

OIL INDIA LIMITED

GAS PIPELINE FROM GGS/EPS BAGHJAN TO CGGS MADHUBAN, DULIAJAN NATURAL GAS PIPELINE PROJECT

BID DOCUMENT FOR PROCUREMENT OF

SCADA & APPS SYSTEM

UNDER OPEN INTERNATIONAL COMPETITIVE BIDDING

BID DOC. NO.: 05/51/23U1/OIL/099

Tender No.: CPG0898P19

VOLUME-II OF II PREPARED AND ISSUED BY



MECON LIMITED

(A Govt. of India Undertaking) **Delhi, India**

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SCADA & APPS SYSTEM BID Doc No.: 05/51/23U1 /OIL/099 मेकॉन 3001 Com⁹ करे

MECON LIMITED

Rev. 0

Page 1 of 1

INDEX

SCADA & APPS SYSTEM

- A. MATERIAL REQUISITIONS
- B. VENDOR DATA REQUIREMENT
- C. VENDOR DRAWING/ DATA APPROVAL PROCEDURE
- D. VENDOR DRAWING/ DOCUMENT SUBMISSION SCHEDULE
- E. PARTICULAR DESIGN SPECIFCATIONS
- F. TECHNICAL SPECIFICATION FOR SCADA & APPS SYSTEM.

Annexure – SCADA & RTU (Existing make of M/s ABB)

Annexure – APPS system



OIL INDIA LIMITED

GAS PIPELINE FROM GGS/EPS BAGHJAN TO CGGS MADHUBAN, DULIAJAN

MATERIAL REQUISITION FOR SCADA & APPS SYSTEM

MR NO.: MEC/S/05/E5/T/23U1/OIL/099 Bid Document No.: 05/51/23U1/OIL/099

PREPARED & ISSUED BY



(INSTRUMENTATION& CONTROL SECTION) MECON LIMITED

(A Govt. of India Undertaking)
Delhi, India

Document No.	Revision No.	Date
MEC/05/E5/T/MR/S-99	0	14.03.2019

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SCADA & APPS SYSTEM BID Doc No.: 05/51/23U1 /OIL/099

MECON LIMITED

Rev. 0

Page 2 of 5

MATERIAL REQUISITION

ITEM : SCADA & APPS SYSTEM

PROJECT: NATURAL GAS PIPELINES FROM GGS/EPS BAGHJAN

TO CGGS MADHUBAN

MR NO. : MEC/S/05/E5/T/23U1/OIL/099

BID Doc NO. : 05/51/23U1/OIL/099 CLIENT : OIL INDIA LIMITED

Sr. No.	DESCRIPTION	Unit	Quantity
T	The Scope of work for 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 with HMI (OEM – M/s ABB), RTU Modules, erection of foundation support channel on trench for panel erection, cable trays, Tower for Radio Telecom equipments, Interfacing with IEDs, Instrumentation, Electrical, CP system, APPS/LDS System, Site Acceptance testing & Integration, Test Run, Precommissioning activity, Commissioning, Integration with Telecom System (Radio link network), APPS System, Training, technical support, Supply & Commissioning of APPS system, Integration with existing SCADA (OEM – M/s ABB), Warranty, Post warranty maintenance (after completion of main warranty – comprehensive for 3 years), Mandatory spares & commissioning spares, Documentation for Supervisory Control & Data Acquisition (SCADA) & APPS System with & Remote Telemetry Unit, and shall be executed on turnkey indivisible works contract basis as per details scope of work, Technical Specification of respective SCADA, APPS /LDs equipments & Job specification PJS No. MEC/05/E5/T/23U1/PJS-099 Rev 0.		
T.1.1	Work related to extension of SCADA System for new pipeline Supply and Services related to Installation, Testing & Commissioning, Integration with existing SCADA system (OEM – M/s ABB) of Remote terminal units (RTU) with HMI (OEM – M/s ABB) at front end with required graphics for round the clock online monitoring and control, integration with new Radio telecom equipment and all works as per Job specification PJS No. MEC/05/E5/T/23U1/PJS-099 Rev 0. Rev 0 and as per IO lists. (Remote Terminal Unit for Makum HNE SV Station) The work required preparation of GRAPHICS page in existing SCADA for the new pipeline.	Set	01
T.1.2	Modification in existing RTU (OEM – M/s ABB) at Baghjan by adding the necessary new hardware & upgradation of existing hardware as required, IO modules as required & software up gradation if required, GRAPHICS Modifications / preparation, integration of new pipeline parameters with existing SCADA system.	Set	01
T.1.3	Modification in existing RTU (OEM – M/s ABB) at RT Madhuban by adding the necessary new hardware & upgradation of existing hardware as required, IO modules as required & software up gradation	Set	01



SCADA & APPS SYSTEM BID Doc No. : 05/51/23U1 /OIL/099



Rev. 0 Page 3 of 5

	if required, GRAPHICS Modifications / preparation, integration of new pipeline parameters with existing SCADA system.		
T.1.4	Additional Web Client License (OEM – M/s ABB) for Web client at Central Gas gathering station at RT Madhuban with necessary integration with existing SCADA.	Set	01
T.1.5	Web Client with 21" / 22" Monitor & Windows OS. (OEM – M/s ABB) at Central Gas gathering station RT Madhuban with necessary integration with existing SCADA.	Set	01
T.1.6	PDT with all accessories including all cables & connectors as per the Technical specifications of RTU with RTU configuration software.	Set	01
T.1.7	Industrial standard Tool kit for equipments with leather bag	Set	01
T.1.8	Portable Power Source cum Calibrator (Current & Voltage)	Set	01
T.1.9	4 ½ Digit Multi-meter	Nos.	02
T.1.10	Modifications in the existing SCADA software for adding these additional RTU and necessary graphics development including Design, Engineering, System Installation, Commissioning, for all the RTU/SCADA devices, All erection accessories including 8 port Ethernet Switch, Ethernet cable, Cable trays, FRLS armoured Signals & Alarm Cables from Instrumentation panel / electrical panel / CP panel to respective RTU, Exp Gland double compression, Rack, termination with printed ferruling, Power supply & cabling, etc, Modification in SCADA configuration of at MCS Duliajan for integrating the proposed Pipeline SCADA and new APPS (LDS) system, Integration at DT Baghjan & RT Dulianjan to Incorporation / modification in HMI Graphics for new facilities to accommodate monitoring of flow metering and other online parameters as well as control and monitoring of S/D Valves, All other field parameter including flow metering, online parameter including CP, power supply through RTU, interfacing with Instrumentation, new APPS system, Radio based telecom system etc complete in all respect all inclusive as per the specification requirement define in the tender.	Set	01
T.1.11	Training – SCADA system (as defined in PJS MEC/05/E5/T/23U1/PJS-099 Rev 0. specifications at OEM works / OEM testing facilities) before the final acceptance of the SCADA system by the Client (04 engineers for 05 man days).	Lot	01
T.2	APPS System for new pipeline		
T.2.1	Supply & Services related to Installation, Testing & Commissioning, and Integration with existing SCADA system and all related work for new APPS system for pipeline leak detection for new pipeline as per the scope of work define in the specification.	Lot	01
T.2.2	Training – APPS system (as defined in PJS MEC/05/E5/T/23U1/PJS-099 Rev 0. Specifications at OEM works / OEM testing facilities) before the final acceptance of the SCADA system by the Client (04 engineers for 05 man days).	Lot	01



SCADA & APPS SYSTEM BID Doc No.: 05/51/23U1 /OIL/099 MECON LIMITED

Rev. 0

Page 4 of 5	MECON LIMITED

T.3	Radio based Telecom system for new pipeline		
T.3.1	New Radio Tower (Self-supported tower with minimum height of 35	Lot	01
	metres with earthing, dedicated earthing pit, aviation lamp and fall		
	arrestor with civil foundation work as required) for installation of		
	Radio equipment antenna, Supply & configuration of Cisco 4221 router		
	(minimum 2 WAN ports, 4 LAN ports) with OSPF support installed in		
	wall mounted Rack with front Glass; lockable at Makum HNE SV Station		
	with complete detailed engineering, inspection, erection &		
	commissioning all inclusive and Interfacing with existing Radio system		
	of client including erection accessories, as per the specification. The interfacing of new RTU with new radio equipment for SCADA		
	connectivity is in bidder's scope. (The new radio equipment will be		
	supplied and installed by client with antenna). Interacting with router /		
	switch is in bidder's scope.		
	All inclusive per month rates for maintaining store at site (for the	Month	06
	supplied material) during extended period as required (payable if site	11011111	
T.4	is not ready even after 6 months of actual date of completion as per		
	terms & condition of contracts and as define in the tender scope of		
	work). (Refer Note 6)		
T.PW.5	Post warranty maintenance contract (PWMC) - comprehensive	Lot	01
	for complete SCADA system and RTU as define in the Particular Job		
	specification / bid document for complete telecom system for 3 years		
	after completion of main warranty / extended warranty complete in		
	all respect as define in particular Job specification. Payment will be		
	made on quarterly basis. (Note -7)		0.4
T.PW.6	Post warranty maintenance contract (PWMC) - comprehensive	Lot	01
	for complete APPS system as define in the Particular Job		
	specification / bid document for complete telecom system for 3 years		
	after completion of main warranty / extended warranty complete in		
	all respect as define in particular Job specification. Payment will be made on quarterly basis. (Note -7)		
	made on quarterry basis. (Note - 1)		

NOTES:

- 1. Bidder shall quote for all the items.
- 2. Bid offer will be evaluated package wise. All the items will be considered for evaluation purpose. Completion of total work as a TURNKEY work is Bidder's responsibility.
- 3. Commissioning spare as required will be part of the offer.
- 4. Details of Mandatory spares with part no., make etc. shall be given separately with the offer & price part.
- 5. The quantity and the location of the stations may change as per change in site requirements; bidder shall take prior approval for procurement and erection.
- 6. Bidder has to complete the work as per the schedule, if the site is not ready even after 6 months of the completion schedule as define in the contract then bidder may compensate the expenditure of store (as per all inclusive rate per month available in the tender) till the



SCADA & APPS SYSTEM BID Doc No.: 05/51/23U1 /OIL/099



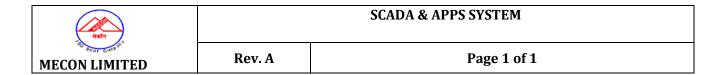
Rev. 0

Page 5 of 5

readiness of the site. The payment will be made from seventh month (No payment upto six months from date of completion from LOA) onward from actual date of completion

six months from date of completion from LOA) onward from actual date of completion as per the certifications by EIC/ Client. In this situation, after intimation from OIL, the site work has to be completed within the time stipulated for site works as per tender.

- 7. Post warranty maintenance contract comprehensive as define in the bid shall be provided by original equipment supplier along with bidder for the 03 years of period specified in the tender. However OIL may place separate order for Post Warranty Maintenance as per terms & condition of the contract. PWMC work will start after completion of Main warranty.
- 8. Operation & maintenance OEM suggestive spares (to be used after PWMC), each module, with complete list, part no, unit rate shall be provided. The validity of rates shall be upto contractual period including PWMC from date of commissioning / acceptance of complete work (i.e. 5 year 2 year warranty + 3 year PWMC).



VENDOR DRAWING/ DATA APPROVAL PROCEDURE

SCADA & APPS SYSTEM

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 client /PMC.

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 client / PMC 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.

	MECON Limited	Vendo	or Drawii	ng/ Docu	ımeı	nt Subm	ission	Sched	lule		
Client/ Project: Vendor's Name:				Contact Person (Name/ Tel/ Fax/ email) :				9	Status Date:		
Item Description : PR No.: SCADA & APPS System						Review Status		mante			
Bid Doc No. :		PO No.: Date of PO:	PO No.:				 APPROVED - No Comments APPROVED AS NOTED - Proceed with manufacture/ fabrication as per commented document. Revised document required. NOT APPROVED Document does not conform to basic requirements as 				
		- 1	Contact Person:			marked. Resu				ned for Refer	
Sl. No	Drawings / Documents as per Client / PMC 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 Client /PMC Review Status (Code) Form Electronic (E)/ Print (P)						
		ride				Rev. 0	Rev. 1	Rev. 2		1	
					Ant Act						
			1		Rew Code						
					Ant						
			4		Act Rew						
					Code						
					Ant Act						
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					Rew					-	
					Code					1	
					Ant Act					-	
					Rew Code					1	

MECON LIMITED

SCADA & APPS SYSTEM

Rev. A Page 1 of 2

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 EQUIREMENTS ARE RECIVED BY THE CLIENT / CONSULTANT.

			Certified inf	ormation req	uired after Pu	rchase Order
Sl. No.	Documents and Data	Quotes	Soft Copy CDs	Printed Matter	Date needed	Date Promised
1	Functional design Specification for SCADA	1	2	2	6 weeks	-
2	Logistic support, PMR, SOS & PCUR From	1	-	-	-	-
3	Bill of Material	1	2	2	6 weeks	-
4	List of Mandatory Spares (if applicable)	1	2	2	6 weeks	-
5	List of Commissioning Spares	1	2	2	6 weeks	-
6	Equipment plan in Control Room Layout for each station	-	2	2	8 weeks	-
7	Equipment Interconnection diagram including details of various interfaces, signal protocols	-	2	2	8 weeks	-
8	RTU internal Layout including mounting arrangement, interconnection, RTU Cabinet Wiring diagram	-	2	2	8 weeks	-
9	Internal layout of SCADA cabinets, consoles, desks etc. including mounting arrangement, interconnection etc.	-	2	2	8 weeks	-
10	LAN interconnection diagram	-	2	2	8 weeks	-
11	I/O point database SCADA & APPS system	-	2	2	8 weeks	-
12	HMI Graphics (Colour document)	-	2	2	6 weeks	-
13	Standard SCADA & APPS, RTU Manual for operation & maintenance, User guides, maintenance & configuration manuals for all supplied equipments / subsystems	-	2	2	-	W/S
14	SCADA, APPS, RTU operation, maintenance and configuration manual	-	2	2	-	W/S
15	RTU-IED interface manuals including manuals of special tools used for interfacing IEDs	-	2	2	-	W/S
16	Quality Assurance Plan (SCADA, APPS, RTU)	1	2	2	6 weeks	-
17	FAT Procedure (SCADA, APPS, RTU)	-	2	2	6 weeks	-
18	SAT Procedure & Test Run Procedure (SCADA, APPS, RTU)	-	2	2	6 weeks	
19	Station wise power consumption calculations of RTU, MMS, BMS & RWS, APPS system	-	2	2	6 weeks	-

MECON LIMITED

SCADA & APPS SYSTEM

Page 2 of 2

20	Functional design Specification for APPS System	1	2	2	6 weeks	-
21	Internal layout of APPS cabinets, consoles, desks etc. including mounting arrangement, interconnection with SCADA etc.	-	2	2	8 weeks	1
22	Overall System configuration Diagram of SCADA & APPS system	1	2	2	6 weeks	-
23	Project execution schedule	1	2	2	6 weeks	-
24	All the Annexure as per PJS and TS requirements	1	2	2	6 weeks	-
25	As built & Final documents (Note 11)	-	6	2	A/C	-

Notes:

- 1. The above VDR based on the schedule (Supply: 16 weeks ETC: 24 weeks from LOA; any different schedule it will be reconfirmed during placement of order.
- 2. Categories proceeded with "*" will be approved for fabrication by Client / Consultant. The remaining drawings are needed for information only.
- 3. Fold all drawing to 210mm x 297mm.
- 4. Vendor to provide all printed matter and the soft copy to Client / Consultant
- 5. Legends: A/C = As completed, W/S = With Shipment, W= Weeks

Rev. A

- 6. 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
- 7. All these documents shall be submitted along with dispatch of the system to site
- 8. 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
- 9. The documents / information required with offer sheets to be furnished otherwise the offer shall be liable for rejection.
- 10. During detail engineering stage, 1 set of printed matter and 2 soft copies (CDs) shall be submitted till the final approval of documents/drawings.
- 11. As built Drawings & Documents 2 sets hard copies with 6 sets soft copies (6 nos CDs & one external hard disc) (contents PO, FDS, FAT, IC, SAT, testing reports, Commissioning & Handing over Reports)



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PARTICULAR JOB SPECIFICATION TELECOMMUNICATION SYSTEM PJS NO.: MEC/05/E5/ T/23U1/PJS- 099

PREPARED & ISSUED BY



INSTRUMENTATION & PROCESS CONTROL (OIL & GAS SBU) MECON LIMITED

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



INSTRUMENTATION & PROCESS CONTROL OIL & GAS SBU, DELHI

PJS DOCUMENT NO.

MEC/05/E5/T/23U1/PJS-099

Page 2 of 21

5/T/23U1/PJS-099 REVISION : 0

SYSTEM (LDS)

			Table of Contents
1.0	Introduction		
2.0	Brief Project D	etails	
3.0	Brief scope of s	supply a	and works for SCADA system
4.0	Completion Per	riod	
5.0	Bidders Qualifi	cation (Criteria
6.0	Projection Requ	uiremer	nts & Detail Scope of Work
7.0	Test Equipmen	ts	
8.0	Documentation		
9.0	Training		
10.0	Warranty		
11.0	Submission of o	complia	ance report
12.0.	QA / QC Requi	rement	s
13.0	Annexure		
ANN.	EXURE I	-	SCADA SYSTEM SPECIFICATIONS
ANN.	EXURE II	-	TECHNICAL SPECIFICATION OF APPS
ANN.	EXURE –III	-	I/O COUNT FOR RTUS

ANNEXURE-IV - P & ID FOR ALL STATIONS

PIPELINE SCHEMATIC ROUTE DIAGRAM

PROCESS DESIGN BASIS FOR APPS SYSTEM DESIGN

ANNEXURE -V

ANNEXURE – VI -



PARTICULAR JOB SPECIFICATION
SCADA & APPS SYSTEM

PJS DOCUMENT NO.

MEC/05/E5/T/23U1/PJS-099

Page 3 of 21

REVISION: 0

1.0 INTRODUCTION:

- i) The purpose of this specification is to define the outline requirement of Extension of Supervisory Control and Data Acquisition (SCADA) System and integration with existing OIL SCADA and new APPS (Leak Detection System) for 30"NB x 40.0 Kms. (Approx.) Mainline from GGS Baghjan to CGGS Madhuban, Duliajan for transportation and distribution of Natural Gas Pipeline Project
- ii) 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.
- iii) 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.

1.1 **BRIEF PROJECT DETAIL**

Oil India Limited, a Government of India Enterprise is proposing to lay a Natural Gas pipeline starting for 30"NB x 40.0 Kms. (Approx.) Mainline from GGS Baghjan to CGGS Madhuban, Duliajan for transportation and distribution of Natural Gas Pipeline Project. This new pipeline has to be integrated with existing OIL Supervisory Control and Data Acquisition (SCADA) System (OEM – M/s ABB). New SCADA & APPS system for 30"NB x 40.0 Kms. (Approx.) Mainline from GGS Baghjan to CGGS Madhuban, Duliajan for transportation and distribution of Natural Gas Pipeline Project. OIL has already existing SCADA system supplied & commissioned by M/s ABB. New pipeline facilities has to be integrated with existing SCADA system through already available RTU / new RTU along the pipelines for smooth remote operation & control on real time basis.

M/s Oil India Limited has awarded MECON Limited Engineering Procurement Construction Management consultancy (EPCM) services for laying 30"NB x 40.0 Kms. (Approx.) Mainline from GGS Baghjan to CGGS Madhuban, Duliajan for transportation and distribution of Natural Gas.

2.0 DETAILED SCOPE OF SCADA & APPS SYSTEM:

The successful bidder shall undertake full responsibility on turnkey basis for providing extension of existing SCADA & new APPS (LDS) 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.

The Scope of work for 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 with HMI (OEM – M/s ABB), RTU Modules, erection of foundation support channel on trench for panel erection, cable trays, Tower for Radio Telecom equipments, Interfacing with IEDs, Instrumentation, Electrical,



INSTRUMENTATION & PROCESS CONTROL OIL & GAS SBU, DELHI

PJS DOCUMENT NO.

Page 4 of 21

MEC/05/E5/T/23U1/PJS-099

REVISION: 0

CP system, APPS/LDS System, Site Acceptance testing & Integration, Test Run, Precommissioning activity, Commissioning, Integration with Telecom System (Radio link network), APPS System, Training, technical support, Supply & Commissioning of APPS system, Integration with existing SCADA (OEM – M/s ABB), Warranty, Post warranty maintenance (after completion of main warranty – comprehensive for 3 years), Mandatory spares & commissioning spares, Documentation for Supervisory Control & Data Acquisition (SCADA) & APPS System with & Remote Telemetry Unit, and shall be executed on turnkey indivisible works contract basis as per details scope of work, Technical Specification of respective SCADA, APPS /LDs equipments & Job specification PJS No. MEC/05/E5/T/23U1/PJS-099 Rev 0.

Refer Technical specifications as enclosed Annexure – I, II for SCADA, RTU & APPS system.

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.

2.1 BRIEF SCOPE OF SUPPLY & WORKS FOR SCADA SYSTEM:

- i. Supply and Services related to Installation, Testing & Commissioning, Integration with existing SCADA system (OEM M/s ABB) of Remote terminal units (RTU) with HMI (OEM M/s ABB) at front end with required graphics for round the clock online monitoring and control, integration with new Radio telecom equipment and all works as per Job specification PJS No. MEC/05/E5/T/23U1/PJS-099 Rev 0. Rev 0 and as per IO lists. (Remote Terminal Unit for Makum HNE SV Station). The work required preparation of GRAPHICS page in existing SCADA for the new pipeline. The Rack shall be of minimum size 2000 mm (H) x 800 mm (W) x 800 mm (L) with base 100 mm and 15 mm ant vibration pad. The RTU shall be supplied with the HMI inbuilt at rack from front viewing.
- ii. Modification in existing RTU (OEM M/s ABB) at Baghjan by adding the necessary new hardware & upgradation of existing hardware as required , IO modules (required to meet the process requirement as per the P&ID with spare 25 % for future) & software up gradation if required, GRAPHICS Modifications / preparation, integration of new pipeline parameters with existing SCADA system.
- iii. Modification in existing RTU (OEM M/s ABB) at RT Madhuban by adding the necessary new hardware & upgradation of existing hardware as required , IO modules (required to meet the process requirement as per the P&ID with spare 25 % for future) & software up gradation if required, GRAPHICS Modifications / preparation, integration of new pipeline parameters with existing SCADA system.
- iv. Additional Web Client License (OEM M/s ABB) for Web client at Central Gas gathering station at RT Madhuban with necessary integration with existing SCADA.
- v. Web Client with 21" / 22" Monitor & Windows OS. (OEM M/s ABB) at Central Gas gathering station RT Madhuban with necessary integration with existing SCADA.
- vi. PDT with all accessories including all cables & connectors as per the Technical specifications of RTU with RTU configuration software.



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PJS DOCUMENT NO. Pag

Page 5 of 21

MEC/05/E5/T/23U1/PJS-099 REVISION: 0

- vii. Industrial standard Tool kit for equipments with leather bag
- viii. Portable Power Source cum Calibrator (Current & Voltage)
 - ix. 4 ½ Digit Multi-meter
 - x. Modifications in the existing SCADA software for adding these additional RTU and necessary graphics development including Design, Engineering, System Installation, Commissioning, for all the RTU/SCADA devices, All erection accessories including 8 port Ethernet Switch, Ethernet cable, Cable trays, FRLS armoured Signals & Alarm Cables from Instrumentation panel / electrical panel / CP panel to respective RTU, Exp Gland double compression, Rack, termination with printed ferruling, Power supply & cabling, etc, Modification in SCADA configuration of at MCS Duliajan for integrating the proposed Pipeline SCADA and new APPS (LDS) system, Integration at DT Baghjan & RT Dulianjan to Incorporation / modification in HMI Graphics for new facilities to accommodate monitoring of flow metering and other online parameters as well as control and monitoring of S/D Valves, All other field parameter including flow metering, online parameter including CP, power supply through RTU, interfacing with Instrumentation, new APPS system, Radio based telecom system etc complete in all respect all inclusive as per the specification requirement define in the tender.
 - xi. Training SCADA system (as defined in PJS MEC/05/E5/T/23U1/PJS-099 Rev 0. specifications at OEM works / OEM testing facilities) before the final acceptance of the SCADA system by the Client (04 engineers for 05 man days).
- xii. Post warranty maintenance contract (PWMC) comprehensive for complete SCADA system and RTU as define in the Particular Job specification / bid document for complete telecom system for 3 years after completion of main warranty / extended warranty complete in all respect as define in particular Job specification. Payment will be made on quarterly basis.

xiii. APPS System for new pipeline

- Supply & Services related to Installation, Testing & Commissioning, and Integration with existing SCADA system and all related work for new APPS system for pipeline leak detection for new pipeline as per the scope of work define in the specification.
- Training APPS system (as defined in PJS MEC/05/E5/T/23U1/PJS-099 Rev 0. Specifications at OEM works / OEM testing facilities) before the final acceptance of the SCADA system by the Client (04 engineers for 05 man days).
- Post warranty maintenance contract (PWMC) comprehensive for complete APPS system as define in the Particular Job specification / bid document for complete telecom system for 3 years after completion of main warranty / extended warranty complete in all respect as define in particular Job specification. Payment will be made on quarterly basis.
- xiv. New Radio Tower (Self-supported tower with minimum height of 35 metres with earthing, dedicated earthing pit, aviation lamp and fall arrestor with civil foundation work as required) for installation of Radio equipment antenna, Supply & configuration of Cisco 4221 router (minimum 2 WAN ports, 4 LAN ports) with OSPF support installed in wall mounted Rack with front Glass; lockable at Makum HNE SV Station with complete detailed engineering, inspection, erection & commissioning all inclusive and Interfacing with existing Radio system of client including erection accessories, as per the specification. The interfacing of new RTU with new radio equipment for SCADA connectivity is in bidder's scope. (The new radio equipment will be supplied and installed



PARTICULAR JOB SPECIFICATION
SCADA & APPS SYSTEM

PJS DOCUMENT NO.

Page 6 of 21

MEC/05/E5/T/23U1/PJS-099 REVISION: 0

by client with antenna). Interacting with router / switch is in bidder's scope.

- xv. All inclusive **per month rates** for maintaining store at site (for the supplied material) during extended period as required (payable if site is not ready even after 6 months of actual date of completion as per terms & condition of contracts and as define in the tender scope of work).
- xvi. All the Power, signal and control cables required shall be FRLS armoured cables as per the specification provided. CAT-6/CAT-7 Cable shall be FR-PVC armoured cable.
- xvii. The Vendor shall provide the required programming for the interface to the Leak Detection server. It is the responsibility of the vendor for complete seamless integration of the SCADA server with the Leak Detection Server.
- xviii. New RTUs will be multi-dropped & communicated through DNP 3.0 (TCP/IP) with SCADA server at MCS. New RTUs as envisaged shall be procured & commissioned.

xix. Screen & 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 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. 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.



PARTICULAR JOB SPECIFICATION
SCADA & APPS SYSTEM

PJS DOCUMENT NO. Page 7 of 21

MEC/05/E5/T/23U1/PJS-099 REVISION: 0

- 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) PID Controllers. All PID control loops shall be displayed to appear as a stand-alone PID loop controller. The operator shall be able to adjust the set point and put the loop controller into manual and adjust the output.
- 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
- m) 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.

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



PARTICULAR JOB SPECIFICATION			
SCADA & APPS SYSTEM			

PJS DOCUMENT NO.

Page 8 of 21

MEC/05/E5/T/23U1/PJS-099 REVISION: 0

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.

Tag Name

• Each tag name shall followed the standard name convention.

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 midsequence.
- 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.
- 1) 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.
- n) 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.

Reports

As per existing SCADA System philosophy

Security

As per existing SCADA System philosophy

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

A APPS system - Leak Detection Server is part of the SCADA system and the SCADA system must provide data interface with this computer.

APPS system; during normal operations, all daily Pipeline Operator interactions with the application software shall be performed via the SCADA system man-machine interface (HMI) and Operator workstations. Additionally, any reconfiguration of system parameters shall be performed by a system engineer via the SCADA HMI. The model shall receive specific quantified data from the SCADA database in a continuous stream. The entire measurement system shall be scanned at a rate specified by the SCADA Vendor for optimum model



PARTICULAR JOB SPECIFICATION SCADA & APPS SYSTEM			
INSTRUMENTATION & PROCESS CONTROL OIL & GAS SBU, DELHI	PJS DOCUMENT NO.	Page 9 of 21	
	MEC/05/E5/T/23U1/PJS-099	REVISION: 0	

performance, this specified rate, is to be determined during the leak sensitivity study. The results of all calculations shall be transferred back to the SCADA system databases.

Leak Detection HMI Requirements: The vendor shall configure the following features in the HMI:

- A. Leak Detection Screen: a "pop-up" window in the HMI showing the Leak detection state-of health, alarms, and advisory messages.
- B. Leak detection alarms shall be incorporated into the overall SCADA alarm system.
- C. Leak detection messages shall be displayed prominently on the HMI and shall be accorded the highest priority

Control Logic to Support Leak detection System

SCADA logic shall set an alarm if it detects the Leak detection software has stopped, by means of the state-of-health signal from the Leak detection software.

Leak detection alarm messages shall be incorporated into the overall SCADA alarm system.

Data Exchange: Between SCADA and Leak detection

A Leak detection computer is part of the SCADA system and the SCADA system must provide data interface with this computer

Data Exchange: SCADA to Leak detection

- a) The following data shall be passed from the SCADA system to the Leak detection. Update frequency shall be nominally five seconds maximum:
- b) All measured flows, pressures, densities, and levels.
- c) All control valve statuses: open, closed, or in travel.
- d) All control valve statuses: percent open.
- e) All pump states: running or stopped.
- f) Status of key control loops: PID loops for flow, level, density, etc. values for mode (auto/manual), process variable, set point and output will be passed.
- g) Alarm limits for key process variables, such as flows, levels, densities, and pressures.
- h) Other important discrete status values, such as rupture disk status.
- i) Motor run times.
- j) Valve stroke counts.
- k) The quality of each value (e.g., a failed instrument will have a "bad" quality) shall also be transmitted.
- 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

Data Exchange: Leak detection to SCADA

The following data shall be passed from the Leak Detection to SCADA. This data will be passed on an exception basis (i.e. when the value changes), except for the "health" word, which shall change periodically.



INSTRUMENTATION & PROCESS CONTROL OIL & GAS SBU, DELHI

PJS DOCUMENT NO.

Page 10 of 21

MEC/05/E5/T/23U1/PJS-099 REVISION: 0

A. Leak Detection state-of-health: a value of 0-59, sent by the Leak Detection periodically. If the Leak Detection is functioning normally this number will change periodically. If the value does not change within a specified time, the SCADA shall set an alarm, indicated that either the Leak Detection or the communications link has failed

B. Leak Detection alarms.

C. Leak Detection advisory messages.

The SCADA Vendor shall create his own mimic displays as required by Owner. The APPS shall display all inputs and outputs using SCADA HMI displays. These displays shall be developed during the detailed functional definition stage.

Displays shall be required for the following types of information:

- Calculated flow, temperature, pressure, density and head profiles for the complete pipeline, together with pipeline profile and user-definable trending displays.
- Combination displays for e.g. calculated parameters (as a line plot), combined with bar plots of measured parameters (such as pressure);
- alarm displays (segregated from other SCADA system alarms where possible);
- system summaries/reports;
- batch/ pig tracking displays
- batch scheduling displays
- help mimics;
- Leak location displays.

The results from the APPS shall be made available through a standard Applications Programming Interface to facilitate easy selection of data to be transferred to the SCADA system.

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

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

- a) Participation in system engineering, system integration, factory acceptance testing of the complete SCADA & APPS 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 & APPS software, upgradation of software license version on migration to new hardware etc in line with conditions of the tender.



PARTICULAR JOB SPECIFICATION			
SCADA & APPS SYSTEM			

PJS DOCUMENT NO.	
MEC/05/E5/T/23U1/PJS-099	RI

Page 11 of 21

REVISION: 0

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

The Application Software (APPS) will be provided by other Contractor & reside on the separate Machine. SCADA vendor has to interface with SCADA Server through OPC. Smooth interfacing with Apps will be in bidder's scope.

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.

Mandatory requirements for RTU supplier (other than OEM of SCADA) & interfacing:

ABB make similar to existing supplied RTU (OEM: ABB) shall be provided. In addition to the requirements as define in the existing technical specification of RTU (Provided in SCADA tender of OIL); following has to be considered while designing the RTU and integration with SCADA.

- 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. 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.
- iii. RTU should have calculation features in it for defining RTU resident calculation points.
- iv. 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.
- v. RTU shall be interfaced with supplied SCADA system without using any interfacing Device / Protocol convertor between SCADA server and Main RTU [RTU which hardwired IO and serially connected to field devices (FC & PLC), MOV's, Station PLC's, RTU's, Fire Alarm Panel, UPS/ Power supply / Solar system].

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 ignore) with SCADA system on multi-dropped environment.
- ii. Both the communication port should support Class 0 and Class 1, 2, 3 polling from SCADA independently.
- iii. The ports (serial and Ethernet) for communication with Main Master Station, Backup Master Station shall be available on a separate card. 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.



PARTICULAR JOB SPECIFICATION SCADA & APPS SYSTEM			
INSTRUMENTATION & PROCESS CONTROL	PJS DOCUMENT NO.	Page 12 of 21	
OIL & GAS SBU, DELHI	MEC/05/E5/T/23U1/PJS-099	REVISION: 0	

- 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.

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. RTU vendor will get only two SCADA channels (LAN A & LAN B) from Telecom Vendor.
- iv. On RTU restart/ power failure, RTU shall reset the output circuit, shall not generate false control signal and cancel all pending control signal.
- v. AI, DI and DO card of the RTU should have define IO as per existing RTU and suitable for project requirement. However minimum point may further be deliberated considering the sizing of the RTU and availability.
- vi. All the field / IED Paramaters should be configurable at the RTU end.
- vii. 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
- viii.Each AI shall be wired in Sink mode configuration. However, if source mode configuration is required, the same will be decided during detail engineering
- ix. Active Analog barriers have to be provided for each channel of AO card in the RTU panels
- x. Each RTU should have 25% spare I/O points and additional 25% spare slots of total installed serial and I/O cards slots.
- xi. RTU should be internally wired between IO cards and terminal blocks for all the IO points in all the IO cards in the RTU.
- xii. The terminal blocks to be mounted either on front or back or both but not on sides.
- xiii.RTU rack shall be of minimum size of 2000 mm H x 800 mm D x 800 mm W with 100 mm base channel and 15 mm of anti vibration pad meeting the specification requirement as define in the spec of tender.

Aspects related to RTU configuration and diagnostics

- i. Licensed RTU configuration software (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. RTU configurator / diagnostic software shall have the following provision:
 - 1. 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.
 - 2. Error detection/control feature to ensure data integrity.
- iii. RTU should have the utility for configuration and diagnostics through remote and local.
- iv. RTU should have diagnostic provision without uploading / downloading RTU configuration to PC/laptop.
- v. The RTU should have diagnostic feature for hardwired IOs. DNP/IEC and IED communication.
- vi. RTU should be internally wired between IO cards and terminal blocks for all the IO points in all the IO cards in the RTU.
- vii. 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



PARTICULAR JOB SPECIFICATION SCADA & APPS SYSTEM			
INSTRUMENTATION & PROCESS CONTROL	PJS DOCUMENT NO.	Page 13 of 21	
OIL & GAS SBU, DELHI	MEC/05/E5/T/23U1/PJS-099	REVISION: 0	

viii. The RTU back panel, CPU, IO cards and any other device susceptible to 230V AC discharge shall be installed insulated from the panel body through proper insulators

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.

Support and inputs to SCADA vendor for:

- 1. Establishing communication between SCADA system and RTU.
- 2. RTU vendor should provide the final indexing of all I/O points for each RTU to enable SCADA vendor to configure the SCADA database.
- 3. RTU vendor to provide Field I/O details (list of I/O points along with engineering units, range, alarm, limits, status corresponding to open/close contacts, indexing details in the RTU etc) for configuring in SCADA as per client standard IO list format to be provided by client.

As – built Documentation (For RTU)

- i. User's manual for configuration and testing of the RTU.
- ii. RTU system manual.
- iii. RTU serial port configuration details for IED interface.
- iv. RTU cabinet layout.
- v. Cabling schedule
- vi. Field I/O details (list of I/O points along with engineering units, range, alarm limits, status
- vii. corresponding to open/close contacts, termination details at RTU and TIC panel, indexing details in the RTU etc. for configuring in SCADA

3.2 DESIGN & ENGINEERING OF SCADA & APPS 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 Integration of RTUs with MCS all similar to existing SCADA System supplied by M/s ABB.
- c. Interfacing with Pipeline Modeling software (APPS) software for exchange of parameters (as required)
- d. Refer enclosed "Process Design Basis" for the pipeline parameters for APPS design

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



PARTICULAR JOB SPECIFICATION				
SCADA & APPS SYSTEM				

PJS DOCUMENT NO.

MEC/05/E5/T/23U1/PJS-099

Page 14 of 21

REVISION: 0

3.3 SUPPLY OF SCADA & APPS SYSTEM:

The vendor shall supply all the items / equipments including softwares, SCADA & APPS 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.

3.4 In the tender, Technical specification MCS / MMS / Mater Station / Main control room etc synonyms of Master Management Station of SCADA system located at RT Madhuban

3.5 TRANSPORATION AND STORAGE OF SCADA & APPS SYSTEM:

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

- a) Transportation, loading, unloading of equipment and all other components from locations of manufacturing/supply to the locations of installation.
- b) Storage during transit, transit insurance & storage/ warehousing as required
- c) Statutory clearances including clearances of customs, excise, octroi, entry tax and others, as required for all the supplied items.

3.8 INSTALLATION OF SCADA & APPS SYSTEM AT SITES:

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

- a. Installation of SCADA & APPS equipments including network devices, modems etc at MCS locations following standard installation procedure.
- b. Interfacing of SCADA & APPS equipments with telecom equipments as define
- c. Laying & routing of all FRLS cables through conduits, glanding, termination of cables, dressing and ferruling for all the cables as per define in tender document.
- d. Providing earthing to SCADA & APPS equipments at MCS and RTUs locations by extending the earth conductor of suitable dimension from earth pit to the equipment rack.

For taking up above installation activities by the vendor, client shall provide the following infrastructure facilities at different sites as per enclosed Annexures:

- a) Air conditioned space at MCS locations
- b) UPS power at single point
- c) Telecom channels between MCS and RTU.



PARTICULAR JOB SPECIFICATION	
SCADA & APPS SYSTEM	

PJS DOCUMENT NO.	Page 15 of 21
MEC/05/E5/T/23U1/PJS-099	REVISION: 0

3.9 **INTEGRATION WITH RTUS & OTHER SYSTEMS:**

The vendor shall carry out the integration of SCADA system for its successful implementation with integration of RTUs as defined in tender document

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.

3.10 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.

3.11 FACILITY MANAGEMENT SERVICES (FMS):

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

4.0 **COMPLETION PERIOD**

As per bid documents; refer bid documents.

5.0 **BIDDER'S QUALIFICATION CRITERIA (BEC)- TECHNICAL:**

This will be as define in Bid documents. Bidder must fill the BQC provided at respective section without fail and provide all the necessary supporting documents along with offer.

5.1 **EQUIPMENT QUALIFICATION CRITERIA (EQC) - TECHNICAL:**

The SCADA System (Internet Protocal - IP based) & RTU proposed shall be similar / compatible to existing supplied System (of M/s ABB make) and should have successfully tested for similar application.

The APPS System (Leak detection System) proposed to be supplied shall be from the existing range and should have successfully tested for similar application.

6.0 **TEST EQUIPMENTS:**

- 6.1 SCADA vendor shall supply test equipments and tools for testing and calibration of all the equipments as per SOR.
- 6.2 Diagnostics software for RTU, SCADA shall be supplied along with necessary documentation and accessories. All the supplied software should be licensed to client for the complete life period of the equipments.
- 6.3 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



INSTRUMENTATION & PROCESS CONTROL OIL & GAS SBU, DELHI

PJS DOCUMENT NO.

Page 16 of 21

MEC/05/E5/T/23U1/PJS-099 REVISION: 0

and loaded with all the RTU configurations and diagnostic software. All the necessary cables and connectors shall be supplied with the PDTs.

6.4 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 reputed make as approved by client.

It shall be possible to use the PDT both locally and remotely to manage SCADA system. 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 Microsoft Windows 7

professional

Processor : Min Intel Core i7 8th-Generation or later

Memory : Min. 8GB DDR4 SDRAM, Expandable upto 16GB Hard Drive : Min. 1TB HDD @5400rpm/7200rpm SATA

Optical Drive : Internal/ DVD +/- RW

Display: 14 inch Widescreen with resolution 1366X768 or better.

Mouse : Touch Pad

Ports: 2 number of USB 3.0., 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 & one Serial (RS232) port

onboard or via PC/Express card SD Memory Card Reader

2 slots for either Express Card 54mm or PC Card (32bit) or both

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



PARTICULAR JOB SPECIFICATION SCADA & APPS SYSTEM			
INSTRUMENTATION & PROCESS CONTROL	PJS DOCUMENT NO.	Page 17 of 21	
OIL & GAS SBU, DELHI	MEC/05/E5/T/23U1/PJS-099	REVISION: 0	

Battery: Internal minimum 45 W Hr

Anti-virus : Latest Antivirus with license for virus definition free update

till 3 years, Latest MS Office suite

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.

6.5 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

6.6 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.

7.0 <u>DOCUMENTATION</u>

The language used in all correspondence, documentation, literature, drawings, markings etc., shall be English.

SCADA & 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.

All the drawings and documents shall be verified by the SCADA & APPS vendor before presenting the same for Client review.

All these documentation shall be furnished in hard cover loose ring folders in A4 size ($210 \text{mm} \times 297 \text{ mm}$).



INSTRUMENTATION & PROCESS CONTROL OIL & GAS SBU, DELHI

PJS DOCUMENT NO.

MEC/05/E5/T/23U1/PJS-099

Page 18 of 21

REVISION: 0

All SCADA & APPS documents shall also be supplied in "SOFT COPY" form.

SCADA & APPS engineering documents (FAT, SCADA & APPS engineering manual, SCADA & APPS 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 & APPS vendor shall review, duly sign & stamp all the documents and ensure compliance to the requirements of the contract.

7.0 TRAINING

Vendor shall provide training to technical, operator & maintenance personnel of the company 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 has to be provided at vendor's works having full training facilities for all the training specified in various clauses. Training documents contains all the details as specified have to be provided to all the trainee as per the schedule. Details will be as per respective Technical specifications.

8.0 WARRANTY / EXTENDED WARRANTY:

SCADA & APPS vendor shall be responsible for the manufacture in respect of proper design, quality, workmanship & maintenance of all equipment, accessories etc. supplied including all services, spares for a period of 24 months after taking over the system at site, for meeting the functionality and performance requirements of this contract.

The warranty of the SCADA & APPS system shall be 24 months date of issuing of completion certificate after successful trial run & commissioning. In case site is not made available for commissioning of the system after delivery of material, then 24 months warranty of system hardware shall commence after 6 months from receipt of material at all the sites. (i.e. 30 months from all the material received at all sites). However, system software warranty shall start only after trial run & commissioning of entire system. to fulfil the same, it shall be obligatory on the part of SCADA & APPS vendor to modify/ upgrade or replace any hardware from the supplied equipments and modify/ upgrade the operating system software, SCADA software, APPS software, HMI software, other software, supply the required spares and attend to the maintenance of the system, free of cost, during start-up and on-line operation & maintenance of the SCADA & APPS system, within the warranty period. Any modifications/ Upgradation or replacement of any hardware & software during warranty shall not affect the performance & functionality of the system.

During warranty period, the replacement/ maintenance requirement of the total system shall be attended on call basis within three days from the first service call by Client / Consultant.

After the successful completion of trial run, the Completion Certificate and acceptance shall be issued by the Client and thereafter Warranty phase will start.

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.



INSTRUMENTATION & PROCESS CONTROL OIL & GAS SBU, DELHI

 PJS DOCUMENT NO.
 Pa

 MEC/05/E5/T/23U1/PJS-099
 R:

Page 19 of 21

REVISION: 0

Additionally the following shall also apply:

- i) 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.
- ii) 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.)

- a) The vendor shall provide trained engineers and technicians on site during warranty maintenance.
- b) 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 a period of 24 months (warranty period) after taking over the system at site, 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.
- c) The repair work should not however exceed 7 days otherwise warranty period shall be suitably extended.
- d) 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.
- e) 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.
- f) 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.



INSTRUMENTATION & PROCESS CONTROL OIL & GAS SBU, DELHI

PJS DOCUMENT NO.

Page 20 of 21

MEC/05/E5/T/23U1/PJS-099

REVISION: 0

In case of failure of any equipment, replacement is send immediately within 15 days. It is advice that Vendor should keep sufficient spare for warranty support in its stores (designated store to be informed during detailed engineering).

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 client within warranty/extended warranty period.

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

9.0 POST WARRANTY MAINTENANCE CONTRACT FOR 3 YEARS: (Comprehensive for complete SCADA & APPS system & RTU)

- a) The Vendor shall quote for providing post warranty maintenance (comprehensive) for 3 years after completion of warranty /extended warranty period and provide technical support for the maintenance of the SCADA & APPS / RTU and associated system / subsystem including any repair / replacement of faulty cards/ equipments.
- b) The proposal shall include travel, boarding & lodging of service engineer as and when required n case of site visit.
- c) In the event of any malfunction of the system hardware/ system software, vendor will provide technical guidance to client to resolve the issue with available spares with client. In case the problem is not resolved through remote technical guidance then the vendor should sent experienced service engineer to site within 24 hours on the receipt of such information from owner and rectify the issue.
- d) 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.
- e) 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.
- f) 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 3 years comprehensive post warranty and the price validity shall be available for the entire period of contract. Payments shall be made quarterly.

10.0 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



INSTRUMENTATION & PROCESS CONTROL OIL & GAS SBU, DELHI

PJS DOCUMENT NO.

Page 21 of 21

MEC/05/E5/T/23U1/PJS-099 REVISION: 0

Technical Support Services that extends coverage for CLIENT after handover of the system. This includes 24 hours x 7 days a week on line support. CLIENT 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.

11.0 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.

12.0 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 9001:2015 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 & APPS system as define in tender document.

13 <u>ANNEXURES</u>:

Annexure I to VI



PARTICULAR JOB SPECIFICATION

PJS No.: MEC/05/E5/T/23U1/PJS-099

Rev. 0 ANNEXURE to PJS

Page 1 of 1

MECON LIMITED DELHI

ANNEXURES SCADA & APPS SYSTEM



OIL INDIA LIMITED

TECHNICAL SPECIFICATION SCADA SYSTEM

TS NO: MEC/05/E5/T/TS/S-99

PREPARED & ISSUED BY



(INSTRUMENTATION& CONTROL SECTION) MECON LIMITED

(A Govt. of India Undertaking)

Delhi, India

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NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 2 of 24

Table of Contents

- 1. INTRODUCTION
- 2. SCOPE OF WORK
- 3. BOM & DETAILED SCOPE OF WORK
- 4. GENERAL TECHNICAL REQUIREMENTS
- 5. SHIPMENT, HANDLING, PACKAGING & TRANSPORTATION
- 6. INSTALLATION OF SCADA SYSTEM
- 7. QUALITY ASSURANCE & ACCEPTANCE PROGRAMME
- 8. DOCUMENTATIONS
- 9. TRAINING
- 10. SUBMISSION OF COMPLIANCE REPORT
- 11. CERTIFICATE FOR LOGISTICS SUPPORT
- 12. SUPPLY & STORAGES OF EQUIPMENT
- 13. SITE PREPARATION
- 14. WARRANTY
- 15. POST WARRANTY MAINTAINACE CONTRACT
- 16. TECHNICAL SUPPORTS ON WARRANTY / POST WARRANTY
- 17. 2 YEARS MANUFACTURER'S RECOMMENDED O & M SPARES

0	Date	Prepared By	Checked By	Approved By
Rev	20.10.2018	Namita Beniwal	Ratnadeep Gupta	Pankaj Shrivastava

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INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION
SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 3 of 24

1. INTRODUCTION

Oil India Limited, a Government of India Enterprise is proposing to lay a 40 kms. (approx.) long Natural Gas pipeline starting from Baghjan to Madhuban, Duliajan. The proposed Baghjan to Duliajan gas Pipeline is in addition to the existing 400 mm NB (16"NB) gas pipeline. The new gas pipeline is proposed as the existing 400 MM NB (16"NB) pipeline is running on almost full capacity (i.e. 1.5 MMSCMD) and the projected gas production from the Baghjan area will reach a plateau limit of 4.5 MMSCMD by 2019-2030 with peak production at 5.134 MMSCMD of natural gas. Therefore the proposed capacity of the new pipeline is 3.634 MMSCMD. However as decided by M/s OIL capacity for the new pipeline to be considered as 5.0 MMSCMD. The new pipeline shall be laid in the OIL's existing ROW as far as possible. The ROW is 18 Meter wide and already 2 (two) nos. of pipelines viz. one 400 mm NB (16"NB) gas pipeline and one 200 mm NB (8"NB) crude oil pipeline are already laid in the ROW and are in operation. One more 400 mm NB (16"NB) gas pipeline is being laid from Loc. HNE, Makum (Chainage 21.0 kms, approx. from Baghjan) to Madhuban (Chainage 38.70 kms, approx. from Baghjan) in the existing ROW. Further available ROW width for laying of the proposed 40 kms. (approx.) long Natural Gas pipeline is 9.0 Meter (approx.).

M/s Oil India Limited has awarded MECON Limited Engineering Procurement Construction Management consultancy (EPCM) services for laying 30"NB x 40.0 Kms. (Approx.) Mainline from GGS Baghjan to CGGS Madhuban, Duliajan for transportation and distribution of Natural Gas.

The purpose of this specification is to define the outline requirement of Supervisory Control and Data Acquisition (SCADA) System for 30"NB x 40.0 Kms. (Approx.) Mainline from GGS Baghjan to CGGS Madhuban, Duliajan for transportation and distribution of Natural Gas Pipeline Project for OIL. OIL has already existing SCADA system supplied & commissioned by M/s ABB. New pipeline facilities has to be integrated with existing SCADA system through already available RTU / new RTU along the pipelines for smooth remote operation & control on real time basis.

1.1 PURPOSE OF THIS DOCUMENT

- 1.2 The purpose of this specification is to define the outline requirement of SCADA system limited to integration / interfacing of new RTU in existing SCADA and upgradation of existing RTU to accommodate new IO's of present pipelines parameters Pipeline. The existing Supervisory Control and Data Acquisition (SCADA) System of OIL (supplied by M/s ABB) for Natural Gas Pipeline from GGS Baghjan to CGGS Madhuban, Duliajan in the state of Assam.
- 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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 4 of 24

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 for providing a complete solution for the Installation of new RTU / modification of existing RTU and necessary integration with existing SCADA system supplied by M/s ABB as per the scope define in this specification as required for new pipeline. Providing necessary Supports for interfacing of SCADA to new APPS (LDS) system (supplied & installed by other APPS contractor) with Open architecture, meeting specific requirements as described in the tender also part of the scope of the vendor.

The vendor shall take full responsibility of the following as a minimum for successful execution of the SCADA system (as per limited scope):

- a) Participation in system engineering, system integration, factory acceptance testing, and integration with client's SCADA, commissioning and site acceptance of the complete system.
- b) Furnishing & Vetting of FDS, all Design & Engineering Documents
- c) Provide technical support, up gradation of software license version on migration to new hardware etc in line with conditions of the tender if required.
- d) Ensuring QA / QC programs of the project conforming to standards and integration with SCADA software

The SCADA System & Software (supplied & maintained by ABB) provided by ABB & reside on the separate Machine. SCADA vendor interfaced with SCADA Server through OPC.

1.6 BRIEF EXISTING SCADA SYSTEM:

Oil India already has a SCADA system, which is used to monitor and control different on line parameters like Oil collecting stations (OCS), Gas compressor stations (GGS), FGGS, OTP and electrical substations. The total area has been distributed to Greater Naharkatiya, Greater Moran area, Greater Jorajan Area, Greater Tengakhat area & Eastern Producing area; all theses stations are collocated within the radial distance of approximately 50 Km from MCS at Duliajan, except 2- 3 installations which are at a radial distance 80 km approximately. Facility to interface to existing SAP for corporate level is also provided in the MCS. The SCADA system consists of two levels of SCADA Servers consolidating information from the Field level, to Asset head quarters or Corporate Headquarters.

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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 5 of 24

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.

2. SCOPE OF WORK:

For smooth monitoring & control of new pipeline facilities with SCADA system, new RTUs have been envisage and it will be interface with SCADA system. The MCS/ ECS of SCADA shall have SCADA servers, Engineering work stations, HMI, history archiving, storage, web functionality, message/reports through SMS / email. It has web server and should be able to display graphics through web.

The centralized server of SCADA shall poll the RTUs of GGS Baghjan to CGGS Madhuban, Duliajan pipeline through high speed links. The communication between MCS/ECS server and RTUs will be multi-dropped serial low speed digital channels, multi-dropped serial low speed analog channel, dialup, and TCP/IP, GPRS, Radio or any combination thereof.

New RTUs will be multi-dropped & communicate through DNP 3.0 (TCP/IP) with SCADA server. New RTU (or upgradation of existing RTU) shall be install & commission along the pipeline as per requirement for configuration of process parameters with SCADA system.

The MCS / ECS will be interlinked with Remote Telemetry Units (RTUs) located along the pipeline by dedicated Radio link (existing Radio communication) available or provided at location where it is not available through new equipment.

The Application Software (APPS) will be provided by other Contractor & reside on the separate Machine. SCADA vendor has to interface with SCADA Server through OPC. Smooth interfacing with Apps will be in bidder's scope.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 6 of 24

3. BOM & DETAILED SCOPE OF WORK:

BOM & BETMELD SCOTE OF WORK.
The detailed scope of work & works of Vendor shall include but not limited to the following:
The Supply & site services required minimum:
Remote Terminal Unit for Baghjan Dispatch Station – Modification in existing RTU at Baghjan by adding the necessary hardware & software
Remote Terminal Unit for Madhuban Duliajan (WELL -50) receiving station - Modification in existing RTU at WELL -50 by adding the necessary hardware & software and integration of new hardware and software at existing RTU to bring field data to MCS Madhuban, Duliajan
Modification in SCADA system at MCS Duliajan for integrating the proposed Pipeline SCADA and LDS Application.
Modification in existing SCADA RTU (Supplied by M/s ABB) by adding new IO modules (of ABB or equivalent) as required (as per P&ID of new pipelines). Design, Engineering, System Installation, Commissioning, for all RTU/SCADA devices, components under the scope of this project
Additional WEB Client License for Web client at Central Gas gathering station at MCS Madhuban, Duliajan and integration with existing SCADA.
Web Client with 21" monitor & windows OS –for new pipeline at MCS Madhuban, Duliajan and integration with existing SCADA.
Modifications in the existing SCADA software for adding these additional RTU and necessary graphics development including any upgaradation of existing licenses as required.
All erection accessories including 8 port Ethernet Switch, Ethernet cable, Cable trays, FRLS armored Signals & Alarm Cables, Exp Gland double compression , Rack, Power supply etc as required
Supply, laying of all type of cables (FRLS armored), cable Glanding with Double compression exp glands, termination, ferruling, dressing of all instruments (mentioned above), power cabling from dedicated feeder to RTU and accessories to interface local control panel to respective RTU panel, providing earthing to SCADA equipments at as required by extending the earth conductor of suitable dimension from earth pit to the equipment rack at RT/DT and new pit at SV location
Interfacing of SCADA RTU equipments with telecom equipments as define, Configuration of SCADA including network devices at MCS/ ECS locations as required for adding new pipelines
Any other work not define above but required for smooth interfacing with existing SCADA system, Telecom System for implementation of remote SCADA for new pipeline and APPS (LDS) system for new pipeline as per the instruction of EIC / client.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 7 of 24

☐ As the works as define in Particular Job specifications.

4.0 GENERAL TECHNICAL REQUIREMENTS

A. Environmental specification of equipment to be supplied

- 1. The equipment at the MCS shall operate satisfactorily in air-conditioned environment under temperature of 15 35°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 MCS/ECS if required. 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. At SV the power will be provided at Electrical room (24 V DC, 250 Watts).
- 2. If any other voltage levels are required, then all necessary conversions shall be in the scope of APPS Vendor.

C. Earthing

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 SCADA 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 SCADA system and associated items including but not limited to the following:

- o Transportation, loading, unloading of equipment and all other components from locations of manufacturing/supply to the locations of installation
- o 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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION
SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 8 of 24

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 : "OIL (INDIA) LIMITED" Project : "SCADA & APPS system"

Description of Equip : "Equipment title"

Serial no. of the equipment"

Address : "Destination address as per P.O."

6.0 INSTALLATION OF SCADA SYSTEM

Installation of all field instruments, calibrations, Cabling, Glanding, and Termination including all erection accessories (Tray, Trench preparation, marker etc.) upto Inst Panel / RTU panel has to be done. Scope regarding cables (all cables shall be FRLS armoured including serial & LAN CAT 6 cables), glands and interconnection of cabling and accessories including cable routing between the following cabinets/ equipments are as follows:

Sl. No.	Type of Cabling FRLS	Location	From	То	Scope of SCADA Vendor (as applicable)
1.	Serial Interface cables (RS 232/RS 485/Ethernet)	RTU locations	RTUs.	IEDs (FC, CP, LEL etc) at Remote locations	Complete interfacing requirements including supply of cables with connectors at IED end, RS 232C / RS 485 / Ethernet connection intrinsically safe box (ISB) ends.
2.	Power cables	RTU locations	Power Distribution cabinet	RTU	Supply of cable including Glanding, termination, ferruling, dressing etc. at RTU end.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 9 of 24

3.	Telecom Interface Cable	RTU locations	Telecom panel / router / switch	Ethernet port of RTU / Lease line modem	Supply, Laying, routing, Glanding termination both end.
4.	Instrumentatio n Cables	RTU Location s	Field	RTU	Glanding, ferruling, termination of instrumentation signal from field device to RTU with barriers both ends. Cabling from all field instruments to RTU including laying & terminations. (As required, if not completed by laying contractor)

^{6.2} Vender shall consider separate cable FRLS for each type of digital and analog signals. Over all & individually shielding cable for analog signals and over all shielded for digital signals. Necessary tray, Glands, other erection accessories as required has to be supplied.

6.3 BATTERY LIMIT WITH OTHER CONTRACTORS

SI. No.	Item	Scope of Pipe Laying Contractor or other contactor	Scope of RTU (as applicable)
1.	Cathodic Protection (CP)	Supply & laying of cable for hardwired signals (which shall be interfaced with RTU) from CP panel to Inst/ TIC panel including glanding, termination, ferruling, dressing etc. both end	Supply & laying of cable for hardwired signals/ serial communication from Inst / TIC panel to RTU including glanding, termination, ferruling, dressing etc. both end
2.	Fire & Gas Detection System	Supply & laying of cable for hardwired signals (which shall be sent to RTU) from Fire & Gas panel to TIC/INST panel including glanding, termination, ferruling, dressing etc. both end	Supply & laying of cable for hardwired signals from TIC/INST panel to RTU including glanding, termination, ferruling, dressing etc. both end
3.	Door Switches	Supply of Door switches & Supply & laying of cable for hardwired signals (which shall be sent to RTU) from Switches to TIC/INST panel including glanding, termination, ferruling, dressing both end	Supply & laying of cable for hardwired signals from TIC/INST panel to RTU including glanding, termination, ferruling, dressing etc. both end.
4.	Corrosive Monitoring System	Supply & laying of cable for hardwired signals (which shall be sent to RTU) from CMS to TIC/INST panel including glanding, termination, ferruling, dressing etc. both end	Supply & laying of cable for hardwired signals from TIC/INST panel to RTU including glanding, termination, ferruling, dressing etc. both end.
5.	Hardwired Signal Cable	Supply of cable & laying of cables from field instruments to JB, JB to	All the hardwired signal of field instrument / IEDs from

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 10 of 24

	for field instruments (field I/Os)	INST panel including, gas actuated valve & manual valves to INST panel including glanding, termination, ferruling, dressing at Panel end.	TIC to RTU.
6.	Soft Signals from INST to RTU	Provide modbus details to RTU/SCADA vendor	Supply of communication cable with connectors at both ends from INST to RTU including glanding, termination, ferruling, dressing etc. at INST cabinet end and laying of the same cable up to RTU cabinet also Configuration at RTU end by RTU vendor
7	UPS system /Solar System	Supply of solar system & provision for RS485 in Solar system for interfacing with RTU by Solar panel vendor also provide modbus details in modocon modbus format to RTU/SCADA vendor.	Supply of communication cable with connectors at both ends from Solar panel to RTU including Laying, glanding, termination, ferruling, dressing etc. at both ends.

Note:

- (i) Distance between Telecom Panel and RTU equipment at stations shall be considered as 15 meters. However, these distances shall be firmed up during detail engineering.
- (ii) Distance between IEDs/ Inst / CP /Solar / UPS and RTU Panel to be considered as maximum 30 meters. However, these distances shall be firmed up during detail engineering.
- (iii) Vendor has to supply & lay the cable tray, supply & erection of foundation channel on trench provided by client as required.
- (iv) All the serial cables shall be laid in the conduits from various panels to RTU.
- (v) Field cable will be terminated upto Instrument Panel/RTU Panel as required. For integration with RTU & cables have to be laid from field / Instrument panel to RTU. Supply, Laying, termination of all cables (armoured FRLS required for integration of all the signals from Instrument panel to RTU shall be in scope of Bidder. For serial communication cables directly terminated to RTU. All gland shall be double compression Exp certified.
- (vi) Cables for servers / HMI / work stations (all type and must be armored FRLS).
- All the signals from CP panel, door switches, CMS system and Fire & gas detection system shall connect with RTU through hardwired signal or serial communications (on MODBUS) as per the provisions available in the respective panels. If the signals are not made available then it will be treated as spare I/Os.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 11 of 24

6.5 **RTU Features:** The existing RTU are equipped with dual microprocessor with respective communication card, Central Processor (unit:AC-800 F- with SCADAvantage s y s t e m software of M/s ABB) based modular electronic control device equipped with I/O terminals, suitable for connecting directly/ through panel interface to the field wiring of analogue, digital devices; It is capable of supporting multiple standards, RTU protocols like MODBUS, HART, FF. It can capable required communication protocol by RS-232C/RS-485 and also support open standard communication such as OPC,TCP/IP Profibus, Foundation Field bus as per the requirement. The new supply of RTU must have following cards (OEM-M/s ABB) and additional card for existing RTUs based on the process parameters required to be interface as per P&IDs of New pipeline. Refer separate IO list and module requirements for existing and new RTU. 25 % spare IO's shall be considered over and above of present use. The RTU rack should have inbuilt display unit as per the existing supplied RTU of ABB. Quantity, additional module as required for the project shall be supplied within quoted rate.

1	PM 803F BASE UNIT AND POWER SUPPLY SD812F
2	EI 813F ETHERNET MODULE 10 BASE T
3	BATTERY MODULE AM 811F
4	FI 820F SERIAL COMMUNICATION MODULE
5	FI 830F PROFIBUS-DP MODULE
6	FI840F FOUNDATION FIELDBUS MODULE
7	CI840 FIELD COMMUNICATION MODULE
8	(DI810) DIGITAL INPUT MODULE
9	(DO810) DIGITAL OUTPUT MODULE
10	LD800HSE LINKING DEVICE
11	RLM01 REDUNDANT LINK MODULE
12	ETHERNET SWITCH FOR FF
13	FF POWER SUPPLY
14	FF POWER HUB WITH DIAGNOSTIC CARD
15	POWER FEED MODULE
16	DI BARRIER

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 12 of 24

7.0 QUALITY ASSURANCE & ACCEPTANCE PROGRAMME

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 9001:2015 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.

The SCADA Vendor shall provide the quality assurance for testing & acceptance of SCADA system as per Scope of Work of the tender document and shall include but not limited to the following:

- o **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, SCADA Vendor shall invite Client / PMC, to witness FAT. FAT shall be carried out as per the FAT approved procedure at SCADA 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 SCADA Vendor by Client / PMC
- o **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 SCADA on pipelines, the SCADA system shall be put under Test Run for a minimum period of 15 days as per approved procedure.

8.0 **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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 13 of 24

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.

8.1 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 new pipelines of OIL. The requirement of updated SCADA FDS shall be to focus on the implementation aspects of these requirements with existing system.

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, MCS, ECS 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.]

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 telemetry points database document

SCADA vendor is required to incorporate the complete requirements of telemetered points for SCADA system taking the inputs from the I/O point database (I/O Point list) which shall be provided by Client during detail engineering. 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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 14 of 24

c). 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 MCS, interconnections of SCADA equipments at ECS/RWS, 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. This document will be submitted at the earliest so that required power availability can be ascertained by OIL in time.

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 Purchase Requisition (PR), 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.

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.

TWO HARDCOPIES AND TWO SOFTCOPIES AT MCS; 1 HARDCOPY AND 1 SOFTCOPY AT EACH ECS /RWS WILL 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:

INSTRUMENTATION & PROCESS CONTROL **SECTION Delhi**

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 15 of 24

- 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.

I) **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.

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As-Built documentation shall be provided by the Vendor within one if 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

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 16 of 24

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Bandwidth / data traffic for various telecom links among MCS/ ECS locations

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

- m) 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.
- n) 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.
- o) 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.
- p) 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.

9.0 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 has to be provided at vendor's works having full training facilities for all the training specified in various clauses. Training documents contains all the details as specified have to be provided to all the trainee as per the schedule.

Training to be done at the integration centre where all the types of equipments supplied are simulated for practical training as defined elsewhere in the tender document.

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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 17 of 24

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.

Vendor shall, Fifteen (15) days prior to start of training, send complete training program including details of each course, duration, subject matter etc. The Owner/engineer reserves the right to suggest any additions/deletions in the program which shall be incorporated by the Vendor at no additional cost.

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

SCADA Engineer's / System manager's Training

Vendor shall train Client's engineers/system manager in batches of 4 engineers for 5 working days on SCADA system before installation of the system in their work place/training centre. Presently two batches are envisaged.

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.

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 in batches of 4 engineers of 4 days duration (2 working days per batch) for SCADA system after test run at one of the client locations. Presently two batches are envisaged. 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.

Depending upon the availability of client engineers/users the number of batches may be decreased or increase by client. The payment will be made as per actual no of batches for which training has been imparted.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 18 of 24

9.1 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.

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

SCADA Training

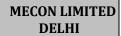
Owner personnel shall be trained in each aspects of the system required for day-to-day and emergency operations.

Training courses shall be given for

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

9.2 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):



INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 19 of 24

- a) Operate & maintain the system
- b) Add new RTUs and change media of communication between MCS/ECS and RTU
- c) Generation and modification of HMIs (graphics && reports) and Point database
- d) Integration of new IEDs like flow computers, GC 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) Configuration of RTU.

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.

10.0 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.

11.0 CERTIFICATE FOR LOGISTICS SUPPORT

Vendor shall provide backup engineering, maintenance support and spare part supports for a period of seven (7 years) for the RTU being supplied .Logistic support certificates as per format attached with the bid document.

12.0 SUPPLY AND STORAGE OF EQUIPMENT

This shall include but not limited to supply and storage of equipment and all other items required for installation and commissioning of the network including the following:

- Transportation of equipment and all other components from locations of manufacturing to Site or Site store and then to locations of installation.
- Storage during transit & storage after installation till the handing over to owner.
- Statutory clearances including clearances of Customs, Excise, Octroi and others, as required for all the supplied items.

Bidder has to deliver the material at site after FAT and store at site till the readiness of the control room at respective locations. When the site is ready then shift the RTU at respective locations.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 20 of 24

13.0 SITE PREPARATION

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

ACCESSORIES / OTHER ASSOCIATED ITEMS

Supply & Installation of necessary equipment, cables trays, cables & accessories to meet the overall system requirements along Natural Gas Pipeline at respective sites, separate earthing & lighting protection of indoor equipment (not earth pit) 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.

Civil Trench inside the control room will be provide by client, however, the erection of foundation channel including support welding etc work as required as per the base frame of RTU shall be provided by the bidder.

The vendor shall extend the power from client provided power point to the DCDB, to be installed in the equipment room using the armoured DC cable. For the same, the DCDB and armoured cable shall be supplied and installed by the vendor.

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.

14.0 WARRANTY / EXTENDED WARRANTY: (Limited to supplied item only).

SCADA vendor shall be responsible for the manufacture in respect of proper design, quality, workmanship & maintenance of all equipment, accessories etc. supplied by the SCADA vendor including all services, spares for a period of 24 months after taking over the system at site, for meeting the functionality and performance requirements of this contract.

The warranty of the SCADA system shall be 24 months date of issuing of completion certificate after successful trial run & commissioning. In case site is not made available by client for commissioning of the system after delivery of material, then 24 months warranty of system hardware shall commence after 4 months from receipt of material at all the sites. (i.e. 28 months from all the material received at all sites). However, system software warranty shall start only after trial run & commissioning of entire system. to fulfil the same, it shall be obligatory on the part of SCADA vendor to modify/ upgrade or replace any hardware from the supplied equipments and modify/ upgrade the operating system software, SCADA software, HMI software, other software, supply the required spares and attend to the maintenance of the system, free of cost, during start-up and on-line operation & maintenance of the SCADA system, within the warranty period. Any modifications/ Upgradation or replacement of any hardware & software during warranty shall not affect the performance & functionality of the system.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 21 of 24

During warranty period, the replacement/ maintenance requirement of the total system shall be attended on call basis within three days from the first service call by Client / Consultant. After the successful completion of trial run, the Completion Certificate and acceptance shall be issued by the Client and thereafter Warranty phase will start.

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.

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 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 a period of 24 months (warranty period) after taking over the system at site, 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.
- e) The repair work should not however exceed 7 days otherwise warranty period shall be suitably extended.
- f) After the successful completion of Trial run & successful performance testing, the PRE WARRANTY COMPLETION CERTIFICATE shall be issued by the Client and there after Warranty phase will start.
- g) 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 Client 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.
- h) 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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 22 of 24

- 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
- i) In case of failure of any equipment, replacement is send immediately within 15 days. It is advice that Vendor should keep sufficient spare for warranty support in its stores (designated store to be informed during detailed engineering).

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 configuration software upgrade free of cost to client within warranty/extended warranty period.

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

15.0 POST WARRANTY MAINTENANCE CONTRACT FOR 3 YEARS:

(Comprehensive for complete extended SCADA system & RTU only including modification in RTU)

- a) The Vendor shall quote for providing post warranty maintenance (comprehensive) for 3 years after completion of warranty /extended warranty period and provide technical support for the maintenance of the SCADA / RTU and associated system / subsystem including any repair / replacement of faulty cards/ equipments.
- b) The proposal shall include travel, boarding & lodging of service engineer as and when required n case of site visit.
- c) In the event of any malfunction of the system hardware/ system software, vendor will provide technical guidance to client to resolve the issue with available spares with client. In case the problem is not resolved through remote technical guidance then the vendor should sent experienced service engineer to site within 24 hours on the receipt of such information from owner and rectify the issue.
- d) 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.
- e) 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.

MECON LIMITED
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INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 23 of 24

- f) 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 3 years comprehensive post warranty and the price validity shall be available for the entire period of contract. Payments shall be made quarterly.

16.0 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 client after handover of the system. This includes 24 hours x 7 days a week on line support. Client 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.

17.0 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 0.2 (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

MECON LIMITED
DELHI

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION SCADA SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-99, Rev-0

Page 24 of 24

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 24 months prior notice to such discontinuation so that Owner may order requirements of spares in one Lot.

		PARTICULAR JOB SPECIFICATION						
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I/O LIST - GAS PIPELINE FROM GGS/EPS BAGHJAN TO CGGS MADHUBAN,DULIAJAN																												
	vo. RTU		cation Type of RTU as per MR		Al I/O's					A0 I/O			DI 1/0'				DO 1/0's							Serial Port RS 485				
Sl. No.		Location		Inst	CP/CC & Cathodic Protection	UPS / Solar	Fire	LEL	Total AI (Note - 1)		Inst	CP/CC & Cathodic Protection	UPS / Solar	Fire	LEL	Total DI (Note - 1)	Inst	CP/CC & Cathodic Protection	UPS / Solar	Fire	LEL	Total DO (Note - 1)	Inst	CP/CC & Cathodic Protection	UPS / Solar	Fire	LEL	Total RS (Note - 1)
1	RTU-DT1	DISPATCH TERMINAL BAGHJAN	Existing	20	6	8	4	3	41	1	30	8	8	4	3	53	8	0	0	0	0	8	5	1	2	1	1	10
2	RTU-SV 1	Makum HNE SV Station	RTU -Type-1	7	6	8	4	3	28	0	16	8	8	4	3	39	6	0	0	0	0	6	0	1	2	1	1	5
3	RTU -RT	RECEIVING TERMINAT AT MADHUBAN	Existing	20	6	8	4	3	41	1	30	8	8	4	3	53	8	0	0	0	0	8	5	1	2	1	1	10

NOTES:

- In Addition to the above Quantities 25% Spare I/Os shall be considered while sizing of RTU for each Station.
- 2 The I/Os for Inst are tentative & are as per P&ID. Finalization of I/O counts is in Bidder's Scope based on the P&ID and tender specification
- 3 The I/Os are tentative I/Os typically considered for Electrical, Solar, Fire & Safety, UPS & Cathodic Protection System (CP).
- 4 Serial Port includes for Electrical (Solar, UPS), Fire & Safety and Cathodic Protection (CP) are tentative and will be finalised.



OIL INDIA LIMITED

TECHNICAL SPECIFICATION LEAK DETECTION SYSTEM FOR GAS PIPELINES

TS NO: MEC/05/E5/T/TS/S-94 A

PREPARED & ISSUED BY



(INSTRUMENTATION& CONTROL SECTION) MECON LIMITED

(A Govt. of India Undertaking)

Delhi, India

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MECON LIMITED DELHI	INSTRUMENTATION & PROCESS CONTROL SECTION Delhi	NATURAL GAS PIPELINES PROJECT	<u> </u>
TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)		MEC/05/E5/T/TS/S-94 A, Rev-0	Page 2 of 30

Table of Contents

- 1. INTRODUCTION
- 2. SCOPE OF WORK
- 3. DESIGN & ENGINEERING OF 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

0	20.10.2018	Prepared By	Checked By	Approved By
Rev	Date	Namita Beniwal	Ratnadeep Gupta	Pankaj Shrivastava

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 3 of 30

1. INTRODUCTION

Oil India Limited, a Government of India Enterprise is proposing to lay a 40 kms. (approx.) long Natural Gas pipeline starting from Baghjan to Madhuban, Duliajan. The proposed Baghjan to Duliajan gas Pipeline is in addition to the existing 400 mm NB (16"NB) gas pipeline. The new gas pipeline is proposed as the existing 400 MM NB (16"NB) pipeline is running on almost full capacity (i.e. 1.5 MMSCMD) and the projected gas production from the Baghjan area will reach a plateau limit of 4.5 MMSCMD by 2019-2030 with peak production at 5.134 MMSCMD of natural gas. Therefore the proposed capacity of the new pipeline is 3.634 MMSCMD. However as decided by M/s OIL capacity for the new pipeline to be considered as 5.0 MMSCMD. The new pipeline shall be laid in the OIL's existing ROW as far as possible. The ROW is 18 Meter wide and already 2 (two) nos. of pipelines viz. one 400 mm NB (16"NB) gas pipeline and one 200 mm NB (8"NB) crude oil pipeline are already laid in the ROW and are in operation. One more 400 mm NB (16"NB) gas pipeline is being laid from Loc. HNE, Makum (Chainage 21.0 kms, approx. from Baghjan) to Madhuban (Chainage 38.70 kms, approx. from Baghjan) in the existing ROW. Further available ROW width for laying of the proposed 40 kms. (approx.) long Natural Gas pipeline is 9.0 Meter (approx.).

M/s Oil India Limited has awarded MECON Limited Engineering Procurement Construction Management consultancy (EPCM) services for laying 30"NB x 40.0 Kms. (Approx.) Mainline from GGS Baghjan to CGGS Madhuban, Duliajan for transportation and distribution of Natural Gas.

Given the goals established for the scope of the pipeline automation project of OIL, each bidder should include in the scope of supply of its proposal a Leak Detection System, based on Real-Time Transient Hydraulic / Statistic Modeling Technology, in accordance with the specifications written in this document.

OIL is interested in purchasing a mature field-proven commercial software application, successfully installed in several pipelines with similar conditions to the one owned and operated by OIL; 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 (Leak Detection) interfaced with Supervisory Control and Data Acquisition (SCADA) System of OIL (supplied by M/s ABB) for Natural Gas Pipeline from GGS Baghjan to CGGS Madhuban, Duliajan in the state of Assam.
- 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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 4 of 30

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 for leak detection 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 client's SCADA of the complete APPS system, commissioning and site acceptance of the complete system.
- b) Furnishing & Vetting of FDS, all Design & Engineering Documents
- c) Provide 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 offered 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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 5 of 30

The SCADA System & Software (supplied & maintained by ABB) provided by ABB & reside on the separate Machine. SCADA vendor interfaced with SCADA Server through OPC. Smooth interfacing with SCADA with APPS server will be in bidder's scope.

2. SCOPE OF WORK:

The technical requirements for Pipeline application software (Leak Detection System and supplementary modules) in conjunction with Supervisory Control and Data Acquisition (SCADA) System for monitoring and control of leak detection facilities.

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 at Master Control Stations 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**

	MECON LIMITED DELHI	INSTRUMENTATION & PROCESS CONTROL SECTION Delhi	NATURAL GAS PIPELINES PROJECT	मेवमेन
TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)			MEC/05/E5/T/TS/S-94 A, Rev-0	Page 6 of 30

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

	MECON LIMITED DELHI	INSTRUMENTATION & PROCESS CONTROL SECTION Delhi	NATURAL GAS PIPELINES PROJECT	मेवर्गन
TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)			MEC/05/E5/T/TS/S-94 A, Rev-0	Page 7 of 30

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 / equipments including 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 underconstruction 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 Control Station (MCS) / Backup Control Station (BCS) as required (where existing SCADA system Server installed).
- Redundant APPS server setup will be provided at MCS for Leak Detection System (LDS), Real Time Modeling (RTM)/ Real Time Statistical Analysis (RTSA), OPC, Predictive Module (PM).

The server Primary and Secondary servers at MCS shall be hot standby i.e. synchronized with each other in real-time.

• APPS Trainer system (including Pipeline Simulator) in dual cold standby configuration, along

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 8 of 30

with APPS Training HMIs shall be provided at MCS. The APPS trainer shall mimic Despatch Terminals (DT), Receiving Terminals (RT), Sectionalizing Valve stations (SV) along with Set point controllers.

- Engineering Work Station (EWS) and APPS user HMIs shall be provided at MCS. These EWS and APPS HMIs shall be used only for APPS system.
- The APPS system shall be connected to Client SCADA network at MCS to facilitate communications as per following:
 - a) Between SCADA system and APPS system through OPC for data exchange
 - b) Between APPS set ups at MCS through SCADA network
 - c) Between SCADA HMIs (being used as APPS HMIs) and APPS system

PROJECT REQUIREMENT:

A APPS system - Leak Detection Server is part of the SCADA system and the SCADA system must provide data interface to APPS system at computer level.

APPS system; during normal operations, all daily Pipeline Operator interactions with the application software shall be performed via the SCADA system man-machine interface (HMI) and Operator workstations. Additionally, any reconfiguration of system parameters shall be performed by a system engineer via the SCADA HMI. The model shall receive specific quantified data from the SCADA database in a continuous stream. The entire measurement system shall be scanned at a rate specified by the SCADA Vendor for optimum model performance, this specified rate, is to be determined during the leak sensitivity study. The results of all calculations shall be transferred back to the SCADA system databases.

Leak Detection HMI Requirements: The vendor shall configure the following features in the HMI:

- A. Leak Detection Screen: a "pop-up" window in the HMI showing the Leak detection state-of health, alarms, and advisory messages.
- B. Leak detection alarms shall be incorporated into the overall SCADA alarm system.
- C. Leak detection messages shall be displayed prominently on the HMI and shall be accorded the highest priority

Control Logic to Support Leak detection System

SCADA logic shall set an alarm if it detects the Leak detection software has stopped, by means of the state-of-health signal from the Leak detection software.

Leak detection alarm messages shall be incorporated into the overall SCADA alarm system.

Data Exchange: Between SCADA and Leak detection

A Leak detection computer is part of the SCADA system and the SCADA system must provide data interface with this computer

MECON LIMITED DELHI INSTRUMENTATION & PROCESS CONTROL SECTION Delhi NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION
APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 9 of 30

Data Exchange: SCADA to Leak detection

- a) The following data shall be passed from the SCADA system to the Leak detection. Update frequency shall be nominally five seconds maximum:
- b) All measured flows, pressures, densities, and levels.
- c) All control valve statuses: open, closed, or in travel.
- d) All control valve statuses: percent open.
- e) All pump states: running or stopped.
- f) Status of key control loops: PID loops for flow, level, density, etc. values for mode (auto/manual), process variable, set point and output will be passed.
- g) Alarm limits for key process variables, such as flows, levels, densities, and pressures.
- h) Other important discrete status values, such as rupture disk status.
- i) Motor run times.
- j) Valve stroke counts.
- k) The quality of each value (e.g., a failed instrument will have a "bad" quality) shall also be transmitted.
- 1) 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

Data Exchange: Leak detection to SCADA

The following data shall be passed from the Leak Detection to SCADA. This data will be passed on an exception basis (i.e. when the value changes), except for the "health" word, which shall change periodically.

A. Leak Detection state-of-health: a value of 0-59, sent by the Leak Detection periodically. If the Leak Detection is functioning normally this number will change periodically. If the value does not change within a specified time, the SCADA shall set an alarm, indicated that either the Leak Detection or the communications link has failed.

B. Leak Detection alarms.

C. Leak Detection advisory messages.

The SCADA Vendor shall create his own mimic displays as required by Owner. The APPS shall display all inputs and outputs using SCADA HMI displays. These displays shall be developed during the detailed functional definition stage.

Displays shall be required for the following types of information:

- Calculated flow, temperature, pressure, density and head profiles for the complete pipeline, together with pipeline profile and user-definable trending displays.
- Combination displays for e.g. calculated parameters (as a line plot), combined with bar plots of measured parameters (such as pressure);
- alarm displays (segregated from other SCADA system alarms where possible);
- system summaries/reports;
- batch/ pig tracking displays

MECON LIMITED DELHI

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 10 of 30

- batch scheduling displays
- help mimics;
- Leak location displays.

The results from the APPS shall be made available through a standard Applications Programming Interface to facilitate easy selection of data to be transferred to the SCADA system.

3.3 SPECIFICATIONS FOR REAL TIME MODEL/ REAL TIME STATISTICAL ANALYSIS

3.3.1 General

- a) Due to the compressible nature of gas, 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, Gas Composition, 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 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 us e field data from a SCADA system or RTU's directly can be used for statistical analysis. Apply

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 11 of 30

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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 12 of 30

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 Leak Detection 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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 13 of 30

- 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

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 14 of 30

- 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 fluid composition as they move through the pipelines.
- b) Each operational pipeline should be represented via a graphical display showing the location of all relevant gas composition. 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 composition 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

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 15 of 30

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. Userconfigured 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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 16 of 30

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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 17 of 30

- 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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 18 of 30

- 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.

MECON LIMITED PROCESS		INSTRUMENTATION & PROCESS CONTROL SECTION Delhi	NATURAL GAS PIPELINES PROJECT	Harier Bo BOOT CONTROL
	TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)		MEC/05/E5/T/TS/S-94 A, Rev-0	Page 19 of 30

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 MCS:

The setup at MCS shall comprise of following equipments located in SCADA/APPS Server Room of client:

- a) Real Time Modeling (RTM) -cum- Leak Detection System (LDS) -cum- OPC servers
- b) Predictive Module (PM) -cum- Compressor / Pump Station Optimizer (CPSO) servers
- c) APPS Trainer Servers
- d) LAN switches
- e) 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

MECON LIMITED
DELHI

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 20 of 30

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 MCS shall operate satisfactorily in air-conditioned environment under temperature of 15 35°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 MCS. 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 MCS 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

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 21 of 30

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

- o Transportation, loading, unloading of equipment and all other components from locations of manufacturing/supply to the locations of installation
- o Storage during transit, transit insurance & storage/ warehousing as required.
- o 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 : "OIL (INDIA) LIMITED"

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 MCS 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 MCS locations as per the approved FDS
- Laying & routing of cables through conduits, glanding, termination of cables, dressing and

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 22 of 30

ferruling for all the cables as Scope of Work of the tender document.

- Providing earthing to APPS equipments at MCS 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 MCS.
- o UPS power at MCS 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 client's ABB SCADA system through OPC as per Scope of Work of the tender document. The Centralized SCADA vendor (M/s ABB) shall cooperate for providing the required details as part of existing Centralized SCADA system contract.

Oil India already has a SCADA system, which is used to monitor and control different on line parameters like Oil collecting stations (OCS), Gas compressor stations (GGS), FGGS, OTP and electrical substations. The total area has been distributed to Greater Naharkatiya, Greater Moran area, Greater Jorajan Area, Greater Tengakhat area & Eastern Producing area; all theses stations are collocated within the radial distance of approximately 50 Km from MCS at Duliajan, except 2-3 installations which are at a radial distance 80 km approximately. Facility to interface to existing SAP for corporate level is also provided in the MCS. The SCADA system consists of two levels of SCADA Servers consolidating information from the Field level, to Asset head quarters or Corporate Headquarters.

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

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 23 of 30

the level 1 information and is able to review and report production from all sites. Full graphical and data details available at Level 1 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:

- o **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
- o **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.

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 24 of 30

- 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.
- 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.

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INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 25 of 30

- **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.
- 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

MECON LIMITED
DELHI

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 26 of 30

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 TEST RUN

- This test aims at keeping the complete integrated system operational for a period of 7 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 7 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

MECON LIMITED DELHI	INSTRUMENTATION & PROCESS CONTROL SECTION Delhi	NATURAL GAS PIPELINES PROJECT	Halier No scott confess
TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)		MEC/05/E5/T/TS/S-94 A, Rev-0	Page 27 of 30

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

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROIECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 28 of 30

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 MCS.

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

MECON LIMITED
DELHI

INSTRUMENTATION & PROCESS CONTROL SECTION Delhi

NATURAL GAS PIPELINES PROJECT



TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)

MEC/05/E5/T/TS/S-94 A, Rev-0

Page 29 of 30

- 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

APPS Vendor shall be responsible for meeting the functionality and performance requirements of all hardware, software and accessories supplied by the APPS Vendor including all services, spares for a period of 24 months after successful test run.

APPS Vendor shall supply all required software upgrades / patches /new versions on its release during warranty period. During warranty period, the replacement/ maintenance requirement of the total system shall be attended as per contract.

The warranty of the system shall not be affected, due to any modifications/ up gradation or replacement of any hardware & software by APPS Vendor, during warranty period.

The APPS Vendor shall also provide a letter from the hardware OEM for back to back support for the spares / support of the hardware being supplied mentioning the EOL (end of life) as well as EOSL (End of Service life) for each of the hardware equipments supplied.

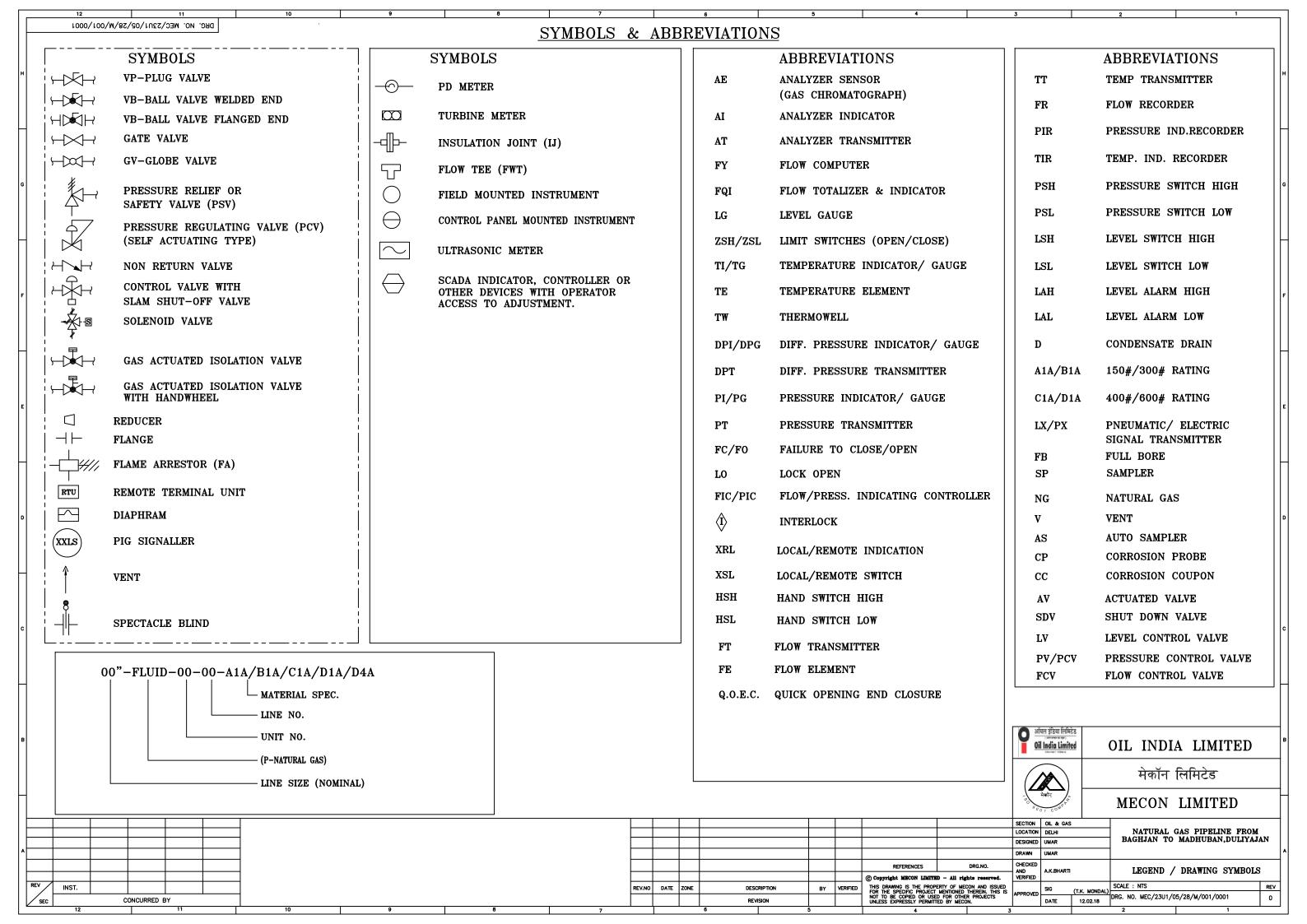
12.0 ANNUAL MAINTENANCE CONTRACT (AMC)

APPS Vendor shall provide AMC (after warranty) as per contract for another 3 years comprehensive for hardware, software and accessories supplied by the APPS Vendor.

- **12.1** APPS system (hardware & software) is to be maintained during the AMC period after completion of defect liability period.
- 12.2 Vendor to provide APPS patch/performance updates time to time during the entire AMC period. Any reconfiguration/ fine tuning required after installation of patches/ performance updates shall be part of AMC.
- **12.3** Any OS upgrade if required in supplied Hardware required to support the patches / Performance updates of APPS shall be part of AMC.
- Any changes to be done in APPS due to change in the existing pipeline including addition/ deletion of delivery/ pumping station, instrument, equipment, delivery point/ tapoff are part of AMC.

MECON LIMITED DELHI	INSTRUMENTATION & PROCESS CONTROL SECTION Delhi	NATURAL GAS PIPELINES PROJECT	मेवर्गन
TECHNICAL SPECIFCATION APPS SYSTEM (GAS PIPELINES)		MEC/05/E5/T/TS/S-94 A, Rev-0	Page 30 of 30

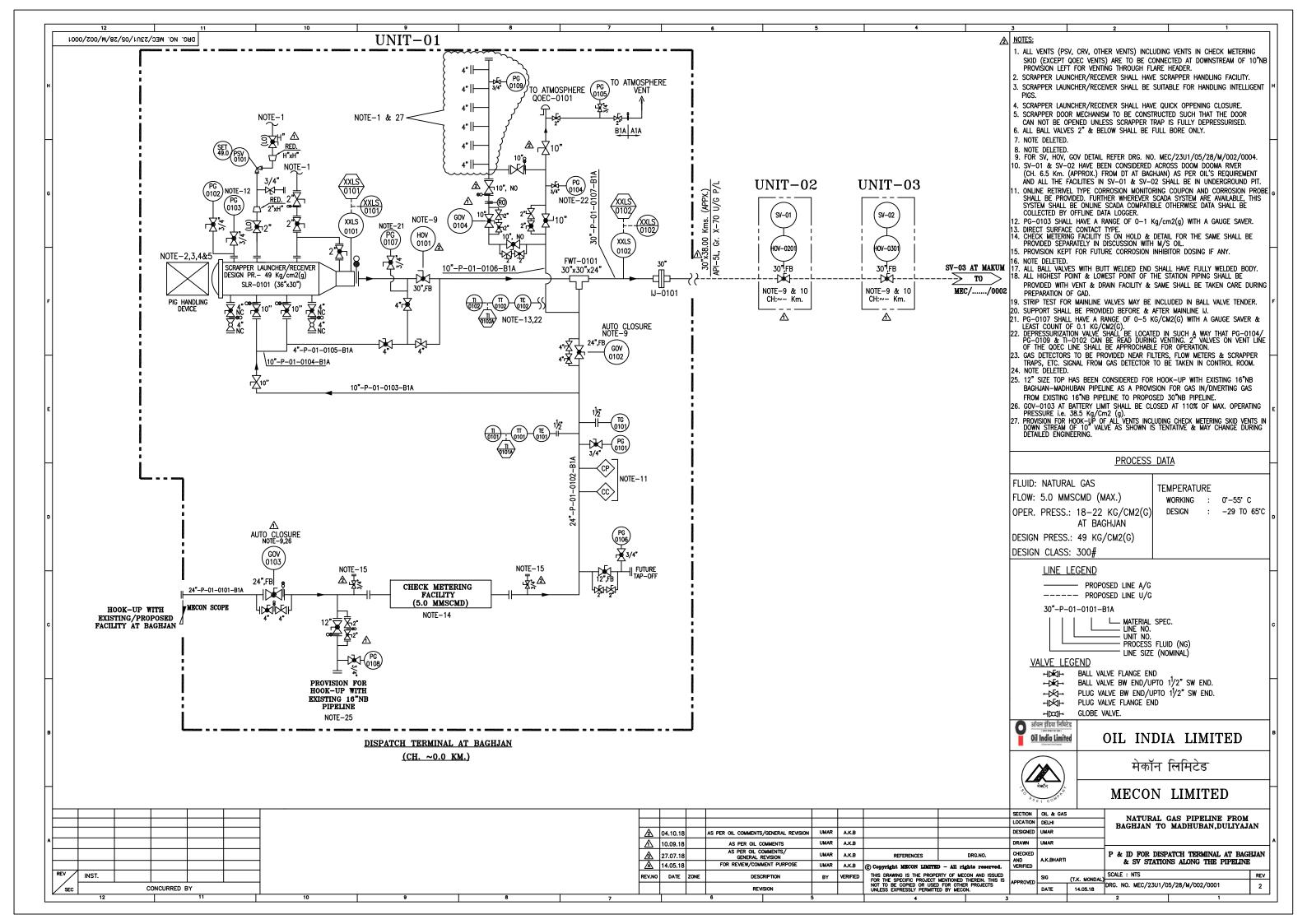
- 12.5 As a part of AMC APPS vendor (OEM person) shall make quarterly preventive visits and min 2 breakdown/call visits in a year.
- 12.6 During the quarterly visits the APPS vendor shall check data validation and do fine-tuning of the system in coordination with Client personnel.
- APPS vendor shall also assist client personnel during mandatory annual testing of leak detection by simulating a leak in mainline and / or station/MOV 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.

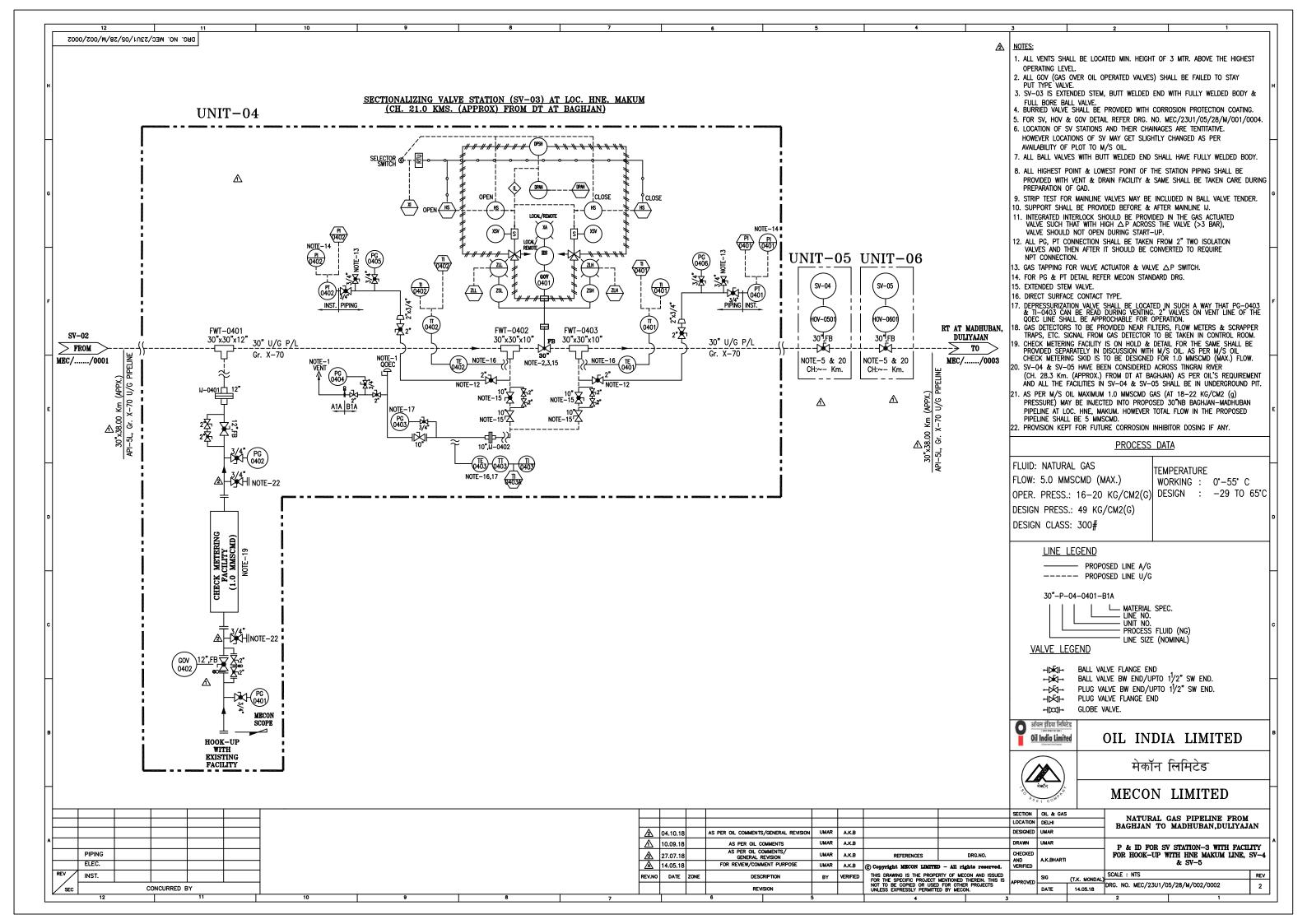


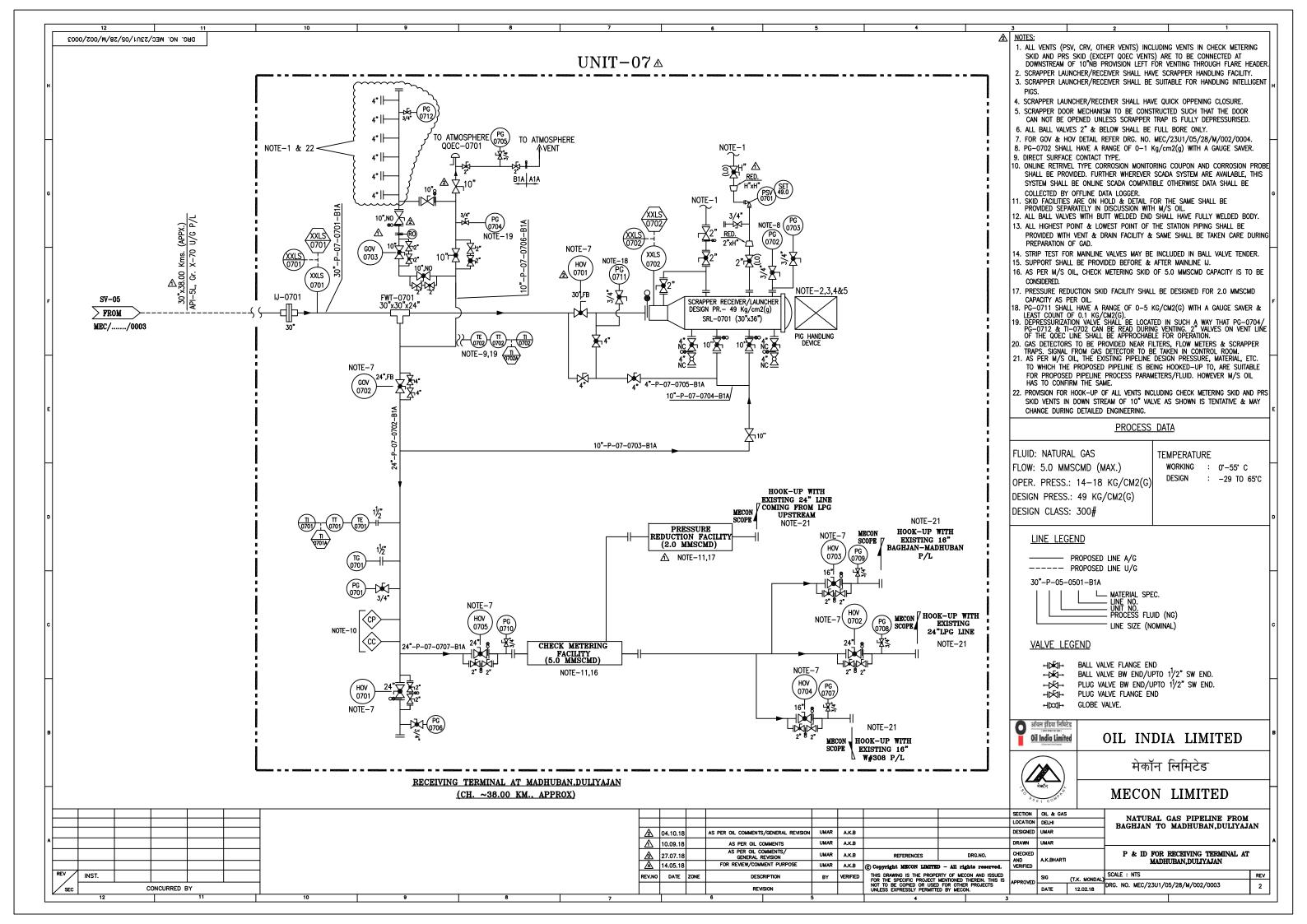
SYMBOLS ABBREVIATIONS SYMBOLS SYMBOLS \bowtie SHUT-OFF VALVE, GENERAL SPRING-OPERATED ACTUATOR FILTER. GENERAL EMERGRNCY SHUT-DOWN **ESD** AUTOMATICALLY OPERATED ACTUATOR, GAS FILTER, GENERAL SAFETY SHUT-OFF VALVE \bowtie EW DRAIN **GENERAL** \bowtie CONTINIUOUS-ACTION VALVE FAIL-BLOCKED ELECTRIC MOTOR-OPERATED ACTUATOR, FB CARTRIDGE FILTER \triangleright **GENERAL** RIGHT-ANGLE SHUT-OFF VALVE, GENERAL GAS-OPERATED CONTROL VALVE GCV VALVE CLOSED ON FAILURE OF ACTUATING GAS SORPTION FILTER THREE-WAY VALVE, GENERAL GAS-OVER OIL OPERATED VALVE GOV LIQUID FILTER, GENERAL VALVE OPENED ON FAILURE OF ACTUATING FOUR-WAY VALVE, GENERAL **ENERGY** HYDRAULIC-OPERATED VALVE HOV "Y" TYPE STRAINER K VALVE RETAINS POSITION ON FAILURE OF LC LOCKED CLOSED \bowtie NEEDLE VALVE PRESSURE REDUCING VALVE, \bowtie **ACTUATING ENERGY** IN AUXILIARY AND CONTRAL FACILITIES LOCKED OPEN LO \bowtie PUSHBUTTON VALVE TURBINE, GENERAL LP LOCKED POSITION PRESSURE CONTROL VALVE, GENERAL CHECK VALVE (SPRING TYPE) \bowtie LPT LOW POINT 0 COMPRESSOR, GENERAL NON RETURN VALVE (SWING TYPE) PROCESS PRIMARY LINE ROTARY PISTON COMPRESSOR MCV MOTOR CONTRAL VALVE PROCESS SECONDARY LINE Se. BUTTERFLY VALVE **(** PISTON COMPRESSOR MANHOLE MH +++ELECTRIC LINE 0 JET BOOSTER CONTINUOUSLY VARIABLE BORE MOTOR-OPERATED VALVE MOV \odot PNEUMATIC LINE """ **BUTTERFLY VALVE** FAN, GENERAL CAPILLARY LINE HEAT EXCHANGER WITHOUT COUNTERFLOW 100 LOUVRE SOLENOID VALVE SV (1) COUNTERFLOW HEAT EXCHANGER INSTRUMENT LINE SEPERATOR GENERAL PCV PRESSURE CONTROL VALVE Ж PLATE HEAT EXCHANGER HEAT TRACING LINE SAV SAFETY SHUT-OFF VALVE 2 STAGE SEPERATOR -///-/--JACKETED LINE FINNED HEAT EXCHANGER WITH VENTILATOR 11111 0 SBV CYCLONE SEPERATOR PRESSURE RELIFE VALVE -//-//- JACKETED & HEATED LINE PRV φ BLIND PLATE Λ CONDENSATE TRAP VENT STACK SP SETPOINT "FIGURE 8" PLATE, BLIND PLATE IN SCRAPPER TRAP **FUNCTION** THERMOCOUPLE FLOWMETER GENERAL TE "FIGURE 8" PLATE, GOGGLE PLATE IN Œ LIQUID PUMP GENERAL THERMOWELL . TW METER GENERAL **FUNCTION** Θ CENTRIFUGAL PUMP $\widehat{\Pi}$ NON-RETURN VALVE TURBINE METER INSULATING FLANGE NRV ** LIQUID RING PUMP CV CHECK VALVE ₽• П INSULATING COUPLING VORTEX-SHEDDING FLOWMETER **(** PISTON PUMP FLOW CONTROL VALVE FCV STRAIGHTENING VANES DIAPHRAGM METER 0 DIAPHRAGM PUMP \triangleright RUPTURE DISK POWER GAS SUPPLY PGS MANUALLY OPERATED ACTUATOR, GENERAL \circ (CP) SIGHT GLASS. GENRAL CORROSION PROBE INTRUMENT AIR SUPPLY IAS 4 900 DIAPHRAGM ACTUATOR **EXPANSION JOINT** CORROSION COUPON NC NORMAL CLOSED PISTON ACTUATOR Ľ. SILENCER NORMAL OPEN NO PULSATION DAMPENER ELECTROMAGNETIC ACTUATOR RESTRICT ORIFICE RO MIXING NOZZLE HYDRAULIC OR PNEUMATIC ACTUATOR, D CAP **GENERAL** FLANGE CONNECTION ऑयल इंडिया लिमिटेड OIL INDIA LIMITED Oil India Limited मेकॉन लिमिटेड MECON LIMITED SECTION OIL & GAS NATURAL GAS PIPELINE FROM BAGHJAN TO MADHUBAN, DULIYAJAN UMAR LEGEND / DRAWING SYMBOLS SCALE : NTS REV INST. REV.NO DATE ZONE DESCRIPTION BY VERIFIED (T.K. MONDAL) DRG. NO. MEC/23U1/05/28/M/001/0002 0 CONCURRED BY REVISION DATE 12.02.18

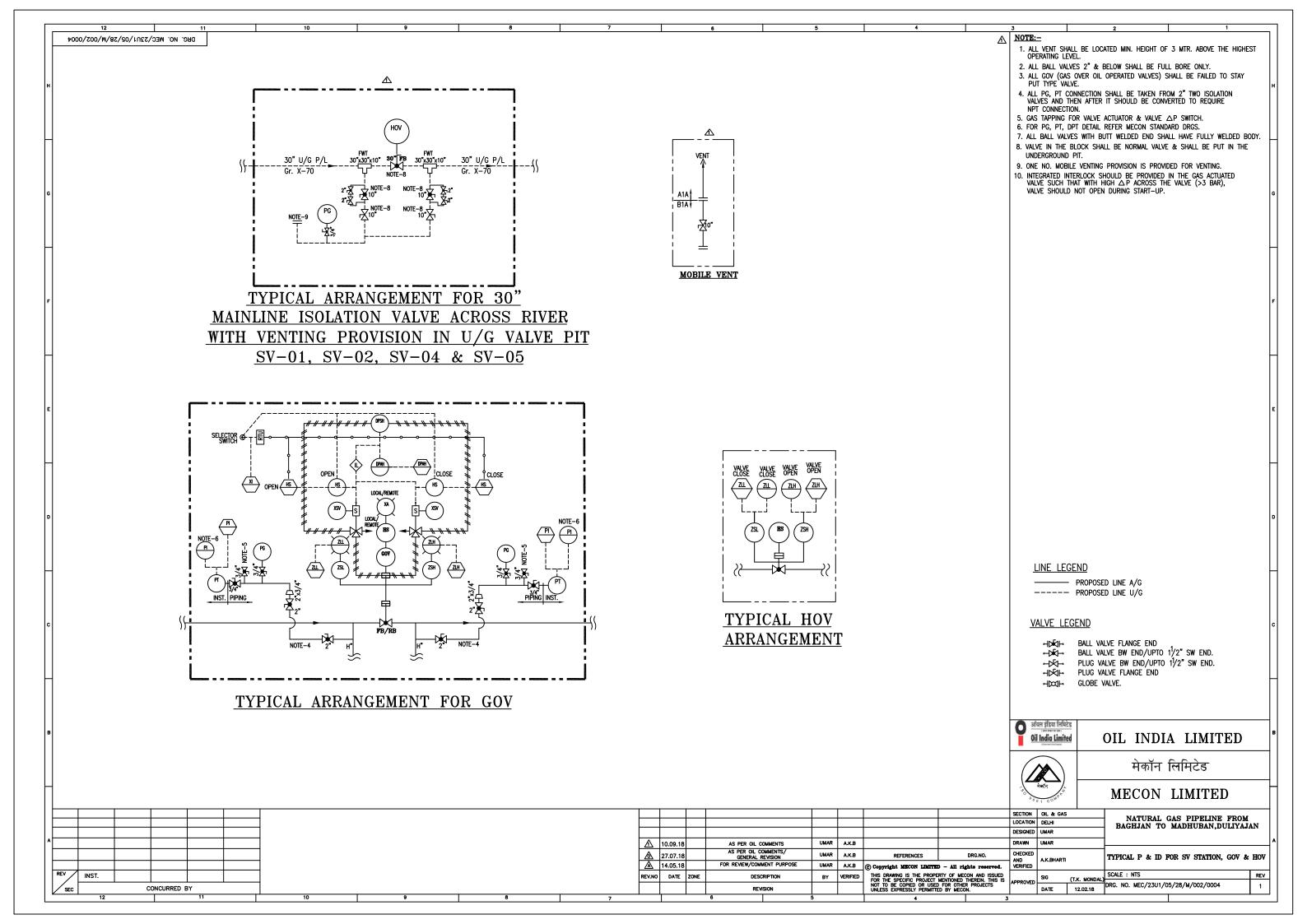
SYMBOLS & ABBREVIATIONS

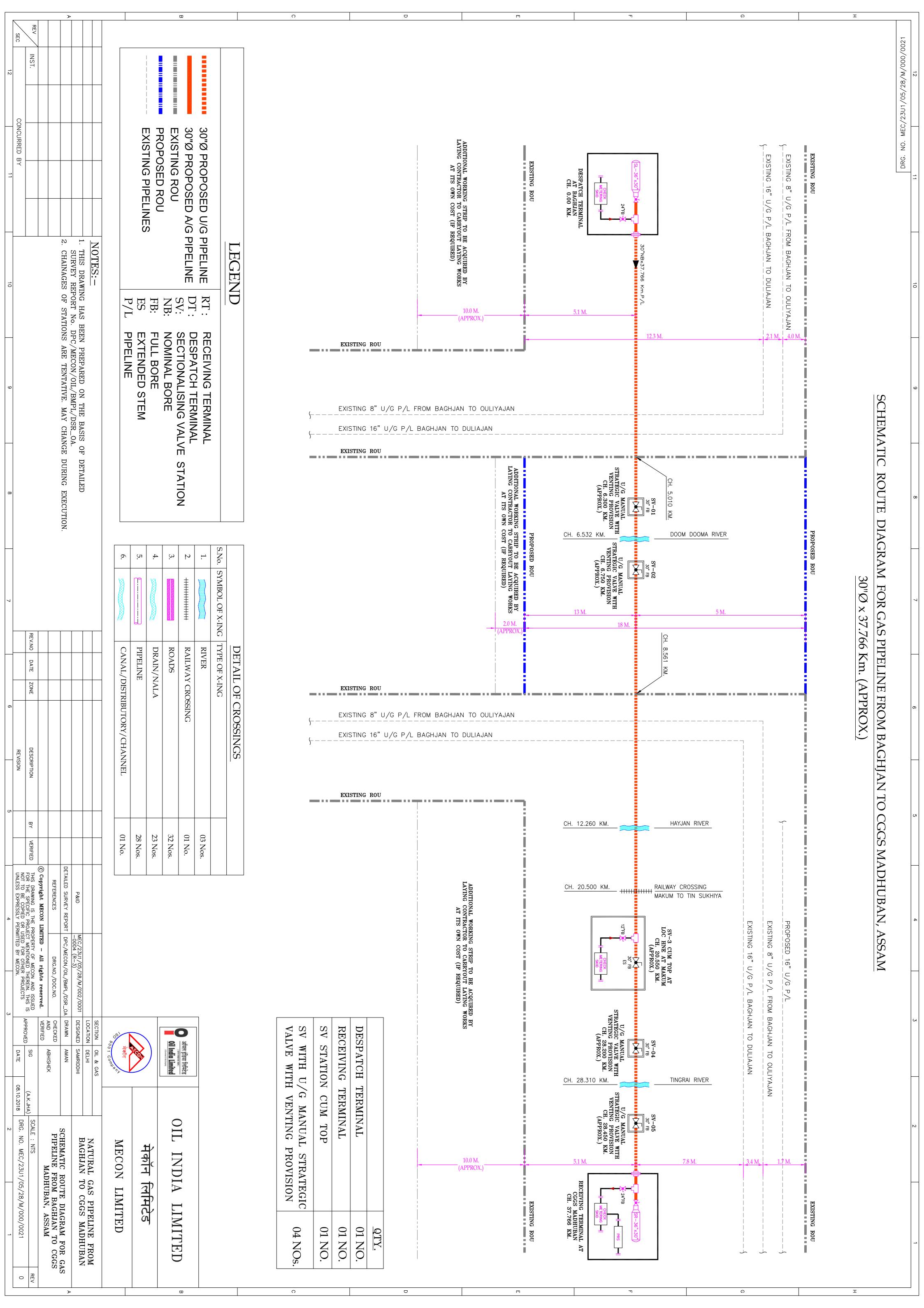
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OIL INDIA LIMITED

PROCESS ENGINEERING DESIGN BASIS (Revised)

GAS PIPELINE FROM GGS/EPS BAGHJAN TO CGGS MADHUBAN, DULIAJAN



(PROCESS ENGG. GROUP - OIL & GAS SECTION)
MECON LIMITED DELHI

Sep, 2018

Document No.	Revision No.	Date
MEC/23U1/05/28/M/PEDB/001	0	14.09.2018

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Oil & Gas Section Delhi

GAS PIPELINE FROM GGS/EPS BAGHJAN TO CGGS MADHUBAN



Process Engineering Design Basis

MEC/23U1/05/28/M/PEDB/001, Rev-0

Page 1 of 12

		CONTENTS		
SI. No.	Description		Page No.	
1.0	INTRODCUTION		2	
1.1	Purpose of this do	cument	2	
1.2	Pipeline Route Ove	erview	2	
2.0	PROCESS DESIG	N BASIS	5	
2.1	Project scope		5	
2.2	Details of scope of	work	5	
2.3	Station battery limit	t conditions	6	
2.4	Pipeline Paramete	Pipeline Parameters for Proposed Pipeline		
2.5	Materials	Materials		
2.6	Pipeline external c	Pipeline external corrosion protection & monitoring		
2.7	Characteristics of I	Characteristics of Natural Gas		
2.8	Sectionalizing Valv	e stations	9	
2.9	Dispatch Terminal		10	
2.10	Receiving Termina	ıl	11	
2.11	Facility at Sectiona	lizing valve stations	12	
3.0	LIST OF ASSUMP	LIST OF ASSUMPTIONS		
4.0	ANNEXURES			
4.1	Annexure-I	List of standards		
4.2	Annexure-II	Process flow diagram		
4.3	Annexure-III	Hydraulic simulation		
4.4	Annexure-IV	Line pipe thickness calculation		

Rev. No.	Date	Prepared By	Checked By	Approved By
0	14.09.2018	(Umar Khan)	(Anil Bharti)	(A.K.Jha)

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MECON LIMITED DELHI	Oil & Gas Section	GAS PIPELINE FROM GGS/EPS	Habir
	Delhi	BAGHJAN TO CGGS MADHUBAN	Wall common
Process Engineering Design Basis		MEC/23U1/05/28/M/PEDB/001, Rev-0	Page 2 of 12

1. INTRODUCTION-

Oil India Limited, a government of India enterprise is proposing to lay a 37.76 kms. (approx.) long Natural Gas pipeline starting from Baghjan to Madhuban, Duliajan. The proposed Baghian to Duliajan gas Pipeline is in addition to the existing 400 mm NB (16"NB) gas pipeline. The new gas pipeline is proposed as the existing 400 MM NB (16"NB) pipeline is running on almost full capacity (i.e. 1.5 MMSCMD) and the projected gas production from the Baghjan area will reach a plateau limit of 4.5 MMSCMD by 2019-2030 with peak production at 5.134 MMSCMD of natural gas. Therefore the proposed capacity of the new pipeline is 3.634 MMSCMD. However as decided by M/s OIL capacity for the new pipeline to be considered as 5.0 MMSCMD (max.). The new pipeline shall be laid in the OIL's existing ROW as far as possible. The ROW is 18 Meter wide and already 2 (two) nos. of pipelines viz. one 400 mm NB (16"NB) gas pipeline and one 200 mm NB (8"NB) crude oil pipeline are already laid in the ROW and are in operation. One more 400 mm NB (16"NB) gas pipeline is being laid from Loc. HNE, Makum (Chainage 21.0 kms, approx. from Baghjan) to Madhuban (Chainage 37.76 kms, approx. from Baghjan) in the existing ROW. Further available ROW width for laying of the proposed 37.76 kms. (approx.) long Natural Gas pipeline is 9.0 Meter (approx.).

M/s Oil India Limited has awarded MECON Limited Engineering Procurement Construction Management consultancy (EPCM) services for laying 30"NB x 37.76 Kms. (Approx.) Mainline from GGS Baghjan to CGGS Madhuban, Duliajan for transportation and distribution of Natural Gas.

1.1 Purpose of this Document-

This document provides key process and facility design basis for GGS/EPS Baghjan to CGGS Madhuban Pipeline project.

1.2 Pipeline Route Overview-

Below figure depicts an overview map of the route selected for GGS/EPS Baghjan to CGGS Madhuban Pipeline. Also existing 18 meter ROW & all existing/proposed pipelines of OIL have been shown in the sketch as provided by M/s OIL.

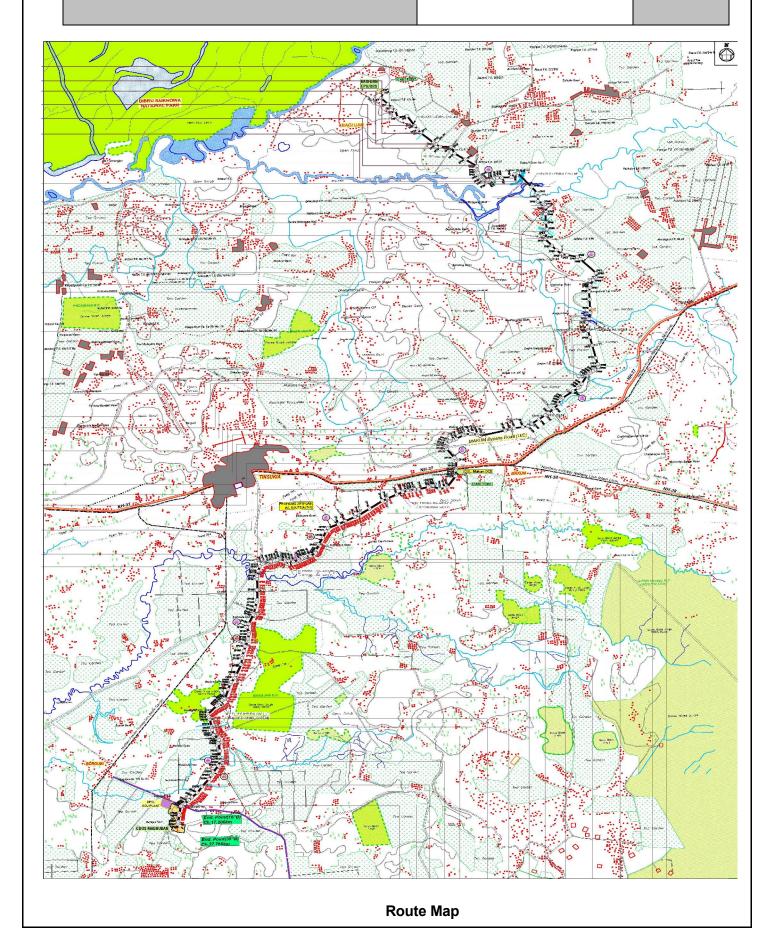
Oil & Gas Section Delhi GAS PIPELINE FROM GGS/EPS BAGHJAN TO CGGS MADHUBAN



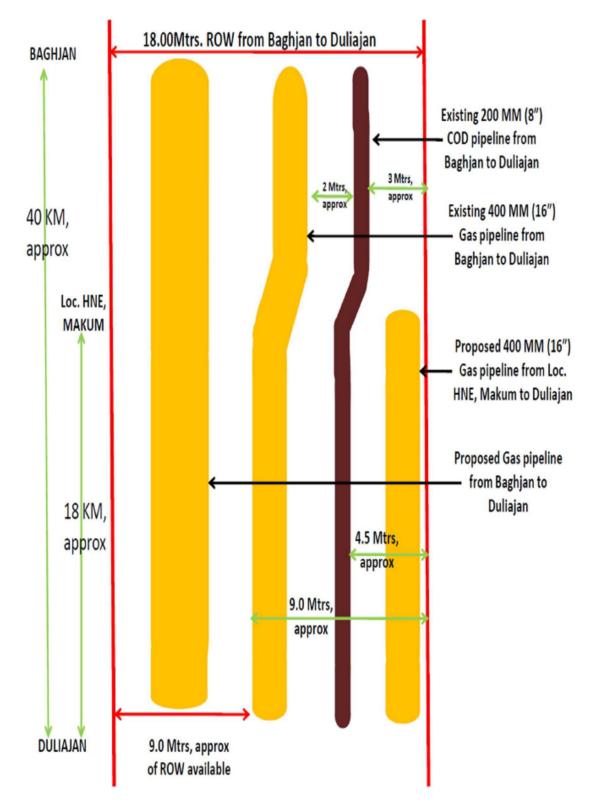
Process Engineering Design Basis

MEC/23U1/05/28/M/PEDB/001, Rev-0

Page 3 of 12



MECON LIMITED DELHI	Oil & Gas Section	GAS PIPELINE FROM GGS/EPS	Parket
	Delhi	BAGHJAN TO CGGS MADHUBAN	Bases comme
Process Engineering Design Basis		MEC/23U1/05/28/M/PEDB/001, Rev-0	Page 4 of 12



Existing & Proposed Pipelines in the 18 Meter ROW

MECON LIMITED DELHI	Oil & Gas Section	GAS PIPELINE FROM GGS/EPS	Hatir
	Delhi	BAGHJAN TO CGGS MADHUBAN	Bases comm
Process Engineering Design Basis		MEC/23U1/05/28/M/PEDB/001, Rev-0	Page 5 of 12

2.0 PROCESS DESIGN BASIS-

2.1 Project Scope-

- 1) Laying of 30"NB x 37.76 kms. (approx.) Mainline from GGS/EPS Baghjan to CGGS Madhuban at Duliajan
- 2) Dispatch Terminal/Receiving Terminal facilities
- 3) En route Sectionalizing Valve/ Mainline valve
- 4) Instrumentation
- 5) Modification in existing RTU & hook-up in existing HMI/SCADA through existing RTU (For D/T & R/T) and new RTU & hook-up in existing HMI/SCADA (For SV at Loc. HNE,Makum) of OIL
- 6) Radio based telecommunication system & hook-up with existing system (At Makum)
- 7) Electrical
- 8) Fire protection system
- 9) Gas Detection System
- 10) Civil, Structure & Architecture
- 11) TCP (Temporary Cathodic protection) & impressed current type permanent Cathodic Protection System (PCP)
- 12) Corrosion Monitoring System
- Optical Fiber Cable Laying, Jointing & termination. Optical Fiber Cable 24 Fiber as per ITU T G652 (18 fiber) & as per ITU T G 655 (6 fiber) shall be laid by Blowing Technique in ϕ 40 mm PLB HDPE Telecom duct to be laid along the pipeline in same pipeline trench. At crossing additional duct will be provided for future use.

2.2 Details of SCOPE of work-

Laying of 30"NB x 37.76 kms. (approx) Mainline from GGS/EPS Baghjan to CGGS Madhuban at Duliajan-

- Dispatch facility (along with check metering & other necessary facility) at GGS/EPS Baghjan (Ch. 0.0 Kms. from GGS/EPS Baghjan).
- SV (Sectionalizing Valve)/ Mainline valve along the pipeline.
- Future tap-off at D/T at Baghjan and R/Tat Madhuban.

MECON LIMITED DELHI	Oil & Gas Section	GAS PIPELINE FROM GGS/EPS	Haller
	Delhi	BAGHJAN TO CGGS MADHUBAN	West comm
Process Engineering Design Basis		MEC/23U1/05/28/M/PEDB/001, Rev-0	Page 6 of 12

- A separate 12" TOP with necessary check metering facility at proposed SV-03 at Loc. HNE,Makum (Ch. 21.0 kms. from Baghjan) for injection of natural gas from the nearby gas grids at Loc. HNE, Makum into proposed 30"NB Baghjan-Madhuban pipeline.
- Receiving facility (along with check metering & dedicated PRS for existing 24"NB P/L coming from LPG upstream & other necessary facility) at CGGS Madhuban at Duliajan (Ch. 37.76 Kms. from GGS/EPS Baghjan).

2.3 Station battery limit conditions-

Gas Pressure at Inlet (Min./Nor./Max.) : 18/22/35 Kg/cm²(g) at GGS/EPS Baghjan

& Loc. HNE, Makum

Gas Temperature at Inlet (Min./Max.) : 10 – 40 deg. C

Aboveground Temperature (Min.) : 0°C Aboveground Temperature (Max.) : 55°C

2.4 Pipeline parameters for proposed pipeline-

2.4.1 30"NB x 37.76 kms. (approx) Mainline from Dispatch terminal at GGS/EPS Baghjan to Receiving terminal at CGGS Madhuban at Duliajan-

Length of Pipeline : <u>~</u>37.76 kms.

Flow Rate, (Max.) : <u>~</u>5.0 MMSCMD

Operating Pressure (Min./Nor.) : <u>~</u>14 - 22 Kg/Cm²(g)

Operating temperature : 0 - 55 °C Pipeline Diameter : 30" NB

Required Pipeline Thickness : 10.31 mm (Class-I), 11.91 mm (Class-II), 12.70

mm (Class-III) & 15.88 mm (Class-IV)

Material : API 5L (LSAW/HSAW)

Pipeline Grade : X-70, PSL-2
MOC : CS (Carbon Steel)

Pipeline Rating : ANSI 300# Corrosion Allowance : 5.0 mm

Roughness (micron) : 35-40 microns (without internal coating)

Note- For a design life of 25 years, a total corrosion allowance of 5.0 mm is considered in pipeline thickness calculation at a corrosion rate of 0.20 mm per year. (To keep the design effective and for safe operation of the pipeline in future, it is required to consider higher corrosion allowances in the natural gas pipelines connected to wet gas source. As per M/s OIL natural gas which is to be transported through the proposed 30" NB P/L is considerably wet & also contains water vapours)

Further, Corrosion coupon and corrosion probe are considered at D/T at Baghjan and receiving terminals at R/T at Madhuban for corrosion monitoring of the pipeline and if corrosion rate comes more than 0.20 mm per year in actual then necessary mitigation for corrosion control i.e. injection of suitable corrosion inhibitor is to be considered by the M/s OIL in future.

MECON LIMITED DELHI Oil & Gas Section Delhi GAS PIPELINE FROM GGS/EPS BAGHJAN TO CGGS MADHUBAN Delhi Process Engineering Design Basis MEC/23U1/05/28/M/PEDB/001, Rev-0 Page 7 of 12

2.4.2 Pipeline Design Parameters-

Source : Natural gas
Pipeline Operating Life : 25 Years
On-stream : 365 Days

Design Code/Regulation : ASME B31.8 / OISD-226

Pipeline Laying : Buried

2.4.3 Design Pressure, Kg/cm²(g)-

Design Pressure, Kg/cm²(g) : 49 Kg/cm² (g)

2.4.4 Design Temperature, °C-

Buried : -29°C to +60°C Above ground : -29°C to +65°C

2.5 Materials-

Pipeline & its appurtenances shall be provided with carbon steel material suitable for the intended service as indicated below.

Line Pipe-

LSAW/HSAW, Line pipe shall confirm to API Specification 5L, PSL-2 Quality. The grade of line pipe shall be API 5L Gr. X-70. Pipe wall thickness shall confirm to ASME B31.8 and shall also meet the requirement of OISD 226.

Scrapper Trap-

Scrapper Trap shall be Bi-directional type along with Pig Signaller with limit switch, PSV, Vent, necessary instruments, QOEC etc. facilities. Scrapper Trap shall be designed as per ASME B 31.8 and QOEC shall be designed as per ASME Section VIII, Div.-1.

Mainline Valves/ Station Isolation Valves-

All mainline valves shall be full bore, butt welded end & of fully welded body (i.e. for aboveground & underground valve both), extended stem (wherever required) with GOV type and designed as per API 6D and API 6FA/ API 607 fire safe design requirements.

The Station isolation valves shall be reduce bore/full bore, butt welded end & of fully welded body with GOV type and designed as per API 6D and API 6FA/ API 607 fire safe design requirements.

MECON LIMITED DELHI	Oil & Gas Section	GAS PIPELINE FROM GGS/EPS	Habir
	Delhi	BAGHJAN TO CGGS MADHUBAN	Wall common
Process Engineering Design Basis		MEC/23U1/05/28/M/PEDB/001, Rev-0	Page 8 of 12

• Flanges, Terminal Pipes & Fittings-

All aboveground piping system shall be seamless pipes of equivalent grade to match ANSI class 600#/300#/150# pressure and temperature rating as per requirement. All fittings & flanges shall be as per piping material specification and shall conform to ANSI class 600#/300#/150# as per requirement.

Station Valves-

All valves for station/terminals shall be full bore/reduce bore type, flanged/welded end and shall be in accordance with Piping material specification.

Flow Tees-

All branch connections on the main line, which are greater than 40% of mainline, would be provided with flow tees (as per OISD-226) to allow smooth passage of pigs.

However, all branch connections greater than 25% of mainline would also be provided with flow tees for buried pipeline section only. Flow tees material would be same as that of line pipe.

Insulating Joint-

Insulating joints would be provided at transition point of aboveground & underground portion of pipeline for electrical isolation. These will be mono-block type suitable for both above/underground installations. Support shall be provided before and after mainline insulation joint.

Cold Field Bend-

Cold field bends shall be in accordance with codes but in no case with a radius below 40 times diameters for 30" NB pipe.

LR Bends-

Induction bend (R=6D) shall only be used wherever there is space constraint while laying the mainline such as at station approach and at critical bend (i.e. horizontal/ vertical) location.

Other Equipments-

Other necessary equipments such as K.O. Drum, Scrubbers, Filters, etc. (if required) shall be designed as per ASME Section VIII, Div-1.

2.6 Pipeline External Corrosion Protection & monitoring-

Corrosion Coupon/Corrosion probe shall be installed for Corrosion Monitoring. To protect pipeline from external corrosion three layers of polyethylene (3 LPE) coating shall be provided.

MECON LIMITED DELHI	Oil & Gas Section Delhi	GAS PIPELINE FROM GGS/EPS BAGHJAN TO CGGS MADHUBAN	THOSE OF THE PARTY
Process Engineering Design Basis		MEC/23U1/05/28/M/PEDB/001, Rev-0	Page 9 of 12

2.7 Characteristics of Natural Gas-

When handled properly Natural Gas is a safe fuel. It is a non-poisonous, non-toxic combustible source of energy. Natural Gas is composed essentially of methane with minor quantities of ethane, propane, carbon dioxide and traces of higher hydrocarbons and oxygen.

Natural Gas can be hazardous in the following ways-

- From asphyxiation through overexposure to natural gas, usually in a confined space, caused by inadequate ventilation or mechanical or accidental failure of equipment.
- From explosion through an accumulation of escaping gas, also usually in a confined space, being ignited when mixed with air.
- From fire through the uncontrolled burning of gas, usually after an explosion.
- From overpressure through submitting gas facilities such as regulators, valves, gauges, etc, to pressures in excess of their maximum working pressure

Natural Gas composition- As provided by M/s OIL in % (Vol/Vol.)

- a) Methane- 92.83
- b) Ethane- 3.10
- c) Propane- 1.23
- d) i-Butane- 0.23
- e) n-Butane- 0.30
- f) i-Pentane- 0.10
- g) n-Pentane-0.08
- h) Hexane-0.14
- i) Nitrogen- 0.77
- j) Carbon dioxide- 1.22

2.8 Sectionalizing Valve/ Mainline valves-

01 no. remote operated sectionalizing valve/mainline valve is considered at Loc. HNE,Makum and 04 nos. manually operated mainline isolation valves (02 nos. each for Doom Dooma & Tingrai river) have been considered across the rivers and same shall be installed in underground pit as per OIL's requirement for operation, maintenance and control of emergencies. Spacing between sectionalizing valve/mainline valves in various locations shall not exceed values as per given table:

Location Class	Maximum Distance in km
1	32
2	24
3	16
4	8

MECON LIMITED DELHI	Oil & Gas Section Delhi	GAS PIPELINE FROM GGS/EPS BAGHJAN TO CGGS MADHUBAN	THE PARTY OF THE P
Process Engineering Design Basis		MEC/23U1/05/28/M/PEDB/001, Rev-0	Page 10 of 12

The number of such valves and their location depends on the population density along the route of the pipeline.

2.8.1 Sectionalizing Valve /mainline valves along the Mainline-

- (i) 01 no. remotely operated sectionalizing valve/mainline valve (SV-03) at chainage 21.0 kms. (approx.) at Loc. HNE,Makum.
- (ii) 02 nos. manually (HOV type) operated mainline isolation valves (SV-01 & SV-02) in underground pit across Doom Dooma river at chainage 6.50 kms. (approx.).
- (iii) 02 nos. manually (HOV type) operated mainline isolation valves (SV-04 & SV-05) in underground pit across Tingrai river at chainage 28.30 kms. (approx.)..

2.9 Dispatch Terminal-

2.9.1 Facility for Dispatch terminal at GGS/EPS Bhagjan (Ch. 0.0 kms. from GGS/EPS Bhagjan)

- 1. Scrapper Launcher (Bi-directional): (36" x 30" NB)
- 2. Future tap-off.
- 3. Local & panel mounted instruments such as PT, TG & Pig Signalers etc.
- 4. Control Panel.
- 5. Power source (Existing)-All power requirements shall meet through existing UPS system.
- 6. Modification in existing RTU & hook-up in existing HMI/SCADA through existing RTU.
- 7. New APPS system to be installed and hooked-up with existing SCADA system.
- 8. Control room (existing)
- 9. Cold venting facility & venting provision for gas venting through existing flare header.
- 10. Fire protection system.
- 11. GOV/Manual Operated Valves.
- 12. Corrosion monitoring system
- 13. LEL Detection System.
- 14. Check Metering Skid (5.0 MMSCMD Capacity).

Note- As per OIL, first station isolation valve at battery limit at D/T, Baghjan to be closed at 110% of the max. Operating pressure i.e. 38.5 kg/cm2(g).

MECON LIMITED DELHI	Oil & Gas Section	GAS PIPELINE FROM GGS/EPS	Halir
	Delhi	BAGHJAN TO CGGS MADHUBAN	Base comm
Process Engineering Design Basis		MEC/23U1/05/28/M/PEDB/001, Rev-0	Page 11 of 12

2.10 Receiving Terminal-

2.10.1 Facility for Receiving Terminal at CGGS Madhuban, Duliajan (Ch. 37.76 kms. from GGS/EPS Bhagjan)

- 1. Scrapper Receiver (Bi-directional): (36" x 30" NB).
- 2. Future tap-off.
- 3. Local & panel mounted instruments such as PT, TG & Pig Signalers etc.
- 4. Control Panel.
- 5. GOV/Manual Operated Valves.
- 6. Power source (Existing)-All power requirement shall meet through existing UPS system.
- 7. Modification in existing RTU & hook-up in existing HMI/SCADA through existing RTU.
- 8. New APPS system to be installed and hooked-up with existing SCADA system.
- 9. Cold Venting facility & provision for gas venting through existing flare header.
- 10. Fire protection system.
- 11. LEL Detection System.
- 12. Corrosion monitoring system
- 13. Control room building (Existing).
- 14. Check Metering Skid (5.0 MMSCMD Capacity).
- 15. Pressure Reduction Facility (2.0 MMSCMD Capacity).

Note- i) Check metering facility of 5.0 MMSCMD to be considered at RT,Madhuban. Further, as per M/s OIL, PRS (Pressure reduction skid) facility of 2.0 MMSCMD capacity to be considered at R/T, Madhuban for existing 24" line coming from LPG upstream.

- ii) As per M/s OIL, no facilities for liquid separator such as K.O. Drum, filter separator to be considered at R/T, Madhuban.
- iii) 24" hook-up point, each for existing 24" NB line coming from LPG upstream & existing 24" LPG line and 16" hook-up point, each for existing 16" NB Baghjan-Madhuban pipeline & existing 16"NB W#308 pipeline to be kept at R/T, Madhuban

MECON LIMITED DELHI	Oil & Gas Section	GAS PIPELINE FROM GGS/EPS	Halier
	Delhi	BAGHJAN TO CGGS MADHUBAN	W BOOT COMPA
Process Engineering Design Basis		MEC/23U1/05/28/M/PEDB/001, Rev-0	Page 12 of 12

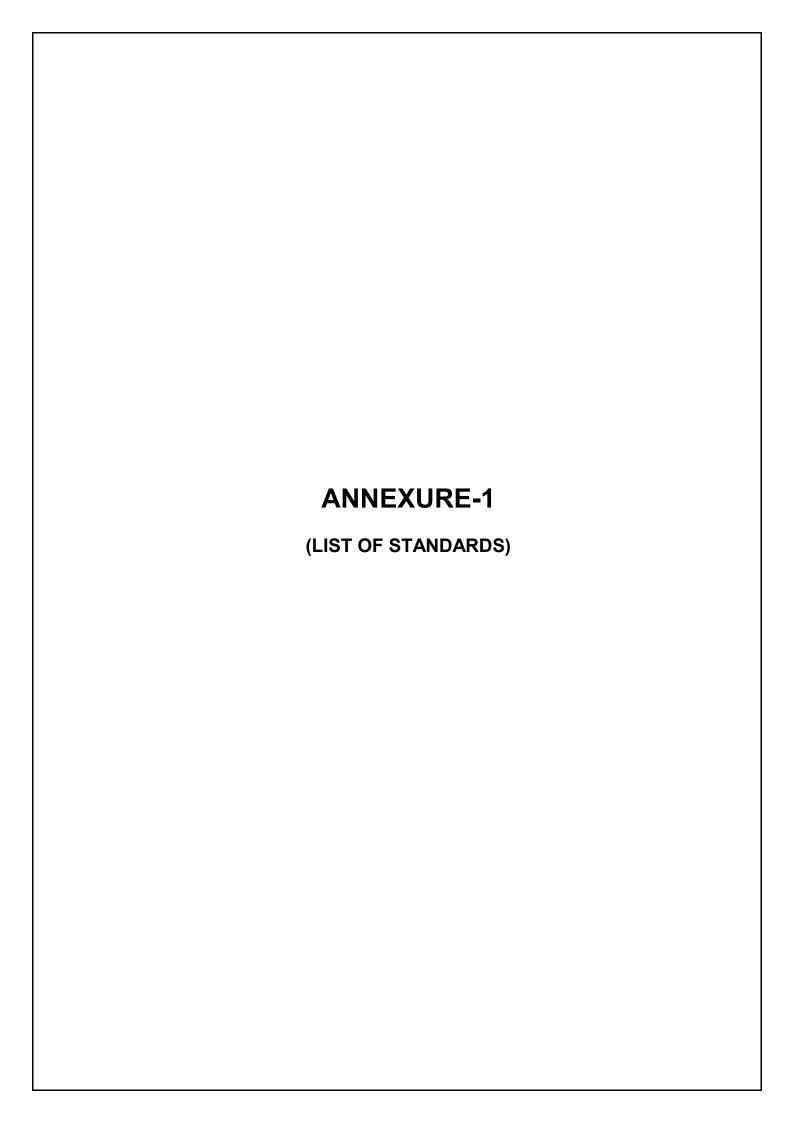
2.11 Facility at Sectionalizing Valve/ mainline valve Station at Loc. HNE, Makum-

- Full Bore GOV operated, Extended Stem, Butt Welded End Ball Valve with fully welded body.
- 2. Local & panel mounted instruments such as PT, TT etc.
- Control Panel.
- 4. Control Room with associated facilities.
- 5. SCADA & Telecom.
- 6. Provision for power source (Gas based Generator set to be used & UPS shall be considered for critical power requirements).
- 7. Cold Venting facility.
- 8. Check Metering Facility (1.0 MMSCMD Capacity).

Note- As per M/s OIL only gas injection of Makum line into Baghjan-Madhuban pipeline to be considered. Further, 0.2 (min.), 0.5 (nor.) & 1.0 (max.) MMSCMD flow to be considered for design of the check metering skid at Loc. HNE. Makum.

3.0 LIST OF ASSUMPTIONS-

- **3.1** Instruments shall be gas operated only.
- The following tentative plot size has been considered based on standard practice. However, actual plot size may vary as per site conditions and shall be firmed up during detail engineering stage.
 - i. 60 mtr. x 40 mtr. plot for Dispatch Terminal at GGS/EPS Baghjan.
 - ii. 80 mtr. x 80 mtr. for Receiving terminal at CGGS Madhuban.
 - iii. Other plot size
 - a) Remote Operated Sectionalizing Valve Station at Makum (SV-03): 45 mtr.x45 mtr.
 - b) Manually (HOV) operated mainline isolation valve (SV-01, SV-02, SV-04 & SV-05)-Suitable pit size



MECON LIMITED DELHI Oil & Gas Section Delhi GAS PIPELINE FROM GGS/EPS BAGHJAN TO CGGS MADHUBAN Delhi Process Engineering Design Basis MEC/23U1/05/28/M/PEDB/001, Rev-0 Page 1 of 3

LIST OF STANDARD

Pipeline Codes and Standards

a) American Society of Mechanical Engineers (ASME)

ASME B31.8 : Gas Transmission and Distribution Piping System

ASME B31.3 : Process Piping

ASME B16.5 : Pipe Flanges and Flanged Fittings

ASME B16.9 : Factory Made Wrought Steel Butt Welding Fittings
ASME B16.10 : Face to Face and End to End – Dimensions of Valves

ASME B16.11 : Forged Fittings, Socket-Welding and Threaded

ASME B16.20 : Metallic Gaskets for Pipe Flanges – Ring Joint, Spiral

Wound and Jacketed.

ASME B16.21 : Non-Metallic Flat Gaskets for Pipe Flanges

ASME B16.25 : Butt Welding Ends

ASME B16.28 : Wrought Steel Butt Welding Short Radius Elbows ASME B16.34 : Valves – Flanged, Threaded & Welding Ends

ASME B16.36 : Orifice Flanges

ASME B16.47 Series "A": Large Diameter Steel Flanges NPS 26 through NPS 60

ASME B18.2.1 : Square and Hex. Bolts and Screws

ASME B18.2.2 : Square and Hex. Nuts

ASME B36.10M : Welded and Seamless Wrought Steel Pipe

ASME Boiler & Pressure: Section-IX – Qualification standard for welding and

Vessel Code Brazing procedures, welders, brazes, and welding and

brazing operators

ASME Boiler & Pressure: Part C – Specifications for Welding Rods, Electrodes, and

Vessel Code-II Filter Metals

ASME Boiler & Pressure : Section-V, Nondestructive Examination`

Vessel Code

ASME Boiler & Pressure : Section-II Materials Part A – Ferrous Materials

Vessel Code Specifications

b) American Petroleum Institute (API)

API Spec 5L : Specification for Line Pipe

API RP 1102 : Recommended Practice for Liquid Petroleum Pipelines

Crossing Railroads and Highways

API Std 1104 : Standard for Welding Pipeline and Related Facilities

API Std 607 : Fire Test for Soft Seated Quarter Turn Valves

API RP 500 : Recommended practice for classification of locations of

Electrical installations at Petroleum Facilities classified as

Class I, Div. 1 and 2.

API 6D : Specification of Pipeline Valves.
Spec 6FA : Specification for Fire Test for Valves

STD 590 : Steel Line Blanks

STD 594 : Check Valves, Wafer, Wafer Lug and Double Flanged Type

MECON LIMITED DELHI Oil & Gas Section Delhi GAS PIPELINE FROM GGS/EPS BAGHJAN TO CGGS MADHUBAN Delhi Process Engineering Design Basis MEC/23U1/05/28/M/PEDB/001, Rev-0 Page 2 of 3

STD 598 : Valve Inspection and Testing

STD 600 : Steel Gate Valves Flanged or Butt Welding Ends, Bolted

and Pressure Seal Bonnets

STD 602 : Compact Steel Gate Valves – Flanged, Threaded, Welding

and Extended Body Ends.

c) British Standard Institute

BS1868 : Steel Check Valve (Flanged and Butt-Welding Ends) for

Petroleum, Petro-Chemical and Allied Industries

BS1873 : Steel Globe, Globe Stop and Check Valves (Flanged and

Butt Welding Ends) for the Petroleum, Petrochemical and

Allied Industries

BS5351 : Steel Ball Valves for Petroleum, Petrochemical and Allied

Industries

BS5352 : Steel Wedge Gate, Globe and Check Valves 50mm and

Smaller for Petroleum, Petro-Chemical and Allied Industries

BS6755 Part-I : Testing of Valves Part-1: Production Pressure Testing

Requirements

BS6755 Part-2 : Testing of Valves Part-2: Specification for Fire Type Testing

Requirements.

NBN EN 10208-2 : Steel pipes for pipelines for combustible fluids – Technical

delivery conditions - Part 2

ISO-15590-1 : International Standard for Petroleum and natural gas

industries – Induction bends, fittings and flanges for pipeline

transportation systems

DIN 30672 : Coatings of corrosion protection tapes and heat-shrinking

products for pipelines for operational temperatures up to

50°C

DIN 30670 : Polyethylene coatings for steel pipes and fittings ISO/TR 5168 : Measurement of fluid flow-Evaluation of uncertainties

d) Oil Industry Safety Directorate (OISD Standards)

OISD-GDN-115 : Guidelines on Fire Fighting, Equipment and appliances in

Petroleum Industry

Fire Protection Manual: Fire Engines, Trailer Pumps and Hydrant Systems

- TAC

OISD-Standard-118 : Layouts for oil and gas installations

OISD-Standard-226 : Natural Gas Transmission Pipelines & City Gas Distribution

Networks

e) American Society for Testing and Materials (ASTM)

ASTM A82 : Standard Specification for Steel Wire, Plain, for Concrete

Reinforcement

ASTM A185 : Standard Specification for Steel Welded Wire Fabric, Plain,

for Concrete Reinforcement

ASTM E92 : Standard Test Method for Vickers Hardness Testing of

Metallic Materials

MECON LIMITED DELHI Oil & Gas Section Delhi Process Engineering Design Basis GAS PIPELINE FROM GGS/EPS BAGHJAN TO CGGS MADHUBAN MEC/23U1/05/28/M/PEDB/001, Rev-0 Page 3 of 3

ASTM E94 : Standard Practice for Radiographic Testing

ASTM E165 : Standard Practice for Liquid Penetrate Inspection Method ASTM E709 : Standard Guide for Magnetic Particle Examinations

f) MSS Standard Practices

MSS SP 75 : Specification for High Test Wrought Welding Fittings

g) Manufacturers Standardization Society (MSS)

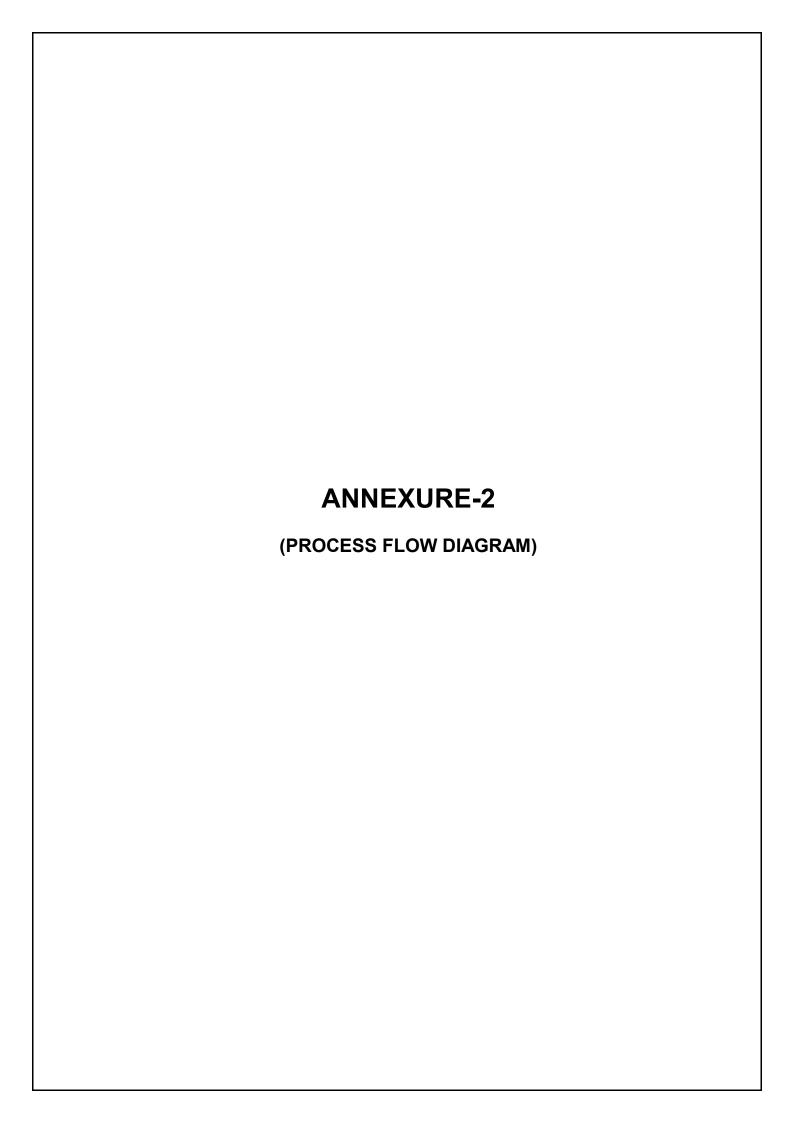
MSS-SP-6 : Standard Finishes for Contact Faces

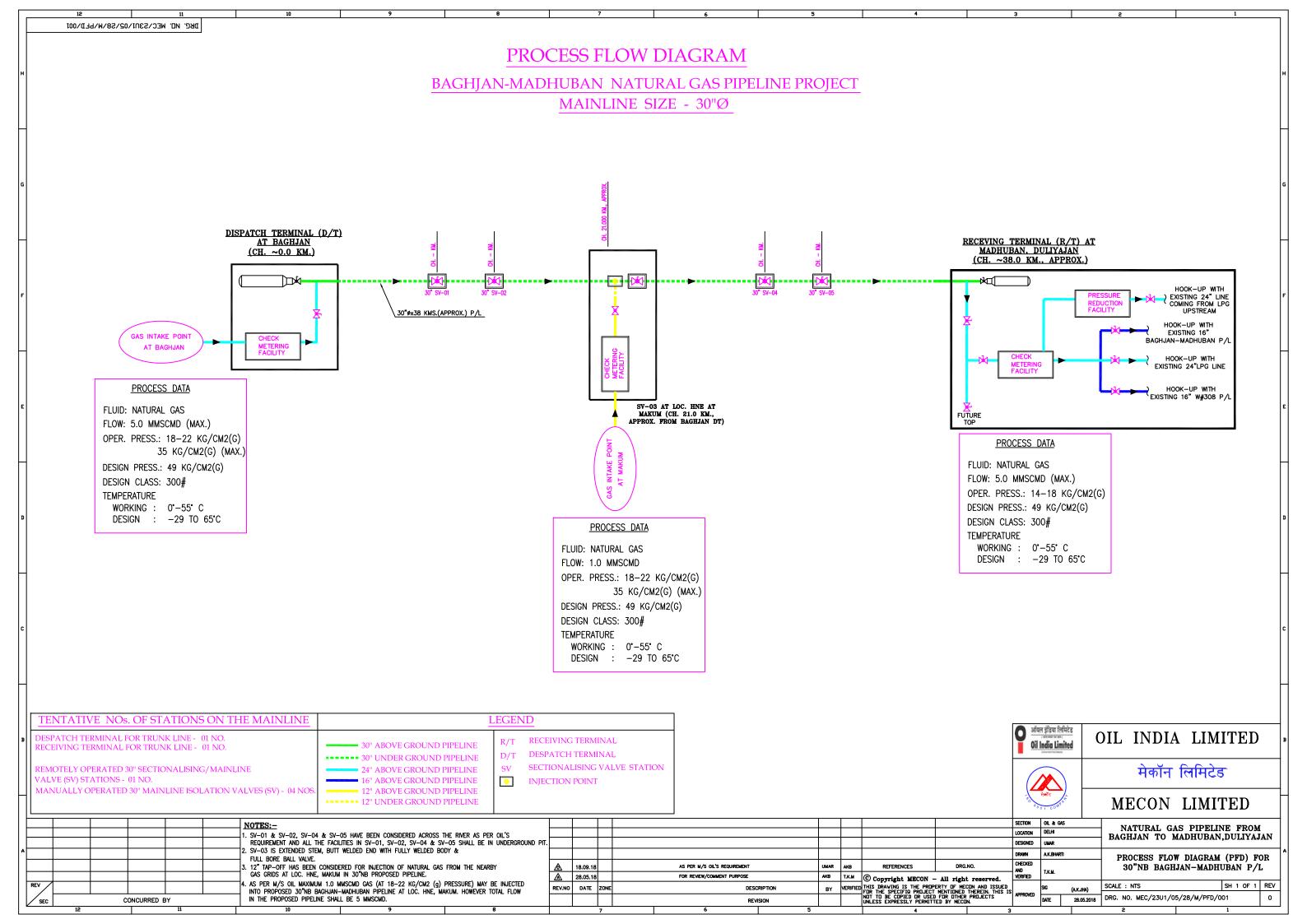
MSS-SP-9 : Spot Facing for Bronze, Iron and Steel Flanges

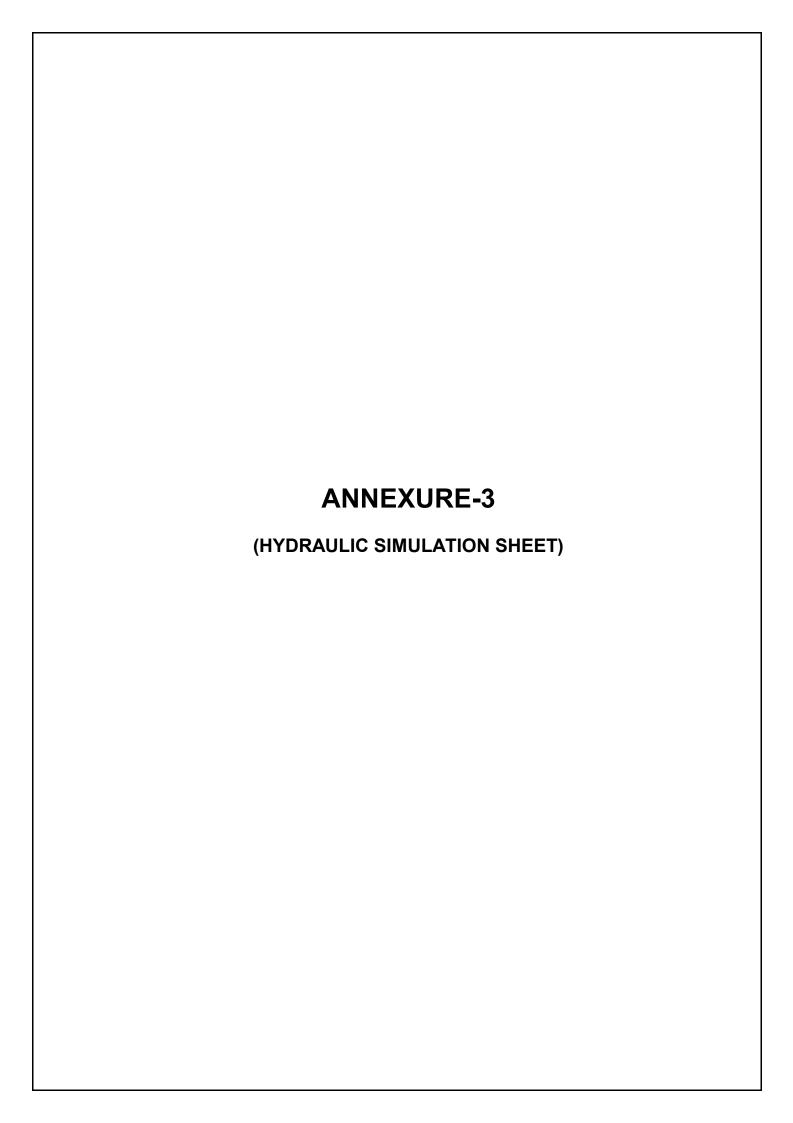
MSS-SP-25 : Standard Marking Systems for Valves, Fittings, Flanges and

Union

h) Guidelines on pipeline crossing under railway track (Report no. BS-105)



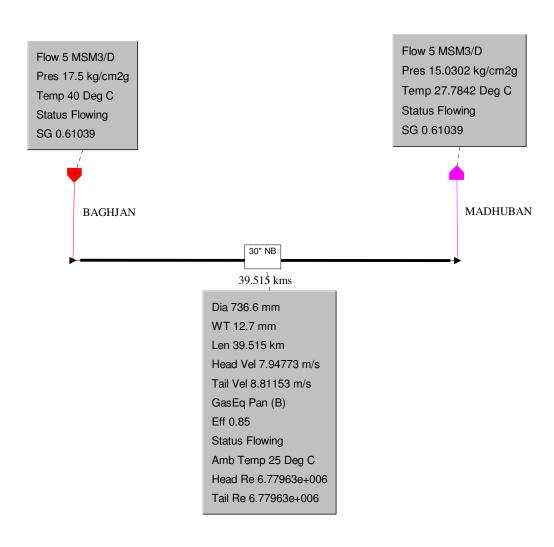




BAGHJAN-MADHUBAN NG P/L- OIL INDIA FLOW- 5.0 MMSCMD (30" NB P/L)

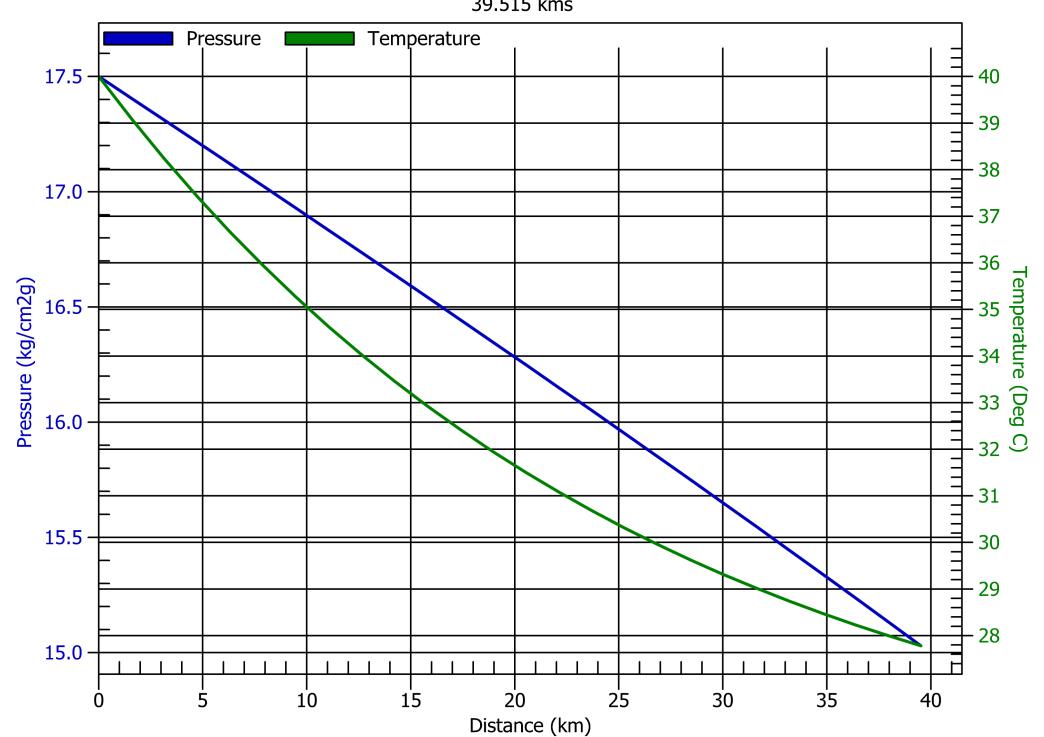
Assumptions/Notes- 1) 85% efficiency is considered assuming prevailing operating condition for simulation purpose.

- 2) Gas Composition of AGCL Baghjan provided by OIL considered for simulation are-C1-92.83, C2- 3.10, C3- 1.23, IC4- 0.23, NC4-0.30, IC5-0.10, NC5-0.08, C6-0.14, CO2-1.22, N2-0.77
- 3) Equivalent length of 1.515 kms. (aapx.) added in total route length for simulation purpose.

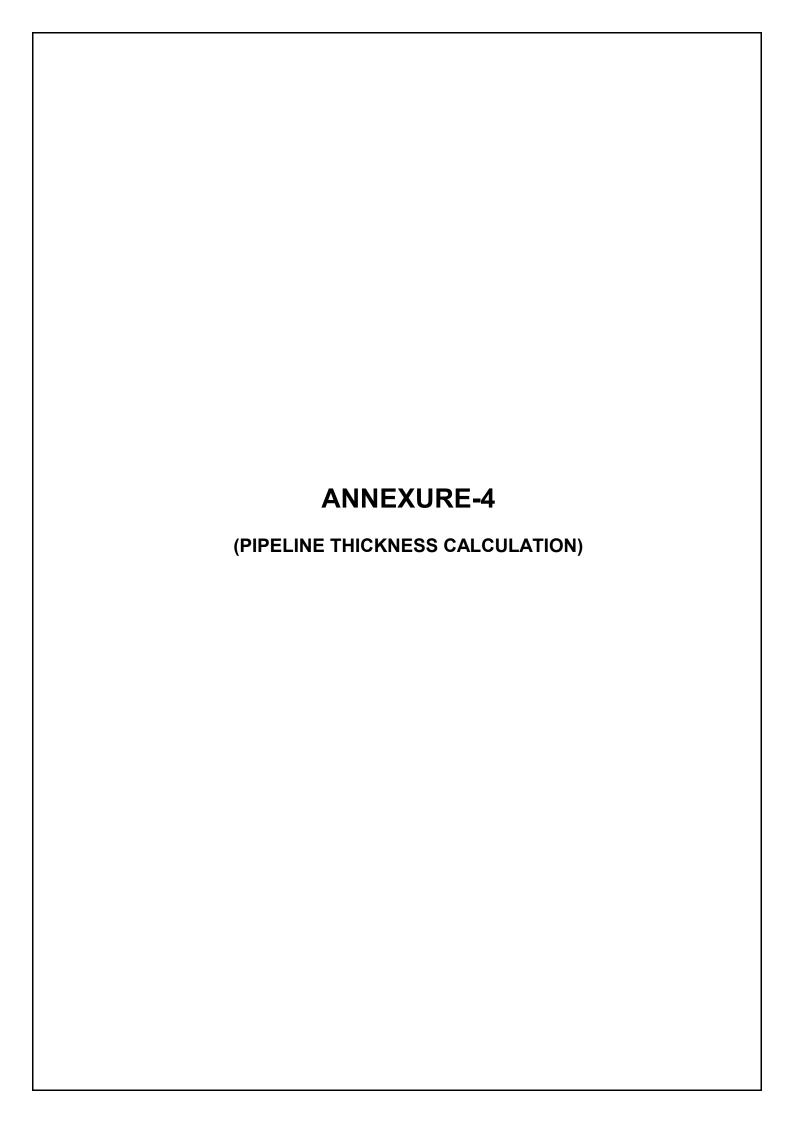


Pressure/Temperature Profile

39.515 kms



Sl. No.	Length	Pressure	Temperature		
31. IVO.	km	kg/cm2g	Deg C		
1	0	17.5	40		
2	1.5806	17.4054	39.0899		
3	3.1612	17.3105	38.2319		
4	4.7418	17.2155	37.4231		
5	6.3224	17.1201	36.6606		
6	7.903	17.0246	35.942		
7	9.4836	16.9287	35.2647		
8	11.0642	16.8325	34.6264		
9	12.6448	16.7361	34.0249		
10	14.2254	16.6392	33.458		
11	15.806	16.5421	32.9239		
12	17.3866	16.4445	32.4206		
13	18.9672	16.3466	31.9465		
14	20.5478	16.2482	31.4997		
15	22.1284	16.1495	31.0788		
16	23.709	16.0502	30.6823		
17	25.2896	15.9506	30.3086		
18	26.8702	15.8504	29.9567		
19	28.4508	15.7498	29.6252		
20	30.0314	15.6486	29.3128		
21	31.612	15.547	29.0186		
22	33.1926	15.4448	28.7414		
23	34.7732	15.342	28.4802		
24	36.3538	15.2386	28.2343		
25	37.9344	15.1347	28.0026		
26	39.515	15.0302	27.7842		



30" NB Line Pipe Grade: X-70

	Selected Thickness			10.31	mm		
	THICKNESS(With Allowances)			10.26856219	mn		
	Thikness Safety Marign	0%		-	mn		
	Corrosion Allowance			5	mn		
t	THICKNESS(Calculated) 5.268562192 mm						
<u>'</u>	•	I					
т	Temp. Factor	1		1			
e	Joint Factor	1		1			
f	Population Density Factor	0.72		0.72			
S	YIELD STRESS	70000	psia	70000	psi		
D	Outer Dia.(Selected)	30	inches	762	mr		
Р	Design Pressure	49	Kg/cm ² (g)	696.94366	psi		

	Selected Thickness			11.91	mm
	THICKNESS(With Allowances)			11.32227463	mm
	Thikness Safety Marign		0%		mn
	Corrosion Allowance			5	mn
ι	I FILONINE 35 (Calculated)			0.32227403	111111
t	THICKNESS(Calculated)			6.32227463	mn
Τ	Temp. Factor	1		1	
е	Joint Factor	1		1	
f	Population Density Factor	0.6		0.6	
S	YIELD STRESS	70000	psia	70000	psi
D	Outer Dia.(Selected)	30	inches	762	
Р	Design Pressure	49	Kg/cm ² (g)	696.94366	psi

TH	HICKNESS CALCULATION FOR	30" OD, CLASS-III			
Р	Design Pressure	49	Kg/cm ² (g)	696.94366	psi
D	Outer Dia.(Selected)	30	inches	762	mn
S	YIELD STRESS	70000	psia	70000	psi
f	Population Density Factor	0.5		0.5	
е	Joint Factor	1		1	
T	Temp. Factor	1		1	
t	THICKNESS(Calculated)			7.586729556	mn
	Corrosion Allowance			5	mn
	Thikness Safety Marign	ness Safety Marign 0%		0	mn
	THICKNESS(With Allowances)			12.58672956	mn
_	Selected Thickness			12.7	mr

TI	THICKNESS CALCULATION FOR 30" OD, CLASS-IV						
Г							
Р	Design Pressure	49	Kg/cm ² (g)	696.94366	psig		
D	Outer Dia.(Selected)	30	inches	762	mm		
S	YIELD STRESS	70000	psia	70000	psia		
f	Population Density Factor	0.4		0.4			
е	Joint Factor	1		1			
Т	Temp. Factor	1		1			
t	THICKNESS(Calculated)			9.483411945	mm		
	Corrosion Allowance			5	mm		
	Thikness Safety Marign		0%	0	mm		
	THICKNESS(With Allowances)			14.48341195	mm		
L							
L	Selected Thickness			15.88	mm		

Pipeline wall thickness calculation Basis

As per ASME B 31.8

Steel pipe design formula is P=(2*S*t*f*e*T)/D

Thikness Safety Marign Therfore, Minimum wall thickness required t=(P*D)/(2*S*f*e*T) Corrosion allowance

Where,

P = Design Pressure (psig)

D = Outer diameter (mm)

S = Yield Stress (psi)

F = Poplulaton density factor

e = Joint factor

T = Temp. factor

t = Wall thickness (mm)