	Reset of surge	Auto
12.	Contacts for remote wiring	NC/NO, 24 V DC, 2 Amp
13.	Temperature (Ambient)	0 to 70^0 C
14.	Relative Humidity	10% - 95% Non condensing
15.	SPD Compliance	IEC 61643 / 21 / 24
16.	Safety Compliance	UL 1449 2^{nd} Edition or Equivalent
17.	Dimension	Bidder to state
18.	Weight	Bidder to state
19.	Make	Phoenix/ MTL

SPD for RS-232/RS-485 Network Line Protection

The surge protection devices for RS 232/RS 485 network data line protection shall be bipolar devices and shall be directly pluggable into the input and output ports.

S.No.	Functionality/ Description	Minimum Specifications
1.	Connection type	Terminal strip
2.	Nominal Surge Current(In)	Core to Core: 5 KA (8/20 µs) Core to Ground: 1.25 KA (8/20 µs)
3.	Maximum Continuous operating voltage	15 V DC

S.No.	Functionality/ Description	Minimum Specifications
4.	Enclosure	IP20
5.	Casing	Moulded plastic/ Bidder to state
6.	Température (Ambient)	0 to 70^0 C
7.	Relative Humidity	10% - 90% Non-condensing
8.	SPD Compliance	IEC 61643 / 21 / 24
9.	Mounting	Mounting Plug directly into I/O ports & their respective cable connectors.
10.	Make	Phoenix/ MTL

Technical Specifications of CAT-7 cable (Armoured)

Armoured cable shall be provided inside control room building also

S.No.	Feature/ Description	Minimum Specifications
1.	Type	Cat 7 UTP FRPVC Armoured cable consists of 4 unshielded twisted pairs for transmission of high speed data, digital and analogue voice and video (RGB) signals on LANs. Supports Gigabit Ethernet (1000 baseT) standard. Operates at bandwidth of 250 MHz. Suitable for Indoor/ Outdoor and Direct Burial Applications.
2.	Structure	Construction – UTP
3.	No of Pairs	4 pairs
4.	Conductor	AWG – 23 AWG
5.	Conductor material	Solid bare copper
6.	Conductor dimension	0.5 ± 0.01 mm

S.No.	Feature/ Description	Minimum Specifications
7.	Insulation	Insulation material – HDPE
8.	Number colour (Strip marking)	1-2 White/Orange(Strip) & Orange 3-6 White/Green(Strip) & Green 4-5 White/Blue(Strip) & Blue 7-8 White/Brown(Strip) & Brown
9.	Cable Diameter	Outer diameter – 10.0 mm (Nominal)
10.	Inner diameter	5.60 mm (Nominal)
11.	Inner Sheath	Extruded PVC type FRLS Minimum thickness 0.2 mm
12.	Armouring	Galvanised Steel Wire, Nominal OD of each wire: 1.4+/-0.06 mm or Corrugated ECCS Tape
13.	Outer Sheath	Extruded PVC type, FR Minimum thickness 1.24 mm
14.	Outer Sheath colour	Black
15.	Inner sheath colour	Natural
16.	Application :	Direct Burial Application Installation : Horizontal & Vertical Type. Better performance and extra headroom especially NEXT (Near End Cross Talk).
17.	Operating Temperature:	- 10°C to 75 °C
18.	Overall Diameter (in mm)	Bidder to specify

75 inch Active LED Monitor

S. No.	Functionality / Description	Minimum Specifications
1)	Type of Monitor	75" LED Colour Display UHD 4K suitable for 24/ 7 operation
2)	Backlight	LED
3)	Display	Wide screen large format display with high picture quality & high contrast ratio
4)	Display Resolution	1920 x 1080 or better
5)	Dynamic Contrast	50,00,000:1
6)	Sync format	PAL
7)	Viewable picture area	75 inch measured diagonally
8)	Display Colours	16 million
9)	Indicators/ Controls	User friendly on-screen menus & front panel controls, indicators
10)	Speakers	Integrated
11)	Input Voltage	230 V+/- 10% AC, 50 Hz
12)	Input Signal & Connections	To suit the requirements of system The monitor shall be installed on console desk / in cabinet. Required interfaces and cables of suitable length (minimum 5-7 m) shall be provided to install the monitor at a suitable location.
13)	Mounting	On Console / table (Using Mounting Brackets- Supply of the same is also under the scope of bidder)
14)	Power Consumption	Bidder to specify
15)	Dimensions	Bidder to specify
16)	Weight	Bidder to specify
17)	Operating	0° to 35°C or better

S. No.	Functionality / Description	Minimum Specifications
	temperature	
18)	Operating Humidity	20% to 80%, non-condensing
19)	Accessories	All required cables and connectors including HDMI cable, Console Mounting bracket Documentation: Installation guide, Operation & Maintenance Manuals, Installation CDs for driver software

Power Supply Converter

A) TYPE : SMPS
B) Redundancy : redundant SMPS shall be provided with MOSFET module

C) Input:
1. Voltage : as per the tender requirement
2. Current : To be provided by the Bidder
3. Efficiency: > 95%
4. Protection: Current limiting circuit breaker; Over & Under voltage protection; Automatic shutdown at lower input voltage.

D) Output:
1. Voltage : as per the tender requirement
2. Power : As per tender requirement
3. Load Current: As per tender requirement
4. Regulation : + 2%
5. Conversion frequency : > 90 KHz
6. Load sharing : Active current sharing & Democratic load sharing in parallel operation.
7. Protection : Circuit breaker/fuse
   a) Over voltage: Only faulty unit shuts down
   b) Over Current: Can sustain short circuit at o/p indefinitely
   c) Over Temperature : Required

E) Other:
a. Lightening & Surge protection : As per latest national & International Standards
b. EMI protection : As per latest national & International Standards

c. Insulation Resistance :
   a) Input & Earth : > 2 mega ohms
   b) Output & Earth : > 1 mega ohms
   c) input & O/p : > 5 mega ohms

d. Mechanical Noise : < 60 dBA

F) Monitoring:

1. Shall provide Display for display / monitoring of the following with accuracy of 1%:
   a. Input Voltage & Current.
   b. Output Voltage & Current

2. Shall provide facility for visual indication / display / monitoring of following Alarms locally:
   a. Input Failure
   b. Output Failure
   c. Module failure
   d. o/p Over Voltage
   e. o/p Under Voltage
   f. Overload

The above-mentioned alarms shall be categorized under Urgent & Non-urgent alarms depending upon the intensity of the abnormalities. Every Alarm condition shall be accompanied with Audio alarm with the audio cut-off facility. Potential Free contacts shall be provided for the extension of alarms to central location.

G) Temperature Range :- -100 C to +600C.
H) Mains Buffer : >10ms
I) Integrated Gas Field Surge protection :- 4KV
J) Static Boost:- upto 125% (PN) for sustained period, Dynamic Boost :- upto 200% (PN) for 5 Sec. & Selective Fuse Breaking :- upto 6 times the nominal current for 15ms
K) Residual ripple :- < 50 mVpp
L) Voltage converter shall have push button on its face plate for manual voltage setting

TECHNICAL SPECIFICATION

FOR

RTU PANEL & ACCESSORIES

TS. No. : MEC/05/E5/T/TS/PANEL /001A

MECON LIMITED

DELHI - 110 092

SPECIFICATIONS
FOR
PANEL & ACCESSORIES

GENERAL

Site of Installation

1.	Plant and Location	:	As per MR
2.	Client	:	IGGL
3.	Consultant	:	MECON LIMITED.
4.	Location of panel	:	Control Room and accessories.
5.	Floor	:	Trench/ Concrete (By client)
6.	Air Conditioning	:	Yes (By client)
7.	Control Panels Quantity	:	As per MR

Scope of Work :

a) Supply of RTU Panel (free standing, cubicle type) along with all accessories like Lamps, MCBs, Relays, Barriers / Isolators, Selector Switch, Signal Multipliers (SDC), etc. as per this Technical specification.

b) Quantities of control panel accessories (Push Buttons, Lamps, Relays, Zener Barriers, and SDC Cards etc.) shall be as per the Technical Requirements during drawing approval/detail engineering.

c) Panel Dimensions :

Height – 2115mm (including 100mm base channel and 15 mm anti-vibration pad)
Width – 800 mm , Depth – 800 mm

d) Mounting heights (tentative, final shall be decided during detail eng.) :

i) Miniature and subminiature items (3 rows)	Bottom row	1100mm
	Middle row	1350mm
	Top row	1600mm

PANEL CONSTRUCTION

1.	Type	:	Self-supported, Free Standing, enclosed cubicle and Non-graphic.
2.	Panel Manufacturing Standard		IEC 62208 Mechanical protection impact – IEC 62262, IK-08
A	Corrosion Protection		Salt spray test, should comply 720 hours as per ISO 9227
B	Panel Certification		TUV/BV/UL/other third party
C	Load Bearing Capacity		Minimum 1000 Kg
D	Life of panel		20 Years
3.	Lighting	:	Required for inside panel with door switch on each side of door.
4.	Ventilation	:	2 nos. Fan on top side of rear door Required with louvers backed by wire fly screen & fan. Fan Failure alarm required. Also, 2 nos. Louvers with filter shall be provided on front and rear doors
5.	Doors	:	CRCA door in the front and Rear of the Panel with locking arrangement. Both Doors shall be provided with minimum 3-Point Ergofoam type Lock or similar with key and handle
6.	Door width	:	Each max. of 800mm and shall suit width of the panel. Panel width is indicative only. The sizes shall be sufficient to accommodate the required hardware specified in MR.
7.	Cable Entry	:	Bottom, Cable Glands shall be double compression type for external armoured cables. All unused entries shall be plugged.
8.	Receptacles	:	Required for incomer supply.
9.	Painting	:	The finish shall include sand blasting, grinding, chemical cleaning, surface finishing by suitable filter and two coats of high grade lacquer with wet sanding between coats.. Two coats of paint in panel colour shall be given for Non-glossy high stain finish. ROHS shall be complied Panel face final colour shall be of the following: a) Siemens Grey (RAL 7035) b) Panel internal shall have a finish color of Siemens Grey (RAL 7035) c) Channel Base shall have a finish color of black
	Channel Base	:	100X50X6 MM, MS material

10.	Tag Plates	:	Front of Panel Instrument Tag plates shall be black laminated plastic with white core. Tag plate shall be provided on the rear of the panel also.
11.	Name Plates	:	Name plates shall be black laminated plastic with white core. It shall include project details. It shall be provided on Front Side of Panel.
12.	Laptop Tray	:	Tray for Placement of Laptop shall be provided inside the panel

13 Dimensions & Material of Construction

a)	Panel dimension	:	2115 (mm) H (including 100 mm base + 15 mm anti-vibration pad) x 800 (mm) W x 800 (mm) D with modular construction
b)	Control Panel	:	1.5 mm thick CRCA steel
c)	Side & Top plates	:	1.5 mm thick CRCA steel
d)	Door panel	:	2 mm thick CRCA steel, Single door in the front and rear
e)	Cable gland plate	:	3 mm thick CRCA steel
f)	Mounting Plate	:	3 mm thick or as decided during detail eng.
g)	Anchor Bolt Size	:	By vendor
h)	Lifting Eye Bolt	:	Required
i)	Anti Vibration Pad	:	Required (15mm thick rubber pad).
j)	Laptop Tray	:	3 mm thick CRCA steel. Paint of Laptop tray shall be same as panel.
k)	Cable Routing	:	All cables inside the panel shall be router through proper covered PVC duct of suitable sizes. The same shall be provided as decided during detail engineering.
l)	Equipment Arrangement	:	The MCBs for incomer power supply and distribution supply shall be provided at the top of the Panel. RTU shall be mounted Approx. in the middle at the approachable height TBs shall be arranged vertically in the RTU for AI, AO, DI and DO. MCBs and Power TBs shall be provided with acrylic sheet cover for safety.
m)	Gasket	:	PU Foam

Note :

***Panel shall be electrically isolated from base frame.**

12 WIRING

a) Type : General purpose, Intrinsically safe

b) Wiring details

24 V DC Wiring (Incomer)	:	2C x 4.0 mm² copper conductor
230 VAC Wiring (Non UPS)	:	3C x 4.0 mm² copper conductor
24 V DC Wiring (Inside)	:	2C x 2.5 mm² copper conductor
Cabinet power distribution		

c) Signal Wiring

External to Cabinet	:	1.0 mm² twin twisted individual shielded overall shielded with overall drain PVC insulated armoured
Inside the cabinet	:	Multi stranded min. 1.0 mm² copper conductor PVC insulated twin twisted and shielded.
Electrical Earth	:	Multi stranded min. 4.0 mm² copper conductor PVC insulated
Instrument Earth	:	Multi stranded min. 4.0 mm² copper conductor PVC insulated

d)	**Terminal type**	:	Screw less push-in type terminal blocks (TB) Suitable for
	Terminal size for signal	:	min. 2.5 mm² size conductor
	Terminal size for power dist.	:	Suitable for min. 4.0 mm² size conductor and higher as per actual cable sizes.

f) **Power Indication Lamps** : 230VAC NUPS – Red Color
24VDC – Green Color

SPECIFICATIONS FOR ACCESSORIES

1. MCB

Make	: As per Vendor List
Qty.	: As required + 20% spare

2. Lamps

Type	: LED Clustered Type
Voltage	: 24 VDC
Make / Model No.	: As per Vendor list
Quantity	: As required

3 Relays

Type	: Plug in relays
Contact Type	: Potential free contact
Contact No.	: 1 NO. + 1 NC
Rating	: 24V DC, 5.0 A
Make / Model No.	: As per vendor list.
Quantity	: As required + 20% spare

Different colour codification shall be followed for various types of wiring. The suggested wiring colour code is:

SN	Description	Wire Colour	Wire Size	TB Colour
		INCOMER		
1	230V AC PHASE	RED	2.5 mm2	RED
2	230V AC NEUTRAL	BLACK	2.5 mm2	BLACK
3	ELECTRICAL EARTH	GREEN	6 mm2	GREEN
4	24V DC POSITIVE	RED	4 mm2	RED
5	24V DC NEGATIVE	BLACK	4 mm2	BLACK
		INTERNAL DISTRIBUTION		
4	24V DC POSITIVE	YELLOW	2.5 mm2	YELLOW
5	24V DC NEGATIVE	WHITE	2.5 mm2	GREY
6	INSTRUMENT EARTH	GREEN WITH YELLOW STRIPS	6 mm2	GREEN
		INPUT/OUTPUT		
6	DIGITAL INPUT (+ve)	BLUE	1.5 mm2	BLUE
	DIGITAL INPUT (-ve)	BLACK	1.5 mm2	BLUE
7	DIGITAL OUTPUT/ POTENTIAL FREE (+ve)	ORANGE	1.5 mm2	BLACK
	DIGITAL OUTPUT/ POTENTIAL FREE (-ve)	BLACK	1.5 mm2	BLACK
8	ANALOG INPUT +ve	GREY	1.0 mm2	YELLOW
	ANALOG INPUT –ve	WHITE	1.0 mm2	YELLOW
10	ANALOG OUTPUT +ve	BROWN	1.0 mm2	YELLOW
	ANALOG OUTPUT –ve	WHITE	1.0 mm2	YELLOW

Terminal Block

1. Make to be specified
2. Fused Type TBs to be provided for each channel of AI, AO, DI and DO signals with Blow – out indicator
3. Separate color TB for different signal type
   a. Red – AO
   b. Yellow – AI
   c. Blue – DI
   d. Black – DO
   e. Grey – Serial
4. TB for other types of connections
   a. Red – Phase
   b. Black – Neutral
   c. Green – Earth
5. 25% spare TBs to be provisioned (for signal as well as bus bar)

Minimum & Mandatory Specification for Terminal Block		
Sr.No.	**Discription**	**Requirement**
1	Connection method	Screw less push-in type terminal blocks (TB)
2	Insulating material	Vendor to provide
3	Flammability rating according to UL 94	V0
4	Visual indication for wire Connection making & breaking	Required
5	Double shorting facility	Required
6	Marking Facility	Marking should be on Center & both side of TB .
7	TB Wire size	Wire size required + Lug Zize
8	Special tool requirement	Should not required

SPD Specs

Make : MTL / Phoenix Contact

Main **Incomer**

Minimum Specification For Power supply	Technical Parameter 24V	Technical Parameter 230V
Nominal voltage Un	24 V AC (TN-S)	230 V AC (TN-S)
Maximum continuous operating voltage Uc	34 V AC 34 V DC	264 V AC 230 V DC
Nominal discharge current In (8/20) µs (L-N)	1 kA	3 kA
Rated load current IL	26 A (30 °C)	--
Combination wave UOC	2 kV	6 kV
Voltage protection level Up (L-N)	≤ 0.25 kV	≤ 1.35 kV
Voltage protection level Up (N-PE)	≤ 0.65 kV	≤ 1.5 kV
Response time tA (L-N)	≤ 25 ns	≤ 25 ns
TOV behavior at UT (L-N)	50 V AC (5 s / withstand mode) 50 V AC (120 min / withstand mode)	440 V AC (5 s / withstand mode) 440 V AC (120 min / withstand mode)
Surge protection fault message	Optical, remote indicator contact	Optical, remote indicator contact
Ambient temperature (operation)	-40 °C ... 80 °C	-40 °C ... 80 °C
Degree of protection	IP20	IP20
IEC test classification	III T3	III T4
Standards/regulations	IEC 61643-11 2011 EN 61643-11 2012	IEC 61643-11 2011 EN 61643-11 2012
Approvals	KEMA, UL Recognized	KEMA, UL Recognized

Ethernet SPD

SPD Specification for Ethernet switches	Technical Parameter 24V
Maximum continuous operating voltage UC	≤ 3.3 V DC
Maximum continuous voltage UC (wire-wire)	≤ 3.3 V DC (± 60 V DC/PoE+)
Maximum continuous voltage UC (wire-ground)	≤ 180 V DC
Nominal current IN	≤ 1.5 A (25°C)
Operating effective current IC at UC	≤ 1 µA
Nominal discharge surge current In (8/20) µs (Core-Core)	100 A
Nominal discharge surge current In (8/20) µs (Core-Earth)	2 kA (per signal pair)
Total surge current (8/20) µs	10 kA
Nominal pulse current Ian (10/700) µs (Core-Core)	≤ 40 A
Output voltage limitation at 1 kV/µs (Core-Core) spike	≤ 85 V (PoE)
Residual voltage at In, (conductor-conductor)	≤ 15 V ≤ 100 V (PoE)
Protection level UP (Core-Core)	≤ 9 V (B2 (1 kV/25 A)) ≤ 100 V (B2 (1 kV/25 A) - PoE) ≤ 15 V (500 V/100 A)
Protection level UP (Core-Earth)	≤ 600 V ≤ 700 V (C2 (4 kV/2 kA))
Response time tA (Core-Core)	≤ 1 ns
Standards/regulations	IEC 61643-21 EN 50173-1 ISO/IEC 11801-Am.1
Approvals	UL Listed, GOST

Serial (RS485)

SPD Specification for RS-485	Technical Parameter
IEC category	C1 C2 C3 D1
Nominal voltage UN	12 V DC
Max. operating voltage Umax	14 V DC
Nominal current IN	450 mA (45°C)
Response time :	≤ 500 ns
Operating Temperature range	-40 °C ... 85 °C
Degree of protection	IP20
Total surge current (8/20) µs	20 KA
Nominal discharge surge current In (8/20) µs (Core-Core)	10 kA (Core to core) 10 kA (Core to Earth)
Lightning Impulse current	2.5 kA per path
output voltage limitation at 1 kV/µs (Core-Core) spike	≤ 55 V
Output voltage limitation at 1 kV/µs (Core-Earth) spike	≤ 55 V
Voltage protection level Up (core-core)	≤ 80 V (C1 - 1 kV/500 A)
Voltage protection level Up (core-ground)	≤ 85 V (C1 - 1 kV/500 A)
Certificates / Approvals	UL Listed / GL / EAC / EAC

INSTRUMENTATION SECTION

TECHNICAL SPECIFICATION

FOR

Server PANEL

MECON LIMITED

DELHI - 110 092

SPECIFICATIONS
FOR
PANEL

GENERAL

Site of Installation

1.	Location	:	As per MR
2.	Client	:	IGGL
3.	Consultant	:	MECON LIMITED.
4.	Location of panel	:	Control Room and accessories.
5.	Floor	:	Trench/ Concrete (By client)
6.	Air Conditioning	:	Yes (By client)
7.	Control Panels Quantity	:	As per MR

Scope of Work :

a) Supply of Server Panel (free standing, cubicle type) along with all accessories like Lamps, MCBs, Switch Sockets, etc.

d) Quantities of panel accessories shall be as per the Technical Requirements during drawing approval/detail engineering.

PANEL CONSTRUCTION

1.	Type	:	Self-supported, Free Standing, enclosed cubicle and Non-graphic.
	Panel Manufacturing Standard	:	IEC 62208
	Corrosion Protection	:	Mechanical protection impact – IEC 62262, IK-08 Salt spray test, should comply 720 hours as per ISO 9227
	Panel Certification	:	TUV/BV/UL/other third party
	Load Bearing Capacity	:	Minimum 1000 Kg
	Life of panel	:	20 Years
2.	Lighting	:	Required for inside panel with door switch on each side of door.
3.	Ventilation	:	Required. 4 Nos. Fans shall be mounted on top of panel
4.	Doors	:	CRCA Perforated door at front and back of the Panel. Both Doors shall be provided with Ergofoam type Lock or similar with key and handle
5.	Door width	:	Each max. of 800mm and shall suit width of the panel. Panel width is indicative only. The sizes shall be sufficient to accommodate the required hardware specified in MR.
6.	Cable Entry	:	Bottom, Cable Glands shall be double compression type for external armoured cables. All unused entries shall be plugged.
7.	Receptacles	:	Required for incomer supply.

8.	Painting	:	The finish shall include sand blasting, grinding, chemical cleaning, surface finishing by suitable filter and two coats of high grade lacquer with wet sanding between coats.. Two coats of paint in panel colour shall be given for Non-glossy high stain finish. Panel face final colour shall be of the following: a) Siemens Grey (RAL 7035) b) Panel internal shall have a finish color of Siemens Grey (RAL 7035)
9.	Wheel	:	Not required
10.	Tag Plates	:	Front of Panel Instrument Tag plates shall be black laminated plastic with white core. Tag plate shall be provided on the rear of the panel also.
11.	Name Plates	:	Name plates shall be black laminated plastic with white core. It shall include project details. It shall be provided on Front Side of Panel.
12.	Keyboard Tray	:	NA

13 Dimensions & Material of Construction

a)	Panel dimension	:	2000 (mm) H + 100 mm base channel+15mm AVP x 800 / 1000(mm) W x 800/1000 (mm) D (the width and depth of panel shall be decided during detail engineering based on the dimensions of the components.)
b)	Control Panel	:	2 mm thick CRCA steel
c)	Side & Top plates	:	1.5 mm thick CRCA steel
d)	Door panel	:	Perforated Doors in the front and rear of the Panel
e)	Cable gland plate	:	3 mm thick CRCA steel
f)	Anchor Bolt Size	:	By vendor
g)	Lifting Eye Bolt	:	Required
h)	Keyboard Tray	:	NA

Note :

***Panel shall be electrically isolated from base frame.**

12 WIRING

a) Type : General purpose, Intrinsically safe

b) Wiring details

230 VAC Wiring : 2C x 6 mm² copper conductor (to be decided during detail eng based on power consumption, if higher size cable is required as per the power consumption details, same shall be provided by bidder). Also, separate cable shall be laid for redundant power connection. Separate cables shall also be laid for UPS and Non-UPS power supply.

c) Signal Wiring

External to Cabinet : 1.5 mm² twin twisted individual shielded overall shielded with overall drain PVC insulated armoured

Inside the cabinet : Multi stranded min. 1.5 mm² copper conductor PVC insulated twin twisted and shielded.

Electrical Earth : Multi stranded min. 6.0 mm² copper conductor PVC insulated

d) **Terminal type** : Screw clamp type (with fuse)with Pressure Plate

Terminal size for signal : Suitable for min. 2.5 mm² size conductor

Terminal size for power dist. : Suitable for min. 4.0 mm² size conductor and higher as per actual cable sizes.

e) **Wiring colour code**

Power Supply(230V AC) : Hot – Red, Neutral - Black, Earth – Green

Electrical Earth : Solid Green

Identification of Cable : Criss – Crossing PVC tube ferruling. Solid Green

SPECIFICATIONS FOR ACCESSORIES

1.	**MCB**	: As per Vendor List
	Make	: As required + 20% spare
	Qty.	All power distribution shall be through MCB
2.	**Lamps**	
	Type	: LED Clustered Type
	Voltage	: 230 VAC
	Make / Model No.	: As per Vendor list
	Quantity	: As required
3	**Surge Protection Device**	Shall be provided as per following – 1. For each incoming power connection

SPD Specs

Make : MTL / Phoenix Contact / P&F

Main **Incomer**

Minimum Specification For Power supply	Technical Parameter 230V
Nominal voltage Un	230 V AC (TN-S)
Maximum continuous operating voltage Uc	264 V AC 230 V DC
Nominal discharge current In (8/20) µs (L-N)	3 kA
Rated load current IL	--
Combination wave UOC	6 kV
Voltage protection level Up (L-N)	≤ 1.35 kV
Voltage protection level Up (N-PE)	≤ 1.5 kV
Response time tA (L-N)	≤ 25 ns
TOV behavior at UT (L-N)	440 V AC (5 s / withstand mode) 440 V AC (120 min / withstand mode)
Surge protection fault message	Optical, remote indicator contact
Ambient temperature (operation)	-40 °C ... 80 °C
Degree of protection	IP20
IEC test classification	III T4
Standards/regulations	IEC 61643-11 2011 EN 61643-11 2012
Approvals	KEMA, UL Recognized

1	**Distributed storage at distributed storage location (minimum specifications, however bidders shall design entire solution and submit specifications in technical bid)** **Make: HP/DELL/SCADA OEM CERTIFIED** (In case bidder is proposing server and storage as different components then same should vetted by software OEM. Bidder is allowed to quote Server cum storage / Server & storage as per below specification).	
1.1	Storage Media Type	The IP Video Storage System should contain a Solid state drive (SSD) which contains a non-volatile backup image of all system software which can be used to initiate a full system recovery in the event the system partition is lost or corrupted
1.2	Recording & Management	The Storage System shall be an embedded, all-in-one Storage subsystem that provides "plug-and-play" iSCSI-based recording and management
1.3	Mounting & Protection	Storage Array shall be rack-mount chassis with hot swappable, 12 Gbps, 8 port SAS RAID card, SSD hard disk drives with RAID-5 protection.
1.4	iSCSI Hardware	Storage shall be a pre-configured and pre-installed iSCSI disk array iSCSI should provide load balancing, iSCSI management & interface for storage server configuration iSCSI should support unified storage application management, user-friendly setup and management of storage, Microsoft iSCSI Software Target
1.5	Monitoring Protocol	SNMP, Remote Desktop, HTTP/S monitoring
1.6	Processor	Intel® Xeon® E-2226GE , 3.4 GHZ or better
1.7	Memory	Minimum 32GB DDR4-2666 2Rx8 ECC UDIMM) of memory installed or better.

		Slots should be free for future upgrade up to 128GB. Memory usage of CPU should not exceed 50% for smooth operation. If required RAM size should be increased appropriately.
1.8	Motherboard	OEM Motherboard
1.9	Operating System	Microsoft Windows Server IoT 2019 for Storage Standard or latest
1.10	Network Interface	The Storage Array shall be configured with 30 days storage, 24 x 7 hard disk drives in RAID-5 configuration and two (2) redundant 1 GbE network interfaces
1.11	Power supply	Two redundant hot-swap (Input voltage: 100-240VAC 50/60Hz) with Power Cord, Power supply should be 90% efficient with EPEAT Gold certification for the system.
1.12	Operating Temperature	0°C to +35°C
1.13	Network interface	4 Nos. (10/100/1000 Mbps autosensing on board integrated RJ-45 Ethernet port)
1.14	Certifications & Approvals	UL/EN, CE,FCC

SPECIFICATION OF CONSOLE, PRINTER TABLE AND CHAIR

	Consoles		
	1.	Tag No.	During detailed engg
	2.	Quantity	1 each for All Workstations
SPECIFICATION	3.	Location	During Detail Engineering
	4.	Make	As per Preferred vendor list
	5.	Model No.	*
	6.	Ordering Code	*
	7.	Type	Open desk type consoles with bottom entry and wooden top, Sliding Tray for Keyboard
	8.	Construction	CRCA
	9.	Front & Rear doors	1.5 mm
	10.	Finishing & colour	Powder coating Enclosure and doors – RAL 7035 Base – RAL 7022
	11.	Dimensions	~ 800 (D) X 750 (H) X 800 (W)
	12.	Handles	Turn to lock type with handle and keys 1no. for front door and 1 no. for rear door
	13.	Fan	2 nos. of fans
	14.	Illumination	2 nos. of LED with door switch, 1no. for front door and 1 no. for rear door
	15.	Ventilation	Required, Louvers with wire fly screens
	16.	Anti vibration pad	Min 25 mm
	17.	Earthing bolts	Min 2 nos. of bolts required on the exterior
	18.	Busbars for Earthing	2 nos. of min, 25 mm wide and 6 mm thick of copper of suitable length.
	19.	Protection class	IP 31
	20.	Base frame	*
	21.	Profile	
	Printer Table		
	22.	Tag No.	During detailed engg
	23.	Quantity	1 each for all the printers supplied
	24.	Location	Control room
	25.	Make	As per Preferred vendor list
	26.	Model No.	*
	27.	Ordering Code	*

SPECIFICATIO N	28.	Type	Open table top suitable for LaserJet printers
	29.	Construction	CRCA
	30.	Finishing & colour	Powder coating colour – RAL 7035
	31.	Paper mounting rack	Required
	32.	Paper collection tray	Required
	33.	Dimensions	~ 450 (D) X 800 (H) X 600 (W)(to suit the printer dimensions, if higher dimension is required , the same shall be provided)
	Chairs		
SPECIFICATION	34.	Tag No.	During detailed engg
	35.	Quantity	1 no. for each for All Workstations
	36.	Location	Control room
	37.	Make	Godrej
	38.	Model No.	*
	39.	Ordering Code	*
	40.	Type	Ergonomic computer chair with Multi-position locking with anti shock feature, Adjustable backrest, Pneumatic seat height adjustment with tilt tension adjustment, 360 degree adjustment with fixed armrests
	41.	Colour	*
	42.	Dimensions	*
	1.	'*' = Vendor to specify	
	2.	SS tag plate with panel / console name and terminal location shall be fixed on the location	
	3.	Documents: Specification with catalogue, GA drawing, Installation / Mounting drawing, test certificates, Installation & maintenance manual.	

SPECIFICATION FOR LASERJET PRINTER:

Make	:	HP/ Cannon/ Brothersoft
Quantity	:	As per PJS and TS
Model No.	:	Vendor to specify
Type	:	LaserJet A3 (Colour)
Paper size	:	A3 &A4
Print Speed	:	20 ppm (Draft Mode) Document delivery
speed	:	Vendor to specify
Duty Cycle	:	40,000
Resolution	:	600 X 600 dpi (min)
Processor	:	Latest
Memory	:	128MB expandable
Two Side printing	:	Required, Automatic
Networking	:	Ethernet - 2nos. Languages & fonts
	:	Vendor to specify
Client operating system	:	Windows
Network operating system	:	Windows
Network protocols	:	Vendor to specify
Security features	:	Required
Power Supply	:	230VAC, 50 Hz

ANNEXURE –I

RTU SPECIFICATION

Rev. : 1
Edition : 1

SPECIFICATION

FOR
REMOTE TELEMETRY UNITS

SPECIFICATION NO.: MEC/S/05/E5/099

ELECTRICAL & INSTRUMENTATION
(OIL & GAS SBU)
MECON LIMITED
DELHI 110 092

AMENDMENT STATUS

Sl. No.	Clause / Paragraph / Annexure / Exhibit / Drawing Amended	Page No.	Revision	Date	By (Name)	Verified (Name)
1	Cyber security update		01	02.07.2019	Ratnadeep	Pankaj

Table of Contents

1.0 GENERAL

2.0 RTU SUBSYSTEMS

2.1 DIGITAL INPUT

2.2 DIGITAL OUTPUTS

2.3 ANALOG INPUTS

2.4 ANALOG OUTPUTS

2.5 PULSE INPUT MODULE

3.0 COMMUNICATIONS

4.0 RTU FEATURES

5.0 INTERLOCKING LOGIC

6.0 DATABASE STORAGE AND RETRIEVAL

7.0 SERIAL LINK REQUIREMENT

1.0 GENERAL

The RTU's shall be 32 bit microprocessor based programmable units with both erasable RAM and ROM memory. Each of the RTUs shall have its own processor, battery backed / non-volatile memory, power supply unit & communication processors confirming to communication protocol like DNP 3, Ethernet etc and I/O cards complete in all respects. The RTUs shall have TCP/IP port for polling from MMS & BMS.

The I/O cards shall not be combined for the functionalities i.e. each card shall have dedicated modules for Analog input, Analog output, digital Input, Digital output etc. The RTU's shall be designed to function such that no single point of failure or the inadvertent leaving of a printed circuit board out of the RTU shall cause a control mal-operation or result in any false operation or continuous communication transmission.

The complete RTUs shall be supplied with all its components including the cabinets. The cabinets should be weather proof and suitable for non-air-conditioned room. The actual layout of RTU along with its internal wiring, mounting arrangement etc. shall be carried out in detailed engineering. Proper illumination shall be provided inside the RTU cabinet.

2.0 Environmental

The equipment selected will operate in the following conditions:

- Ambient Temperature 55 ° C
- Humidity 05-95% RH.
- Non air-conditioned environments

3.0 Power Supply

The power supply available will be 24V DC UPS Power supply. RTU shall operate at 24 V DC power supply. The bidder shall furnish the detailed consumption of each equipment.

4.0 RTU SUBSYSTEMS

4.1 The RTUs shall comprise the following subsystems**:**

- Central processor with system software.
- Back pane/ chassis
- Analog input Module
- Digital (contact) input Module
- Digital (contact) output Module
- Analog Output Module
- Ethernet ports for polling from MMS and BMS through DNP 3.0 (TCP/IP).
- Serial ports/Ethernet port to connect Portable Diagnostic Test Unit (PDT)
- Serial ports for connecting IEDs e.g. Flow computers
- Diagnostic tools
- Interposing Relays for Digital Output

The RTU's shall be configured such that interdependence of function is minimized and failure of any part of a RTU Module subsysterm except the common logic subsystem shall not directly affect the integrity of the unit, as a whole.

The RTU should be able to store alarm/ events in case of communication failure till the time of communication restoration.

4.2 The RTU system software shall provide the overall management of the supervision, monitoring and control function within the RTU and also manage the local Programmable Diagnostic Test Unit, communications, comprehensive diagnostic facilities and RTU start up procedures.

4.3 The RTU shall be programmable and shall have facilities for developing logic to interface with the IEDs as and when required. To this effect, all necessary tools, software and documentation shall be part of supply of the RTUs within the scope of this tender.

5.0 POWER SUPPLY

- RTU shall have single power supply modules.
- RTU shall have Power Supply module having 24V DC input which shall cater output requirement of all the modules of RTU. Power supply card shall have an independent on- off switch
- If RTU requires other voltage levels, then the necessary converter shall be supplied and provided without any additional financial implication to Client

6.0 CENTRAL PROCESSOR MODULE

- The RTU shall be a 32-bit microprocessor based programmable unit with both non-volatile RAM and FLASH memory. The RAM memory size shall be minimum 32 Mb.
- Central Processor module shall have CPU & power supply for total functionality of the RTU
- All the alarms, events and command history shall be stored in RTU memory (which shall be non-volatile) with date and time stamp on FIFO basis. Minimum 5000 alarms and events and 200 commands shall be stored in RTU memory which shall be non-volatile and accordingly the RTU memory shall be provided. The alarms, events, command log shall be stored in RTU memory and shall be accessible any number of times from the RTU.

7.0 DIGITAL INPUTS

Typical specification of Digital Input Modules to be supplied is as given below:

Input Type	:	Min. 16 nos. of Volt free contacts (2 wire isolated)
Contact Wetting	:	2-4mA per input at 24V DC
Resistance recognized	:	Not exceeding 1 Kilo Ohms as a closed contact
Resistance recognized	:	Not less than 50 Kilo Ohms as an open contact
Isolation	:	Using optocouplers/ external isolation
Insulation Resistance	:	20 M ohms at 500 V Dc inputs
Debounce circuitry	:	10 m/sec
Indicators	:	Loop & State LEDs for each DI point
Filter	:	Support for chatter and de-bounce filter

Voltage withstand Capacity	:	1.5 KV RMS
No/NC contacts	:	mixing of NO/NC contacts in the same card.
Security	:	Each DI channel shall be protected by suitable mechanism like fuse with suitable fuse blow indication provided

8.0 DIGITAL OUTPUTS

Typical specification of Digital Output Modules to be supplied is as given below:

Output Type	:	Max. 16 nos. of relay contacts, individually isolated
Indicators	:	LED indication for each DO point
Relay Type	:	Miniature power relay
Contact arrangement	:	1 NO + 1 NC relay contacts configuration to be provided up to the RTU terminal block
Contact Rating	:	Potential free contact rating of output interposing relay for each DO point (Contact rating 24 V DC, 5A)

(RTUvendor to provide interposing relays for each digital output point)

Isolation	:	2KV RMS Contacts to Logic/ external isolation
DO command activation	:	Configurable Pulse duration (min 2 sec) / Latch. For repeat DO output requirement, permanent DO shall be provided
Security	:	Output contacts shall be monitored via Opto-isolators and must be short circuit proof and protected by suitable mechanism like fuse with suitable fuse blow indication provided.

9.0 ANALOG INPUTS

Typical specification of Analog Input Modules to be supplied is as given below:

Input Type	:	Min 8 isolated, Current Inputs
Ranges	:	4 - 20 mA, 0-5 V
Input impedance	:	Not less than 100 K for Voltage input Not more than 0.4 K for current Input, 250 Ohm nominal
Multiplexer	:	Vendor Standard
ADC type	:	12 bit binary, (exclusive of sign bit)
Series Mode Rejection	:	Greater than 30 db at 50 Hz
Common Mode rejection	:	Greater than 100 db at 50 Hz
Roll over error	:	1 bit
Temperature coefficient	:	0.005% per degree C
Resolution	:	min. 14-bit data + 1 sign bit
Accuracy	:	± 0.1% of range including drop in resistor @25 deg

10.0 ANALOG OUTPUTS

Specifications of Analog Output modules to be supplied is as given below:

Output type	:	Min.4 Completely Isolated current (4-20 mA) outputs The external isolator, if required, for isolated output shall

		be included for each AO point
DAC Type	:	12 bit binary (exclusive of sign bit)
DAC span	:	10 V or 5 V
Output Range	:	4-20 mA DC
Isolation	:	Each output shall be isolated from logic and others to 500 Volts
Loading	:	1K ohm for Current outputs
Differential Linearity	:	½ L.S.B.
Accuracy	:	± 0.1% of range at 20 degree C @ 25 deg
Temperature coefficient	:	0.01% FSD per degree C
Update	:	within 10 msec.
Retentivity	:	Set-point value to be held by AO card till update by new set-point value from SCADA system

11.0 COMMUNICATIONS

The RTU shall support both internal and external communications functions.

The communication network internal to the RTU shall be designed and implemented in such a way that the passing of data and commands between modules shall not be prevented by the failure of any module not directly involved in the communication exchange. In addition the internal network shall not become overloaded under the heaviest traffic possible in the RTU's ultimate expansion configuration.

The MMS / BMS shall initiate communications with a selected RTU by the addressing function. Each RTU shall recognize its own unique address and shall have the capability of being assigned any address within a range of possible addresses (minimum 256). It shall be possible to address all or selected number of RTUs from the MMS/BMS in order that global or broadcast message may be sent. The LED indication shall be provided in the RTU to check the health of RTU communication.

The RTU shall support DNP 3.00 (TCP/IP) / IEC-5-104 protocol for communicating with SCADA system at MMS / BMS. However, RTU shall communicate with SCADA system over DNP 3.0 (TCP/IP) protocol.

The RTU shall be polled through Ethernet port from MMS / BMS.

12.0 RTU FEATURES

12.1 The RTU sub-system shall support the following:

a) Scanning of Input and Output points.
b) Fast scanning of selected I/O's points.
c) Field input initiated discrete control action.
d) Discrete control action corresponding to Remote Control Command reception.
e) RTU shall store all Alarms, events and command log with time stamping in its non-volatile memory in FIFO basis. The command log and event log shall be available in RTU such that it shall be possible to know about the source of command by logging in the RTU. Similarly, it shall be possible to know about the events and critical alarms by logging in the RTU. All commands executed through RTU (whether given through SCADA or through RTU) shall

be stored in RTU log. Minimum 100 command logs, 3000 events and alarms shall be stored in RTU. Accordingly the RTU memory shall be provided.

f) Operator initiated discrete control action with check before execute and time out feature.
g) Operator initiated discrete control action with sequencing and interlocking.
h) Derivation of calculated digital points based on logical functions AND,OR,NOT etc from Digital and Analog input points.
i) Derivation of calculated analog points based on arithmetic functions +, -, /, *, sq, root etc. and driving external hardware. Calculation shall be performed in RTU in engineering units with 16 bit or higher floating point accuracy in case engineering conversion is being done at RTU level. (Calculations shall be performed in the SCADA server in case engineering conversion is being implemented in the SCADA server.)
j) Deviation of counter values using Integration of hardware and software generated analog points
k) All RTU cards, serial ports, and communications channels health points are to be configured in RTU and DNP3.0 index of same are to be reflected in I/O list and all serial ports should be independently configurable
l) RTU should have diagnostic feature for hardwired I/Os, DNP3.0 and IED (serial) communication
m) All the field / IED parameters should be configurable at RTU end
n) IED (Flow computers, CP Panel, UPS panel etc.) interfacing through RS232/ RS 485 ports/ Ethernet ports for serial data on MODBUS protocol. RTU shall support standard MODBUS (ASCII and RTU) protocol.
o) The RTU shall have provision to give analog and digital data (available in the RTU) over MODBUS protocol to third party systems (other than SCADA servers) through serial port. The register addresses for AI and DI parameters shall be configurable.
p) It shall be possible to do configure / write IED interface in RTU for which necessary software tools shall be supplied.
q) For communication with IEDs through serial ports, the RTU shall support 16-bit, 32-bit, signed, unsigned, integer and floating point data type
r) Rate of change of alarm
s) RTU resident accumulator points driven by analog points.
t) RTU should be capable to bulk AO (writing): SCADA – RTU on DNP protocol, RTU To IED (FC) on Modbus [RTU take AO all the around 10 gas composition parameter (as per AGA-3/8]

12.2 Time synchronization of Remote Telemetry Units shall be possible from SCADA System with a resolution of 100 msec.

12.3 The RTU shall scan and acquire parameters from field as per programmed (user configurable) scan cycles.

12.4 RTU should have event logging and buffering feature. In case of communication loss, RTU shall store the time stamped 5000 analog events and 1000 digital events in the buffer and transmit to master station on receiving the poll request after restoration of link.

12.5 The RTUs shall have a self diagnostic feature and software watchdog timer devices to monitor & report the healthiness of CPU, memory, power supply, comm. interfaces and Input/Output modules at the local level. Further the RTUs shall support remote diagnostics from MMS / BMS so that all these status shall be transmitted to MMS / BMS and displayed in the RTU status graphic.

12.6 Analog input card and Analog output card shall be self calibrating type and event shall be sent to MMS / BMS for out of calibration. Analog input card shall generate an event, if it is out of calibration, which shall be sent to MMS / BMS. Further if Analog output card is not self-calibrating type then all Analog outputs shall be wired back as along inputs and calculations performed on each channel to detect AO card out of calibration. This out of calibration shall be available as part of RTU status graphics along with set point value displayed in the graphics, next to the corresponding controller symbol.

12.7 It shall scan and acquire parameters from process as per programmed scan cycles.

12.8 RTUs shall be intelligent in support of the following:

a) It shall process the analog data for high-low limit violations as per stored limit tables and communicate the same to MMS / BMS along with time stamping.
b) Linear conversion to engineering units and input filtering, in case engineering unit conversion is being done at RTU level [conversion of raw data to normalized values (e.g. 0 to 1.0) for communication shall also be acceptable].
c) To support remote reconfiguration and downloading of parameters i.e. addition, deletion, modification and reassignment with different range, limits etc. from workstations to avoid local engineering at RTU level. The following requirements of RTU configuration form MMS / BMS shall be fulfilled:

(i) The remote configuration wrt following parameters for the points defined in the RTUs shall be remotely done form active SCADA Server at MMS / BMS, in case the features of Alarm generation, association of the alarm priority and engineering unit conversion are implemented at the RTU level.

- Analog alarm limits
- Analog scaling factor for engineering unit conversion
- Threshold value
- Smoothing factor (filter time constant) etc.

These shall be automatically updated to the standby SCADA Server also.

(ii) PDT configuration unit (Laptop, hardware & software with cables & connectors) shall be provided to create configuration file involving definition of:

- I/O modules attached to the RTUs
- Type of each I/O modules and time stamping requirements for points in each module.
- Software logic in RTUs
- Physical and software interfaces connected to the RTUs

(iii) The configuration file shall be able to be transferred online from MMS / BMS using the existing data channels to the corresponding RTU.

(d) Time stamping of all exception reports.

12.9 RTU shall comply the following:

a) RTU shall be capable of updating process parameters data and configuration data in its own built-in memory. Time stamping of all field values at RTU shall be required. In the event of failure or break of communication link, the RTU shall continue to scan all parameters and update its database.

b) RTU shall retain in its database the complete analog and digital information of the field till it is completely and correctly read by MMS / BMS in order to take care of no loss of data in case of failure of MMS / BMS. The RTU shall scan the field and the memory buffer is to be sized to store all the changing data (i.e. new exception report for the data every poll time) and MMS / BMS receive the same without any loss of data and alarms in the SCADA system.

c) Further to take care of long term communication outage with SCADA system, the RTUs shall be designed to also scan the field and store in the memory time stamped 5000 analog events and 1000 digital events during the period of communication outage for retrieval by SCADA system subsequently. The RTU memory sizing shall be adequate for the same. In case additional memory cards are required to meet this requirement, the same shall be provided by the vendor. RTUs buffer shall also be circular buffer with new events replacing old events.

d) The RTU system shall have the facility to attach to each digital event signal a time tag generated by the RTU local clock to enable the occurrence to be recorded and transferred to SCADA system.

12.10 At the RTU, failure of a module in a subsystem shall be identified by an individual LED display

12.11 Each I/O shall be protected against the reversal polarity of the power voltage to I/O

12.12 The RTU should have provision for time stamping of all analog exception reports and digital state changes. The RTU time stamped analog & digital data shall be sent to SCADA system

12.13 The RTU shall support communication protocol supporting report by exception to prevent unnecessary data communication when data is not changing and also support downloading of exception value deadband (each analog input wise) from SCADA system

12.14 It shall be possible to have highest priority of alarms, in order for the same to be sent to MMS / BMS.

12.15 It shall provide 'Check before Execute' feature before execution of command.

12.16 Every control associated with the RTU shall report the status of the point after control execution. In case the status has not changed within fixed specified time it shall report to MMS / BMS for not having executed the control.

12.17 RTU shall not generate any false control signal due to power supply on-off conditions.

12.18 RTU shall support communication protocol supporting report by exception to prevent unnecessary data communication when the data is not changing.

12.19 It shall provide error detection and control feature for data communication with SCADA Server to ensure data integrity.

12.20 It shall have feature of connecting a pluggable Programmable Diagnostic Test unit (PDT) with keyboard & monitors diagnostic and programming aid to trouble shoot and configuration tool for RTU and I/O boards. It shall be possible to exercise all the functions of the RTU without disconnecting the RTU from process.

12.21 RTU shall have provision for applying filtering on the input signals and scaling for engg. units conversion.

12.22 From SCADA Server, it shall be possible to off-scan complete RTU individually in addition to off-scan RTU points. In case of failure of complete RTU or off-scan of complete RTU only one alarm shall be generated and the RTU along & digital points shown in various graphics and printed in reports shall correspondingly have data integrity qualifier flag.

12.23 The RTU shall be able to store the configuration data and the process database upon power failure for at least one month on continues basis. Upon restoration on the power, RTU shall resume the normal operation automatically.

12.24 The failed RTU once put online shall initiate service requirement to SCADA Server for reinitialization

12.25 RTU shall operate power supply (230 V AC or 24 V DC as define elsewhere) as per power availability at site. Separate on/off power supply switch and fuse shall be supplied with each RTU. Vendor shall indicate power consumption for all the RTUs. Adequate isolation of input, output and power supply circuits shall be provided along with over voltage and short circuit protection.

Wherever 230V AC supply is provided for RTU, SCADA vendor shall carry out necessary conversion to covert the AC voltages to 24V DC for supply to field instrumentations and to RTU. The power to the field instrumentations is to be provided through barriers and all the digital output has to be driven through 3-5 A interposing relays. The necessary converter to covert the AC voltages to 24V DC, the barriers and the imposing relays shall form the integral part of the RTU.

12.26 All the field instrument connections for RTUs shall be terminated in the Control cum TIC panel. The I/O point wires shall not be directly terminated on the RTU I/O boards. Terminal blocks/panels is to be provided in the RTU cabinet. I/O termination blocks shall have both male and female portions so that to isolate the field wiring at RTU level, male/female termination block attached to be field wiring can be pulled out instead of removing the wiring. Printed tube type Cross ferruling shall be done.

12.27 The RTU shall be Immune to radio frequency interference generated by any nearby source meeting the latest international standards in this regard (MIL, VDE etc.)

12.28 The RTU equipment shall function continuously without requiring any preventive maintenance.

12.29 RTUs shall be multidropped on a pair of communication channels. Upon failure of primary channels, RTU shall respond to MS / EMS requests/ interrogation on secondary channel automatically without any loss of data & operation. System shall provide status on the availability of each of the channels.

12.30 It shall be possible to output any AI (Including serial data from IEDs) & DI point value available in real time database at SCADA Server, as AO (Including serial data from IEDs) & DO to any RTU respectively. The relay contact configuration shall be provided up to the RTU terminal block. The DO command contact closure duration shall be configurable. It shall be possible to configure DO contact duration open or close for a long duration as per the DI status. Within the scope of this tender, vendor shall down load Gas Chromatograph value to those Flow Computers, in whose locations Gas Chromatograph is not available, through the same serial link which is used for reading the Flow Computer values. Source Gas Chromatograph and target Flow Computers will be finalized during detail engineering.

12.31 For Gas Composition AGA Data writing from SCADA to Modbus Slave Flow Computer through RTU, Vendor should implement logic in RTU for smooth writing of AGA parameters in Modbus Slave after checking its validity and Gas Composition value of 100% as aggregated value. SCADA will write GC Analysis data to RTU over DNP Protocol, RTU will write all the GC data analysis data to IED (Flow computer over Modbus Protocol) Location, Modbus address shall be provided by Client/ MECON.

12.32 Non availability of any one of the two communication channels should not hamper the functioning of the other RTUs multidropped on the pair of channels.

12.33 It shall have feature of connecting a pluggable Programmable Diagnostic Test unit (PDT) with keyboard & monitors diagnostic and programming aid to trouble shoot and configuration tool for RTU and I/O boards. It shall be possible to exercise all the functions of the RTU without disconnecting the RTU from process.

12.34 Vendor shall detail the shelf and inter-shelf wiring and the termination of the wiring harness between the RTU, the terminal block area and the field instrumentation. Easy access to cabinet wiring, for maintenance purposes is essential. The RTU components shall be designed for high temperature rating and low power consumption so that air exchange with the ambient environment will not be required.

12.35 Identification labels for RTUs, RTU card files, power distribution boards, terminations etc complete in all respects properly correlating with the drawings is to be ensured by the vendor.

12.36 SCAN RATES

The local scan rate for the individual I/O modules shall be such that the time-tagging resolution and system performance requirements are achieved.

The consideration of scan times shall include the acquisition of data, processing and updating of the RTU database. The overall RTU local scan shall be defined as the time required to acquire field data and update the RTU database and the same shall be much faster than RTU poll time by MS / EMS. It is expected that scan rate shall not exceed 100 msec.

12.37 DIGITAL OUTPUT (CONTACT) SUBSYSTEM

- The contact output subsystem shall provide momentary closure of potential free contact relay output for the operation of equipments.

- The relay contact configuration shall be provided up to the RTU terminal block.

- The DO command contact closure duration shall be configurable. It shall be possible to configure DO contact duration open or close for a long duration and all contacts shall be voltage free.

- It shall not be possible for the RTU to energize an output that has not been selected for control.

- At RTU restart, following an RTU power failure, shall not reset the output circuits, shall not generate false control signal and shall cancel any pending control selection.
- The Digital Output should be configured for pulse duration. No separate program or logic will be acceptable at RTU end.
- The RTU shall provide 'Check before execute' feature as part of RTU protocol before execution of command
- Every control associated with RTU shall report the status of the point after control execution. In case, the status has not changed within specified time, it shall report to SCADA system for not having executed the control
- Each I/O shall be protected against the reverse polarity of the power voltage to I/O.

12.38 RTU Panels

RTU Panels shall be free standing and conform to NEMA-4 (IP52) requirement. The panels shall have lockable front and rear doors and bottom cable entry and provided with gasket and fitting to keep out moisture, dust, gases and corrosives. The panel shall be naturally cooled.

All doors, drawers, trays and other weight supporting parts shall be fabricated of metal and adequately reinforced to limit vibrations. All components and devices inside the panel shall be well highly and the panel shall have a tidy look.

The bidder shall furnish details of the shelf and inter-shelf wiring and the termination of the wiring harness between the RTU and the terminal block area.. the connections from PCB's to back frame wiring shall preferably be with gold plated edge connectors which utilize a wiping action. Easy access to cabinet wiring for maintenance purpose is essential. The I/O point wires shall not be terminated directly on the I/O boards. Termination panel is to be provided for this.

The CONTRACTOR shall guarantee satisfactory functioning of the system hardware mounted in the panels even in the event of failure of air-conditioning unit.

Each panel shall have provision for fully wired 20% spare additional space on the back pane/ chassis for mounting of additional IOs in future.

Hardware mounted and wired panels of all systems included in the scope of the CONTRACTOR shall be subjected to burn-in operation for minimum 15 days before dispatch to site.

12.39 SET POINT CONTROLS

- All analog output control functions shall utilize the select-check-operate control sequence associated with set point control.

12.40 COMMUNICATION PORT

- The RTU shall support both internal and external communication functions. The communications network internal to the RTU shall be designed and implemented in such a way that the passing of data and commands shall not be prevented by the failure of any module not directly involved in the communication exchange. In addition, the internal network shall not become overloaded under the heaviest traffic possible in an RTU's ultimate expansion configuration.
  a) Each RTU shall recognize its own unique address and shall have the capability of being assigned any address within a range of possible addresses. The LED indication shall be provided in the RTU to check the health of RTU communication.
  b) The RTU shall support DNP 3.0 protocol (both DNP 3.0 (Serial) and DNP 3.0 (TCP/IP)) for communicating with SCADA servers.
  c) The RTU shall have dual Ethernet ports (IEEE 802.3) for TCP/IP communication with SCADA system in multi-dropped environment.
  d) The RTUs shall have the provision to be polled for data by SCADA system, independently and simultaneously on both communication ports. Both the primary and secondary ports (for SCADA server communication) shall have same data in their buffer at a time.
  e) RTU buffer shall be sized in such a way to include simultaneous polling of 10 flow computers over dedicated point to point serial communication and simultaneous polling of flow computers shall not degrade the performance of RTUs.
  f) Each communication port of RTU shall be isolated and surge protected.

12.41 SERIAL PORT FOR POLLING IED OVER MODBUS (MASTER AND SLAVE)

- The RTU shall be equipped with the necessary no of serial ports for polling the IEDs as specified.
- Each serial port of the RTU shall have following provision for communication with Flow Computer / Gas Chromatograph/Sulfur & Moisture Analyzer / PLC:

a) RS-232C communications
b) Support for baud rates from 4800 bps to 64 kbps.
c) Variable parity: Odd, Even, None
d) Variable data bits: 7, 8
e) Support for various Modbus function codes.
f) Support for Modbus ASCII and RTU
g) Provision to be configured as Modbus Master or slave.
h) DB-9 port for serial communication
i) Diagnostic feature for Modbus communication. It shall be possible to view the Modbus data transfer either in the RTU serial card or through the RTU configuration software for diagnostic purpose

12.42 RTU DIAGNOSTIC AND CONFIGURATION SOFTWARE

- The RTU diagnostic and configuration software shall provide the overall management of the supervision, monitoring and control function within the RTU and communications, comprehensive diagnostic facilities and RTU startup procedures. Bidder to supply licenses for 6 Nos of RTU configuration software.
- RTU configurator / diagnostic software shall have the following provisions:

a) The software shall be compatible with latest OS.
b) DNP index of all I/O points along with real time field value shall be viewable in diagnostic software table/window.
c) Facility to issue controls (DOs) from RTU to field.
d) The RTU configurator shall have provision for configuring / interfacing IEDs (Flow computer/ PLCs/ GC) over MODBUS protocol (ASCII and RTU) with the RTU.
e) The RTUs shall have a self-diagnostic feature (without uploading / downloading RTU configuration to PC/Laptop) and software watchdog timer devices to monitor and report the healthiness of CPU, memory, power supply, comm. Interfaces (both DNP communication with SCADA system and serial communication) and input/output modules at the local level. Further the RTUs shall support remote diagnostics from SCADA system so that all these status shall be transmitted to SCADA system for displaying in SCADA graphics.
f) The RTU configurator shall have provision for configuring RTU serial port as Modbus slave for polling by third party systems (other than SCADA servers). It should be possible to assign AI and DI data available in RTU to Modbus register addresses for accessing by 3rd party systems.
g) It should be possible to download configuration to RTUs from the SCADA system / PDT online and offline.
h) RTU configurator licenses shall be preferred in software (software key) form instead of hardware (dongle).
i) RTU shall have error detection/control feature to ensure data integrity.
j) It shall be possible to configure, generate and compile RTU configuration file in Offline mode that can be downloaded in RTU

12.43 CYBER SECURITY REQUIREMENTS FOR RTU

- The proposed RTU by the vendor shall have the following cyber security features from the outset.
- Any licensed software or license required to meet the following cyber security features shall be provided by the vendor with the RTU –
  a) DNP3 with level-4
  b) DNP3 (SAv5)
  c) AGA-12 DNP3 Data encryption
  d) RTU should be capable to bulk AO (writing): SCADA – RTU on DNP protocol, RTU To IED (FC) on Modbus [RTU take AO all the around 10 gas composition parameter (as per AGA-3/8] from SCADA and then buffer it and calculate total Gas composition to 100%, only then RTU should write to FC) which is in compliance of O&M maintenance policy.
  e) User access control
  f) Password complexity
  g) Role Based Access Control
  h) Integrated firewall
  i) Patch management (The frequency of patches as provided by OEM shall also be indicated)
  j) Support Network access control (Authentication) IEEE 802.1X
  k) Support Application access control (Authentication) DNP3 Secure Authentication in firmware
  l) Should be able to restrict Master IP

13.0 PACKAGING:

The RTU shall be packaged to withstand rough handling during ocean shipment and in-land journey. It shall be vendor's responsibility to make good any deterioration that

occurs during shipment. Sling points shall be clearly indicated on crates.

14.0 DATA AND DRAWING DETAIL

Vendor shall furnish all the documents as per "Vendor Data Requirements" enclosed with Material Requisition/ Job Specifications. All the other documents as per Technical specification and the documents required for better understanding and execution of the job to be supplied by the Vendor.

A certificate from statutory authorities confirming suitability of design / construction of all electrical and electronic items for use in hazardous area classification has to be furnished.

ANNEXURE-1

TECHNICAL SCHEDULE TO BE FILLED BY THE TENDERER

The Bidder shall fill the following technical particulars and submit the same with the offer for selected Remote Telemetry Unit.

Item	Description	Particulars
	GENERAL	
1.	Make	
2.	Model no.	
3.	Degree of protection (IP No.)	
4.	Operating temperature range (degree centigrade)	
5.	Operating relative humidity range %	
6.	Maximum number of I/O modules per subrack Main subrack Extension subrack	
7.	Maximum number of communication modules per subrack	
8.	Selectable communication speed range	
09.	Resolution of time tagging	
10.	High/low limit checking yes/no	
11.	Whether RTU supports self-checkback-execute and time out feature yes/no	
12.	Interfacing with flow computers of different makes (Instromet/Spectra Tek, etc.) yes/no	
13.	Remote configuration and downloading of parameters from Master Station supported yes/no	
14.	Self diagnostic of RTU and reporting it to Master Station yes/no	
15.	Number of serial ports supported in addition to redundant communication links with Master Station (minimum 4 nos.)	
16.	Whether RTU supports connection of portable maintenance diagnostic test unit yes/no	
17.	Whether hardware for 25 % spare installed I/O's for RTU included yes/no	
18.	MTBF for a fully equipped RTU h	
19.	Equipment availability %	
20.	MTTR for a fully equipped RTU h	
21.	Power requirement for a fully equipped RTU W	
22.	Maximum number of I/O modules per RTU (separately for each type to be given)	
23.	Spare capacity for each type of I/O	

Item	Description	Particulars
24.	Rack dimensions	
25.	**Main Processing Module** Module designation	
26.	Microprocessor type	
27.	Word length	
28.	Basic clocking rate	
29.	Engineering unit conversion yes/no	
30.	Arithmatic processor facility with floating point capability yes/no	
31.	Programe location (i.e. EPROM,RAM)	
32.	EPROM k bytes	
33.	RAM k bytes	
34.	RAM battery back up for one month yes/no	
35.	Type of data bus available for communication among the I/O modules (serial/parallel)	
36.	MTBF h	
37.	Equipment availability %	
	Response Times	
38.	Time taken to access and display information requested by the user from the Master Station	
39.	Time taken to write one modified entry to the data base from Master Station	
40.	Time taken to write one modified entry to the data base from RTU maintenance facility	
41.	Time taken to validate a complete database following an instruction from the Master Station	
	Compliance with CCITT recommendations	
42	Physical interface	

Item	Description	Particulars
	ANALOG INPUT MODULE	
1.	Module designation	
2.	Microcontroller/microprocessor type	
3.	No. of inputs per module	
4.	Type of ADC	
5.	Scanning resolution bits	
6.	Whether AI module of self calibrating type and event reporting to Master Station if out of calibration yes/no	
7.	Accuracy %	
8.	Conversion time ms	
9.	Type of Analog multiplexer	
10.	Method of isolation	

11.	Surge withstand capability (as per IEEE Standards)	
12.	MTBF h	
13.	Equipment availability %	
14.	Power requirement W	
15.	Signal support: 4-20 mA and 0-5 V(Yes/No)	
	DIGITAL INPUT MODULE	
15.	Module designation	
16.	Microcontroller/microprocessor type	
17.	No. of inputs per module	
18.	Is input module type configurable as a) Status and alarms b) Sequence of events c) Parallel input d) Pulse accumulator e) Any combination of these	
19.	Contact bounce protection yes/no	
20.	Optical isolation yes/no	
21.	Scan time ms	
22.	Noise rejection yes/no	
23.	Surge withstand capability (as per IEEE standard)	
24.	MTBF h	
25.	Equipment availability %	
26.	Power requirement W	

	DIGITAL OUTPUT MODULE	
27.	Module designation	
28.	Microcontroller/microprocessor type	
29.	No. of outputs per module	
30.	Maximum output current mA	
31.	Maximum switched output voltage V	
32.	MTBF h	
33.	Equipment availability %	
34.	Power requirement W	
	ANALOG OUTPUT MODULE	
35.	Module designation	
36.	Microcontroller/microprocessor type	
37.	No. of outputs per module Max. no. of voltage outputs Max. no. of current outputs	
38.	Type of output interface (DAC)	
39.	DAC resolution bits	

40.	Overall accuracy	
41.	Type of isolation	
42.	Whether module of self calibrating type and event reporting to Master Station if out of calibration yes/no	
43.	MTBF h	
44.	Equipment availability %	
45.	Power requirement W	
	COMMUNICATION MODULE	
46.	Module designation	
47.	Microcontroller/microprocessor type	
48.	No. of communication channels	
49.	Type of communications interfaces supported	
50.	Designation of communication protocol	
51.	Type of protection	
52.	Type of isolation	
53.	MTBF h	
54.	Equipment availability %	
55.	Power requirement W	
56.	The standards to which modem conforms to	

	POWER SUPPLY MODULE	
57.	Module designation	
58.	Nominal input voltage V	
59.	Operating voltage range %	
60.	Output voltage range V	
61.	Input voltage protection kV	
62.	Output voltage protection kV	
63.	MTBF h	
64.	Equipment availability %	
65.	Power requirement for a fully equipped RTU W	

ANNEXURE –II

I/O LIST

MECON LIMITED	PARTICULAR JOB SPECIFICATION			
	PJS No.: MEC/05/E5/T/23VC/PJS-094			
	Rev. 0		ANNEXURE-II to PJS	Page 1 of 1

I/O LIST

Sl. No.	RTU	Location	Type of RTU as per MR	AI I/O's						AO I/O's	DI I/O's						DO I/O's						Serial / Ethernet ports					
				Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total		Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total	Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total	Inst	Electrical	UPS / Solar	Fire	LEL	Total
PART A																												
1	RTU - Guwahati Ph-I	DT, Guwahati Ph-I	DT	12	4	6	0	0	22	2	26	2	10	5	2	45	8	2	0	0	0	10	2	1	1	0	1	5
2	RTU-SV 1	SV-1	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
3	RTU-SV 2	SV-2	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
4	RTU-SV 3	SV-3	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
5	RTU-SV 4	SV-4	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
6	RTU-IP 1	IPS	IP	12	4	6	0	0	22	2	26	2	10	5	2	45	8	2	0	0	0	10	2	1	1	0	1	5
7	RTU-SV 5	SV-5	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
8	RTU-SV 6	SV-6	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
9	RTU-SV 7	SV-7	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
10	RTU-SV 8	SV-8	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
11	RTU-IP 2	IPS	IP	12	4	6	0	0	22	2	26	2	10	5	2	45	8	2	0	0	0	10	2	1	1	0	1	5
12	RTU-SV 9	SV-9	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
13	RTU-SV 10 cum DT	SV-10 cum DT	SV cum DT	12	4	6	0	0	22	2	26	2	10	5	2	45	8	2	0	0	0	10	0	1	1	0	0	2
14	RTU-SV 11	SV-11	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
15	RTU-SV 12	SV-12	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
16	RTU-SV 13	SV-13	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2

MECON LIMITED	PARTICULAR JOB SPECIFICATION			
	PJS No.: MEC/05/E5/T/23VC/PJS-094			
	Rev. 0		ANNEXURE-II to PJS	Page 1 of 1

I/O LIST

Sl. No.	RTU	Location	Type of RTU as per MR	AI I/O's						AO I/O's	DI I/O's						DO I/O's						Serial / Ethernet ports					
				Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total		Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total	Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total	Inst	Electrical	UPS / Solar	Fire	LEL	Total
17	RTU-IP 3	IPS	IP	12	4	6	0	0	22	2	26	2	10	5	2	45	8	2	0	0	0	10	2	1	1	0	1	5
18	RTU-SV 14	SV-14	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
19	RTU-SV 15	SV-15 cum DT	SV cum DT	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
20	RTU-SV 16	SV-16	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
21	RTU-RT Numaligarh	RT Numaligarh	RT	12	4	6	0	0	22	2	26	2	10	5	2	45	8	2	0	0	0	10	2	1	1	0	1	5
22	RTU-SV 1 (I)	SV-1 (I)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
23	RTU-RT Itanagar	RT Itanagar	RT	12	4	6	0	0	22	2	26	2	10	5	2	45	8	2	0	0	0	10	2	1	1	0	1	5
24	RTU-SV 1D	SV-1 D	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
25	RTU-SV 2D	SV-2 D	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
26	RTU-SV 3D	SV-3 D	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
27	RTU-SV 4D	SV-4 D	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
28	RTU-SV 5D	SV-5 D	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
29	RTU-SV 6D	SV-6 D	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
30	RTU-SV 7D	SV-7 D	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	0	0	4	0	1	1	0	0	2
31	RTU-RT Dimapur	RT Dimapur	RT	22	4	6	0	0	32	2	44	2	10	5	2	63	12	2	0	0	0	14	2	1	1	0	1	5
32	RTU - Guwahati Ph-II	RT cum DT, Guwahati Ph-II	DT	12	4	6	0	0	22	2	26	2	10	5	2	45	8	2	0	2	0	12	2	1	1	0	1	5

MECON LIMITED	PARTICULAR JOB SPECIFICATION			
	PJS No.: MEC/05/E5/T/23VC/PJS-094			
	Rev. 0		ANNEXURE-II to PJS	Page 1 of 1

I/O LIST

Sl. No.	RTU	Location	Type of RTU as per MR	AI I/O's						AO I/O's	DI I/O's						DO I/O's						Serial / Ethernet ports					
				Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total		Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total	Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total	Inst	Electrical	UPS / Solar	Fire	LEL	Total
33	RTU-SV 1	SV-1	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
34	RTU-SV 2	SV-2	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
35	RTU-SV 3	SV-3	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
36	RTU-SV 4	SV-4	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
37	RTU-IP 1 cum DT	IPS-1	IP	19	4	6	0	0	29	2	38	2	10	5	2	57	12	2	0	2	0	16	2	1	1	0	1	5
38	RTU-SV 5	SV-5	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
39	RTU-SV 6	SV-6	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
40	RTU-SV 7	SV-7	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
41	RTU-IP 2	IPS	IP	12	4	6	0	0	22	2	26	2	10	5	2	45	4	2	0	2	0	8	2	1	1	0	1	5
42	RTU-SV 8 cum DT	SV-8 cum DT	SV cum DT	12	4	6	0	0	22	2	26	2	10	5	2	45	4	2	0	2	0	8	2	1	1	0	1	5
43	RTU-SV 9	SV-9	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
44	RTU-SV 10	SV-10	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
45	RTU-SV 11	SV-11	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
46	RTU-SV 12	SV-12	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
47	RTU-RT Panisagar	RT Panisagar	RT	24	4	6	0	0	34	2	48	2	10	5	2	67	16	2	0	2	0	20	4	1	1	0	1	7
48	RTU-SV 1 (SH)	SV- 1 (SH)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
49	RTU-RT Shillong	RT Shillong	RT	12	4	6	0	0	22	2	26	2	10	5	2	45	4	2	0	2	0	8	2	1	1	0	1	5

MECON LIMITED	PARTICULAR JOB SPECIFICATION			
	PJS No.: MEC/05/E5/T/23VC/PJS-094			
	Rev. 0		ANNEXURE-II to PJS	Page 1 of 1

I/O LIST

Sl. No.	RTU	Location	Type of RTU as per MR	AI I/O's						AO I/O's	DI I/O's						DO I/O's						Serial / Ethernet ports					
				Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total		Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total	Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total	Inst	Electrical	UPS / Solar	Fire	LEL	Total
50	RTU-SV 1 (SIL)	SV- 1 (SIL)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
51	RTU-SV 2 (SIL)	SV- 12(SIL)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
52	RTU-RT Silchar	RT- Silchar	RT	12	4	6	0	0	22	2	26	2	10	5	2	45	4	2	0	2	0	8	2	1	1	0	1	5
53	RTU-SV 1 Agartala	SV-1 (AG)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
54	RTU-SV 2 Agartala	SV-2 (AG)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
55	RTU-SV 3 Agartala	SV-3(AG)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
56	RTU-SV 4 Agartala	SV-4 (AG)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
57	RTU-SV 5 Agartala	SV-5 (AG)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
58	RTU-SV 6 Agartala	SV-6 (AG)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
59	RTU-RT Agartala	RT Agartala	RT	19	4	6	0	0	29	2	38	2	10	5	2	57	12	2	0	2	0	16	2	1	1	0	1	5
60	RTU-DT Kubal	DT Kubal Fields	RT	12	4	6	0	0	22	2	26	2	10	5	2	45	4	2	0	2	0	8	2	1	1	0	1	5
61	RTU-SV 1 Aizawl	SV-1 (AZ)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
62	RTU-SV 2 Aizawl	SV-2 (AZ)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
63	RTU-SV 3 Aizawl	SV-3 (AZ)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
64	RTU-SV 4 Aizawl	SV-4 (AZ)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
65	RTU-SV 5 Aizawl	SV-5 (AZ)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
66	RTU-SV 6 Aizawl	SV-6 (AZ)	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2

I/O LIST

Sl. No.	RTU	Location	Type of RTU as per MR	AI I/O's						AO I/O's	DI I/O's						DO I/O's						Serial / Ethernet ports					
				Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total		Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total	Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total	Inst	Electrical	UPS / Solar	Fire	LEL	Total
67	RTU-RT Aizawl	RT Aizawl	RT	12	4	6	0	0	22	2	26	2	10	5	2	45	4	2	0	2	0	8	2	1	1	0	1	5
68	RTU-SV 1 Tulumura	SV-1	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
69	RTU-SV 2 Tulumura	SV-2	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
70	RTU-SV 3 Tulumura	SV-3	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
71	RTU-SV 4 Tulumura	SV-4	SV	6	4	6	0	0	16	0	6	2	10	5	0	23	2	2	0	2	0	6	0	1	1	0	0	2
72	RTU-DT Tulumura	DT Tulumura	RT	12	4	6	0	0	22	2	26	2	10	5	2	45	4	2	0	2	0	8	2	1	1	0	1	5
73	RTU-RT Neepco	RT Neepco	RT	12	4	6	0	0	22	2	26	2	10	5	2	45	4	2	0	2	0	8	2	1	1	0	1	5

PART -B

1	SV-1 (DIPL)	SV-1 of DIPL	SV	3	0	4	0	0	7	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
2	SV-2 (DIPL)	SV-2 of DIPL	SV	3	3	4	0	0	10	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
3	SV-3 CUM RT (DIPL)	SV-3 of DIPL	SV	3	0	4	0	0	7	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
4	SV-4 (DIPL)	SV-4 of DIPL	SV	3	3	4	0	0	10	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
5	SV-5 (DIPL)	SV-5 of DIPL	SV	3	0	4	0	0	7	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
6	SV-6 (DIPL)	SV-6 of DIPL	SV	3	3	4	0	0	10	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
7	IP-1 (DIPL)		IP	9	5	3	0	0	17	0	34	0	8	5	0	47	8	0	0	0	0	8	1	0	1	1	0	3

MECON LIMITED	PARTICULAR JOB SPECIFICATION			
	PJS No.: MEC/05/E5/T/23VC/PJS-094			
	Rev. 0		ANNEXURE-II to PJS	Page 1 of 1

I/O LIST

Sl. No.	RTU	Location	Type of RTU as per MR	AI I/O's						AO I/O's	DI I/O's						DO I/O's						Serial / Ethernet ports					
				Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total		Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total	Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total	Inst	Electrical	UPS / Solar	Fire	LEL	Total
8	SV-7 (DIPL)	SV-7 of DIPL	SV	3	0	4	0	0	7	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
9	SV-8 (DIPL)	SV-8 of DIPL	SV	3	3	4	0	0	10	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
10	SV-9 (DIPL)	SV-9 of DIPL	SV	3	0	4	0	0	7	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
11	SV-10 (DIPL)	SV-10 of DIPL	SV	3	3	4	0	0	10	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
12	RT-IMPHAL (DIPL)	RT OF DIPL	RT	5	4	3	0	0	12	0	18	0	8	5	0	31	4	0	0	0	0	4	1	0	1	1	0	3
13	DT-SILIGURI (SGPL)	DT OF SGPL	DT	5	4	3	0	0	12	0	14	0	8	5	0	27	4	0	0	0	0	4	1	0	1	1	0	3
14	SV-1 (SGPL)	SV-01 of SGPL	SV	3	0	4	0	0	7	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
15	SV-2 (SGPL)	SV-02 of SGPL	SV	3	3	4	0	0	10	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
16	SV-3 (SGPL)	SV-03 of SGPL	SV	3	0	4	0	0	7	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
17	SV-4 (SGPL)	SV-04 of SGPL	SV	3	3	4	0	0	10	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
18	SV-5 (SGPL)	SV-05 of SGPL	SV	3	0	4	0	0	7	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
19	IP-1 (SGPL)	IP-01 of SGPL	IP	9	5	3	0	0	17	0	34	0	8	5	0	47	8	0	0	0	0	8	1	0	1	1	0	3
20	SV-6 (SGPL)	SV-06 of SGPL	SV	3	0	4	0	0	7	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
21	SV-7 (SGPL)	SV-07 of SGPL	SV	3	3	4	0	0	10	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2

MECON LIMITED	PARTICULAR JOB SPECIFICATION			
	PJS No.: MEC/05/E5/T/23VC/PJS-094			
	Rev. 0		ANNEXURE-II to PJS	Page 1 of 1

I/O LIST

Sl. No.	RTU	Location	Type of RTU as per MR	AI I/O's						AO I/O's	DI I/O's						DO I/O's						Serial / Ethernet ports					
				Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total		Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total	Inst	CP/CC & Cathodic Protection	UPS / Solar / Electrical	Fire	LEL	Total	Inst	Electrical	UPS / Solar	Fire	LEL	Total
22	SV-8 (SGPL)	SV-01 of SGPL	SV	3	0	4	0	0	7	0	8	0	8	5	0	21	2	0	0	0	0	2	1	0	0	1	0	2
23	RT-GANGTOK (SGPL)	RT of SGPL	RT	5	4	3	0	0	12	0	18	0	8	5	0	31	4	0	0	0	0	4	1	0	1	1	0	3

NOTES:

	1	In Addition to the above Quantities 25% Spare I/Os shall be considered while sizing of RTU for each Station. Each spare channel of each type of I/O shall be terminated till the terminal block of each RTU.
	2	The I/Os for each system are tentative. If any number of the IO points (including the MODBUS port) mentioned in the IO list is not used for its intended purpose, the same shall be utilised by IGGL/ MECON for other purpose as deemed necessary by IGGL/ MECON.
	3	The I/O Counts will be finalized during Detail Engineering.
	4	In addition to above, Minimum 1 no. spare RS-232 and 2 nos. of spare RS 485 ports shall be provided at each station
	5	Serial Port includes for Electrical (Solar, UPS), Fire & Safety and Cathodic Protection (CP).
	6	Spare SV type RTU shall be provided similar to the RTU of SV-1 (RTU- SV-1) of Part A. Spare RT /DT type RTU shall be provided similar to the RTU of RT, Panisagar (RTU- RT- Panisagar) of Part A.

SCADA SYSTEM SPECIFICATIONS

The Bidder shall provide state of the art SCADA System to meet the total functional requirements of the specification, including future expansion and consisting of the following [Refer System Drawings]:-

1.0 SCADA System Network:

SCADA System shall comprise of Redundant Main Master Station (MMS), Redundant Backup Master Station (BMS) History Server, Web Server, OPC Server, GPS Server (only at MMS Location), APPS Server, APPS EWS, SCADA EWS, Remote Work Station (RWS), several Remote Telemetry Units (RTUs). These RTU's shall be multi dropped on DNP 3.0 (TCP/IP (Ethernet)) channels via OFC link for a reliable SCADA function from MMS.

The SCADA system operation shall be through unmanned Local control through RTU's and shall be based on a 24 Hrs per day, 365 day per year schedule. The Main Master Station, shall monitor the pipeline integrity and operation and BMS to act as backup for the MMS.

The SCADA EWS and RWS shall be connected to MMS as well as BMS through separate 2 Mbps OFC links as remote clients so that in case of failure of MMS, data can be viewed using BMS. The SCADA EWS at BMS shall remain connected to MMS in normal operation. Location will be finalized during detailed engineering.

1.1 SCADA Main Master Station [MMS] has been proposed tentatively at DT, Guwahati of Ph-I Backup Master Station [BMS] has been proposed tentatively at RT, Numaligarh and SV cum DT, Silchar. SCADA EWS and RWS have been planned as per the system architecture. The locations of MMS, BMS , SCADA EWS , History Server, Web Server, OPC Server, GPS Server, APPS Server, APPS EWS, RWS indicated are tentative and shall be firmed up during document approval.

1.2 **Remote Terminal Units [RTUs]**

Providing number of RTU as per MR. These RTUs shall be polled and switch-able among MMS and BMS.

These RTU's shall be multidropped on DNP 3.0 (TCP/IP (Ethernet)) channels via OFC link for a reliable SCADA function from MMS/BMS.

1.3 SCADA SYSTEM SPECIFICATIONS

1.3.1 OPERATING SYSTEM REQUIREMENT OF SCADA SYSTEM

1.3.1.1 The SCADA system shall be reliable, field proven and evolutionary state of the art.

1.3.1.2 The SCADA system shall meet the following requirements for operating system:

(i) The SCADA system shall be built around Microsoft Windows / UNIX operating systems as per following:

- All the servers of the SCADA system) at MMS and BMS shall be based on OS as recommended by SCADA OEM.

- The web server, OPC server, History Server, GPS server, APPS Server and SCADA EWS, APPS EWS, RWS etc. shall be based as per SCADA Vendor's recommendation.

ii) The SCADA system shall be Web based.

(iii) The SCADA system shall be OPC server and client compliant for interfacing with third party applications like Web Server, GPS server etc.

(iv) All the SCADA servers, machines and networking devices shall be IPv4 and IPv6 compliant.

(v) The networking shall support OSI TCP/IP network connectivity.

2.0 SCADA SYSTEM PHILOSOPHY

2.1 Main Master station (MMS) & Backup Master Stations (BMS-1 and BMS-2)

The MMS and the BMS (BMS-1 and BMS-2) shall have the complete SCADA database of all pipelines including field value database, point database, and configuration database. In case of partial or complete shutdown/failure of MMS, all the affected SCADA functionalities shall be operational from BMS-1 automatically and incase of failure of MMS and BMS-1, all the affected SCADA functionalities shall be operational from BMS-2 automatically. Health status of each of the SCADA Servers, system nodes, and field devices (RTU/PLC / IEDs) communication paths/routes/links shall be updated in SCADA system.

The servers at MMS/BMS(BMS-1 and BMS-2) will have real time information of all the pipeline areas. Also all real time information to third party application through OPC, Web servers, History servers will be provided by the SCADA servers. The servers (MMS and BMS(BMS-1 and BMS-2)) shall support communication through OPC.

Web Servers shall be used for providing the data to users connected over Intranet / Internet.

SCADA Engineering workstation (EWS) shall be used for development / engineering activities related to database, graphics, reports etc All database, graphics, reports etc shall be downloaded from MMS/BMS(BMS-1 and BMS-2) to SCADA EWS and RWS.

For interfacing the SCADA data with third party software, the SCADA system shall be OPC compliant (client as well as server).

The MMS and BMS shall have the complete SCADA database including the real time database and integrated alarm / event management summary for overall operations management & control for the entire pipeline network.

The SCADA system shall be completely redundant in design, built of dual redundant modules or sub systems, like servers, networks, workstations, communication equipment, printers, storage devices and RTUs. Individual network cards shall be installed in these devices to connect to each LAN. The workstations at BMS(BMS-1 and BMS-2) and other RWS locations shall provide complete SCADA HMI capability and shall access the MMS as remote clients.

MMS SCADA Server #1 (Primary) and SCADA Server #2 (Secondary) shall be configured in dual hot standby mode.

Similarly, BMS-1 SCADA Server #1 (Primary) and SCADA Server #2 (Secondary) shall be configured in dual hot standby mode. BMS-2 SCADA Server #1 (Primary) and SCADA Server #2 (Secondary) shall be configured in dual hot standby mode.

Normally, primary server at MMS shall poll all the RTU's on primary path. In case of any problem in primary paths, polling of RTUs shall be done by secondary path. In case of problem in both primary and secondary paths of primary server at MMS, the RTU's shall be polled by secondary server at MMS on the primary path. In case of problem in primary path of secondary server at MMS, polling of RTUs shall be done by secondary path. So in case of primary server failure, polling of RTU's shall be done by secondary server. The change over from primary to secondary shall be accomplished within 1 minute automatically without causing any loss of data and without any effect to SCADA functionality. The Switchover between redundant equipment or sub system shall be transparent and bump-less for both the process and the operations, apart from the event/alarm announcing the switchover. (Refer below details for RTU polling on MMS & BMS(BMS-1 and BMS-2)).

Operator shall be informed about the failed system by an event massage by active SCADA server / standby server. When a RTU is being polled through one path, the MMS shall continue to obtain health as well as path status of the RTU through the secondary / other path of the RTU. On restoration of a failed path, MMS shall revert back to the earlier preferred path for polling as desired above. The entire sequence as mentioned above shall be fully automatic without any human intervention whatsoever.

In case both the server of at MMS are down i.e. MMS is not available, then the polling shall be done by BMS-1 automatically using the above control philosophy. All the SCADA EWS and RWS shall get connected to BMS-1 via router at MMS and SCADA EWS and RWS shall also be connected to MMS via router at BMS-1.

In case both the server of at MMS and BMS-1 are down i.e. both MMS and BMS-1 are not available, then the polling shall be done by BMS-2 automatically using the above control philosophy. All the SCADA EWS and RWS shall get connected to BMS-2 via router at BMS-1

At MMS the database including Real time database, historic database, archive database and configuration database (the operator supervisory actions i.e. manual inputs, online SCADA data base, alarm acknowledgments, alarm inhibit, digital controls, set-point controls etc.) shall be synchronized between Primary & Secondary Server to maintain database consistency. The interchange of health message between Primary & Secondary Server shall be implemented through dual Local Area Network (LAN). Health status of each of the SCADA Servers, system nodes, RTUs and the remote workstations shall be updated at MMS in real-time.

On re-induction of failed SCADA Server, the operator shall be informed by a suitable event message generated by the system that the Server is fully synchronized with the active SCADA Server. Based on the decision by supervisor or engineer, the restored machine shall continuous to be hot standby or it shall be possible by system engineer under suitable security password control to change the status of restored machine as active primary machine also.

In case of failure of MMS completely, BMS-1 SCADA server which is in hot standby mode shall take over automatically and polling of the RTUs shall be done through BMS-1 as per the philosophy described above. On restoration of MMS, it shall be possible by system engineer at MMS under suitable security password control to put BMS-1 SCADA Server in hot standby and subsequently make MMS to take control. The changeover to BMS-1 server shall be accomplished automatically without causing any loss of data and control and without any effect on SCADA functionality. Operator both at MMS & BMS-1 shall be informed about the failed system by a

suitable message by active SCADA / standby server. BMS-1 database to be synchronized with MMS database on real time all the time.

In case of failure of MMS and BMS-1 completely, BMS-2 SCADA server which is in hot standby mode shall take over automatically and polling of the RTUs shall be done through BMS-2 as per the philosophy described above. On restoration of MMS, it shall be possible by system engineer at MMS under suitable security password control to put BMS-2 SCADA Server in hot standby and subsequently make MMS to take control. The changeover to BMS-2 server shall be accomplished automatically without causing any loss of data and control and without any effect on SCADA functionality. Operator both at MMS & BMS-2 shall be informed about the failed system by a suitable message by active SCADA / standby server. BMS-2 database to be synchronized with MMS database on real time all the time.

Further, if the OFC link/low speed data channel fails at any intermediate position of the pipeline and MMS is not able to access the RTUs beyond the failure position, RTU shall be available through BMS-1 or BMS-2 on the other side of the broken link/channel automatically and the information of these effective RTUs shall be transferred through Leased line data channels for database synchronization, in such a manner that both the MMS/BMS(BMS-1 and BMS-2) shall have real time data acquisition and control functions and database synchronization for the complete Pipeline network.

All the RTUs shall be multi-dropped on Ethernet DNP 3.0 (TCP/IP) OFC based data channels on primary and secondary ports and shall be interlinked with both the MMS & BMS(BMS-1 and BMS-2), such that each MMS/BMS(BMS-1 and BMS-2) shall be adequate and capable for monitoring and control of the entire pipeline. All the RTUs shall be distributed on dedicated LAN A / B on OFC based Ethernet channels. All the channels shall be extended to each MMS / BMS(BMS-1 and BMS-2). The ONE test jig RTU (at MMS, BMS(BMS-1 and BMS-2) location) shall also be multi-dropped on the Ethernet TCP/IP data channels.

In normal operation, MMS shall poll all the RTUs from first port of RTU and BMS(BMS-1 and BMS-2) shall poll the RTU from the second port of RTU. Each RTU shall be dropped on two high speed data channels (One primary and one secondary channel). Also primary server at MMS consists of primary path and secondary path and secondary server at MMS consist of primary path and secondary path. BMS(BMS-1 and BMS-2) will be exact replica of MMS and both the Primary and Secondary servers at BMS(BMS-1 and BMS-2) consist of primary path and secondary path.

The MMS MCC shall have an integrated alarm/event management summery and alarms originating from the pipeline shall be acknowledged and accepted from MCC. However the integrated alarm/event summery shall also be available at the BMS(BMS-1 and BMS-2).

The databases including the real time databases of all the SCADA Servers at both MMS / BMS(BMS-1 and BMS-2) shall be identical and a facility shall be built in to update and verify the consistencies of databases and correct any discrepancy automatically.

In case both the MMS & BMS(BMS-1 and BMS-2) are becoming isolated from each other due to any data channel failure, both the MMS /BMS(BMS-1 and BMS-2) may take the role of MCC and poll the RTUs accessible by each MMS /BMS(BMS-1 and BMS-2).

Each MMS /BMS(BMS-1 and BMS-2) shall be adequate for and capable of monitoring and control of the entire pipeline network as MCC, upon failure of other.

The SCADA system vendor shall interface and test with APPS System for one each at MMS / BMS(BMS-1 and BMS-2) and shall run independently.

Under normal operation, the MMS and BMS(BMS-1 and BMS-2) shall always be in complete synchronized mode. In case of link failure between MMS and BMS(BMS-1 and BMS-2), all the data shall be updated and stored at each MMS and BMS(BMS-1 and BMS-2) independently and upon restoration of the link, The MMS and BMS(BMS-1 and BMS-2) shall be completely synchronized automatically without any user intervention.

For user presentation, the data source for SCADA displays, reports, trends, alarm / events etc at workstations at MMS, BMS(BMS-1 and BMS-2), RWS locations shall be from active SCADA server.

The data from an RTU shall not be lost in case of a data communication channel failure and shall be automatically switched over to the back-up data channel. SCADA Server / CCU / Ethernet Switch / Front-end shall periodically check for the availability of the back-up data channel and update the status at MMS and BMS(BMS-1 and BMS-2) , accordingly causing no loss of data and control & without any effect on SCADA functionality. Each SCADA EWS and RWS shall provide complete SCADA HMI capability (Display, Graphics Reports). SCADA EWS and RWS to get all the information (alarm/event, real time data base, historic data base) access from active SCADA server.

The SCADA EWS and RWS shall be capable of performing all SCADA HMI functions such as call of all displays; graphics, reports, alarm acknowledgments, issuing control etc. (pass word control). The System status display shall include the complete status for MMS, BMS(BMS-1 and BMS-2), SCADA EWS and RWS.

Polling of RTUs in pipeline section

Servers of MMS /BMS(BMS-1 and BMS-2) will be installed on pipeline locations along the pipelines in hot redundant configuration. Thus each Server will have dual servers active and standby concept. On failure of the active server, standby server will become active.

Servers will communicate to the RTUs on the pipeline sections connected to MMS/BMS(BMS-1 and BMS-2). Telecom channels (Ethernet based) shall be extended from MMS/BMS(BMS-1 and BMS-2) to RTU locations along the pipeline section. The RTUs of the pipeline section will be connected on these channels in multi-dropped mode.

Each RTU has two communication ports for polling from M M S / B M S (BMS-1 and BMS-2). Each RTU will be connected to MMS & BMS(BMS-1 and BMS-2), one on either side of the RTU. For each RTU on a section of a pipeline communicating to MMS & BMS(BMS-1 and BMS-2), MMS will be primary and BMS(BMS-1 and BMS-2) will be secondary. The active Server on the primary MMS will poll the RTU for data and the active server on secondary BMS(BMS-1 and BMS-2) will poll the RTU for health check.

In case any RTU is not accessible by the active server on primary due to telecom link failure / RTU port failure / CLS port failure etc, the active server at secondary will the poll the affected RTU for data and active server at primary location will poll the affected RTU for health check.

On restoration of connectivity of RTU with active server on primary MMS, the RTU will be polled for data from active server on primary MMS and for health check by active server on secondary BMS(BMS-1 and BMS-2) server.

MMS & BMS(BMS-1 and BMS-2) will have same SCADA database. The active server shall

update the other standby servers over LAN and WAN.

RWS connectivity

All the remote workstations shall take the data from the active server at MMS/BMS(BMS-1 and BMS-2). In case active server is not accessible, the RWS shall get connected to designated server for providing monitoring and control of pipeline section being polled by the designated server. The monitoring and control facilities in the RWSs will be restricted to their pipeline jurisdiction by user access authorization.

2.2 SCADA SERVER FUNCTIONALITIES

MMS / BMS(BMS-1 and BMS-2) **server**

The MMS/BMS server shall poll the RTUs of the pipeline section adjacent to it. The received polled data shall be processed by these servers for values, quality tag, alarms, events etc. The processed data shall also be passed on to the other servers at MMS / BMS. Apart from polling the RTU, server shall also time synchronize the RTUs. However time synchronization for RTUs to be polled on Modbus protocol is not applicable.

The RWSs shall communicate with servers for monitoring and control of the pipeline.

The server shall also pass on the data to web server, e-mail server. It shall also be used for interfacing with 3rd party applications like APPS etc. through OPC servers.

History Server

The history server shall get time-stamped real-time value and store in history database for future retrieval in graphical and reports format. It shall have the provision to analyze and compare different parameters in a single graphical & tabular window with time-stamp and quality. The active history server shall write the data to storage at MMS and BMS simultaneously.

It shall be possible to retrieve the archived historical data from the storage device without any data loss for using in various reports.

WEB Server

The SCADA systems shall be WEB based. The web servers shall be put in the Client's internet / intranet network. Web server shall fetch the data from the server (which will be in SCADA network). The users over internet shall access the web server through the firewall system. These users shall not be able to access the SCADA servers in the inside zone of the firewall.

The SCADA software shall use the standard ports (http, https) for providing data to the users over Internet / Intranet. Use of non-standard ports is unacceptable.

The users shall enter the URL and IP address of the web server for accessing the data. They shall be presented with a window asking for the user name and password. On successful authentication, the user shall be able to view the SCADA data authorized to him only. The software shall have the provision for configuring the SCADA screens to user based on authorization.

The external customers and suppliers accessing the data through internet shall be able to view the certain data pertaining to them (e.g. flow rate, previous day total, pressure, temperature, gas composition etc) in some tabular form. The control functions shall not be allowed to these users.

The internal users of Client accessing the data over Client's intranet shall be able to view the pipeline data as being shown in the SCADA graphics.

The web server shall be able to provide following facilities:

- To view all the online SCADA HMI displays with automatic data updating. Any change of value in server shall get reflected to the user connected over web server.
- To view reports in pdf format, to get the comments in the reports; and verification confirmation from customers/suppliers through internet.
- The web server shall have the feature of address resolution protocol (through DNS service)

At a time 10 no. of concurrent users shall be able to access the web server. In case of no of concurrent users exceeding the allowed limit, a suitable message will appear to the users logging subsequently, stating the exceeding of user limits. The users already connected to web server shall not get disconnected in such event.

If any user does not use the web server for certain duration (configurable in slots of 5 minutes) his session shall get expired.

E-MAIL & SMS Facility

The SCADA system shall be able to send process data / measurement data/ alarms in desired format through e-mail and SMS to dedicated persons of client / user automatically as well as manually. For the same, E-mail and SMS server shall be provided by bidder and same shall be combined with web server. The system should also be able to send e-mails and SMS on event trigger basis. It shall be possible to configure the users to whom the SMS and e-mails will be sent. The mobile no and e-mail addresses will be editable/configurable as and when required. If Separate e-mail and SMS server is required for this, then the vendor shall provide separate e-mail server without any cost and time implication to Client. This e-mail server shall be interfaced with Client exchange server in future.

The system shall have provision to escalate the levels for sending the SMSs / emails based on the time elapsed from occurrence of alarm. In case of occurrence of a critical alarm, a SMS/email shall be sent automatically to concerned maintenance persons. If the alarm does not return to normal within a specific time of occurrence of alarm e.g. 1 hour (configurable), then the SMS/email will be sent to some higher officials (configurable) also. If again the alarm does not return to normal within a specific time of occurrence of alarm e.g. 6 hour (configurable), then the SMS will be sent to some further higher officials (configurable).
System shall have provision to enable / disable the facility of sending SMSs & emails in totality as well as for individual alarms.

SCADA Engineering Workstation (EWS)

The engineering workstation installed at MMS and BMS locations shall have all the functionalities required for making database changes, creation and modification of graphics & reports, addition/deletion of remote workstations etc. The engineering workstation shall be equipped with all required software to carry out the above mentioned engineering activities independently. Once the changes have been carried out, it shall be possible to download these changes in the SCADA machines at MMS, BMS and RWS locations.

TIME SYNCHRONIZATION - SCADA MACHINES AND RTUS:

GPS time server shall be installed at MMS. As long as MMS and BMS are interconnected, GPS server at MMS shall be used as primary clock to synchronize time of all SCADA machines at MMS, BMS and RWS locations within 2 seconds. RTUs shall be time synchronized by the respective active server within 2 seconds.

In case of MMS failure or isolation of BMS from MMS, the BMS shall synchronize with MMS on restoration of the link.

FAILOVER AND RESTORATION BETWEEN MMS AND BMS

The SCADA system shall have facility to handle various failover scenarios. Failover of any component / system / station shall not affect the working of the SCADA system and restoration after failover shall be without any data loss.

MMS Failure

On failure of MMS due to power failure / communication channel failure / force majeure conditions, all the SCADA activities shall be done from BMS-1. The changeover from MMS to BMS-1 shall be accomplished automatically without causing any loss of data and control and without any effect on SCADA functionality within 5 minutes. The operator at SCADA EWS and RWS shall be informed about the failed system by a suitable event/message by new primary SCADA server.

On re-induction of MMS, the SCADA servers at MMS and BMS-1 shall be synchronized. Based on the decision by supervisor or system engineer, the BMS-1 shall continue to be active or it shall be possible by system engineer to start the SCADA functionalities from MMS.

MMS and BMS-1 Failure

On failure of MMS and BMS-1 due to power failure / communication channel failure / force majeure conditions, all the SCADA activities shall be done from BMS-2. The changeover to BMS-2 shall be accomplished automatically without causing any loss of data and control and without any effect on SCADA functionality within 5 minutes. The operator at SCADA EWS and RWS shall be informed about the failed system by a suitable event/message by new primary SCADA server.

On re-induction of MMS, the SCADA servers at MMS and BMS-2 shall be synchronized. Based on the decision by supervisor or system engineer, the BMS-2 shall continue to be active or it shall be possible by system engineer to start the SCADA functionalities from MMS.

BMS (BMS-1/ BMS-2) Failure

Normally the SCADA activities shall be carried out from MMS. In case of failure of BMS(BMS-1/ BMS-2) , the SCADA system shall continue to operate from MMS. The operator at SCADA EWS and RWS shall be informed about the failed system by a suitable event/message.

On restoration of BMS(BMS-1/ BMS-2), the database of MMS and BMS(BMS-1/ BMS-2) shall be synchronized.

Isolation of MMS and BMS due to communication Failure

MMS and BMS may become isolated due to communication / router failure. Situation arising out of it will be handled in such a manner that data is not lost and MMS and BMS are

synchronised on restoration of communication channel / router.

The RWS shall get connected to the active server at MMS/BMS.

DATABASE AND ALARM SYNCHRONIZATION BETWEEN SCADA SERVERS AT MMS, BMS:

The database and alarms of standby server shall always be synchronized with its active SCADA server. Operator supervisory actions (manual inputs, online SCADA database, alarm acknowledgements, alarm inhibit, digital controls, set-point controls etc.) shall be updated from the active Server to database of standby SCADA Server to maintain database synchronization.

3.0 SYSTEM HARDWARE: MAIN MASTER STATION (MMS) & BACKUP MASTER STATION (BMS)

As per the PJS

Auxiliary equipments including cabling, connectors, converters, tap offs, interfaces etc.

Any other items required to fulfill the requirements and functionality of the tender shall be supplied and included as part of lump sum price by the SCADA vendor.

3.1 REMOTE WORK STATION (RWS) Locations:

The SCADA system data shall be extended to Remote workstation locations from MMS and BMS (Refer to SCADA System Architecture drawings) through 2 Mbps high capacity data channels.

4.0 SYSTEM CONFIGURATION

4.1 The system configuration at MMS & BMS(BMS-1 and BMS-2) shall be as follows:-

a) Two Server i.e. Server # 1(Primary) and Server # 2 (Secondary) shall be configured as SCADA servers. Each SCADA server shall be fully adequate to fulfill the entire monitoring, operation and control requirements of the entire pipeline and sized so that average CPU, average Memory, disk utilization do not exceed 50% in the implemented system (including the requirement of future expansion of Clause 4.7).The Servers, HMIs, Ethernet Switch and WAN Routers along with printer will be distributed in LAN. The MMS and BMS shall be connected through OFC channels and Lease line link through each WAN router.

b) The workstations shall provide complete SCADA HMI capability and shall access MMS and BMS servers. HMI functionalities shall not be affected by server switchover.

The SCADA EWS shall be configured in dual hot standby mode such that in case of any failure or fault in the Active machine, smooth changeover to standby machine shall be accomplished within 1 minute and without causing any loss of data & control and effect on functionalities. Operator shall be informed about the failed system by a suitable message by active machine.

4.2 The system configuration at BMS shall be replica of MMS and HMI functionalities shall not be affected by server switch-over in case of network cut.

4.3 The system configuration at RWS location shall be as follows:-

Each workstation with monitor shall be connected to MMS and BMS through WAN Routers using 2 Mbps data channel. One color ink jet printer shall be connected to workstation.

The workstations shall provide complete SCADA HMI capability and its functionalities shall not be affected by server switch-over.

RWS hardware and software shall be complete and similar to RWS at MMS/ BMS in all respect.

4.4 The RTUs buffer size is required to be suitably sized and SCADA vendor to ensure that no loss of data and alarms occur and RTUs buffer suitably stores all the data in the RTUs (to be sized for data changing every scan) to take care of switch-over time of Server / Communication Channel. All the data in the RTUs has to be time stamped at RTU. The data must be retrieved without any loss of data and alarms in the SCADA system, to take care of switchover time.

The SCADA vendor shall have the option to implement the features of Alarm generations, annunciation of the alarm priority and engineer of unit conversion at the RTU level or at the SCADA host level

4.5 This shall optimize the performance of workstations and ensure the availability of processor resources for more advanced applications i.e. database management, alarm management, network management and HMI, while the CCUs/Ethernet Switch, WAN routers and RTUs shall provide for intelligent and focused control to their respective real-time tasks to improve the overall efficiency of the system, provide for multiple layers of redundancy and allow greater flexibility of system configuration and growth.

4.6 Each remote workstation shall be fully adequate to provide SCADA HMI and to fulfill the entire monitoring, and control requirements of entire pipeline network and sized so that CPU memory disc utilization does not exceed 50% at maximum load.

4.7 The supplied SCADA system shall be adequate (without adding any further hardware / software to the system to be installed at MMS, BMS and RWS locations) and without affecting the system performance parameters and loading criteria to accommodate 50 additional RTUs (25% each of SV / IP type and balance RT/DT type) other then supplied RTUs and four additional RWSs for future pipeline expansion without any limitation and without affecting various system performance parameters of loading and system timing specified elsewhere in the tender.

5.0 SYSTEM REDUNDANCY & BACK-UP REQUIREMENTS

The SCADA system shall be configured with redundancy and automatic failovers for the major components and communication channels. The SCADA system shall support the following failover scenarios (SCADA Server failure, Switch failure, Channel failure, LAN failure) without causing any loss of data and to contribute to the high reliability & availability of system for operation and control of the pipeline without any effect on SCADA functionality.

a) RTU to Ethernet Switch Communication

The data from an RTU shall not be lost in case of data communication card failure or a communication channel failure and shall be automatically switched over to the

backup channel. Ethernet Switch shall periodically check for the availability of the back-up channel and update the status at MMS / BMS.

b) MMS / BMS Failure

i. In the event of failure of a MMS / BMS or inability of a MMS / BMS to communicate with the other MMS / BMS, the associated group of RTUs shall be polled automatically by another MMS / BMS, with out any loss of data.

ii. If the failed MMS / BMS, happened to be the MCC, the other Master Station shall perform all MCC functions automatically.

c) OFC link failure: Refer to requirements covered above.

d) The redundancy aspects of SCADA Server, CCUs/Ethernet Switch, WAN routers, LAN network etc. are covered elsewhere in this section.

e) Operator supervisory action (manual inputs, online SCADA database, alarm acknowledgments, alarm inhibit, digital control, set point controls etc.) shall be updated from the Primary server to data base of secondary server to maintain database synchronization between primary & secondary.

f) **Backup:** The Servers and Workstations shall have backup software and hardware (Drive) installed to allow automatic and manual backups as required of the complete system. It is preferred that the total system is backed up on to a single medium. If multiple backup media are required then a 'stacker" type hardware unit shall be supplied.

6.0 SYSTEM HARDWARE SPECIFICATIONS

The SCADA vendor should upgrade / resize (on higher side) the specifications as per offered SCADA system to meet the functional requirements specified in the tender. At any stage of system implementation, it is found that the SCADA Servers, HMI workstations and remote workstations selected by the SCADA vendor are not having adequate processing power, main memory etc to meet the system performance requirements of this specification, SCADA vendor shall replace these with higher end machines with no cost and time implication. Also if the hardware becomes obsolete, the vendor to replace these with latest hardware with no cost and time implication.

6.1 Each Server shall be stand alone unit with real time features and full complement of system utilities, operational displays, application support tools, SQL access tools, OSI/TCP/IP and network connectivity support and shall provide scalable windows, multiple concurrent sessions & full graphic capability.

6.2 The Server HMI shall use real time multiprogramming, multitasking, interrupt driven with pre-emptive scheduling operating environment. The HMI shall provide full graphical operating environment for operator/supervisors as well as system start up, programming and applications development environment for engineers. All i.e. real time database and historical database, graphics, reports, logs, alarms/events, current/historic trending, calculations, supervisory control functions and configurable tools shall be provided in each workstation.

Each workstation shall be provided with full set of system utilities and operational/programming functions and any workstation can be used for all the functions given the proper password.

6.3 Total responsibility for the development, control, up gradation and maintenance of complete source code including the real time databases part of tender.

6.4 Workstations CPU design shall provide open architecture for performance scalability index w.r.t. seamless on board system expansion and performance up gradation to enhance the system capabilities without causing interruption to the running system to cater for pipeline further expansion. This shall be committed by the Bidder.

6.5 The workstations shall not be Personal Computer based.

6.6 All remote workstations shall be suitable for carrying out engineering, configuration and programming functions with password protection.

6.7 Further augmentation in the hardware of SCADA servers , RWS and other Servers to meet the system requirements specified elsewhere in this bid documents also need to taken care and supplied for this project.

7.0 LAN / WAN Routers /SWITCH

7.1 The All auxiliary equipments including cabling, connectors, interfaces etc for interconnecting the SCADA equipments, powering, earthing, connecting with telecom equipments shall be supplied by the Vendor.

7.2 The WAN router shall provide the facility of high and multiple protocol router and bridge that provides high bandwidth connections in to backbone networks for remote sites. The hardware design shall be based on distributed processing architecture with packets forwarding to be performed on the network interface modules. It shall be based on the modular design and architecture and shall allow new network interface cards to be added in the racks without powering down the unit and ensuring no disruption of service to the network users.

7.3 The router shall implement adaptive routing algorithms and network management routines while off-loading the routing burden from the SCADA workstations. The router shall support both intra-area and intra-area routing for transporting messages between nodes and shall support the network routing/bridging services for OSI, TCP/IP, X.25, LAT and other industry standard wide area networks/protocols.

7.4 Redundant Networks shall be provided for each system and redundant switches shall be provided to establish redundant networks.

8.0 LOCAL AREA NETWORK

Local Area Network (LAN) shall be based on 100/1000 Mbps speed switching network & shall be dual redundant conforming to IEEE 802 LAN standards for MMS/BMS. Flexible conduit shall be provided over the LAN cable to provide mechanical strength and rodent protection with the specification.

100 Mbps ports shall be provided from Ethernet switch to SCADA system at each MMS / BMS. 10 Mbps ports shall be provided from Ethernet switch to other equipment at each MMS / BMS.

9.0 Ethernet Switches for RTU Polling

9.1 Bidder is required to include for redundant Ethernet switches [without any proprietary software and communication protocols] for polling of RTUs at each MMS / BMS.

9.2 a) Each switch shall be provided with TCP/IP communication ports with speed of 10/100/1000 Mbps plus all necessary cables, interfaces, connectors and converters. The number of ports shall be as per the tender requirement and same shall be finalized during detail engineering. FRPVC Armoured Ethernet cables shall be used for all cabling including the cabling inside the control room.

Switch shall reduce the work load of MMS / BMS computers and handle outside MMS / BMS computers the critical task of performing SCADA data acquisition function, communication control polling of RTUs and running of communication protocol drivers.

b) Ethernet switch in a dual redundant configuration shall be connected to LAN for communication with Remote Terminal Units (RTUs) and transmission of data to workstations. Each channel in the Ethernet switch shall be equipped with dedicated TCP/IP communication port. Each TCP/IP communication port will be responsible for scanning respective data channels and managing data interchange mechanism and failure of single TCP/IP communication port would only inhibit scanning for that particular channel only.

9.3 The Ethernet switch shall permit down line loading of new programming and database changes online without interrupting system operations.

9.4 All messages between Ethernet switch and the SCADA Servers shall be in standard format independent of RTU protocol. The Ethernet switch shall be responsible for converting request to and from the SCADA Servers in to the protocol of the RTUs.

9.5 Both the Ethernet switch and SCADA Servers shall have the necessary hardware and software to implement fully automatic transparent redundancy. These units shall operate in dual hot standby scheme such that the primary and back-up units remain synchronized and automatic switchover takes place without any loss of data. The redundancy of the SCADA Servers will not affect the Ethernet switch and vise-versa.

9.6 It shall be possible that operator can individually switch a communication channel to either Ethernet switch and/or all the communication channels on the active Ethernet switch to redundant CCU.

9.7 Each Ethernet switch must be capable of supporting full communication load of all the RTUs including the future expansion.

10.0 Ethernet Switches for SCADA LAN

10.1 Local Area Network (LAN) based on 10/100/1000 Mbps speed switched network shall be employed, conforming to IEEE 802 LAN standards. FRPVC Armoured Ethernet cables shall be used for all cabling including the cabling inside the control room.

10.2 The LAN switches shall be equipped with 24 Nos. of ports for each MMS and BMS.

10.3 Jack panel (24 port), UTP cables, patch etc for LAN interconnection shall be provided as required.

11.0 DISPLAY SCREEN

SCADA vendor shall supply min 75" LED active matrix wall mounted color screen (long life industrial grade), display color power supply 230 V AC, 50 Hz. All civil work related to mounting, installation etc of the LED screen shall be in the scope of the Bidder.

12.0 PRINTERS

12.1 Color Laser jet printers (PR) at MMS / BMS locations shall have in built LAN drivers card so that they can be directly connected to LAN. At RWS locations the Color inkjet printer (PRC) shall be connected to the workstation.

12.2 Printers shall also have following specifications :

Media type	:	Plain paper, Transparencies
No. of color(basic)	:	04
Buffer size	:	64 MB
Paper size	:	A4 , A3
Mounting	:	Self contained with integral stand and with acoustic covers
Noise level (in dBA) while Printing at 1 m distance	:	Less than 56 dBA
Accessories	:	All Consumables one time for color print cartridges and black cartridge and cut sheet papers. Both color & black cartridge to be

13.0 GPS TIME SERVER

GPS time server along with Network Time Protocol shall be provided at MMS location to synchronize the clocks of the entire machine on the DUAL LAN and to synchronize all the RTUs time with MMS / BMS.

The GPS shall have both serial and Ethernet port for connecting to SCADA Network at MMS and BMS.

14.0 COLOR MONITORS, KEYBOARD & MOUSE

14.1 Each color Monitors suitable with each pixel color to be selectable from pallet of 256 colors and selective blink and protect facilities with controls for contrast, brightness & power. The display shall be flicker free. Monitor shall be LED type screen.

14.2 The Monitors shall meet international operational requirements for agency compliance for emissions (X ray, RFI/EMI), health & safety.

14.3 Monitors shall be connected to the system by a quick connect plug and socket connection for easy removal and replacement.

14.4 The keyboards shall be included for each server and workstation.
The keyboard shall be used for system operation, system engineering functions, programming functions, and user defined functions i.e. calling of displays, alarm/event summary displays, trends etc. under single keystroke.

Optical Mouse shall be included as cursor control device for each server and workstation.

15.0 Cabinets/ Racks

15.1 Suitable free standing enclosed type cabinets / rack (2100 mm height [2000 mm height + 15 mm anti vibration pad + 100 mm base plate] and min 800 mm width and min 800 mm Depth) with bottom entry for cable connections, fitted with concealed hinges with pull pins for door removal shall be provided for mounting the WAN routers, servers and comm. interfaces etc. In case all these equipment are not being accommodated in the SCADA equipment cabinet then additional panel of same size has to be supplied. The frame minimum thickness shall be 1.6 mm. In order to effectively remove dissipated heat from the cabinets vent louvers backed by wire fly screen shall be provided to cabinet doors from the floor 450 mm height shall be left blank inside each cabinet.

All the SERVER hardware at MMS, BMS (excluding RWS) shall be mounted in racks. The racks shall be of standard size having dimension as defined above. All the racks should be of same size, have both front and rear doors with locks, with wheels having locking facility, of OEM make. There shall be one retractable monitor with mouse and keyboard for each rack.

Apart from the above racks, one more rack shall be supplied and installed by the vendor at MMS location for housing the test jig RTUs of different pipelines. The specifications of this rack shall be same as the racks of SCADA hardware as mentioned above. Additionally, this rack shall have dividers / separators / metallic mounting slabs to place the RTUs chassis on it.

15.3 Fire-proof cabinets

The backup media, software licences etc shall be kept in fire-proof cabinets to be supplied by the Vendor. Fire-proof cabinet shall be supplied at each MMS and BMS locations. The cabinet shall be resistant to fire, termites, rodents etc. The size of the cabinet shall be min 3 x 3 X 3 ft of width, height and depth.

16.0 SYSTEM SOFTWARE

16.1 The operating system must be having real time capabilities. The operating system shall be modular in design and shall provide effective utilization of resources and facilitate future expansion. SCADA software package shall conform to open standards.

16.2 It shall have the following features:

a) Multiprogramming, Multithreading and Multitasking facility including background and foreground operations in real time mode.

b) Real time capabilities i.e. real time pre-emptive scheduling, Process/memory/file locking, process real time settable priorities, features for time based scheduling calls, asynchronous I/O drivers.

c) Virtual Memory System

d) Dynamic memory allocation

e) System Security features

f) Real time programming and processing

g) Support for disk mirroring

h) Line and page editors, library management

i) Logical volume manager for improved disk management and performance

j) Dual LAN support

k) Bulk Storage Management

l) OSI/TCP/IP network connectivity support

m) Input/output drivers for all peripherals

n) Graphic support package

o) Online and detailed offline diagnostic package to troubleshoot CPU, memory and various system and peripheral cards

p) Automatic configuration of I/O drivers & devices drivers at system boot up

16.3 Utility programs need to be provided such as editors, compilers, linker and extensive debugger, and compilers for the languages in which SCADA source codes are written shall be provided which will have special functions/subroutines to facilitate real time computation and database manipulation and interface with user written programs. Compiler for writing SCADA APIs shall be supplied and installed in primary servers at MMS and BMS locations and shall support the full specifications, data base access APIs. GNU or compliers available for free are not acceptable.

16.4 The SCADA package in the SCADA servers shall be built around real time data base management system to provide fast access to support data processing functions, and other time-critical databases. The databases shall support SQL data access and information interchange mechanism. The database shall be implemented for event log, historical databases, accounting type functions such as custody transfer functions.

16.5 The SCADA EWS and RWS system shall be fully integrated for the complete database systems. The SCADA EWS and RWS system shall have industrial standard window system for high performance graphic user interface and programming interface General purpose networking software shall also be provided and each processing unit shall run its

own copy of operating system and shall be able to operate as connected node and stand alone node. The graphic user interface shall support full resolution of 1280 x 1024 pixels.

16.6 The database with complete record of telemetry points with static, dynamic and configuration parameters shall be resident in all the computer workstations. This database shall be built around same operating system and physically stored, manipulated & maintained in common and consistent data structure, accessible by all the workstations without any file system emulation.

16.7 The changes in the real time, historical, configuration database shall be automatically updated on all the SCADA workstations in both the MMS / BMS locations simultaneously without exercising any software utility manually and without causing any interruption to the running system.

16.8 The database management shall be transparent to the user such that all the attributes of a tag/point can be accessed from any workstation by giving tag No. /point Id.

16.9 Operating system software, SCADA server software, SCADA EWS and RWS software, Office Suite software along with all patches as finally configured on each of the supplied system on readable storage media shall be provided. Complete SCADA Server, SCADA EWS and RWS installation can be done from the storage media provided by the vendor.

16.10 Both the RWS of MMS and BMS locations shall have Graphics Editing capabilities.

Licenses for operating system, SCADA software, RWS software shall be provided for each computer workstation and remote workstation.

16.11 **ANTI-VIRUS (1 CORPORATE LICENSE WITH 50 CLIENT LICENSES)**

Anti virus software to protect the SCADA system from virus attacks is to be provided by the Vendor. The anti virus software can be Symantec, McAfee or Trend Micro. The SCADA machine having the corporate license will update the

17.0 SCADA SOFTWARE

SCADA software which is fully complaint to open standards and field proven in SCADA application shall be supplied.

a) The SCADA package in the SCADA servers shall be built around real time database management system to provide fast access to support data processing functions, and other time-critical databases.

b) The database management shall be transparent to the user such that all the attributes of a tag/point can be accessed from any workstation by giving point ID.

c) As a minimum requirement, SCADA software shall have the following facilities:

i. System and Database configuration.

ii. Data Acquisition from the RTUs/FCs/IEDs, generation and management of real time database over on telecom network (point to point and multi drop).

iii. Generation and management of historic data for trending and archival.

iv. Alarm handling, including storage, display and printout.

v. Generation, storage, presentation of diagrams with dynamic information on RWS monitor.

vi. Display Management for Alarm, Alerts, Mimic diagrams, Analog and digital values, Trend graphs.

vii. Report generation, storage and printout.

viii. Data logging at periodic intervals, on operator request and automatically on occurrence of an event.

ix. Transmission of control commands and configuration parameters to outstations.

x. Redundancy, fail-over and recovery processes.

xi. Provision for giving Analog set point through FCs (by writing in the FC registers).

d) Vendor shall re-generate the software licence keys of the failed machines for restoration of failed machine (supplied by the vendor) as and when required within 24 hours during the entire life of SCADA system.

17.1 **Diagnostic Software**

The prime objective of the diagnostic software shall be to provide, by means of on-line and off-line test programs, continuous correct operation of all system functions by monitoring the health and resource utilization of the system, even when system components fail.

To meet this objective the diagnostic software and any associated hardware shall as a minimum perform the following duties:

• On line monitoring of system hardware and software in order to detect system malfunctions and to take corrective action before they have a deleterious effect on the control system and the station functions

• Provide messages for recording invalid software operations, system hardware faults and automatic/operator instigated control system re-configurations. Also to update the system configurations, and displays

• Prepare and maintain summary fault logs for each control system device

• Provide fail-over and restart facilities. Fail-over and individual device initiation should not affect the real time operation of the on-line system

• Provide off-line diagnostics to permit detailed tracing of faults

17.2 **Equipment Failures**

A single screen to be provided to monitor all the Equipment Health status. In case of failure of any equipment, system automatically generates alarm and notifies the user via the normal

SCADA user interface and MMI system. It shall not require system maintenance to specifically log onto the system to check for alarm and error conditions.

All such alarms and events shall be recorded in the SCADA system's alarm/event log.

18.0 SYSTEM CAPACITY/ SIZING

System at MMS / BMS system shall have an I/Os database capacity / sizing, HMI capacity of [w.r.t. system sizing, including any future expansion & dynamic allocation of these requirements]

A. SCADA Servers

Sl. No.	Requirement	System capacity requirement (without spare)
1	IO points	30000
2	Graphics	20000
3	Reports	1500
4	IO Points for Historical / Realtime trends	30000

B. RWS

Sl. No.	Requirement	System capacity requirement
1.	Graphics	20000
2.	Reports	1500

Note:

1. The IO points include telemetered AI, DI, AO, DO, serial (through serial ports of IEDs), calculation (analog and digital calculation points), manual points.
2. The execution of IO points, Graphics, Reports etc specified in SCADA server will be distributed among the Zonal servers and further over FEP servers.
3. The above mentioned details includes the I/O points count, no of graphics / reports to be configured for the integration of SCADA systems through OPC.

18.1 System Utilization

Utilities shall be provided to monitor the level of utilization of key resources such as CPU and disk capacity. These shall be configurable with alarm set points such that when the utilization level exceeds the alarm limit, an alarm is generated in the SCADA system. These utilization data shall also be stored on the historical database system for future comparison and trending purposes to detect abnormal changes in the system.

18.2 Network Utilization

Network traffic monitoring shall be available to check for and identify network problems such as bad cables/connections or defective devices and transceivers. The level of traffic on any LAN shall not exceed 15% of the maximum (and not the nominal) capacity of the LAN.

19.0 APPLICATION SOFTWARE

Project specific application software shall be provided by the bidder for the entire pipeline. The interfacing and provisions of application software data shall also be done by the bidder.

20.0 COMMUNICATION CHANNELS

a) Telecommunication system based on dedicated optical fiber cables (OFC) / leased line and shall be provided by other contractor.

b) OFC and leased lines from service provider based communication media are being used. The exact details of telecom connectivity of each station with server shall be provided to bidder during detailed engineering stage.

i. The MMS and BMS shall be connected to each other through 10 Mbps telecom channels. Communication link shall be provided among MMS and BMS locations through captive network on OFC and through external service provider.

ii. RWS shall be connected to MMS/ BMS. MMS /BMS link shall also be used by the RWS to get the SCADA data from MMS / BMS for monitoring and control of pipeline.

iii. All the above telecommunication links shall be provided by other contractor.

c) **SCADA Master and Backup Master Station Internal Communication**

Communications on any LAN shall be Fast Ethernet at 100/1000 Mbps using 1000 BaseT / 1000 Base FX cabling and network hubs.

The high speed data channels shall support synchronous serial connectivity between MMS / BMSs and between remote workstations and MMS / BMSs at 10 Mbps. The high speed data channels requirement will be finalized during document approval.

d) **Network Communication**

The SCADA servers at MMS and BMS locations shall be connected to redundant 100/1000 Mbps Ethernet switches and routers. All network connections to the servers (from operator stations and other systems) shall be through the Ethernet switch to allow optimum access to each server.

All networked devices and workstations shall support SNMP client utilities for the purpose of network management.

The SCADA network as a whole shall be configured using Class ‘B’ TCP/IP node addresses. The Bidder shall design, document and submit the SCADA network node IP addressing scheme and a network plan for approval by the Owner at the detailed engineering stage of the project as part of the Network Design Criteria.

The network TCP/IP addressing scheme and network plan to be submitted shall include sufficient details to describe:

• Total SCADA network IP addressing range,

• SCADA master station to RTU communication protocol addressing scheme for the encapsulated protocol,

• Relationships and restrictions between TCP/IP addressing scheme and the SCADA master Station protocol addressing scheme,

• Method of IP address allocation and backup allocation strategies,

• Scope of addresses for each domain, site type, site, equipment type and the network as a Whole,

• Network segmentation and mask ranges,

• Alternative communication routes and networks,

• Routing strategies and method of implementation for each of the alternative network communication routes and backup networks,

• Router configuration routing tables,

• Router and network timeout delay and retry mechanisms settings throughout the network,

•Network bridge configuration tables,

•Network node naming convention,

• List of protocols necessary for each node to support network plan

Where possible standard address prefixes shall be used for the similar equipment types.
It is preferred Dynamic Host Configuration Protocol (DHCP) be used as the method of IP address allocation. If DHCP is to be used, backup DHCP server at the BMS shall be configured.

Remote Access to SCADA network shall be via Web Server through the firewall and security access system, to ensure safety and accessibility and shall be provided to the intended external users only.

e) RTU Communication

The communication to RTU's shall be via DNP 3.0 (TCP/IP) Network links. The RTU network communication port interfaces shall be fully compatible with the network plan, protocols and TCP/IP addressing scheme defined above.

Communication to external systems shall also be possible using Ethernet or serial communication links.

21.0 INPUT/OUTPUT REQUIREMENT

21.1 SCADA vendor is required to incorporate the complete requirements of telemeter points for SCADA system taking the inputs from the I/O point list, P&IDs, Operation & Control Philosophy and list of electrical parameters which shall be provided / finalized during detailed engineering or prior to FAT.

The new RTU I/O's count shall be as per the list and accordingly the card has to be selected considering the spare philosophy define elsewhere / or as a standard practice. However if during execution I/o counts increased at some of the RTUs, vendor shall rearrange the cards and I/O configuration to meet the requirement.

Bidder to note that flow rate signal from meters at various locations may be hardwired signal [Analog input] to the RTU, in addition to be part of the serial link, as per the P&IDs.

For Receipt terminals, IP / SV Stations, dispatch terminals, any requirement of repeat signals as indicated in respective P&IDs, to/from the other agencies control rooms are also required to be included in RTUs/SCADA system. These repeat signals shall be made available in the marshalling cabinets/Telemetry interface cabinets by Client and from telemetry interface cabinets to RTUs by Bidder. The detailed will be provided during detail engineering.

21.2 Also each RTU shall have 25% installed fully wired engineering I/O spares for each type of input and output cards over and above the requirement defined above. The corresponding activities of SCADA engineering, database development, HMI development with displays, reports, trends, networking etc. shall be covered in the SCADA System as part of base quote. In addition to these I/O's the APPS system I/O's (to be provided during detail engineering) shall also be considered for operation.

21.3 I/O racks of each RTU shall have 25% or minimum 2 nos. (whichever is higher) usable additional slots for installing I/O modules of each type and suitable for insertion of any type of I/O cards, trending serial cards

21.4 25% additional relays shall be provided for each RTU. In addition, 20% spare space shall be provided in RTUs to install 20% additional relays.

21.5 The above are the field I/O points and do not include the serial analog points and software calculated points, and cathodic protection points. SCADA vendor is required to consider the total points for sizing the system database to meet the functional requirements.

21.6 Also each RTU shall have 100% expansion capacity.

21.7 Bidder shall furnish the poll time calculations considering the requirements of 50 % I/Os changes every poll during detailed engineering. The calculation shall be carried out by properly distributing the RTUs over the channels and meet the requirements of system.

22.0 REAL TIME DATABASE ACCESS :

The supplied SCADA system shall be ODBC & OPC compliant and have necessary provision for interfacing (data interchange) with third party applications like pipeline application software (AAPS) etc. To achieve the above following facilities as a minimum shall be provided with SCADA system:

Database access routines and related documentation to acquire the data from SCADA system shall be provided by the Bidder during Final submission. Facility to access the current and historical database for further processing by Client shall be provided. Full database access function in C, C++ or any other languages used by SCADA Software has to be provided.

22.1 Complete suite of Application Program Interface (APIs) on C/C++ platform or any other languages used by SCADA software shall be provided. It shall be possible read & write real time parameters values, their quality tags, time tags and other attributes using these APIs. Once parameters value or their attributes are written in to the SCADA real time data base using these APIs (from a third party software), the SCADA system shall treat these parameters in the same manner as the SCADA system acquired values from all purposes including storing, achieving , control etc. Also SCADA vendor to provide facility to export Realtime / historical data to excel sheet format.

22.2 The routers at MMS / BMS shall utilize spare ports and system to provide software facilities to access real time data and reports through Internet [arranging channel from Internet service provider is in Client's scope], Client Internet [supporting TCP/IP] with all the security features so that these data and reports can be accessed by any client personnel having required connectivity with Internet.

23.0 WEB SERVER:

The supplied SCADA system shall be web enabled. The Web server shall be installed in MMS and BMS locations. The users using Web browser shall access the web server at MMS/ BMS locations. The web server shall be able to provide the real time trend and other information irrespective of which SCADA server is primary at the instant. The supplied system shall have the following facilities implemented:-

- To view all the online SCADA HMI displays i.e. graphics and alarms with online updation, trends and reports using Web browser through Intranet/Internet.

- At any time 20 No. of users shall be able to access the web server using Web browser through Intranet/Internet. It shall be expandable for 30 nos of users in future without any change in hardware and software. Licenses for the same have to be supplied.

- The web server should be sized to that the updation of graphics does not exceed 15 seconds with maximum no. of concurrent users.

The WAN router at MMS/ BMS locations shall also be equipped with necessary hardware/interfaces to provide connectivity to the network (Intranet)& ISP ink.

All operator screen display shall be accessible from the Web HMI. and it shall be use commonly available Web browser software. The Web based HMI shall be accessible internally to the SCADA system communication network or externally via the SCADA system firewall. The system shall be sized to ensure a minimum of 30 simultaneously client Web HMI sessions are possible at any one time.

Proper Security to be implemented in the Web Server and User to access the web Server through password Authentication. Also it should be possible to limit a user to view some specific screens only based on the user type created. Access to be restricted based on the User Type created in the Server. Utility has to be provided by the SCADA vendor to convert existing HMI Screens to Web Screens without any programming / designing.

All the operator interface software security measures shall apply to Web based HMI sessions hosted by the SCADA Master station.

24.0 SYSTEM RESOURCE SIZING

The SCADA system shall be designed to function satisfactorily for the present requirements and also taking into account the future requirements and fulfill the system performance parameters of loading and system timings. Bidder shall provide the detailed justification for arriving at the system resource sizing required to meet the system functionalities including future expansion in the FDS documents

25.0 RESTART

The Operator Remote Workstations, RTU or the SCADA system shall automatically restart to restore the normal mode of operation after a critical hardware or software failure, or after major system functions have been suspended for a length of time. Minimum operator involvement shall be required during restart conditions.

It shall not be necessary for any program or configuration parameters to be downloaded from the MMS, BMS to any system to successfully do a restart.

The following are some of the conditions that will cause a restart to occur:

• Software system manually booted from bulk device - this action might occur after maintenance has been performed on part of the computer system
• Critical hardware or software failure
• Resumption of AC power
• Operator initiated.

26.0 SYSTEM PERFORMANCE

When all the systems are installed, a system performance test shall be carried out to confirm all the performance parameters are achieved.

26.1 Operating Performance

The control system shall perform in a satisfactory manner during periods of different system loading and conditions. Refer to The SCADA Datasheets for performance requirements for the SCADA system.

26.2 Definition of Loading Conditions

The system shall continue to operate, with all functions being available, at the performance specified under all conditions of stations and user activity.

For the purposes of testing the system for acceptance, the load conditions are defined as:

- New display pages are requested 6 per minute per CRT.
- 20% of Analog points are in alarm.
- All Analogs are changing 0.5% of range per second.
- 20% of digital points change state progressively over 4 sec.

26.3 **Operator Interface to RTU Performance**

During all system loading conditions the operation of an output relay or setpoint output level change, at any RTU shall occur within 200 milliseconds of the execute command being issued at a MMS, BMS, RWS.

The MMS/ BMS shall indicate to the operator within 1 second that the control has been issued to the field device or display the changed status of the field device if it has occurred.

A status change or significant analog change, not due to a control action, shall be reported back to the MMS and BMS Operators within 1 second of the RTU detecting the change.

26.4 **Man-Machine Performance Requirements**

The SCADA system shall acknowledge all MMS and BMS operator requests or provide the operator with a visual cue that his request is being processed within 1 second. This includes interactions via cursor and function keys. The actual time required to process the request shall be a function of the request type.

26.5 **System Alarming**

Alarm conditions and equipment failures detected by the RTU's shall be processed and presented in chronological order on the appropriate MMI display within one second. The SCADA system shall be capable of meeting these requirements when alarms are being received at a rate of 2 per second.

26.6 **Availability and MTBF**

Bidder shall provide calculations, which show that the system configuration proposed shall meet the availability specified in this section. Bidder shall supply the individual MTBF for all equipment supplied under this contract.

The system shall be engineered to ensure that no single failure in the system shall cause risk to personnel or plant or cause the plant to trip.

The availability for the entire SCADA & Communications system shall be 99.9% or better and shall be supported by the Seller's calculations.

The system shall be considered to be unavailable if any of the following apply:

- more than one input/output card is unavailable
- more than one intelligent module (controller, loop interface, communication, etc) is unavailable
(duplicated or otherwise)
- the time taken to rectify a minor fault exceeds 8 hours. Minor faults can include:
- one operator station being unavailable
- one plant input status card being unavailable
- one intelligent module being unavailable

The system availability shall be tested over the specified Performance Test period.

27.0 <u>FOREIGN DEVICES INTERFACING REQUIREMENTS:</u>

27.1 IEDs shall be interfaced with the respective RTUs through serial links employing Modbus/ TCP /IP protocols. The details of the protocol requirements shall be obtained by the Bidder from the Client. The yesterday's total figure, today's running total figure of flow computers shall also be transmitted to SCADA system through serial link/ TCP/IP link. Also bidder to write data to other IEDs through SCADA. The detail of IEDs writing data will be informed during detail engineering.

27.2 It is Bidder's responsibilities to co-ordinate with the supplier of foreign devices identified and establishes communication for transfer of data and control with them and meet the complete system functionality. The IEDs serial/ TCP/IP link alarms for power supply/ link failure/IED malfunction shall be implemented.

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SCADA SYSTEM

SYSTEM FUNCTIONAL REQUIREMENTS

1.0 PRIMARY FUNCTION

The primary function of the SCADA system shall be operational interface to support the operation of the complete pipeline & distribution network. The system shall provide Monitoring and supervisory control facilities. This interface shall provide the capability to acquire pipeline data from pipeline facilities and pump stations operating conditions and status, show abnormal or alarm conditions and remotely operate the valves, execute pipeline shutdown, flow-path verification and interlock sequences as per pipeline operation and control philosophy.

APPS system has to be provided by bidder and interfacing will be done by SCADA vendor along with APPS system. APPS refers to the Leak Detection System.

2.0 DATA ACQUISITION

The data acquisition function shall provide all the aspects needed to support data collection from the field including the requesting of data from RTUs/PLCs/IEDs and the processing and controlling of analog and digital data received from the same. The data is to be collected from field Devices like RTU/PLC/IED over serial analog / serial digital / leased line / TCP/IP

The data items listed below the representative of the data required from the various types of stations.

Pressure
Temperature
Volumetric flow rate, mass flow rate
Density (Online)
Totalised flows (volume and mass)
Controller set points (speed, flow, pressure)
Valve Open, Close, Remote/local status,
Pressure/Temperature high/low alarms
Cathodic protection parameters
Pipeline shutdown and flow path verification
Valve (GOVs and AVs) controls
Any other major parameters as per the requirements of client.
Fire & Alarm System status
UPS, DG set if any

All polled data shall be time tagged and quality tagged at the server immediately upon receipt of the data.

All analog polled data shall be checked for High, High-High, Low - Low and Low alarm limit violation at the SCADA server. Similarly all polled digital inputs shall be checked for alarm violation/events immediately upon receipt of data at the server.

The following types of data are to be retrieved from the various types of field devices

a) Analog input (4-20 mA) like Pressure, Temperature, PSP, Current, Voltage etc. The configurable ADC scaling feature should be available to get the correct value as per the field RTU/IED devices

b) Digital input (Dry contacts, potential free contacts, On-Off) like status of valve, compressor Run/Stop etc.

c) Serial data from IEDs either directly by the FEP Servers or through the RTUs.

d) Digital Output – control feature to open/close of the sectionizing valve (SV), start/stop of other system, pumps etc in trip/close. Latched, momentary raise close and other combination. It should also be in double DO concept to open and close the valve and start and stop the compressor and pumps with single DO option. The control point should have interlocking feature to provide the safe, verified and protected command

e) Analog output – Flow control set point , FCV through (4-20 mA) hardwired as well as to Serial IEDs. The configurable ADC scaling feature should be available to send the correct value as per the field RTU/IED devices for hardwired control.

f) Accumulator point – The provision should have to accumulate any points (eg. Flow rate) for yesterday total (last 24 hours value), Running total value, hourly average etc

The SCADA system shall support DNP 3.0, IEC-5-101, IEC-5-104 and Modbus protocols for polling RTUs from FEP servers. It shall be possible to read and write data (analog and digital) directly from IEDs/PLCs through serial link using Modbus protocol. The SCADA system shall have provision for all type of Modus functions (e.g. reading and writing of 16 bit registers, 32 bit registers, 64 bit registers, LSB and MSB reading etc).

The system shall have the provision for polling through report by exception. The FEP shall pass on the analog data to the active zonal server only if the value changes cross some dead band defined in the SCADA database.

For some devices e.g. for valves, compressors, etc. it shall be possible to use two digital inputs i.e. open status and close status to derive four states of the valve - Open, Close, Travel and Error. / start, stop, transient and error

The complete requirements of P&IDs, electrical and CP parameters and various parameters included as part of specifications and additional parameters at the time of database document review shall be taken as part of system implementation. For some devices e.g. for valves, it shall be possible to use two digital inputs i.e. open status and close status to drive four status of the valve – Open, Close, Travel and Error.

3.0 REPORTS BY EXCEPTION

All Analog and status data shall be requested on a report by exception basis to avoid unnecessary processing when the Analog dead band has not been exceeded or no status changes has occurred. This has to avoid unnecessary data communication between RTU &

MCS / ECS. Depending on the database downloaded to the individual RTU, an RTU will scan the I/O points and determine the points to be reported when polled by MCS / ECS and communicate the same Analog with time stamp.
The Analog dead band, Debounce time, backup report update time etc. shall be configurable as part of database definition.

Further, it shall be possible to use integrating dead band for analogue data to ensure that even small changes shall cause transfer after some time when the value is stable. Backup report update time shall be user configurable. Changes made in the RTU database at any MCS / ECS shall be updated in RTU online.

4.0 DATA REQUESTS

The SCADA system shall be capable of periodically polling all RTU's by MCS /ECS with data request messages according to polling information in polling tables developed by the Bidder. It shall be possible to define an RTU or RTUs more than once in a polling table per data channel.

RTU's shall be polled by the MCS /ECS for status change, Analog data change and totaliser valve update within every 15 seconds or faster as required by APPS.

5.0 DATA GROUPING & UPDATION

The data at any RTU shall be grouped according to its priority and use from an operating point of view (viz. APPS data requirements) and an MCS / ECS polling frequency assigned to each group of data. Grouping of data and polling frequency shall be user configurable.

1) Report by exception data shall be updated maximum within 10 sec or faster as required by APPS.
2) Backup update report updation for all the parameters shall be every 5 minutes (user configurable)

6.0 DATA PRIORITES

The retrieval of status data shall have a high priority then the retrieval of analogue data and check back execute indications of just completed control actions shall have the higher priority. Bidder shall appropriately consider requirement of updation of field data required for APPS.

7.0 DATA VALIDITY

The SCADA system shall include an analogue data validity analysis function. This validity analysis shall be for out of range, Instrument Bad, scan failure, point on test, RTU on test, manual input etc. Data base qualifiers shall be displayed in the graphics and log in the reports and also indicated as alarms/events. These shall be implemented on all tags SCADA system.

8.0 DATA INTEGRITY

The data request software shall generate an RTU data integrity poll to enable the checking of the integrity of stored data in the database at the RTU. The integrity poll shall be initiated as part of data polling sequence and after pipeline system changes (configuration change), RTU power failure and major computer system events including restart and failover, control of other MS. Also points defined for backup update reporting shall update its valve/status, if it did not report by exception in a given time (user definable) and same be logged as event.

9.0 POLL MODES

In addition to the general polling requirements outlined above, several other poll modes [user configurable] shall be implemented. They are:

- Demand poll – to any RTU/PLC/IED immediately on demand from the User. It shall be possible to poll any FC/RTU/PLC immediately by interrupting the normal polling cycle irrespective of the polling media
- . To enable fast updates of data required for APPS.
- Poll Inhibit - to enable a complete RTU/IED/PLC to be disabled from the polling function.
- Port inhibit – Facility to disable a port of CCU thereby inhibiting polling of all devices on that port

It shall be possible to write data acquired from some other RTU to another RTU and then onward to other devices.The exact details of input stations and no. of parameters shall be decided during detailed engineering or prior to FAT. Similarly it shall be possible to automatically and continuously set Analog or Digital output values in an RTU driven by Analog or Digital input value acquired from the same or different RTU.

10.0 CONTROL FUNCTIONS

It shall be possible to issue control commands from MCS, ECS and any RWS location locations. However the controls shall be assigned to some selective users. The command will be issued only after successful authentication of the user. The exact philosophy of control functions shall be finalized during detailed engineering stage.

The control function shall include the basis start/stop/open/close and set point capabilities. The basis of all control actions shall be the select-check back-execute sequence.

Typical controls to be provided are:

. Valve open [Device start]
. Valve close [Device stop]
. Set point control (Speed set point, Flow set point, Pressure set point)
. Stations shutdown
. Pipeline Shutdown
. CP / Electrical device start / stop

It shall be possible to write data (analog and digital) directly to the IEDs through TCP/IP link using standard protocols supported by IEDs

The system must ensure that all the control actions are reconfirmed before the actual control action is taken. If the confirmation is not given within a specified time (configurable) the control action shall be aborted.

11.0 DEVICE CONTROL SELECTION

Control request initiated by the pipeline operator shall pass control point identification and the required control action to the control software. The software shall validate the control point and the control action required according to system status, defined interlocks, permissive and assigned responsibilities. Error messages shall be displayed if the operation is not permitted. These shall be implemented by the bidder to meet the complete requirements of P&IDs and pipeline operation and control philosophy.

Bidder shall incorporate the required changes in the pipeline operation during the site implementation phase. It shall be possible to override all interlocks / permissive under suitable password control and execute control. It shall also be possible to configure from MCS the width of the digital output pulse used for remote operation / closing of valves etc.

12.0 SELECT-CHECK BACK-EXECUTE

After point selection and control action have been verified, the software shall initiate a select-check back-execute control sequence with the selected RTU.

When the control action is initiated, the software shall set a flag showing that a device change of state is expected. Failure to receive a status change with in a predefined period shall show a faulty control action and initiate a timeout alarm at the MCS. Same shall be implemented for all the digital controls.

13.0 CONTROL TIME-OUT

Configuration mode procedures shall be provided to modify the time-out periods associated with the various types of device control. These time-out periods shall include a maximum time for the operator to select a control action after device selection in which case the entire control request shall be cancelled. The maximum anticipated time to receive a device status change after a control sequence has been completed shall be adjustable under the system configuration mode.

14.0 TELEMETERY FAIL AND POLL INHIBIT

Reliable detection and correction mechanism shall be implemented for data communication. If valid data is not received from an RTU in response to a poll request, the software shall attempt retransmission of data from that RTU. The number of repolls to be attempt shall be adjustable by the maintenance procedures for each poll period. Bidder shall dually take in to consideration the logical sequences and communication statistics for setting up reliable

retransmission mechanism for RTU data. The number of retries to be attempted shall be configurable

If an RTU fails, or its communication channel fails, or RTU is put on test/masked, then all individual points at that RTU shall be marked in the database to indicate telemetry failure but only one alarm shall be generated linking with the corresponding failure status. The database shall retain the last good value or status for every point affected until the telemetry returns to normal. Return to normal alarm shall be generated and RTU shall update (when polled) w.r.t. all points.

The operator shall have the capability to inhibit any point form scanning or an entire RTU from poll processing. In this situation the operator may substitute values for the data for points which defective telemetry or which have been inhibited for poll processing. Alternately a point taken in manual mode shall automatically put the point of the scan. The substitute value shall be retained until poll processing on that point or station is restored.

The status of the data values (valid, subject to telemetry failure, substituted etc.) shall be indicated in the database and shown on HMI displays and printed in reports.

15.0 CALL UP AND UPDATION TIMES:

a) Callup time including display of dynamic points for any graphic display on each HMI of MCS and ECS: not to exceed 2 seconds.

b) Callup time including display of dynamic points for any graphic display on each RWS locations: not to exceed 4 seconds.

c) Callup & updation time for any historical trend graphics on each HMI of MCS and ECS: not to exceed 5 seconds

d) Callup & updation time for any historical trend graphics on each RWS locations: not to exceed 10 seconds

16.0 SYSTEM DATE AND TIME FACILITY

A Gregorian Date and Twenty Four Hour Clock Time Facility shall be incorporated in the MCS & ECS equipment.

The calendar programme shall automatically compensate date for months of less than 31 days and for leap years. The Repeater Station equipment shall have a Time Facility.

The clock time facilities shall be crystal controlled and battery backed-up to overcome the problems associated with power supply frequency fluctuations and interruption.

At the MS the facility shall provide the data for Date and Time for log Printouts consisting of:

* Date in Day. Month, Year format
* Twenty Four Hour Time in Hours, Minutes, and Seconds.

At the MCS there shall be capability for initial calibration, setting up and subsequent adjustment and correction of date and time.

17.0 SYSTEM DIAGNOSTICS & TEST FACILITES

SCADA System shall have comprehensive test facilities and self diagnostic routines that shall facilitate full functional testing of all subsystem including the modules for workstations, routers, CCUs, RTUs etc.

Comprehensive diagnostics and the test facility for each sub-system shall be an integral part of the SCADA system.

18.0 HUMAN MACHINE INTERFACE (HMI)

18.1 FEATURES

The Human Machine Interface (HMI) system is the primary interface to the SCADA functionality. It is critical to the operation of the SCADA system and the Bidder shall provide a secure, flexible and "User-Friendly" interface by which engineers, supervisors and the operators may interact with the system and pipeline network by way of the computing equipment, database and software.

The HMI shall exploit the best characteristics of color graphic Monitor's, keyboards, cursor control devices, character/graphic printers.

The graphic displays shall be windowed, fully supported with appropriate graphics and symbolic diagrams. All procedures shall be selectable by menu and context sensitive help displays shall be available.

The SCADA HMI shall support the feature of full screen data entry update wherein changes made to the number of tags/ fields/ parameters on the graphical display shall be buffered and updated in the database of SCADA. The complete event printout of all the changes to the tags/ fields/ parameters shall be available.

18.2 The HMI operational procedures shall, as a minimum, include the following functions:

- Display requests and paging
- Supervisory control
- Alarm and event message display
- Alarm message acknowledge
- Alarm inhibit, poll inhibit, MONITOR update inhibit, point scan inhibit
- Report and log output request
- MONITOR hard copy report
- MONITOR analogue trending
- Bar graph display
- Manual data entry
- Free form text entry (scratch pad)

- Device warning indications (tagging)
- Assignment of console or workstation operating modes
- Calculated variable definition and modification
- Display page definition and modification
- Alarm and event message definition and modification
- Display and modification of system parameters
- Database management
- System configuration management
- Error statistics acquisition and management
- System resource utilization
- Daily alarms and operator actions
- System status displays including all system nodes, RWS, RTUs, Communication Channel links etc. along with other interconnectivity.
- Interfacing of APPS HMI at site

18.3 The SCADA servers cum HMI machines and engineering work station in MCS, ECS shall be equipped with full fledged graphic editor. The graphic editor as a standard shall contain large no. of objects such as meters, trend windows, alarm Annunciator control buttons and other such items which the user can create for placing in the library. Objects shall include database links for alarm/mode/state/value fetching, for alarm coding and for animation & dynamics.

Facility shall be provided to easily generate and edit the graphic displays, and to move, delete, change symbols, characteristics, colour, dynamic field assignments, copying etc.

Vendor shall install licensed graphics/format editors in all the engineering workstations at MCS and ECS. Apart from these, 03 nos of licensed graphics/format editors shall also supplied by the Vendor.

18.4 **SUPERVISORY CONTROL**

Control to command a change of the state of pipeline network devices from the HMIs shall be supported. In addition, control of the SCADA system functions for starting & stopping, network management, diagnostics, maintenance & house keeping itself shall be supported.

18.5 **ALARMS AND EVENTS**

The HMI shall support the presentation of alarms and events, on displays and printers, to provide information regarding the behaviour of the pipeline network and the SCADA systems. Facilities shall be provided to acknowledge alarms, to delete alarm messages, and to inhibit alarms.

18.6 The facility to manually enter numeric and status data from an operations console in to the SCADA system shall be provided.

19.0 DISPLAYS

19.1 **FEATURES**

Displays shall be in a window format and standardized to the extent that fields necessary for effective operational communication with the SCADA system are fixed. This shall provide efficient and standard HMI procedures across all system functions and serve to reduce the risk of operating errors. However, display support shall be flexible with regard to the presentation of data and customization with maintenance utilities to suit the specific operating requirements shall be available. The operators shall have easy operational access for data from hierarchy of display pages, using 'point and click' cursor actions.

Using SCL 'command scripts' it shall be possible to automate many of the operators procedures such that mouse click operation is all that is require to open/close valves, change set points, while performing logical checking permissive, authorization checking, check before execute security functions and time out functions. The control points shall be selected by clicking their related symbols on the graphic display. The Bidder shall apply standard set of control panel script and these shall be user configurable as well.

19.2 **DISPLAY FORMAT**

Every display shall have the same overall format which shall be, as a minimum, as follows:

. A system window to enable communication with the operator displaying fields such as menus, operator messages, operator dialogues, operating mode etc
. Main display area which may contain multiple windows
. Last alarm window containing the most recent unacknowledged and highest priority alarm message.
. Icons representations minimized windows
. System clock window

19.3 **WINDOWS FORMAT**

Each window display shall be formatted according to approved style with a window header, frame and a menu bar/status line. Format details beyond this initial definition shall be defined during the detailed design phase of the project. The overall display page or window requirements are described below. The displays proposed by Bidder shall be subject to Client approval.

20.0 DISPLAY REQUIREMENTS

20.1 The SCADA HMI shall support the comprehensive range of displays to enable maximum operational, engineering, maintenance and planning benefit to be obtained from the system. All displays shall be subject to approval by the Client.

The station displays to be split in such a manner to ensure proper view ability and legibility covering all the facilities and covering all the signals & controls as per SCADA telemetry database document

The soft keys/buttons for accessing Pipeline single line diagrams, station schematic displays, SCADA system status displays, SCADA reports be available at all the time for direct access.

Further displays shall have navigation built-in covering Page forward, Page backward, Page up, Page down facilities indicating the corresponding names of the displays for navigation.

20.2 The following list shows the types and numbers of displays that are minimum requirement:

- Master and Sub Index Displays
- Pipelines overall status Displays
- Pipeline Single Line Diagram Displays for all pipeline sections
- Network and Station Overview Displays
- Station displays
- Terminals/SV stations Displays
- Alarm and Event List Displays
- Data Trending
- Trend Buffer Assignment Displays
- Bar Graph Displays
- Electrical parameters, CP parameters Displays
- Configuration Management Displays
- Database Review Displays
- System Resource and Error Statistics Displays
- System Resource [CPU, Memory, Disk loading]
- Diagnostics displays
- Single point display
- Metering system display (Filtration, metering & let down)

20.3 The following displays shall show the complete overview of the different equipments i.e. workstations, CCUs, RTUs, Printers, communication channels etc. showing the status & health of each equipment including RTU modules by different color combinations and appropriate text. Whenever change in status of any subsystem is detected by the system self diagnostic, it shall be instantaneously updated in the display. The color schemes for various states of different subsystems and format of the display shall be as defined below

- MCS /ECS / RWS System Status Display
- MCS /RTU Communications Equipment status Displays
- Communications status Display & communication statistics displays
- RTU Status Display
- SCADA System Utility, Support and Diagnostic Displays
- SCADA report

Display of asking rate for the receiving / dispatch terminals with alarm indication using proper color (when asking rate is more than allowed flow rate be some %) and comparison of contractual and actual pressure / temperatures.

Color Scheme: Green : Normal, Yellow: standby, Red - failed

20.4 The dynamic field values along with engineering units shall be indicated next to the analog tag numbers and serial link data. The attributes viz. change of colour, flashing be done with the numeric value to show alarm on these tags in the displays.

The station displays shall constantly display the dynamic field values in engineering units. Also the corresponding display shall include the field values in engineering units.

20.5 The digital points along with their tags and alarm & normal status shall be shown in the displays. Device control panels / boxes / pallets for all controls has to be included by bidder.

20.6 The hot spots shall be confirmed in all the displays for further navigation / selection and direct access.

20.7 The remote/ local status of SV's /IP shall be indicated by the static text 'R/ L' respectively, with 'R' in green and 'L' in red colour in all the station schematic displays.

20.8 Valve displays shall be Green open, red when closed, and flashing red when bad, flashing green travel.

21.0 DISPLAY REQUESTS

It shall be possible for the user to quick access to any required display with one or two mouse 'clicks' using the feature of inter page links (poke points) plus associated display links. All the window windowing functions such as iconisation of displays, window resizing and selection plus window closing etc. shall be supported. At least the following types of display request shall be provided:

- Select Window
- Activate Window
- Move Window
- Resize Window (Including Maximize, Minimize)
- Close Window
- Zoom and Pan Windows
- Page Forward/Backward/Left Right
- Display Request Via Dedicated Function Pushbuttons
- Display Request Via Cursor Selection Points
- Display Request Via manual entry of a display page Identifier

21.1 Colour coding of device symbols and numeric values on the display pages shall be used to show the status of the corresponding device or numeric value. Colour codes shall be subject to Client's approval prior to implementation.

21.2 a) Bidder to ensure that field width of all accumulator points and analog points to be selected properly in display and include at least 2 digits after decimal.

b) Bidder to note that pipe to soil potential analog input signal will have compound range (from negative to positive side). The alarming mechanism to be suitably

implemented with under protected alarm configured as less negative signal and overprotected alarm configured as more negative signal.

21.3 The display hierarchy to be built to permit overview of the station (pump stations, terminals etc) with alarms and important parameters & controls and linking with the detailed displays of various sections of the stations with complete details of all parameters and controls. All the displays will be linked by properly implementing the display navigation mechanism through clicking the mouse.

21.4 The change of alarm limits and set point changes shall be logged on SCADA system as events.

22.0 ALARM & EVENTS ANNOUNCEMENTS

These fall in to two categories i.e.:

ALARM

EVENTS

Functions classified as Monitored states shall be required to be presented on the display at the MS / EMS for all possible states. It shall also be required to announce the change of states as they occur and such change of state shall be displayed at the MS / EMS directly identifying the function changing from one state to other for operator interaction.

ALERTS

All the alarms shall be available in a consolidated alarm list. The event list shall also contain all alarms, return to normal of normal of alarms and change of state.

These are signals which shall be generated by system software and which are generally of a pre-warning or advisory nature.

An area of each display frame shall be dedicated to Display Announcements, so that whichever frame is selected for display by the operator to facility to display these announcements will always be available. SCADA vendor shall provide a hardwired multitune hooter at MS for identification of critical, non critical alarms and alert tone.

22.1 ALARM AND EVENTS PROCESSING

a) The MCS / ECS shall facilitate the alarm reporting to alert the system operator of abnormal conditions through the HMI.

A1) It will be required to given alarm on the absolute value of measured variable, rate of change of measured variable, deviation high and low, change in discrete

status, sensor bad and system related alarms. The system shall also be capable of generating alarms on the computed variables.

A2) The system shall not put off the audio devices and the visual indication as soon as the condition returns to normal, before operator acknowledgement. It shall be possible to assign points in various alarm categories differentiated through colour combination. Alarms shall be flashing in respective colours before operator acknowledgement.

A3) It shall be possible to associate the occurrence of alarm to pre assigned picture for detailed information and acknowledgement, in addition to alarm summery display. Dedicated alarm summery page shall be provided giving chronological information of tag no., set point, actual value, time/date of occurrence, time/.date of return to normal, text descriptor etc. of the acknowledged alarms and acknowledged but existing alarms in the system.

A4) The alarms which are acknowledged and also returned to normal should be cleared from alarms summery. Also when the field is faulty and acknowledges the alarm, the alarm message should go to steady state from flashing. Facility to delete alarm messages is not to be provided. Facility has to be provided to acknowledge alarm on point /page basis. Daily alarm/event file should be available for further processing purpose.

b) The alarm manager shall provide alarm filtering current alarm/historic alarm presentation group/point alarm acknowledgement plus enables/disable alarm history logging & printing specifying start time, plus audible and visual alarm presentation.

Alarms filter mechanism to be provided to screen the alarms and show specific alarms for review purposes. A filter shall be able to operate based on:

. Logical division of pipelines metering
. Various station wise like pump stations, repeater stations and terminals with selection of alarms, events.
. Various class of point database types like AI, DI, pulse inputs, calculated points, manual inputs etc.
. The associated process related point group type.
. Priority wise for various categories of alarms like unacknowledged alarms, acknowledged alarms etc.
. Reason code such as command, manual entry, acknowledgement, .unsuccessful command etc
. RTU wise alarms & events.

SCADA system equipments related alarms to be presented on a separate list form the process related alarms. Further the event filters to sort out various categories of SCADA events for accessing and presenting the same

c) Alarm detection related to process I/O shall be done at RTU level along with time tagging and should be kept, on sending to MCS, till the software acknowledges it as a part of protocol in order to prevent loss of alarm messages.

In addition, separate time tagged display listing of masked points and points inhibited for alarms in the RTU shall also be available.

d) Occurrence of alerts which indicates the behaviour of the pipeline and associated equipment will be displayable on operator request via an alert summery display in white or blue colour and shall be printed on alarm/event printer.

Typical events i.e. alerts/change of states to be stored/printed with proper ID are:

. Commanded device changes
. Un commanded device changes
. Device time out alarm
. Alarm enable/disable messages
. SP initiation for change, SP actually changed
. Alarm Return to normal
- Every operator action wrt Configuration and database changes, ACKS, control commands etc.
- SCADA System events
- All alarm also shall be events
- The Change of alarm limits and set-point changes shall be logged on SCADA system as events.

e) Alarm and alert/change of state summery display shall be different.

f) Alarm and alert history shall be maintained in the system disk file indicating all the alarms and alerts that occurred and acknowledged with in the system in circular file retaining the latest 10000 entries.

g) A procedure shall be provided to inhibit individual points from all or partial alarm processing. Inhibited alarms shall not be annunciated or displayed although an inhibited alarm list shall display all these points having inhibited alarms. The action of inhibiting or enabling alarm shall be logged as event.

h) The quality tags shall be implemented globally for all SVs, MOVs / GOVs, digital points in displays and reports in the SCADA system

23.0 DISPLAY OF MEASUREMENTS

23.1 NUMERICAL DISPLAY OF MEASUREMENTS

Analog values telemetered to the MCS / ECS from the outstation shall be capable of display in numerical values in engineering units along with the alphanumeric identity of the function measured.

It shall be possible to select any single or a combination of such measurement values for display on the main display panels in the form of lists and tables.

Further it shall be possible to display the measurement values on the main display panel showing the mimic of any station with all analog measurement associated with the station that are telemetered to the MCS / ECS.

23.2 **BARCHART DISPLAY OF MEASUREMENTS**

Telemetered analog measurement values shall also be capable of display as horizontal and vertical baracharts, in which the length/height of the bar shall vary according to the current telemetered value of the measurement function.

23.3 **TRENDING**

Real time trends and historical trends shall be possible on any parameters or variable like measured variable, set point, output, calculated variable and digital parameters etc., which shall also be capable of being drawn-out on printers as hardcopy. Bidder to ensure that all analog inputs, analog outputs and calculated parameters in SCADA database are configured in both real time and historical database with correct telemetry tag names and engineering units and ranges.

Historical and real time trends shall be done at both the MCS / ECS. It shall be possible to view any historical trends from remote workstation and through Web also in case one MCS / ECS is down for certain period, or restoration, the trended data for the down period shall be restored from the other MCS.

Trend display capability shall be according to the following functional requirements.

a) Trend displays shall be single line type or bar graph type with additional information like tag no., engineering units, span, present value of the trended point, alarm status etc. displayed. The display of trending parameters from the screen should be user configurable up to at least 08 parameters.

b) Selection of the tag no. and sampling time for real time and historical trending shall be possible from operator keyboard.

c) It shall be possible to select no of measurements for sampling and storing over selected polling intervals.

d) The time periods shall be selectable for any period up to one month for all parameters (for pipe to soil potential up to one year)

e) Exceeding this upper or lower limit shall generate an alarm. However, the alarm shall be capable of being muted by the operator and when muted the alarm shall be signified on the graph by stroke marks.

f) The trace colours shall not normally match with run time annotation colour. Further to distinguish multiple traces having same run time annotation colour, the different markers shall be used on the trends.

g) Facility to access trend data in text file for subsequent processing as required.

h) Facility to select using mouse, the required time period of displayed trend for zooming and to fall back to previous trend screens. It shall be also possible to see the value at a particular time on the trend curve by clicking the mouse on the curve.

24.0 REPORT AND LOGGING REQUIREMENTS

24.1 GENERAL

The SCADA System shall support the definition, generation, assembly, scheduling, buffering, spooling and printing of both logs and reports.

24.2 LOGS

A log is defined as a continuous and generally chronological listing of spontaneous messages such as alarms and events. Logs shall contain no summations or other calculations using the logged quantities.

A log shall comprise single line alarm and event messages printed one at a time as they occur. Each message shall have the same format as the corresponding message in the list displayed on the screen.

Operator interaction (commands, set points etc.) shall be logged with tagging of user ID of the operator and shall be viewable at any time through the HMI.

Daily log files/operator tracking files shall be available for further processing purpose.

24.3 REPORTS

24.4 Reports shall be defined as an output of pre selected data organized in a specific format. Report software to support output to any of the three defined destinations-screen, printer and memory. Reports shall be printed on demand or on the occurrence of predefined trigger events, such as the time of the day, shift wise, daily, monthly. All reports shall be viewable on Monitor prior to printing on demand.

24.5 Data shift reports shall give hourly average values of parameters for the previous 8 hours form the time of scheduling of these reports. These reports shall be printed three times a day on predefined times. Definition of shifts has to be incorporated in the shift definition screen and data to be stored out accordingly.

For status shift reports, the 'Abnormal state' to be maintained for the complete hour even though the status returns to normal with in the same hour.
Daily reports shall give shiftily average values of parameters for all the three shifts of the previous day from the time of scheduling of these reports.

Monthly reports shall give daily average values of parameters for all the days of the previous month from the time of scheduling of these reports.

24.6 The SCADA shall allow the definition of new reports formats and the modification of existing report formats as a system maintenance mode function. Report generator tool shall be based on spread sheet package and shall be able to access to real time database and history database. The report software shall also support embedded arithmetical functions.

24.7 The process parameters and computed variable would be reported along with their status and data qualifier indicators such as alarms, sensor bed, point masked, points manually entered etc. In addition "note pad" field shall be available in the reports for the operator to enter optional notes and field maintenance information (which will be valid for a particular report only where the same is entered). Further KSPL project & Client logo along with data/time of printing has to be included in all the reports. Bidder shall incorporate any additional Client's requirement for text/font/style/colour combinations during site implementation phase. All the reports shall include telemetry tag no. and description in the header of report. Operator shall be able to change/modify the value in the reports, if required.

24.8 All shifts & daily reports which are to be printed at predefined time (configurable), to be automatically screen dumped and stored on hard disk and printed (if printing of reports options is enables). Also option to operator "Yes/No for printing" has to be given (enable / disable of printing).

Another script shall be triggered at the end of the month or in 3 months (configurable) automatically move all stored files from hard disk to optical disk / DVD RAM. In order to free the hard disk storage space.

Files from hard disk & optical disk / DVD RAM shall be accessed by defining report name and shift/day/month/year for printing on demand.

24.9 The following types of reports shall, as a minimum, be made available covering all the requirements of the P&IDs for all terminals, all Intermediate stations, all Receipt terminals, SV& Intermediate piping (IP) stations:

. Metering data reports (shift, daily, monthly) with parameters as pressure, temperature, mass flow rate, totalized mass flow, corrected volumetric flow rate, density etc. for all the metering run.

. Station/terminal data reports (shift, daily, monthly) with parameters as (Run 1+2) mass flow rate, (Run 1+2) totalized mass flow, (Run 1+2)

corrected volumetric flow rate, density, station pressures, station temperatures, set points etc.

. Electrical parameters reports (shift, daily)

. SV/ IP stations pressure & temperature reports (shift/daily)

. SCADA System status

. Emergency response personnel database reports.

- Daily and fortnightly report for the receiving and dispatch terminals.

- Alarms report (current alarms report and alarm duration report).

- All the reports shall include report header at the center.

- The exact formats of reports shall be finalized during engineering stage.

Other daily / monthly / yearly / on demand operational reports such as Power source running hours report, pipeline eqpt (power source CP) availability report, Abnormal pipeline eqpt / PSP / SCADA System /Instrumentation report, operator tracking report, station availability report, ticketing report daily progress report for MIS etc as required by client shall be finalised during detail engineering.

The system shall generate a delivery accounting print out (ticket) of the volume delivered. The time with volume/ energy delivered on the ticket should be verified against the flow rate and time. The module should have provision to allowed the supervisor (with authorised password) to edit and re-issue tickets if a calibration discrepancy is observed. Overall daily progress report for MIS etc., as required by client will be finalised during detail engineering. The monthly report will be generated every day containing the data from the start of the month to the latest completed day

The yearly report will be generated every day containing monthly data up to the current month. The current month data will be from starting of the current month up to the last completed day.

Vendor shall ensure that the correct tag nos with respect to the P&IDs and electrical parameters list, correct points IDs and calculated variables in the database along with point descriptors are properly incorporated in the various reports. All the reports shall include “SCADA Master Station”/ “SCADA Emergency Master Station” (as applicable) and the report name in the centre of the report header. Alarm status, point masked, point manually entered etc. to be report\ed under suitable identifiers.

24.10 **DATA ARCHIVING**

The Bidder shall provide, as an integral part of the system, data archiving functions and facilities at MS & EMS.

The archiving process shall automatic except for those tasks where manual operation is a fundamental requirement.

The archiving function shall not interfere with the operational functionality of the SCADA and shall be decoupled from it.

24.11 **OPERATOR AND ENGINEERING FUNCTIONS**

24.11.1 All operator and engineering functions shall be initiated from the keyboards and mouse associated with the works stations.

24.11.2 The HMI to support use of login access control and assignment of control area to the operator either by console basis as well as user login basis.

a) **ACCESS SECURITY**

The facility shall be provided for restriction of access. Using this facility, the names, authorized access level, access codes, duty times and time/date of entry shall be entered. It is intended that access code shall not be displayed when entry is made for reasons of security. Each workstation shall have no. of defined authorization for process control and for control system interaction along with login capability with password protection.
Each operator login account shall define the level of access and the control for various pipeline(s). The password security shall be built on all workstations including remote workstation for at least 16 divisions, broadly within the following levels. These shall be finalized during FDS stage.

Manager: Top level limited to persons authorized to modify software and allocate access authority called Manager Level.

This is in addition to Engineer, Supervisor and Operator privileges.

Engineer: Limited to persons authorized to access and modify any thing in the data base and display and report formats (data base , display / report configuration)

This is in addition to Supervisor and Operator privileges.

Supervisor Level: Allowed to adjust configuration parameters during system diagnostics / Maintenance level (Manual override, alarm inhibit, take point in / out of scan, take in / out of test mode, take RTU in / out of scan, take RTU in / out of test mode, initial demand scan of RTU etc.) called Engineer level.

This is in addition Operator privileges.

Operator Level: Operators access level for normal day to day system operation.(Allowed to access displays, generate reports, alarm acknowledgement, supervisory digital controls and set point controls, pipeline shut down etc.)

b) **OPERATOR FUNCTIONS**

The operator functions shall be comprehensively covering all aspects of information call up, assignment of display, function select, panning, and windowing for quick display call up and navigation from the keyboard and mouse using special function key pads and mouse together with help displays on the screen.

Operator control functions shall include alarm silencing acknowledgements suppression, request for printouts of logs and reports, open-close-stop type discrete controls, increase-decrease type inching controls and set point controls by transmission of set points to remote outstations by telemetry.

Operator control functions shall also include entering non-telemetered values, constants limits, set points and manual entered text messages for display on selected Monitor frames. These values shall be retained until changed to new values by operator entry and erased as would be the case for manually entered text messages. Manual data entry under password control shall be available on all the displays with validity/limit checking feature.

c) **ENGINEERING FUNCTIONS**

The system shall facilitate on line SCADA system configuration, compilation, modification of configurable parameter i.e. report by exception value, alarm limits, analog display range, additional and deletion of points for installed I/O modules, display logs and reports and expansion of the data base, display, logs and reports.

This shall be user friendly on and down time loadable from the HMI wise station.

It shall also be possible to carry out such functions from any of the operator's console using passwords according to the level of access security. It shall be possible to copy/transfer any HMI display from any WS/ remote WS/ remote WS.

Engineering function shall include running of system diagnostics for online system testing.

24.12 **SUPERVISORY CONTROL**

24.12.1 **GENERAL**

Supervisory control functions shall comprise a multi-step interactive procedures to avoid accidental operation of plant items.

These interactive procedures to be supported shall include:

. Start/stop/close/open control

. Set point control

. Sequential control

Additionally shall follow the sequence:

. Identification of the device to be controlled by cursor positioning
. Selection of the device for control

. Execution of the control

The SCADA system shall lead the operator through all of the correct steps necessary to successfully operate the selected device and minimize the chances of incorrect operation.

24.12.2 **START/STOP/OPEN/CLOSE CONTROL**

This control function shall be used to control multiple state devices in the pipeline system and the SCADA system. All these control functions shall utilize the select-check back-execute control sequence and Digital output subsystem of RTUs shall recognized two commands associated with device control.

The following procedure shall be used for open/close control of device:

- Select a display which shows the required device.
- Position the cursor on the required device and click the symbol and thereafter Select the control (i. e. Select open. Close. Start, stop). At this stage all the permissive (for e.g. Local / Remote mode, other conditions to be full filled for control) are checked. In case it is not valid, then suitable massage to be displayed & printed as event.
- Execute the selected control function. This enables the command to be sent to the RTU (which includes the various steps for control selection, check-back & execute between Server & RTU as bounded sequence) and then out of the RTU. In case the desired state is reached with in the stipulated time then the command status as successful is evented, otherwise time out event is generated indicating that the desired action has not been implemented

- This step shall be time supervised. If the control request in the next step of the dialogue is not made with in a defined period, then the device selection shall be automatically cancelled and the dialogue line cleared.

- Execute the open or close function. If the control request is valid, the device status shall be changed and the dialogue line cleared. If the control request is not valid, the selection of the device shall be cancelled and an error message displayed in the operator message line.

  The control request shall be processed as an event. The various events as indicated above shall be available in the event summary and also printed.

24.12.3 **Set point Control**

The set point control function shall be used to provide a set point for controllers. Operator shall have a facility to change flow and pressure set points manually from SCADA. The action required to perform the above steps shall be as follows:-

- Select a display which shows the required controller. Position the cursor to the required controller and click the controller symbol. At this stage the permissive and flags (for local /remote modes) are checked. In case not valid then suitable message to be displayed and printed as event, other wise message Set-Point Control Initiated shall be displayed.

- The operator shall verify that the correct point has been selected, enter the new set point value. This step shall be supervised, if the value is not entered within defined period, then the same shall be automatically cancelled and the dialogue box cleared. For entry of set point made within this time the event set point control selected shall be generated.

- For Set point change from SCADA to be permitted when controller remote/local switch (digital input to the RTU) is in remote mode, otherwise suitable message that permissive is not available to the generated.

- The operator shall issue a ‘control after select’ command which shall cause the RTU to rout the selected set point analog output value to controller. Any command other than ‘control after select’ shall cause the RTU to cancel the selection. Further if the ‘control after select’ is not received within a predefined period, the RTU shall automatically reset the circuit cancelling the selection.

- Executed the elected set point control function. This enables set point command to be sent to RTU and then out of the RTU. This step shall be supervised, if the value is not entered within defined period, then the same shall be automatically cancelled and the dialogue box cleared.

- The actual set point feedback signal is an analog in put to the RTU coming from the controller in both local & remote modes.

All the messages for set point changes shall be properly listed as event. The Event message for "Set point control initiated", "Set point control selected" , "set point control executed", "set point successfully changed" etc be available in the event summary and also printed.

24.12.4 **SEQUENTIAL CONTROL**

The sequential control function shall initiate the execution of previously defined sequence of control command. The function shall be implemented for possible application in conjunction with pipeline shut down as per operation and control philosophy

24.12.5 **REAL TIME VARIABLE CALCULATIONS**

The system shall have capability of defining computed variables (including server resident analog accumulator points) by arithmetic and logical operators from the real time parameters. The arithmetic operators will include as a minimum X, -, *, /, SQRT, MAX, MIN. and logical operators will include AND, OR, NOT functions on the real time operational parameters.

b) The calculation tool shall also include all types of database access and starting of programs with features of specifying customer specific formulae.

c) These calculated results can be embedded for the purpose of display, reports etc.

d) The Vendor shall write the program(s) to calculate the Linepack for various pipeline sections based on the formula to be provided by NMDC during engineering stage. The program shall take the input from realtime database of SCADA system and write the linepack calculated value to real time database for display in graphics and archiving. While calculating the linepack quality tag of the input parameters will be checked and default value considered wherever required. The output tags shall be current linepack section wise, total line pack of pipeline, yesterday"s line pack(last 24 hrs value) etc. The frequency of the program run shall be user configurable.

e) Void

f) SCADA system shall read the parameters from Pipeline modeling software (APPS) through OPC and write them to realtime database to SCADA system.

g) The SCADA system shall have host resident (at MCS/ECS)

Accumulator points to accumulate running total and yesterday total using the instantaneous flow rate.

24.12.6 **REAL TIME DATABASE ACCESS:**

The supplied SCADA system shall have necessary provision for interfacing (data interchange) with third party applications etc. To achieve this, the following facilities as a minimum shall be provided with the SCADA system.

a) SCADA system shall be OPC compliant to fetch data from third party applications. For this, it should have OPC UA server and OPC UA client as a minimum. It should be able to exchange data with OPC classic versions like OPC 3.0 and OPC 2.0 It shall be able to read values along with quality and time tag and write values along with quality and time tag to the third party applications through OPC.

The SCADA system shall read station wise scheduled quantity from the third party applications and write into its Real time database for further calculation of asking rate by SCADA system.

The SCADA system shall read the important parameter like Line pack etc from Pipeline modeling software (APPS) and write into its Real time database for further use in the Analogue calculation point (ACAL)

Similarly third party applications shall read and write values along with quality and time tag to the SCADA system through OPC.

The required parameter shall be configured in the OPC table for exchange of the values with third part applications

b) Complete suite of APIs, callable from C/C++ programs shall be provided. It shall be possible to read all real time parameter values, their quality tags, time tags and other attributes using these APIs. It shall also be possible to write parameter values, their quality tags, time tags and other attributes using these APIs. Once parameter values or their attributes are written into the SCADA real time database using these APIs (from a third party software), the SCADA system shall treat these parameters in the same manner as the SCADA system acquired values for all purposes including storing, archiving, controls, etc.

c) SCADA system shall be able to provide and receive data in excel, csv (comma separated values) and flat files from third party applications. For providing the data, it shall give the EPN Name (Point Id) in one column, Point description in second column, and its value in the third column measurement unit in fourth column. For receiving the data, it shall fetch the data in the format mentioned above.

24.12.7 **TIME SYNCHRONIZATION**

a) The GPS time server shall be connected with the SCADA system at MS and EMS. The primary SCADA server at MS shall be the "Master Clock" for the overall system Date and Time Facility utilising GPS time reference and the entire node on the LAN at both the MS /EMS shall be synchronised with the Master clock with the resolution of 100 msec.

In case of failure of Master Clock, the redundant SCADA server shall receive the signals from GPS time server and shall have the Master Clock.

The RTUs should be synchronized with the master clock. Whenever the MS date and time is set or reset, an automatic synchronizing signal shall be transmitted by telemetry to all remote stations. Any remote station subject to a "Station Failure" shall automatically be sent a synchronization signal on restoration of telemetry.

b) RTU time synchronization shall be done w.r.t. MS periodically with the time intervals as system definable parameters. The RTU internal circuitry shall compensate for the delay due to message structure, transmission delay and baud rate to arrive at the correctly matching time. Positive acknowledgement for the time synchronization shall be sent by the RTU.

c) Should there be a discrepancy between time at a remote station and the time received from MS by telemetered synchronization signal, then the remote station local intelligence shall automatically re-set and synchronize local time with MCC time within resolution of 100 msec. This synchronization shall be recorded as an EVENT and printed out.

d) All the nodes on the dual LAN at the MS shall be synchronized with the master clock every one minute permitting maximum 100 msec time difference.

e) In case of failure of MS, the LAN equipment & RTU to get synchronized by GPS time server at EMS.

24.12.7 EMERGENCY RESPONSE PERSONNEL DATABASE

The SCADA system shall have built-in programs to assist the pipeline operators in taking actions which are complementary with the overall emergency response plan. These shall consist of a database from which the operator can retrieve names and contact information for the responsible emergency response personnel in the area along the pipeline where the incident occurs and the overall emergency response personnel.

INDRADHANUSH GAS GRID LIMITED

NATURAL GAS PIPELINE PROJECT
FOR
NORTH EAST GAS GRID PIPELINE

TECHNICAL SPECIFICATION FOR
APPS (including LEAK DETECTION) SYSTEM

PREPARED AND ISSUED BY

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Table of Contents

1. INTRODUCTION
2. SCOPE OF WORK
3. DESIGN & ENGINEERING OF LEAK DETECTIN (APPS) SYSTEM
4. SHIPMENT, HANDLING, PACKAGING AND TRANSPORTATION
5. GENERAL TECHNICAL REQUIREMENTS
6. SHIPMENT, HANDLING, PACKAGING & TRANSPORTATION
7. QUALITY ASSURANCE & ACCEPTANCE PROGRAMME
8. TESTING & INSPECTION
9. DOCUMENTATIONS
10. TRAINING
11. WARRANTY
12. ANNUAL MAINTAINACE CONTRACT

1. INTRODUCTION

The APPS System shall be based on Real-Time Transient Hydraulic / Statistic Modeling Technology, in accordance with the specifications written in this document. The Bidder shall provide state of the art Leak Detection System to meet the total functional requirements of the specification, including future expansion

The system shall be a mature field-proven commercial software application, successfully installed in several pipelines with similar conditions to the one owned and operated by Client; not a project specific development, difficult to support in the future.

1.1 PURPOSE OF THIS DOCUMENT

1.2 The purpose of this specification is to define the outline requirement of Pipeline APPS System (including Leak Detection) interfaced with Supervisory Control and Data Acquisition (SCADA) System of Client. The project details shall be as indicated in Particular Job Specification, **PJS No. : MEC/05/E5/T/23VC/PJS-094** attached elsewhere in the tender.

1.3 In case of any conflict between the specifications, enclosed data sheets, enclosed attachments, related codes and standards etc. Vendor shall refer the matter in writing to the purchaser, and shall obtain clarification in writing before starting the manufacturing/ Supply / Engineering of the item. The decision of the purchaser shall be binding on the vendor.

1.4 Vendor shall be responsible for selection of the correct system to meet the purchaser's specifications. In case of any modification / change in selected equipment model has to be changed at a later date to meet the Purchaser's Specifications, the same shall be done by the vendor without any price and delivery implications.

1.5 GENERAL INSTRUCTION FOR THE BIDDER

The successful bidder shall undertake full responsibility on turnkey basis for providing a complete and evolutionary state of the art APPS System with Open architecture, meeting the objectives, functional and specific requirements described in the tender.

The APPS software licensor shall take the responsibility of the following as a minimum for successful execution of the APPS system:

a) Participation in system engineering, system integration, factory acceptance testing, and integration with SCADA, of the complete APPS system, commissioning and site acceptance of the complete system.

b) Furnishing & Vetting of FDS, all Design & Engineering Documents

c) Providing technical support, supply of licensed of APPS software, up gradation of software license version on migration to new hardware etc in line with conditions of the tender.

d) Ensuring QA / QC programs of the project conforming to standards and integration with SCADA software

1.5.1 Standard Software

The bidder should offer proposed solution from the existing standard software application and it must be field proven and currently in use by other pipeline operators and should not be an application specifically developed for this project.

1.5.2 Bidder proven track record

Each bidder shall submit the proven record of accomplishment of supplied technology with document proof to meet the requirement of the project. Therefore, the bidders should provide a list of project executed in last 5 years completed and working successfully for leak detection by using same technology offered for this project. For each of these projects the bidder should provide the following information:

- Customer Name
- Mailing address, Phone, Fax and e-mail address
- Project completion date
- Description of the pipeline
- Applications supplied
- Description of the SCADA integration implemented

Consider completed projects that are currently in operation and executed for the pipelines only for PTR reference. The supplier should be the owner of the intellectual property over the software and the technology that it intends to offer to client.
Smooth interfacing with SCADA with APPS server will be in bidder's scope.

2. SCOPE OF WORK:

The technical requirements for Pipeline application software (APPS) System and supplementary modules shall be read in conjunction with Supervisory Control and Data Acquisition (SCADA) System for monitoring and control of the pipeline.

The scope of work will be Design, supply, installation and commissioning of APPS including Leak Detection System and other modules described in specification shall be under the scope of this tender, as brought below but not limited to:

2.1 Design, supply, installation, testing and commissioning of Pipeline Application Software (PAS) servers and client work stations at Main Master Station (MMS) and Backup Master Station (BMS) locations as per tender requirement (including supply and installation of all required hardware, engineering of the complete system, post installation support during defect liability period & warranty period, engineering support during annual maintenance contract), shall be under the scope of this tender.

2.2 The Leak Detection System (LDS) shall provide functionality specifically targeted to detect and locate leaks and thefts through the use of a real time leak detection system. The following key performance criteria will be used to determine the most suitable technology for this project:

1. **Sensitivity**: minimum detectable leak size and the detection time of different leak sizes.
2. **Reliability**: level of false alarms i.e. a leak alarm when no leak is present
3. **Robustness**: ability to continue the detection of leaks during large operational changes when pumps/compressors are switched on or off, valves are opened or closed and during data faults

4. **Accuracy**: leak rate and location error

2.3 SYSTEM SPECIFICATION:

The offered solution shall be based on either or both of the following methods:

a) Real Time Transient Modelling (RTTM)
b) Real Time Statistical Analysis (RTSA)

Bidder shall be responsible for selection of best LDS model to meet the client's specifications. In case the model is not meeting the requirement and need to be changed at a later stage, to meet the client's specifications, the same shall be done by the bidder without any price and delivery implications.

The bidders should quote all software and engineering services needed to comply with all requirements listed in this document and to successfully complete this project; it includes but not limited to:

2.4 SOFTWARE

The main goal of the software application is to provide a flexible tool which support improving the overall performance of the operation and administration of the pipeline. Therefore, the Leak Detection System offered should be sensitive, accurate, dependable, robust and scalable; with the ability to provide a detailed picture of the current operating conditions of the pipeline. The specific requirements are described in the following sections.

2.5 SERVICES

Application software shall provide operations and planning tools to optimize the operation of the pipeline networks and aid the dispatcher in Pipeline operations. Application software, among others, shall consist following modules for natural gas pipeline networks of client:

- Real Time Modeling (RTM) / Real Time Statistical Analysis (RTSA)
- Leak Detection System (LDS)
- Inventory Analysis / Line pack Calculation
- Look ahead Module including Survival Analysis
- Predictive Module having Contingency Analysis
- Optimizer (Pump/Compressor Station) Module
- Scrapper Tracking
- Pipeline Transportation Efficiency

Each bidder should include in its offer all the engineering services needed for the successful completion of the project; including but not limited to:

- Leak Sensitivity Study (if applicable)
- System Configuration (Database, Graphical User Interface, Trends, Profiles, Events, Alarms, etc.)
- SCADA Interface and Integration
- Factory Acceptance Test
- System Installation and Startup

- System Tuning
- Site Acceptance Test
- Operator and System Administrator/Engineer Training
- Documentation – User and Administration Manual

The successful bidder shall undertake full responsibility on turnkey basis for providing a complete and evolutionary state of the art APPS System with open architecture, meeting the objectives, functional and specific requirements described in the tender.

Scope of supply and works of APPS system vendor shall include, but not limited to, all the activities of project management, preparation of Instrument Adequacy Report for P/L network, preparation of APPS Performance Report for P/L network, design and engineering of APPS system, training, factory testing, supply, installation, commissioning, site testing, test run, packing, forwarding, transportation (freight), insurance, port handling, custom clearance, inland transportation etc (as per commercial section), receipt at site, warranty, quality assurance and quality control of the system, and documentation with the turnkey responsibility and meet the requirements of the tender in all respect.

The APPS Vendor shall submit the Instrumentation Adequacy Report for pipeline network and "APPS Performance Report" for pipeline network.

3.0 DESIGN & ENGINEERING OF APPS SYSTEM:

The APPS Vendor shall be fully responsible for detailed engineering and design of the complete system to meet the following as detailed in the tender document as a minimum:

- System Functional requirement as per APPS system specifications defined in Scope of Work of the tender document
- APPS System Specifications including system sizing, fail-over, and restoration mechanism
- Modification in APPS system configuration for changes in pipelines and to Integrate new (future) pipelines
- Interfacing with SCADA system for exchange of parameters through OPC

After award of contract, APPS Vendor shall submit Functional Design Specifications (FDS) covering the design, engineering, methodology of implementation, etc. of the APPS system in line with Scope of Work of the tender document for approval by client/PMC.

3.1 SUPPLY OF APPS SYSTEM

The APPS Vendor shall supply all the items / equipment including hardware, software, APPS equipment racks, installation materials (e.g. Cables, cable glands, conduits for laying the cable, connectors, ferrules, etc.) required to implement APPS system complete in all respects as per the tender requirement.

The bidder shall provide complete details of executed APPS System and offered for this project and shall furnish the technical specifications / brochures of all offered systems as part of the technical bid document.

3.2 ENVISAGED APPS SYSTEM ARCHITECTURE

For the proposed implementation of APPS system, following system architecture is envisaged:

- APPS system shall be modular, scalable and have capacity to accommodate under-construction and future pipelines.

- APPS system shall be able to run APPS system for multiple independent pipeline networks as well as integrated pipeline networks.
- APPS system shall be OPC compliant for data exchange with third party applications.
- The APPS system hardware shall be installed at Main Master Station (MMS) and Backup Master Station (BMS) as required
- APPS server setup shall be provided at each MMS and BMS locations for Leak Detection System (LDS), Real Time Modeling (RTM)/ Real Time Statistical Analysis (RTSA), OPC, Predictive Module (PM).
- APPS Trainer system (including Pipeline Simulator), along with APPS Training HMIs shall be provided at MMS and BMS locations. The APPS trainer shall mimic Dispatch Terminals (DT), Receiving Terminals (RT), Sectionalizing Valve stations (SV), Intermediate Pigging (IP) Stations along with Set point controllers.
- Engineering Work Station (EWS) and APPS user HMIs shall be provided at each MMS and BMS. These EWS and APPS HMIs shall be used only for APPS system.
- The APPS system shall be connected to SCADA network at MMS and BMS to facilitate communications as per following:
  a) Between SCADA system and APPS system through OPC for data exchange
  b) Between APPS set ups at MMS/ BMS through SCADA network
  c) Between SCADA HMIs (being used as APPS HMIs) and APPS system

3.3 SPECIFICATIONS FOR REAL TIME MODEL/ REAL TIME STATISTICAL ANALYSIS

3.3.1 General

a) The Leak Detection System should be based on a truly transient Real Time Hydraulic Modeling technology. Such Real Time model must simulate and describe in detail the transient behavior of the pipeline. It should also include functionalities to export that information to be used in the decision-making process.

b) It should be designed to run on a standard Microsoft® Windows operating system. Third party applications or system shells should not be required for the system to run.

c) The mathematical model of the pipeline network should be running in Real-Time and be governed by the mass and momentum conservation equations and the energy balance equation.

d) The governing equations of the model should be solved for fixed or dynamic points along the pipeline, in order to guarantee the stability of the system, or using fast and precise high-order finite differences techniques.

e) The real time model should track the thermodynamic and transport properties of the fluid.

f) The results of the real time model should be shown as hydraulic profiles, presented in graphical and tabular forms. The model should calculate, at least, the following profiles: Pressure, Temperature, Flow, Density, Velocity and Friction Factor.

g) It is required that the model is robust enough to perform calculations for pipelines with large elevation changes, regular fluid composition changes and diameter changes. It is required that the bidder provides at least five (5) project references where the proposed application is being used successfully under such conditions in which at least one for Natural Gas Leak Detection.

h) The system should be able to simulate a wide range of physical and operational conditions of the pipeline, based on the information received from the field. Basically, the system should perform its calculations based on the measurements of flow entering and leaving the pipeline, upstream and downstream pressures and temperature of the fluid entering the pipeline.

i) The system should allow for the configuration of logical conditions (such as AND, OR, NOR, NAND, etc.) and logical strategies to adjust the configuration and the mode of operation of the model dynamically, to the particular operational situation of the pipeline at any given moment.

j) The real time model, the base of the Leak Detection System, should be a flexible tool, with the ability to accommodate future changes in the database, due to expansions or enhancements of the pipeline, and to configure additional advanced application, beyond the scope of this project.

k) Different levels of statistical analysis can be applied to leak detection. All use field data from a SCADA system or RTU's directly can be used for statistical analysis. Apply statistical analysis to both the volume balance and rate of change in flow/pressure to reduce the false alarm rate can be used by Pressure Point Analysis & Sequential Probability Ratio Test (SPRT).

3.3.2 Configuration Tool

a) The configuration of the model should be performed through a graphical configuration tool, which allows the engineer to modify the current configuration or create new configurations in a dynamic and intuitive configuration environment.

b) The graphical configuration tool should allow the user to validate the hydraulic connectivity of the elements configured in the pipeline.

c) The graphical configuration tool should include an optional off-line hydraulic simulation engine, which allows the user to run both steady and transient state simulations, in order to evaluate the hydraulic behavior of the pipeline.

d) The configuration structure should be flexible enough to accommodate the division of the model in segments, based on the availability of flow and pressure measurements.

3.3.3 Database Requirements

a) The core of the structure should be an efficient and robust database, designed to operate in real time.
b) The system should allow the user to modify the tuning parameters on-line, with no need to stop and restart the model for the changes to take place.

c) The database should be open and flexible. If should be possible to import the configuration data tables from standard commercial applications such as Excel®. The system should also allow access to a low-level configuration language, in order to permit some customization not available through the basic configuration.

d) It is required that the system is capable of displaying trends of the following model properties: boundary conditions, flow and pressure calculations at the starting and ending points of each pipeline segment, leak detection responses and thresholds. The trend resolution must not be filtered, i.e. all calculated/measured values must be included.

3.3.4 Data Reception and Pre-processing

a) The system should have an open Application Programming Interface (API) available as an option. It should allow third party applications to access model calculated values through function libraries.

b) The Real-Time Model should be interfaced directly to the SCADA system, in order to read the field data. The specifications for such integration will be described later in this document.

c) The Real-Time Model should read process data from the SCADA database. Prior to using this data a quality evaluation must be performed in order to ensure its quality and time consistency.

d) The evaluation process should provide information about the quality of the incoming data, in terms of value, time and state.

e) The Real-Time Model should extract the field data from the SCADA database at predefined intervals. Similarly, it should be able to send results, events and alarms back to the SCADA system using the same interval.

3.4 APPLICATIONS

The following applications have been identified as basic requirements of the APPS System:

3.4.1. Leak Detection and Location

As the essential part of the scope of this project, the bidder must include a reliable, robust and sensitive application to perform Leak Detection and location along the pipeline. As part of the application implementation, the bidder should perform an engineering assessment to determine the accuracy and sensitivity that can be expected of the system when applied to this particular pipeline. The required characteristics for such study are described in the following sections.

3.4.1.1. Leak Sensitivity Study

The Leak Sensitivity Study should comply with the following requirements:

a) The result of the study should be a report, discussing the implementation of the Leak Detection System, where, according to the actual conditions of the pipeline, the best value reachable for the following parameters is determined:

- Smallest detectable leak
- Correlation between size and detection time
- Leak location accuracy

b) Additionally, it should include a description of the instrumentation enhancements that could increase the performance of the Leak Detection and Location application.

c) The Leak Sensitivity Study should be performed at the very beginning of the project; in order to take advantage (when possible) of the conclusions and recommendations of the study.

3.4.1.2. Leak Detection and Location Specification

Wherever the instrumentation is available (pressure, flow and temperature), the modeling system should be able to implement the Leak Detection and Location functionality, complying with the following requirements:

a) The Leak Detection and Location application should be able to run different leak detection methods and performance for different segments of the pipeline.

b) The leak detection method should be based on a real time transient model compensated volume (or mass) balance, tracking the variation of the line pack with a high degree of accuracy. The model

generating the line pack calculations should be configured to use pressure measurements as boundaries where applicable. This will provide the most accurate line pack calculations.

c) To prevent false alarms, the Leak Detection application should include an automatic threshold adjustment module, using as control parameters the quality of the incoming data and the pipeline status. It should also allow the user to adjust the thresholds manually, through the GUI.

d) The automatic threshold adjustment module should be optimized in order to minimize the occurrence of false alarms.

e) The Leak Detection application should use at least five filtering windows for the leak detection responses, in order to guarantee the fastest possible detection for large leaks (short filtering period) and the most effective detection for smaller leaks (long filtering period).

f) The alarm handler should be able to evaluate any leak-suspicious condition, in order to guarantee its veracity before reporting it as a confirmed alarm to the operator. To comply with this requirement the system should handle multiple alert levels.

g) The alarm management module should be designed to keep the average number of false alarms lower than one per month.

h) The leak performance targets can be summarized in the following parameters:

- Minimum detectable leak: 3.0% of the nominal flow rate : 45-60 minutes or better with +- 5 Km of location accuracy - Vendor to confirm & quote
- Leak detection time for leak size 5% of nominal flow rate: 30-45 minutes or better with +- 7 Km of location accuracy Vendor to confirm & quote
- Leak detection time for leak size 10% of nominal flow rate: 30-45 minutes or better with +- 7 Km of location accuracy Vendor to confirm & quote

These performance parameters are highly dependent on the accuracy and repeatability of the field instrumentation and the general performance of the SCADA system. Therefore, the bidder should include a preliminary leak performance analysis of the proposed system, describing the assumptions made to perform the theoretical study and the correlation between leak detection time and leak size. The results of such analysis should be as close as possible – or even better – to the aforementioned desired performance parameters.

i) It is required that the Leak Detection application includes an auto-tuning functionality, which should adjust the friction factor (or the proper tuning parameter for the given leak detection method) to compensate simulation errors due to non-measurable or unpredictable factors, as it is the case of the simulation of complex operating conditions.

j) Once the presence of a leak has been confirmed, the system should provide an estimated location (milepost). The accuracy of the leak location should be determined during the Leak Sensitivity Study.

3.4.2. Composition Tracking

The composition tracking functionality should be completely integrated in the Real Time Model. Its purpose is to track the variance of fluid components along the pipeline, in order to determine the following properties of the fluid:

a) Density

b) Compressibility

c) Enthalpy

d) Heat Capacity

3.4.3. Tracking Display

a) The system should maintain a collection of graphical displays for the purpose of tracking type of Natural Gas as they move through the pipelines.
b) Each operational pipeline should be represented via a graphical display showing different types of Natural Gas fluid. All mileposts, receipt/delivery locations, and major pipeline facilities (i.e., compressor stations, crossovers, interchanges, etc.) should be included on this display. The operator should have a method to access both overview information and detailed information.
c) To facilitate the set-up of fluid tracking/pig data during initial system installation, new program loads and after major system or data upsets, the Tracking application should provide an automated and rapid method of loading this data from saved datasets.
d) Upon Operator command, the system should automatically use real-time and previously retained model data to establish a known state for the pipelines. The system should then use current metering data to bring the Tracking program back to current time. It is acceptable for the system to utilize a periodic save function (e.g., hourly) as the base for the re-initialization simulation.
e) It should be possible for the Operators to supply any missing or incorrect data. It should also be possible to initialize the Tracking package using a strictly manual method of entering the data.

3.4.4. PIG Tracking

a) From time to time, pipeline scraper devices known as "pigs" are injected into the pipeline. For this reason, the vendor may track pigs as a function of the overall tracking process or as a separate process. Using either approach, it should be possible to insert, track, and display pig related information (e.g., estimated time of arrival at downstream locations, etc.).
b) Pigs are "launched" at their receipt location and are "captured" at their delivery location.
c) As pigs travel down a pipeline, they have a tendency to "slip" with respect to the fluid. This means that pigs generally arrive at their capture location at a point in time later than would be calculated from the flow rate and pipeline distance. For this reason, pigs are associated with a "slippage factor". The system should permit the definition of slippage factors on a pig-by-pig basis.
d) When calculating the arrival (capture) time for a pig, the system should adjust for the associated pig slippage factor.
e) Pig launchers and receivers are frequently associated with pig detectors. Pig detectors are devices that detect the passage of a pig and activate a discrete input point. At a pig launcher, this discrete input point indicates that the pig was "launched". At a pig receiver, this discrete input point indicates that the pig was "received". At intermediate locations, this discrete input point indicates that a pig just passed (see below). These signals should be used to automatically launch, remove or adjust the location of the pig within the model.
f) When available, the pig detectors should be used as the primary pig launch/receipt indication. It should also be possible for an Operator to indicate that a pig has been launched or received. Using the manual approach, it should be possible to position the pig anywhere on the line by entering a displacement barrel amount from the pig launcher, Milepost location, or the time when the pig was launched. If launched by time, the system must use the historical velocity information to determine the location where the pig is now located. It should also be possible to delete a pig from the pipeline. It is acceptable for the system to require that a pig be launched before positioning can be performed.

g) If a pig "receipt" signal is not received within an operator enterable time period after a model pig arrives (initially set to ten minutes), the system should generate an alarm.

h) In addition to pig launched/receipt signals, the pipelines may also have "in-line" pig signals, which indicate the passage of a pig. The system should use these signals to correct the calculated position of pigs in the pipelines. If the indication of a pig is behind or ahead of the calculated location by less than a user defined amount of time, distance or volume (definable on a location basis), the system should synchronize based on the "in-line" pig detector without operator approval. However, if the adjustment is greater than the user defined amount of time, distance or volume, the system should generate an alarm message informing the Operator that the auto-adjustment is outside the defined dead band of time. If an adjustment is desired by the Operator, it will require a manual line fill adjustment using provided insert/delete pig tools. The user defined amount of time will initially be set to zero (0), thus alarming the Operator on every pig detection. The system should provide an event message indicating an adjustment has occurred. This event should include the amount of movement incurred.

i) It should be possible to include a note for each pig. This note will travel with the pig and be displayed along all other pig information if desired.

j) The system should also provide a warning alarm to notify the Operator of the imminent arrival of a pig at predefined pipeline locations. It should be possible to enable/suppress alarming at individual sites. The pre-arrival time period should be user defined on a per location basis.

3.4.5. Anomaly Tracking

a) Occasionally, events occur on a pipeline that has ramifications downstream. For example, an unexpected contamination is detected, fluid is accidentally injected at the wrong place or other conditions need to be tracked down the line. It should be possible for an Operator to identify these "anomalies" to the Tracking program. An anomaly should be easily identified

b) All anomalies should be identified on the Tracking display.

c) The system should use the current pipeline flow rate (either from the live data or an operator entry), line capacity, and calculated line pack data to maintain an estimated time of arrival for each anomaly.

3.4.6. Pressure Analysis

a) The system should provide a real-time pressure profile, taking into account the detailed elevation profile of the pipeline. Such calculations should also be compensated by temperature. User-configured pressure limits should also be considered to inform the operator about critical high or low pressure situations that require his attention.

b) The system should continuously compare the calculated pressure values with the user defined limits configured for each pipeline segment. Every time a violation occurs, the system should notify the operator through an alarm message.

c) The comparison is performed between the calculated values of each pipe section and the maximum and minimum operational pressure allowed (MAOP and LAOP). In the same way, the system should inform the operator when an alarm condition goes back to normal.

3.4.7. Leak Detection Performance Analysis

The system must provide a tool that documents the actual performance of the leak detection system. This tool should generate graphs that show the probabilities of detecting various leak sizes as a function

of time. Additionally, it should show the leak location accuracy and the number of false alarms detected for a user specified period of time.

3.4.8. Adaptive Model and Tuning

Client cannot provide complete and precise information with regards to all the pipeline parameters that could potentially affect the hydraulic calculations performed by the model. Parameters as pipe roughness and pressure drops in each valve along the pipeline are not completely known. Likewise, some existing instruments could have experimented changes in its calibration, which could affect the model performance. Therefore, it is required that the Leak Detection System should be able to use measured values read from SCADA to adjust some tuning parameters and to bring its behavior to the real operational condition.

3.4.9. Integration

The Leak Detection System should be able to share information with several different information systems. Among them are administrative databases, information centers and, of course, the SCADA system, which will provide the field data for the model calculations. The SCADA integration should comply with the following parameters.

a) The Leak Detection System should provide an operational interface, sufficiently open and flexible to be used as the writing and reading means for the systems' real-time database.

b) Given the nature of the system, the use of standard communication protocols is required, in the particular case of the SCADA system and the Leak Detection Application; there should be an OPC (ODBC for process control) interface available.

c) As an alternative communication method, it is required that the model allows for the use of alternate protocols and data transfer methods, in case the SCADA does not allow access for the OPC protocol. In such case, the communication interface should be adaptable, through configuration and / or coding, to the requirements of the SCADA system. Such requirements will be determined during the Functional Specification stage of the project.

d) The system should provide a functionality to expose its data to third party applications in a secure yet flexible manner, using standard technologies like XML. It should also provide the functionality to publish its data on the Corporate Intranet / Internet in a very user-friendly and intuitive manner.

3.4.10. Graphical User Interface (GUI)

a) The system should have its own GUI, with extensive graphic capabilities for displaying the model information in a user-friendly and intuitive manner.

b) The GUI should be able to present process data (e. g. profiles and trends) in graphical or tabular form.

c) The GUI should be a native Windows® application. It should be consistent with the Windows® applications' style, being operated through panes, drop-down menus, toolbars, dialogs, drop-down lists, context sensitive menus and data blocks, etc.

d) The GUI should support the drag-and-drop functionality within itself and to / from Microsoft Office® applications.

e) The GUI should provide a functionality to automatically generate a graphical view of the network, based on the configuration created in the graphical configuration tool.

f) The GUI should support multiple languages. The operator should be able to change the language of the entire application, on-line with no need to modify configuration files or stop and restart the GUI.

g) The GUI should support multiple unit systems and should allow the user to define his/her own unit system. The operator should be able to change the unit system of the application, on-line with no need to modify configuration files or stop and restart the GUI.

h) At least two (2) operator stations are required, which will be connected to the application server. Both of the operator stations should have the capability to graphically display information related to the real-time model and it's Leak Detection Application.

i) The GUI should allow for future additional operator stations, up to a minimum number of ten (10).

j) A desirable option is a 3D profile – i.e. capability of displaying a hydraulic property as a function of time and distance within the same graph.

3.4.11. Playback and History Review

a) The Model should save snapshots of line fill, scrapers and other relevant data at a configured interval. It should be possible to review this data by simply selecting a time in the past, or using a dedicated control to move the time into the past.

b) The historical review data should accommodate a predefined configurable period.

c) The ability to permanently capture and replay historical data is required. It should be possible to load a previous state and run the models again using saved SCADA data etc. The model response should be identical to the initial response when it happened in real time. The Vendors should describe in detail their capability in this area.

d) Model based Playback should not interfere with the real time production environment.

3.4.12. Predictive Applications

Other advanced applications needed include:

- **Look Ahead Modeling**: a transient model capable of looking into the future and providing alarms for upcoming operational issues. The operator can then take action now and prevent such issues from occurring.
- **Survival Time Analysis**: a transient model calculating the time it takes to reach operation constraints if a significant issue arises (e.g. loss of main supply or loss of critical compressor station).
- **What If Analysis**: a transient model capable of simulating any type of "what-if" situations. This will enable the operator to fully understand the impact of potential future changes to the pipeline.

3.4.13. Look ahead Module:

This module shall be based upon the current real time state of the pipeline along with present supply/delivery and equipment set points, status of valves and shall predict future operating conditions of the pipeline and warn the operator of impending short-term constraint violations. The module will have high & low flow and pressure limits defined for different segments of the pipeline. During look ahead, the module shall analyze if these limits will be exceeded and shall generate alarms as the case may be. The Look ahead time period shall be at least 30 minutes and shall be user configurable.

The module shall execute automatically. Transient conditions currently in the pipeline and current operation are thus continued forward in time, predicting future consequences of the current operating conditions.

3.4.14. Survival Time Analysis:

A survival time analysis is similar to look-ahead model which analyses and gives suggestions like how much time pipeline can continue to operate until a critical condition occurs. This can be triggered through events or manual.

Survival time analysis shall calculate the time until violation of minimum or maximum inventory for each pipeline network in the event of loss of supply or delivery point. Calculations shall be based upon current inventory and line packing rates obtained from inventory analysis and current measured supply and delivery rates obtained from Real Time dynamic modelling.

3.4.15. Predictive Module:

If consumers request for increase or decrease in Natural Gas delivery, if the Natural Gas supply is less due to any reason, if look ahead alarms are generated, or if real time data deviates from forecast, the software shall be used to prepare a new future operating plan. Such a plan shall be developed by testing several alternatives subsequently by the operator. In test mode, the software shall determine the future trends for the changes proposed in each alternative. Trends shall be for pressure and flow rate v/s time at different locations required by the operator.

The Predictive Module shall begin searching for feasible corrective measures only when triggered by the operator for making a decision. These can involve change in Natural Gas supply, curtailment of Natural Gas supply to some consumers and change of set points accordingly. The software shall analyze different strategies and present only the most feasible ones to the operator and shall help to select the best strategy which involves the most efficient operation, least impact on demands or which satisfies some other pre-defined criterion the most.

The predictive module shall provide a 24-48 hour offline projection into the future of pipeline operation. The model shall be initiated from current pipeline conditions or may be reset to a previously saved condition of all the pipeline process variables. The module shall provide the user with a tool for preparing forecasts of the next hours or days of product transportation through the pipeline system taking into account all known constraints.

The predictive module shall run on dedicated PM Machine. Therefore, for running Predictive module local HMIs at Control center and Remote Work Stations shall be logically connected to PM Machine.

The predictive module shall also take into account constraints of a more permanent character, such as: -

- Maximum/ minimum pressures and temperatures
- Allowable operational ranges at Compressor Stations
- Operational strategies prior to actual implementation
- Possible preventive actions in due time, before critical situations occur
- Consequences of changes in demands and supplies

3.4.16 APPS System requirement:

The offered APPS system shall be reliable, field proven and evolutionary state of the art.

Operating System Requirement of APPS System

The APPS system shall meet the following requirements for operating system:

(i) The APPS system shall be built around Microsoft Windows operating system.

(ii) The Centralized APPS system shall be OPC server and client compliant for interfacing with third party applications like SCADA.

(iii) All the APPS servers, machines and networking devices shall be IPv4 and IPv6 compliant.

APPS Setup at MMS and BMS locations:

The setup at each MMS and BMS location shall comprise of following equipment located in SCADA/APPS Server Room of client:

a) Real Time Modeling (RTM) -cum- Leak Detection System (LDS) -cum- OPC cum Predictive Module (PM) -cum- Compressor / Pump Station Optimizer (CPSO) servers

b) APPS Trainer Servers

c) LAN switches

d) Associated accessories

The APPS User HMI workstations shall be connected to the SCADA switches installed in SCADA control room and shall communicate with APPS servers installed at SCADA server via SCADA switches.

The SCADA system printers shall be used for taking the printouts related to APPS System. The APPS system shall be configured accordingly. SCADA printers are for client's use only and shall not be used by APPS vendor during system installation and commissioning / generating APPS documentation.

3.4.17 System hardware specifications

The hardware specifications to meet the APPS system requirement shall be provided in such a way that it shall take care of any future 100 % requirement of present. In case the bidder software requires additional / higher hardware at the time of commissioning, then the same is to be provided by the bidder without any financial implication to client over and above the quoted prices.

4.0 GENERAL TECHNICAL REQUIREMENTS

A. Environmental specification of equipment to be supplied

1. The equipment at the MMS and BMS locations shall operate satisfactorily in air-conditioned environment under temperature of 15 – 35^{o}C and humidity of 10-95% RH.
2. All equipment to be supplied shall withstand international standard of vibration for industrial application.

B. Power supply

1. UPS power (Single Phase, 230 VAC, 50 Hz) at single point from existing PDB in the SCADA server room shall be provided by client at MMS and BMS locations. Further supply, laying of power cables and distribution of power in the racks to individual equipments (Power extension boards, MCBs, etc.) is in the scope of APPS Vendor.

2. If any other voltage levels are required, then all necessary conversions shall be in the scope of APPS Vendor.

C. Earthing

Each APPS rack at MMS AND BMS locations shall be provided with earthing lugs with their frames. Supply and laying of green colored cable, conduits including glanding, termination, ferruling, dressing etc. at both ends to connect the rack earthing to the electrical earthing bus bar / strip in the existing PDB.

D. Safety requirements

It is the intent of client that operational hazards be reduced to a minimum. The APPS Vendor shall use sound engineering judgment to complete an installation that will perform the required function without compromising this aim.

E. Electromagnetic compatibility – EMC

1. The equipment shall be efficiently screened against EMI, RFI and conductive interference and shall not interfere with other equipment in the vicinity or installed in the same building.

2. The equipment shall be required to meet one of the relevant EMC standards (IEC, MIL, VDE, BS, IEEE etc.).

F. TRANSPORATION AND STORAGE OF APPS SYSTEM

The APPS Vendor shall carryout the transportation and storage of the supplied APPS system and associated items including but not limited to the following:

- Transportation, loading, unloading of equipment and all other components from locations of manufacturing/supply to the locations of installation
- Storage during transit, transit insurance & storage/ warehousing as required.
- Statutory clearances including clearances of customs, excise, octroi, entry tax and others, as required for all the supplied items.

5.0 SHIPMENT, HANDLING, PACKAGING AND TRANSPORTATION

a) The APPS vendor shall be responsible for the handling and transportation, installation and commissioning of the supplied equipment at the sites as specified.

b) Packing and Marking of the goods to be supplied shall be the responsibility of the APPS vendor and shall be such as to protect the equipment from damages due to transportation.

c) All equipments shall be individually packed in suitable containers/crates designed to avoid damage to the equipments during transit and storage in accordance with best commercial practices and requirements of application specifications.

d) The materials for packaging, packing, wrapping, sealers, moisture resistant barriers and corrosion preventives shall be of recognized brands and shall conform to best standards in the areas in which the articles are packed.

e) The packing shall protect the equipments from impact, vibration, static charge, rough handling, rain dust, damp, insects, rodents etc.

f) Each container shall be clearly marked with following information at various prominent places:

Company : "IGGL"

Project	: "APPS system"
Description of Equip	: "Equipment title"
Serial no	: "Serial no. of the equipment"
Address	: "Destination address as per P.O."

6.0 INSTALLATION OF APPS SYSTEM AT SITES

The APPS Vendor shall carry out the installation of APPS system in line with Scope of Work of the tender document and shall also include but not limited to following:

- Installation of APPS equipments including networking devices at Master Control Station Room / Back up control room locations by following standard installation procedure
- Equipment at MMS AND BMS locations has to install in racks supplied by the APPS Vendor.
- Interfacing of APPS equipments with client's SCADA System equipments as per Scope of Work of the tender document
- Configuration of APPS equipments including networking devices etc at MMS AND BMS locations as per the approved FDS
- Laying & routing of cables through conduits, glanding, termination of cables, dressing and ferruling for all the cables as Scope of Work of the tender document.
- Providing earthing to APPS equipments at MMS AND BMS locations by extending the earthing cable of suitable size from earthing bus bar in PDB to the APPS equipment rack
- Supply of cable for power, Exp glands, connectors, switches, fuses, terminations, distribution boxes, MCCBs and other items required but not mentioned herein shall be provided by the APPS Vendor.

  For taking up above installation activities by the APPS Vendor, client shall provide the following infrastructure facilities at different control room:

  - Air-conditioned space MMS AND BMS .
  - UPS power at MMS AND BMS shall be provided through PDB installed in the SCADA server room
  - Existing SCADA WAN Network will be utilized by the APPS System to connect various APPS equipment across the network.

6.1 INTEGRATION WITH THIRD PARTY SYSTEMS

The APPS Vendor shall carry out the integration of APPS system with SCADA system through OPC as per Scope of Work of the tender document.

The main SCADA servers use a SQL compliant Real-time Relational Database (RTRDB) to acquire real-time process values and distribute the data to client MMIs, other SCADA servers, and 3rd party applications.

Level 1 SCADA system (Non redundant) communicates directly with the field RTUs and devices. The SCADA system is local to the RTUs' so it provides a local, high performance, high reliability data acquisition platform. Level 1 system has access to RTU configuration and Instrument diagnosis over the LAN without interrupting data polling. The set points and commands for FF and Hart instruments will

be carried out through the RTU. If Level 1 Server fails, then RTU will automatically transfer data to Level 2 by polling from server at level 2 to RTU at level 1.

Level 2 SCADA Servers acquire data by replicating the real-time changes from the level 1 SCADA system. With few exceptions, all level1data is replicated up to the level 2. Hence the level 2 consolidates the level 1 information and is able to review and report production from all sites. Full graphical and data details available at Level1 are also available through the Level 2 server. At Level 2, data is also passed to a "Data base Server" for storing data.

Level 1 & Level 2 of SCADA system is provided with Redundant LAN functionality. Two Numbers network switch work in primary & secondary LAN feature with both switch connected to each IT Hardware. All servers & workstations are provided with redundant Ethernet ports for connectivity to network. Network teaming feature is utilized to assign IP to each server & work station. Each first port of Server & workstation is connected to primary switch & each second port of server & workstation is connected to secondary switch. Color LaserJet network printer is connected to Primary switch & B/ w LaserJet network printer is connected to secondary switch at Level 2. Similarly, redundant LAN is achieving at Level 1. Any further details will be provided to successful vendor of APPS during detailed engineering / execution of work.

7.0 QUALITY ASSURANCE & ACCEPTANCE PROGRAMME

The APPS Vendor shall provide the quality assurance for testing & acceptance of APPS system as per Scope of Work of the tender document and shall include but not limited to the following:

- **Pre-FAT:** Carrying out pre Factory Acceptance Test (pre-FAT) of Centralized APPS system as per the approved FAT procedure and submission to Client/PMC
- **Factory Acceptance Test (FAT):** On acceptance of pre-FAT report by Client / PMC, APPS Vendor shall invite Client / PMC, to witness FAT. FAT shall be carried out as per the FAT approved procedure at APPS Vendor's premises in presence of Client / PMC, or any third party agency appointed by Client. On successful completion of FAT, dispatch clearance shall be provided to the APPS Vendor by Client / PMC
- **Site Acceptance Test (SAT):** On successful completion of installation and configuration of APPS equipment and associated systems at site, the SAT shall be conducted as per approved SAT procedure.
- **Test Run:** After successful completion of SAT of APPS on pipelines, the APPS system shall be put under Test Run for a minimum period of 15 days as per approved procedure.

8.0 TESTING & INSPECTION:

8.1 All factory tests will be witnessed by client /PMC or any third party agency appointed by client.

8.2 APPS Vendor shall provide client with all reasonable facilities necessary to determine compliance to the system specification.

8.3 APPS Vendor to note that acceptance of the equipments and the system by client or exemption of inspection & testing shall in no way absolve the APPS Vendor of his responsibility to deliver the APPS system meeting all the requirements specified in the contract.

8.4 Till the completion of the warranty, APPS Vendor shall be responsible for any corrections/ modifications/upgradation including supply and implementation of hardware & software to fulfill the

requirements of the contract.

8.5 APPS Vendor's personnel shall be actively involved at the forefront during factory acceptance and site acceptance testing.

8.6 The APPS Vendor shall provide assistance; instruments, labour, and materials as are normally required for the testing.

8.7 As a milestone towards project completion the vendor shall issue for review and approval a set of FAT (Factory Acceptance test) procedures. The procedures shall detail the vendor's standard unit tests. The supplier's standard tests shall verify compliance with each section of the above specification.

8.8 In addition, system functionalities, database configuration, displays as per approved HMI document, engineering functions, system configuration functions i.e. redundancy (hot standby), servers switchover as per system design, APPS reports printing, data transfer with SCADA, data validation, all modules and features as per specifications shall be part of FAT.

8.9 After approval of the test procedures, a witnessed Factory Acceptance Test will be conducted at the vendor's facilities. Since this will be conducted without real time data, the vendor shall provide data to represent the actual pipeline and feed the data into the LDS for the test.

8.10 Standard test protocols shall be followed and shall include:

a. Start from a clean computer and load.
b. Tests shall be witnessed and signed on satisfactory completion.
c. Tests shall be repeated when a discrepancy is resolved.
d. Tests, previously completed, may be repeated if a dependent discrepancy occurs later.
e. The test witness has the authority to suspend the FAT and require a rescheduled test.
f. Verification of supplied documentation.
g. Test completion depends on all tests completed satisfactorily, and all discrepancies resolved.

8.11 Upon completion of the tests the system shall ship to site.

At start-up of the pipeline a witnessed Site Acceptance Test shall be conducted, followed by a 30 day Availability Test.

During the Site Acceptance Test a Leak Test may be conducted to identify the sensitivity of the LDS to an actual leak and the accuracy of leak location. Leak Detection may be tested in a flowing situation, shut-in condition and transient condition.

8.12 The Availability Test shall verify that no failures of the LDS occur and that no false leak alarms occur in the time period while in a pipeline operating environment.

8.13 The objective of the software shall be to provide a proven, comprehensive and flexible method of obtaining and presenting the fundamental data described in the pipeline operation and to use this data to calculate parameters which enable the pipeline to be controlled in an efficient and safe manner. The system shall also store relevant data for pre-set periods to aid historical analysis of the pipeline. The LDS software shall be based on a well proven real time operating system using a modular database and structure, which can be readily modified to take account of both minor and major additions/ modifications. The Contractor shall also state the internal design procedure used to develop, code and test the Application processing software. The database shall have adequate space for present and future expansion requirement.

8.14 Testing shall concern APPS equipments and APPS software. The tests shall consist of:

a) Pre-Factory Acceptance Test (Pre-FAT)

b) Factory Acceptance Testing (FAT)

c) Site Acceptance Testing (SAT)

d) Test Run

APPS Vendor shall submit to cline detailed test plans and procedures well in time so that approved documents are available 1 month prior to actual testing for all factory / site acceptance tests and test run.

8.14.1 Pre-FAT

Pre-FAT shall be conducted by the APPS vendor based on the approved FAT document to ascertain readiness of the system in all respect for FAT. The test results indicating successful completion of pre-FAT shall be duly signed and approved by APPS vendor's concerned personnel.

8.14.2 FACTORY ACCEPTANCE TESTING (FAT)

a) FAT shall be carried out in the premises of APPS Vendor.

b) APPS Vendor shall invite client/PMC well in advance with minimum 1 month notice of the date at which the system is expected to be ready for FAT.

c) The copy of the signed pre-FAT document indicating the compliance/passing of all tests shall be sent to client/PMC, at least 15 days prior to start of FAT. The vendor shall furnish the written undertaking to client/PMC in this regard, prior to offering the APPS system for FAT.

D) Factory acceptance test will be done based on the stipulations in the approved FAT document, which shall completely fulfill the contract requirements and approved APPS FDS document (refer clause pertaining to "Factory Acceptance Test (FAT) Plans and Procedure Document").

e) It shall systematically, fully, and functionally test all the hardware & software in presence of client/PMC inspectors as per approved FAT documents to ascertain compliance with the contract document and approved FDS documents. Test bed shall be prepared with all the equipments loaded with offered softwares (APPS Servers, APPS Trainer (including Pipeline Simulator), HMIs, Switches, and Peripherals etc.) interconnected in actual configuration to perform the testing on total integrated APPS system. Pipeline simulator or any other system shall be arranged by the APPS vendor to provide pipeline real time data.

f) After system FAT, the system shall be shipped to site only when it has been officially released in the form of despatch clearance note by client/PMC.

8.14.3 SITE ACCEPTANCE TESTING (SAT)

g) Prior to SAT, the activities of installation, integration & commissioning of the complete system with APPS shall be performed by APPS vendor. On-line tuning shall be performed to monitor the system response during different operating conditions and to adjust the system parameters so that it meets the requirements of minimum false alarms and optimum leak detection.

h) SAT shall involve integrated testing of complete APPS system. Site Acceptance Testing will be done based on the stipulations in the approved SAT document. Once the test is successfully performed, then the system would be ready for commencement of test run.

i) SAT shall be conducted by the experienced system-engineering group of the APPS vendor (earlier involved in system design, engineering, integration & FAT)

j) The SAT shall be divided into following two parts:

a) **System configuration, networking, and functional requirements covering following**:

- Visual inspection to ensure correct, proper, workmanship / labelling / marking / cabling / ferruling, etc
- Hardware and OS specification (through system generated configuration report) & software compliances w.r.t all the equipment
- System configuration and networking
- SCADA-APPS interface
- Checking of displays, graphics and reports
- User authorization / privileges and passwords
- Database and alarms management
- APPS trainer

k) During SAT, there may be interruptions in the testing due to unavailability of real time data on account of OFC cuts / telecom channel failure / bad instrumentation / RTU failure at some stations. These interruptions shall not have any commercial implication to client.

8.14.4 TRIAL RUN

l) This test aims at keeping the complete integrated system operational for a period of 30 days (on 24 x 7 basis) without any system failures attributable to APPS system.

m) In case of failure, the tests will be restarted till the system operates without failure of any system functionality for 30 days. Failure of tests shall be limited to such system failures, which will affect system availability & reliability and shall not be dependent upon established failure of third party supplied items (SCADA / UPS Power / Air conditioning, etc.). In case of APPS failure on account of third party supplied systems, the test run shall be halted and continued on restoration of failed system i.e. neither the test run shall restart from zero date nor the failure duration shall be counted in the test run.

n) The observations, exceptions, and test results obtained during the test run shall be documented and submitted by the APPS Vendor.

o) Failure of hardware / software modules:

A log of all failed hardware and software modules shall be maintained which shall give date and time of failure, description of the failed hardware / software module.

Upon failure of the hardware / software module, the same shall be rectified / replaced and the test shall be restarted.

p) After successful completion of test run; PRE WARRANTY Completion Certificate shall be issued by client and thereafter Warranty will start.

9.0 DOCUMENTATION

The language used in all correspondence, documentation, literature, drawings, markings etc., shall be English.

APPS Vendor shall furnish all relevant technical manuals, literature and other technical data as required at the various stages of the project indicated in tender.

9.1 The following documents shall be submitted for review / approval :

S.No.	Document
1	Instrumentation Adequacy Report for each P/L network
2	FDS (including design philosophy for symbol, HMI displays, Point database, OPC interface details, Reports etc.)
3	APPS Performance Report for each P/L network
4	Engineering Drawings and Cable connections
5	PUCR
6	FAT
7	Installation & Site Execution Plan
8	SAT
9	Test Run Plans & Procedure
10	Billing Procedure / Bill of materials

Prior to submitting these documents for client's review/ records, the APPS Vendor shall review & duly sign all the documents and ensure compliance to the requirements of the contract.

9.2 AS-BUILT DOCUMENTATION

As-Built documentation shall be provided by the APPS Vendor within one month of completion of test run, covering the following as a minimum:

- Bill of Material along with serial nos of equipment
- Equipment rack layout
- Rack layout in the room
- Cabling and interfacing details
- Equipment configuration details
- Software configuration details
- Final FDS & copy of FAT & SAT report

9.3 APPS SOFTWARE AND HARDWARE MANUALS

Engineering manuals, user manuals, installation, operation & maintenance manuals for all the supplied software, hardware and equipments. APPS Vendor shall also provide the procedure for re-generating software license for any hardware in case of its failure. APPS Vendor shall provide installation procedure of all APPS hardware and software devices.

The vendor shall provide a project specific Operations, Engineering and Maintenance Manual. The Manual shall be at a level to support an engineer, who has undergone basic LDS training by the supplier, in all activities that might be required in diagnosing and maintaining the leak detection system.

The documentation shall also help pipeline Operators in interpreting results from LDS & other APPS modules correctly, as they appear on the SCADA system, validating leak warnings, alarms and identifying abnormal pipeline conditions where appropriate action has to be considered.

9.4 SYSTEM BACKUP & RESTORATION MANUALS

APPS Vendor shall provide in detail the procedure for taking backup & for restoration of various systems / sub-systems at all locations. The procedure must include installation of operating system, loading of APPS software as well as all the necessary customizations for running the software and activation of licenses for operating system, APPS software, and other related software.

9.5 APPS Vendor shall take care of the complete requirements of designing, generation and implementation of APPS displays for pipeline monitoring, APPS reports, APPS alarms/ events, APPS trending taking care of the requirements outlined in this specification for APPS implementation.

10.0 TRAINING

Bidder shall provide training on offered system including the following:

- APPS Operation
- APPS database and HMI modification for addition/ deletion of node.
- Software maintenance functions
- Tuning functions

The training shall include hands on experience of system and to include engineering functions i.e. changes in database & HMI, configuration, threshold changes etc.

APPS Vendor shall conduct training programme for Engineers / System Managers and Operators / APPS end users of client as per details given below:

10.1 ENGINEER'S / SYSTEM MANAGER'S TRAINING

APPS Vendor shall train client's engineers/system manager in one batch for one week duration (5 working days) for APPS system at MMS AND BMS .

In case of training client will provide the PCs for trainees and the APPS Vendor shall arrange the required APPS software (to be loaded on these eight PCs) for the hands-on training.

The depth of the training required shall be adequate enough to enable client to (but not limited to:

a) Operate & maintain the system

b) Configuration Editor for future modifications like addition/ deletion of pipeline sections, installations (DT, RT, SV) etc

c) Generation and modification of HMIs (graphics & reports) and Point database

d) Integration of new stations in APPS system

e) Integration with SCADA System using OPC

f) Backups and other jobs related to APPS system house keeping

g) Back up and restoration procedure

h) Basic trouble shooting techniques

i) Administration of users / accounts

The training will be conducted by bidder's engineer having in-depth knowledge of various modules of APPS system.

10.2 OPERATOR / APPS END USER'S TRAINING

APPS Vendor shall train client's pipeline operation & maintenance engineers in one batch 3 working days for APPS system at site. The training topic should cover the overall operation of the APPS system for Pipeline operation.

11.0 WARRANTY

Warranty shall be as defined in PJS, PJS no. MEC/05/E5/T/23VC/PJS-094

12.0 POST WARRANTY MAINTENANCE CONTRACT (PWMC)

Post Warranty Maintenance shall be as defined in PJS, PJS no. MEC/05/E5/T/23VC/PJS-094

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ANNEXURE- VI to PJS
SCADA SYSTEM

PROJECT MANAGEMENT AND RESPONSIBILITY (PMR) FORM

Name of SCADA Bidder :
Vendor works & address :
Name of the sub-vendor/Service Associates :
Sub-vendor works & Address :

Activity/project Responsibility	Performed by Bidder [yes/no]	Performed by Sub-vendor / Service associate	Manufacturing facilities/ location
Single source responsibility with performance guarantee for the successful execution of the project			
Project management			
Engineering activities including design			
Supply of SCADA system			
Supply of APPS system			
Supply RTU			
Logistic Support			
Integration of RTU and SCADA software & APPS			
Documentation 1) For SCADA, APPS & RTU 2) Detailed engineering drawing and documents 3) For FAT 4) For Construction drawings & documents 5) For SAT			
Factory Acceptance Testing			
Installation of SCADA , APPS, RTU			
Site acceptance testing, test run and commissioning			
Warranty			
Training			

Signature of the authorized signatory

Name of the authorized signatory

Stamp and Date

Note: If the activity is performed by the Bidder, and sub vendor, same shall be differentiated by letter 'P' against the party who is primarily responsible for the same activity.

ANNEXURE- VII to PJS

CERTIFICATE FOR LOGISTICS SUPPORT (SCADA & RTU)

1.0 LOGISTIC SUPPORT CERTIFICATE

1.1. Vendor must furnish Certificate for providing necessary support services in favour of the Owner for SCADA, APPS & RTU committing them to provide logistic to purchaser in the format furnished along with.

1.2. In case of bought-out items, this certificate must be furnished for each of the Sub vendors clearly indicating type, model no. etc.

1.3. The Certificates must be furnished from each manufacturer in case more than one manufacturer is proposed for an item. However it is expected that the vendor proposes
Only one approved manufacturer for an item.

1.4. The Certificate must be signed with seal by the official signatory on the company's letterhead.

CERTIFICATE FOR LOGISTICS SUPPORT

(**To be signed by Manufacturer's corporate level signatory on company's letterhead)**

I, on behalf of M/s_____ confirm that the Item _____ Model No._____ for quoted by M/s_____ for M/s IGGL against Bid Doc No. ……..; respective Particular Job Specification for SCADA system, APPS system & RTU …….. shall continue to be supported by us for a period of minimum 07 years. The quoted system shall not be withdrawn from Indian market as a matter of our corporate policy.

I further confirm that in case of placement of order by IGGL on us, we shall continue to Support IGGL by spare part support for a period of 10 years from the date of placement of order.

Signature of the Bidder authorized signatory

Name of the Bidder authorized signatory

Stamp and Date

ANNEXURE-VIII to PJS
SCADA SYSTEM

DEVIATION FORM

Name of Bidder :

Schedule of Deviation :

Bidder shall; note that this is a **"NO DEVIATION TENDER"**

1. Bidder may given here a consolidated list of deviations/ clarifications/ comments of all sections of the bid package, which for an appropriate offer are considered unavoidable by him.

2. Deviations/ clarifications mentioned elsewhere in the offer shall not be bidding on the Client / Consultant and any such deviations if indicated elsewhere other than this form will render the offer non-responsive and shall liable to be rejected.

3. Bidder shall state the reasons for the deviations in the 'Remark' column.

4. All other clauses of the bid package shall be deemed to be fully complied by the Bidder.

5. **Only the deviations listed herein, in conjunction with the Bid package, shall constitute the contract requirements for the award of job to the Bidder.**

Sl. No.	Page No.	Clause No.	Requirement	Deviations as per Bid package	Clarification/ Comments by Bidder	Remarks
1						
2						
3						
4						
5						
6						
7						

Signature of the Bidder authorized signatory

Name of the Bidder authorized signatory

Stamp and Date

ANNEXURE- VIII to PJS

SOURCE OF SUPPLY FORM (SOS) FORM

This form shall be duly filled and signed by bidder and it shall be submitted along with bid. All the points shall be unambiguously responded, if anything is kept blank by the bidder, it shall be considered as non-compliance of the tender and the bid shall be liable for rejection.

S.No.	Item	Model No.	Name of Supplier/ (for each item / system)	Place of manufacturing and supply
A	**SCADA And APPS System**			
1a)	SCADA server with peripheral & storage devices			
b)	Remote Workstations with peripheral & storage devices			
c)	History Server, OPC server with peripheral & storage devices			
d)	AI/ ML Server, workstation with peripheral & storage devices			
e)	APPS server and Workstation with peripheral & storage devices			
g)	GPRS server with peripheral & storage devices			
h)	Color Monitor			
i)	System software			
j)	HMI workstation with peripheral & storage devices			
k)	Web Server			
2	Routers			
3	Ethernet Switches			
4	Color ink jet printers			
5	GPS time servers			
6	System cabinets & power distribution cabinet			

B	**RTUS**			
1	RTUs with cabinet and all accessories (complete in all respect) for all Dispatch, Receiving terminal			
2	RTUs with cabinet and all accessories (complete in all respect) for SV stations.			
3	RTUs with cabinet and all accessories (complete in all respect) for IPS stations			
4	Comm. Interface			
C	**SCADA Software, APPS software, Other software as per tender**			
E	**Special tools & test equipment**			
1	Programmable Diagnostic units (PDS)			
2 3	Plant simulator Digital multimeter			
F	**Miscellaneous items (Bidder to specify all the remaining items)**			

Signature of the authorized signatory

Name of the authorized signatory

Stamp and Date

ANNEXURE-IV to PJS

SCADA SYSTEM

INSTALLATION & COMMISSIONING

1.0 The installation and commissioning of all the equipment at various sites including the activities of instrumentation signal interconnections, electrical and civil works with power supply distribution and grounding works and other necessary facilities is the responsibility of the Bidder.

2.0 a)All supply and interconnection of cabling and accessories including cable routing between the following cabinets/equipments are also included in Bidder's scope, and to be carried out by the Bidder. The activities of signal identification at site, cable termination, ferruling, glanding, dressing at TIC end, RTU end, telecom rack end etc. are in Bidders scope for all sites.

(i) Between RTUs & Telemetry interface cabinets.
(ii) Between RTUs & Telecommunication equipments.
(iii) Between SCADA (CCUs, WAN routers) & Telecommunication equipments.
(iv) Between Remote workstations & Telecommunication equipments.
(v) Between RTUs and flow computers serial interfacing as required.

b) All cables between TICs and RTUs shall be PVC insulated, single pair (1.5 mm2), multi pair (0.5 mm2), twisted in pair individually, individual pair shielded and overall shielded with aluminium mylar tape. Separate cables for analog and digital cables to be used. The distance between TIC and RTU for each SV, and IP station shall be approx. 15 meters. The cables have to be included accordingly.

Each cable pair shall be identifiable by pair/core no of colour code. The cable shall have multi strand copper conductor. 20% spare pairs shall be provided in all the cables from Telemetry interface cabinet to RTU.

c) The Ethernet cable from RTU to Telecom rack shall be 50 feet long at each station, complete with connectors at each end. The Ethernet cable from CCU to Telecom rack shall be 50 feet long at each MS, complete with connectors at each end. The distance between WAN routers and Telecom racks at each MS location and each remote workstation location shall be approx. 50 meters. G.703, RS232 cables and connectors to be included accordingly. However distances shall be firmed up during detail engineering or prior to FAT.

d) SCADA vendor shall be responsible for proper selection of the RS 232 C or any other cable for ensuring good communication with telecommunications.

3.0 All the erection work shall be carried out as per the established recommended practices and best workmanship.

4.0 Bidder shall bring all installation aids, test equipments and qualified and experienced personnel, in order to carry out the job successfully. A list of the same shall be submitted to the Client / Consultant for the review.

On completion of erection and installation of all equipment and software, and before start-up, each item of the system shall be jointly inspected by the Client / Consultant and Bidder for correctness & completeness of the installation and acceptability of start-up leading of commissioning tests at site.

5.0 The list of commissioning test to be performed shall be mutually agreed upon and included in the Bidder's Quality assurance programmes. Bidder's commissioning engineers shall carry out these tests. After the commissioning tests are over, the system shall be put for SAT.

6.0 All technical personnel assigned to the site by Bidder must be fully conversant with the specific system and its software packages. The Bidder's field personnel shall have both hardware & software capability to bring the system online quickly and efficiently and with the minimum of interference with other concurrent construction and commissioning activity.

7.0 The commissioning spares for all the items/equipments shall be included along with commissioning services as required to commission the complete system. The consumable required during commissioning of system shall be included as part of commissioning spares.

Commissioning spares including consumables as part of commissioning activities. Vendor must ensure availability of following commissioning spares as a minimum at site:

a. 2 nos. of CPU and 2 nos. of each type of I/O card (AI, AO, DI, DO, Serial cards) of RTU

b. One no. Router

Mandatory spares as per MR

SCADA Vendor to note that the mandatory spares are the inventory of the spares to be kept by the COMPANY and the same shall not be utilised by the SCADA Vendor at any stage of the project till completion of warranty, without COMPANY's prior concurrence. Any mandatory spares utilized by the SCADA vendor during Warranty period shall be replenished within 45 days.

8.0 To the extent that the Standard of the works has not been specified in the Contract, the Bidder shall use good quality materials, techniques and standards and execute the Contract with the care, skill and diligence required in accordance with best engineering practice.

9.0 Bidder shall at his own expense supply and provide all the equipment, tools, temporary works material both for temporary and for permanent works, labour, supervisors, engineers and specialist, movement of the supplied equipment at the site, required for installation, commissioning, execution and completion of the works. The Bidder shall make his own arrangements at his own cost for the transport where necessary of his staff and labour to and from the site of the works.

10.0 The Bidder shall provide and maintain an office at the Site, during Installation, Testing & Commissioning phase, for his staff, and such office shall be open at all reasonable hours to receive instructions, notice or other communications as per the advice of the Client / Consultant.

11.0 Appropriate storage of the materials to be supplied in this contract will be arranged at the site by the Bidder at the various stations after the materials have been delivered by the Bidder. The Bidder shall be responsible for the storage, security and safety of all other materials, tools etc. brought by the Bidder for the installation and commissioning of the system at the site.

12.0 The Bidder's responsibility at site shall include all the activities necessary to be performed to complete the entire job as per the contract requirements including the following as a minimum.

a) Receipt of hardware, software and checking the adequacy and completeness of supply.

b) Storage, safety, security of the equipments & other materials including software at site.

c) Installation of the complete system including power supply, earthing, cable terminations, calibration, civil and electrical works.

d) Checking of equipment installation.

e) Checking of interconnection and overall system functionality.

f) On line/Offline debugging of the system.

g) Coordination /interfacing (including obtaining relevant details) with Instrumentation, APPS sub-vendor, CP system & Electrical contractor, Telecom sub-vendor directly or through client for any disputes.

h) On line testing and commissioning of SCADA system and testing of APPS system with sub-vendor.

13.0 For installation, RTUs online testing and commissioning as per the specification of RTU supplier recommendation. After these test, the SCADA system shall be put for SAT.

14.0 SCADA vendor to note that there could be minor database changes, graphics, report logic changes during site commissioning phase as required by the client / consultant. The same shall be treated as part of the scope of SCADA vendor.

15.0 **On line testing, Commissioning**

15.1 Online testing of the SCADA system at Server locations and the RTUs connected to it shall be carried out from respective Server locations.

15.2 Before start of online testing of field parameters, Vendor shall ensure that all hardware and software (network database, I/O point database, graphics etc.) have been implemented at MCS / ECS.

15.3 The testing of the RTUs to SCADA system shall be planned and carried out in a manner to minimize the interfacing time.

15.4 The RTUs will be tested one by one with SCADA system by connecting the existing individual communication channel at server with SCADA system.

15.5 During the online testing, there may be interruptions in the testing due to OFC cuts / other telecom issues. This will not have any commercial implication to client.

16.0 **Site Acceptance Testing (SAT)**

16.1 The SAT document shall be prepared for SCADA system and vendor to submit it 1 month in advance to PMC/client for review and approval.

16.2 SAT shall be conducted by the Vendor after successful integration & commissioning of the complete system.