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TECHNICAL ADDENDUM FOR COMPRESSOR CONTROL SYSTEM (ASC+PC) FOR BPCL KOCHIN BS-VI MS BLOCK PROJECT

1 **REFERENCE DOCUMENTS:**

a. Please refer attached UOP specifications and P&IDs for compressor control system requirements & writeup.
   i. Compressor Antisurge And Process Control Systems 9010436-692 (5 pages)
   ii. UOP Process P&ID (10 pages)

b. The ASC & PC controllers / TAGs / Controller QTY shall be as defined in UOP docyuments listed above.

c. There are TWO (independent) Compressor Control System packages under this RFQ.
   i. CCS for CCR Recycle Gas Compressor: ASC for single stage compressor.
   ii. CCS for Net Gas Compressor: ASC & Performance Control for Two stage compressor.

Honeywell UOP

UOP Engineering Department

COMPRESSOR ANTISURGE AND PROCESS CONTROL SYSTEMS

PROJECT SPECIFICATION

9010436 — **692** SHEET 1

REV	DATE	BY	APVD	REV	DATE	BY	APVD
0	12MAY17	SS	PK				

Item	Quantity	Description
1	1	Provide a Net Gas Compressor Antisurge and Suction Drum Pressure Control System. All items listed herein shall be supplied as part of a complete package by the selected vendor.

Instructions to Contractor and Vendor

This specification describes performance and design requirements which UOP considers essential for the proper operation of the integrated compressor antisurge and process control system, and subsequently the proper operation and safety of the process unit.

It is the responsibility of the antisurge/process control system vendor to furnish the calibration values required to define the surge control line, and to configure the entire system. It is the responsibility of the compressor vendor to provide information, as required, to the antisurge/process control vendor and to review the antisurge/compressor process control system design and proposed calibration values for acceptability.

The vendor shall provide sufficient redundancy such that upset of the antisurge/process control system is mitigated upon loss of transmitter or during a control system hardware failure. Additionally, degraded modes of operation shall be provided such that the control system automatically adapts to the above problems and continues normal operation without causing a process upset or process shutdown.

The vendor to review the requirement of integration of the Suction Drum Pressure Control system with the Motor Control System where applicable. In applications where train speed is used for throughput control, it is recommended that the antisurge/process control system vendor supply a fully integrated motor/compressor control system.

One copy of the complete documentation for the final control system design shall be furnished to UOP. It shall be the responsibility of the Contractor and antisurge/process control system vendor to notify UOP, before fabrication has begun, of all deviations from this specification.

The UOP Piping and Instrument Diagram(s) 9010436-120-A1-18 thru 9010436-120-A1-22 shall be provided to the vendor by the Contractor as an integral part of this specification.

The antisurge/process control system vendor shall furnish a competent service engineer to review the installation and supervise calibration and initial startup. The proposal shall state the terms of this service.

Demonstration of the antisurge control system operation by the vendor is required during a Factory Acceptance Test (FAT). During the FAT, the vendor shall demonstrate that the control system integration between the various loops as defined will respond to process upsets and that the control system recognizes the multiple compressor operating conditions/maps as supplied by the machinery vendor.

Other specifications referenced in this specification:	UOP Standard Specification:
	UOP Standard Drawing:
	UOP Project Specification: 601, this project

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REV	DATE	BY	APVD	REV	DATE	BY	APVD
0	12MAY17	SS	PK				
1	25MAY17	SS	PK				

Item	Description
1 (cont'd)	**System Operation**

The control of the First Stage Suction Drum pressure is accomplished by an integrated approach that adjusts compressor speed, throttles the first stage spillback valve, or throttles the vent valve to the relief header through configuration of controllers PIC-2801A, B. Pressure limiting setpoints in the antisurge controllers are also configured to prevent excessive discharge pressure and insufficient suction pressure. During normal operation, the First Stage Suction Drum pressure controller, PIC-2801A maintains pressure by adjusting the compressor speed. The compressor spillback valve and the vent valve are closed.

For a decreasing pressure in the First Stage Suction Drum, PIC- 2801A will reduce the compressor speed until it reaches its minimum allowable speed. If the suction drum pressure continues to decrease, PIC-2801A will utilize the first stage antisurge controller (XIC-2901) and open the first stage spillback valve (XV-2901) to maintain suction pressure at the setpoint. Provisions shall be included such that the first stage antisurge controller can open the spillback valve before minimum allowable speed is reached to restore the suction pressure to the sepoint during large process upsets. If at any time the first stage antisurge controller detects that the compressor operating point is crossing the surge control line, the first stage antisurge controller will preferentially open the first stage spillback valve to prevent compressor surge. PIC-2801A and XIC-2901 shall utilize decoupling signals to coordinate their control actions during spillback operations.

For an increasing pressure in the First Stage Suction Drum, PIC-2801A will increase the compressor speed until it reaches its maximum allowable speed. If the suction drum pressure continues to increase above the setpoint, PIC-2801B will then open the vent to relief header (PV-2801B). The first stage spillback valve will be closed. If at any time the first stage antisurge controller detects that the compressor operating point is crossing the surge control line, the antisurge controller will preferentially open the first stage spillback valve to prevent compressor surge. A decoupling signal is communicated to the process controller to insure stable pressure control during spillback operations.

Certain process operations may generate discharge pressures capable of exceeding relief valve set pressures. If the compressor discharge pressure for a particular stage increases above a configured discharge pressure limiting setpoint, the first stage anti-surge controller will open the first stage spillback valve and the second stage antisurge controller (XIC-3001) will open the second stage spillback valve (XV-3001) to maintain their individual high limit setpoints.

Certain process operations may generate a low pressure in the Second Stage Suction Drum preventing the Suction Drum's liquid from exiting the vessel. If the process pressure decreases below a configured suction pressure limiting setpoint, the second stage antisurge controller will open the second stage spillback valve to maintain the low limit setpoint.

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COMPRESSOR ANTISURGE AND PROCESS CONTROL SYSTEMS

Item	Quantity	Description
1 (a)	2	**Antisurge Controller**

Tag Number		Service
Controller	DCS Faceplate	
XIC-2901	XIK- 2901	First Stage Net Gas Compressor Antisurge
XIC-3001	XIK-3001	Second Stage Net Gas Compressor Antisurge

Digital antisurge controller with an execution time of 50 milliseconds, or less, designed to protect the compressor from surge while limiting energy consumption. All continuous control algorithms shall reside in a deterministic operating system guaranteeing repeatable execution rates. The substitution of a distributed control system (DCS) with embedded surge prevention control application(s) is acceptable only when using dedicated controller node(s) for surge protection and full loop latency (input terminal to output terminal) time does not exceed 50 milliseconds. When the controller is separate from the DCS it shall be located in the control center and shall be easily accessible by the operator.

The equation used to compute the control variable shall be based on the ratio of polytropic head to volumetric suction flow squared. Alternate equation(s) may be used with the approval of the compressor vendor, Contractor and end user. The antisurge control loop shall continually calculate the distance between the operating point and surge limit line in a manner that is invariant to changes in inlet conditions, including changes in inlet pressure and temperature. The system should also take into account changes in the speed of rotation.

The controller shall utilize a combination of closed-loop proportional and integral control with open-loop derivative control to open the antisurge control valve before surge can occur. Additional computations which enhance the controller's ability to prevent or minimize surge shall be provided in accordance with the controller vendor's recommendations. Alternate equations to determine the location of the surge limit line may be used with the approval of the compressor vendor, Contractor and end user.

The controller shall be designed with fail safe or fault tolerant control modes to prevent a process upset caused by a transmitter or input failure. The controller vendor shall specify the fail safe modes required for each specific installation. Transmitter or input failures shall actuate a common “Trouble” alarm (by others) in the control center.

Should extraordinary conditions push the compressor into surge, the system shall be designed to automatically break the surge cycle before the second cycle can occur. In addition, the system shall provide for automated recovery from surge without operator intervention. Also, upon surge detection, the surge control line shall be automatically readjusted for more antisurge control margin until an investigation of the circumstances of the event can take place.

The antisurge control algorithm shall incorporate a surge detector and surge cycle counter. Surge detection shall be based on comparing the rate of change of the flow and/or discharge pressure to user configurable limits.

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1	25MAY17	SS	PK				

Item **Description**

1 (a) (cont'd) **Antisurge Controller**

For multi-stage compressors, the antisurge controllers need to have a coordinated controller response to minimize process upsets caused by a single stage antisurge controller response. Provisions shall be included though feedforward signals (decoupling) to prevent negative interaction with adjacent stages antisurge controllers.

The antisurge controller shall be capable of performing configurable, independent control loop functions as defined below, each with its own set of tuning parameters. The initial setpoint for the pressure limiting control functions shall be manually input and displayed on the antisurge device. The pressure limiting control function shall take no action until the process variable reaches its particular setpoint.

Controller	Configured Function	Limiting Setpoint	Process Input
XIC-2901	First Stage Discharge High Limiting	16.2 kg/cm2(g)	PT-2902 (0 - 18 kg/cm2(g))
XIC-3001	Second Stage Suction Low Limiting	10.7 kg/cm2(g)	PT-3001 (0 - 18 kg/cm2(g))
	Second Stage Discharge High Limiting	27.7 kg/cm2(g)	PT-3002 (0 - 30 kg/cm2(g))

The controller shall be capable of communicating digitally with the selected distributed control system (by others). The Contractor shall coordinate with the controller vendor to insure compatibility.

The following inputs (specified elsewhere) will be used to characterize the surge control line for each stage. The system vendor, in coordination with the compressor vendor, shall determine if additional inputs are required:

Suction (or Discharge) Flow
Suction Pressure
Suction Temperature
Discharge Pressure
Discharge Temperature
Compressor Speed

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Item	Quantity	Description
1 (b)	2	**Process Performance Controllers**

Tag Number		Service
Controller	DCS Faceplate	
PIC- 2801A	PIK- 2801A	First Stage Suction Drum
PIC-2801B	PIK-2801B	First Stage Suction Drum Vent

Provide a digital controller with an execution time of 50 milliseconds, or less. All continuous control algorithms shall reside in a deterministic operating system guaranteeing repeatable execution rates. The substitution of a distributed control system (DCS) with embedded controller application(s) is acceptable only when using dedicated controller node(s) and full loop latency (input terminal to output terminal) time does not exceed 50 milliseconds. When the controller is separate from the DCS it shall be together with all other controllers specified herein, and located in the main control center.

Process controller PIC-2801A shall be configured to accept an analog remote setpoint from the Separator pressure controller, PIC-2301, located on the DCS. Provisions shall be included to move smoothly from speed to process control using the Suction Drum Vent valve or the first stage antisurge valve. The Process controller shall be capable of performing the function of two independant control loops, each with its own set of tuning parameters and Auto/Manual capabilities. The first controller PIC- 2801A shall be the normal process (Suction Drum Pressure) controller, and the second controller PIC-2801B provides the Suction Drum Vent valve function. The setpoint for the Suction Drum Vent Controller shall be manually input by the Operator and/or automatically calculated using a configurable offset, from the Suction Drum Pressure Controller in an automatic mode. The Suction Drum Vent Controller shall normally take no action until the process variable reaches the Suction Drum Vent Pressure setpoint. Feedforward (decoupling) between the Suction Drum Pressure Controller and Suction Drum Vent Controller shall be used to minimize pressure excursions. PIC-2801A and PIC-2801B shall be functionally separate unaffected from settings and actions of the other.

The controllers shall be designed to communicate digitally with the selected distributed control system. DCS faceplates shall be configured to remotely adjust and/or indicate the following:

Process Control Setpoint for PIC-2801A (via Operator input)
Process Variable
Controller Output
Auto-Manual Transfer
Controller tuning and all configuration parameters (as required).

The Contractor shall coordinate the supply, installation and configuration of the controller with the selected distributed control system vendor. Process controller shall communicate digitally with the other controllers specified herein.

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THIS P AND I DIAGRAM IS DIAGRAMMATIC ONLY. DESIGN OF PIPE LINES MUST BE INVESTIGATED FOR VENTING OF GAS AND VAPOR POCKETS IN PIPING AND EQUIPMENT, LOW POINTS IN PIPING, PUMPS AND EQUIPMENT FOR FREEZING AND DRAINING, AND ACCESSIBILITY OF ALL VALVES, FLANGES, INSTRUMENTS INCLUDING THERMOCOUPLES, ETC.

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2400_X_7700_
SEPARATOR (5)(7)
MR-V-05

MISC CONNS *-P-MR-2313-A5A(B1A1)-NI
DESIGN TEMPERATURE: 120°C
DESIGN PRESSURE: 4.5 KG/CM²(G)

2"-P-MR-2803-A1A(B1A1)-NI → FIRST STAGE SUCTION DRUM 1128 | 211

6"-P-MR-1907-A5A(B1A1)-IT -80°C → REDUCTION GAS EXCHANGER 1127 | 041

3"-P-MR-2407-A1A(B1A1)-NI → SEPARATOR PUMPS 1124 | 039

PRESSURE CONTROLLER PIC-2801A 040 | 1128

8T10
SET@ 4.5 KG/CM²(G)

-LRH-MR-2310-(*)-NI
*-LRH-MR-2308-A5A(B1A1)-NI
-LRH-MR-2311-(*)-NI
-LRH-MR-2312-(*)-NI
PSV 2301A
PSV 2301B
RH
*-P-MR-2305-A5A(B1A1)-NI
*-LRH-MR-2309-A5A(B1A1)-NI
1½"-P-MR-2307-A5A(B1A1)-NI
*-P-MR-2306-A5A(B1A1)-NI
A1A (B1A1)
A5A (B1A1)

PIC 2301 (3) PT 2301 PG 2302
AI 2301 AT 2301 HYDROGEN FREE DRAINING
AI 2302 AT 2302 MOISTURE FREE DRAINING
ANALYZER TROUBLE UA 2301
1800 MAX
30"-P-MR-2302-A5A(B1A1)-NI → RECYCLE COMPRESSOR 037 | 1125

DRAIN FROM BOOSTER GAS COALESCER 9010437 | 1198
2"-P-MR-9803-A5A(B1A1)-NI
CCR REGENERATOR SECTION

PRODUCTS CONDENSER 033 | 1122
32"-P-MR-2201-A5A(B1A1)-NI
TWO PHASE FLOW
FREE DRAINING
2"-P-MR-2803-A1A(B1A1)-NI
6"-P-MR-1907-A5A(B1A1)-IT -80°C
3"-P-MR-2407-A1A(B1A1)-NI
A5A(B1A1) A1A(B1A1)

24" MW 8"

LI 2301A (H) LI 2301B (H) LI 2301C (H)
LAHH 2301 (CRIT)
UC 6502
LSHH
RADAR (S/S) LT 2301C COR 350
RADAR (S/S) LT 2301B 350
RADAR (S/S) LT 2301A 350
4200

2" FF LT 2302 D/P COR LIC 2302 (H) (L)
2000 1300
LG-R 2304
FF LT 2303 D/P 3900 COR LI 2303 (H)
2250
5300

8"-P-MR-2301-A1A(B1A1)-NI
3"
CONTROL VALVE LV-2302 → 038 | 1124
SEPARATOR PUMPS 8"-P-MR-2301-A1A(B1A1)-NI → 036 | 1124

FREE DRAINING
3"-CBD-MR-2303-A1A(B1A1)-NI → CBD
FREE DRAINING
3"-OWS-MR-2304-A1A(B1A1)-NI → OWS

NOTES:
1. MAKE CONNECTION ON TOP OF PIPE
2. 1 SHOWN 3 REQUIRED
3. DETAIL "LVD", SEE DWG 9010434-10
4. SEE STD DWG 8-121
5. LOCATE AS CLOSE TO COMPRESSOR AS POSSIBLE
6. DO NOT TRAP OR POCKET THIS LINE
7. EQUIPMENT IS DESIGNED FOR FULL VACUUM

COMPRESSOR RELATED NOTES:
(A) ALL INSTRUMENTS IN THE SCOPE OF COMPRESSOR VENDOR ARE IDENTIFIED BY (*). (3)

ALL INSTRUMENTS ARE PRE-FIXED WITH MR-
P&ID FOR COMPRESSOR VENDOR SCOPE MARK ONLY (1)

संख्या No.	तिथि DATE	संशोधन REVISIONS	इन द्वारा DRN	द्वारा BY	जाँच CHKD	अनुमोदित APPD.
3	02.11.17	COMPRESSOR VENDOR SCOPE MARKED	PB	DK	RMN	SA

इंजिनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम)
ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

अनुमाप SCALE	कार्य संख्या JOB NO.	विभाग DEPT.	अनुभाग SECTN.	इकाई UNIT	जारेख संख्या DWG. No.	संशो. REV.
NTS	B034	79	41	MR	1123	3

GENERAL NOTES:
FOR GENERAL LEGEND, ABBREVIATIONS, NOMENCLATURE, INSTRUMENTATION, EQUIPMENT SYMBOLOGY AND GENERAL DETAILS
SEE DWG'S 9010434-01 THRU 9010434-10

REV	DFTR	CKR	APVD	DATE	REV	DFTR	CKR	APVD	DATE
1	_AG	_AG	_PK	24APR17	_	---	---	---	-------
2	_SK	_AG	_PK	15MAY17	_	---	---	---	-------

Honeywell UOP
UOP ENGINEERING DEPARTMENT

PIPING AND INSTRUMENT DIAGRAM
SEPARATOR
CCR PLATFORMING PROCESS UNIT

BHARAT PETROLEUM CORPORATION LIMITED-KOCHI REFINERY
BS-VI, MSBP
AMBALAMUGAL, KOCHI, KERALA, INDIA

CUSTOMER DWG NUMBER : 9010436-120-MR-1123

DFTR	CKR	APVD	DATE	PROJECT	TYPE	DWG NO	REV
_KS	AMT	_PK	20MAR 17	9010436-120-13-A1	2		

T300105
QUALTRAX 14472

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(1) RECYCLE COMPRESSOR **MR-C-01**

RATED VOLUMETRIC FLOW RATE: 43800M³/HR
DIFFERENTIAL PRESSURE/HEAD: 3.5 KG/CM²

SEPARATOR 037 1123 — 30"-P-MR-2302-A5A(B1A1)-NI — SIZE BY OTHERS — *-P-MR-2518-A5A(B1A1)-NI — EJECTOR 049 1126

8"-P-MR-2505-A5A(B1A1)-NI MIN

¾"-AV-MR-2508-A5A(B1A1)-NI
¾"-H-MR-2507-B5A(B2A1)-NI
450 MAX

TYPE B MR-SC-02

PDI 2501 H — PDT 2501 FF

1"-AV-MR-2509-A5A(B1A1)-NI
1"-AV-MR-2512-A1A(B1A1)-NI
VENDOR OTHERS
1½"-N-MR-2519-A1A(B1A1)-NI — PURGE — N
¾" 1½"-H-MR-2506-B5A(B2A1)-NI — ADDITION — H
¾"

DEBUTANIZER OFFGAS VENT CHILLER
1½"-H-MR-2514-B5A(B2A1)-NI — 219 1152
NET GAS COMPRESSORS
1½"-H-MR-2515-B5A(B2A1)-NI — 051 1129
ABSORBER
1½"-H-MR-2516-B5A(B2A1)-NI — 213 1143
DEBUTANIZER VENT SEPARATOR
1½"-H-MR-2517-B5A(B2A1)-NI — 214 1155

1½"-H-MR-2506-B5A(B2A1)-NI
¾"-H-MR-2510-B5A(B2A1)-NI

TI 2501A, TI 2501B, TI 2501C — UC 6502 TSHH — TT 2501A, TT 2501B, TT 2501C — TE 2501A, TE 2501B, TE 2501C — CRIT TAHH 2501

30"-P-MR-2302-A5A(B1A1)-NI

SCALED SPEED XI 2502 — HIC 2502 — CONTROL CENTER-FIELD HS 2503 — SIC

COMPRESSOR PG 2502 PG 2503

SI 2501

24"-P-MR-2501-A5A(B1A1)-NI

OTHERS VENDOR — OTHERS VENDOR

COMPRESSOR ALARM CRIT XA 2501

SPEED REFERENCE SIGNAL (NOTE-D)

UC 6503 — CRIT HA 2501 — COMPRESSOR STOP HS 2501

1"-AV-MR-2512-A1A(B1A1)-NI

PI L — PCV — PT — ¾"-N-MR-2513-D1A(B4A1)-NI — HEADER

¾"-N-MR-2511-A1A(B1A1)-NI — VENDOR OTHERS N

FROM OTHER CYLINDERS

FREE DRAINING

DETECTOR TUBE SAMPLE MR-SC-03

24"-P-MR-2501-A5A(B1A1)-NI MIN

18"-P-MR-2501-A5A(B1A1)-NI — FREE DRAINING

18"-P-MR-2504-A5A(B1A1)-NI — NET GAS COOLER 050 1127

8"-P-MR-2505-A5A(B1A1)-NI MIN

MR-C-01 PACKAGE

OTHERS VENDOR
HYDROGEN 2"(H)-B5A
NITROGEN 2"(H)-A3A
INST.AIR 2"(H)-A3A
CW SUPPLY (H")-A91A — CW RETURN (H")-A91A
BCW SUPPLY 1.5"(H)-A91A — BCW RETURN 1.5"(H)-A91A
OWS 2"(H)-A1A
CBD 2"(H)-A1A
(H")-A11A — FLARE

RECYCLE GAS TO REDUCTION GAS HEATER NO 2 OUTLET LINE
2"-P-MR-2503-A5A(B1A1)-IT 150°C NNF
1170 9010437
CCR REGENERATOR SECTION

COMBINED FEED EXCHANGER 1121 031 — 18"-P-MR-2501-A5A(B1A1)-NI — FREE DRAINING

REACTOR PURGE EXCHANGER 1119 015 — 4"-P-MR-2502-A5A(B1A1)-IT 117°C — NNF

NOTES:

1. TOTAL RECYCLE COMPRESSOR CIRCUIT MUST NOT EXCEED EQUIVALENT LENGTH OF PIPE SHOWN IN SECTION C OF THE ENGINEERING DESIGN INFORMATION.
2. BLANKOFF WHEN NOT IN USE
3. NORMALLY NO FLOW (LOW FLOW LOW FIRING MODE)
4. LOCATE OUTSIDE COMPRESSOR SHELTER
5. DUAL PLATE CHECK VALVE
6. PRESSURIZED DRY GAS SEAL SYSTEM (FURNISHED WITH COMPRESSOR)
7. DETAIL "DT",SEE DWG 9010434-06
8. FURNISHED WITH CYLINDER
9. PROVIDE ONE FOR EACH CYLINDER
10. CONNECT THIS LINE ON TOP OF PIPE
11. TO MOTOR CONTROL CIRCUIT
12. BACKUP NITROGEN SUPPLY (IN USE ONLY WHEN PRIMARY NITROGEN SUPPLY HEADER PRESSURE IS LOW) PROVIDED BY (VENDOR)(4)
13. SEPARATE VENTS TO ATMOSPHERE AT SAFE LOCATION
14. SHUTDOWN SYSTEM (FURNISHED WITH COMPRESSOR)
15. DO NOT TRAP OR POCKET THIS LINE
16. FURNISHED BY COMPRESSOR SUPPLIER

COMPRESSOR RELATED NOTES:

(A) ALL IN SCOPE OF COMPRESSOR VENDOR ARE IDENTIFIED BY (*).

(B) IN CASE ANTISURGE PROTECTION IS RECOMMENDED BY THE VENDOR, ANTISURGE SYSTEM & ANTISURGE VALVE ARE TO BE SUPPLIED BY COMPRESSOR VENDOR. RELATED INSTRUMENTS SUCH AS SUCTION FLOW INSTRUMENTS, SUCTION PRESSURE & SUCTION TEMPERATURE INSTRUMENTS, DISCHARGE PRESSURE & DISCHARGE TEMPERATURE INSTRUMENT INSTRUMENTS ARE TO BE SUPPLIED BY COMPRESSOR VENDOR.

(C) PSV (2NOS.) AT COMPRESSOR DISCHARGE, IF REQUIRED, TO BE SUPPLIED BY COMPRESSOR VENDOR.

(D) SPEED REFERENCE SIGNAL FROM VFD.

(4)

ALL INSTRUMENTS ARE PRE-FIXED WITH MR-P&ID FOR COMPRESSOR VENDOR SCOPE MARK ONLY

(4)

पंक्ति No.	तिथि DATE	संशोधन REVISIONS	ड्रॉन द्वारा DRN BY	जाँच CHK'D	अनुमोदित APP'D.
4	02.11.17	COMPRESSOR VENDOR SCOPE MARKED	PB	DK	RMN	SA

इंजिनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) — ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

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NTS	B034	79	41	MR	1125	4

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1	AG	AG	PK	24APR17	3	AG	AG	PK	02JUN17
2	SK	AG	PK	15MAY17					

Honeywell UOP — UOP ENGINEERING DEPARTMENT

PIPING AND INSTRUMENT DIAGRAM
RECYCLE COMPRESSOR
CCR PLATFORMING PROCESS UNIT

BHARAT PETROLEUM CORPORATION LIMITED-KOCHI REFINERY
BS-VI, MSBP
AMBALAMUGAL, KOCHI, KERALA, INDIA

CUSTOMER DWG NUMBER : 9010436-120-MR-1125

DFTR	CKR	APVD	DATE	PROJECT	TYPE	DWG NO	REV
KS	AMT	PK	20MAR 17	9010436-120-15-A1			3

QUALTRAX 14472

T300120

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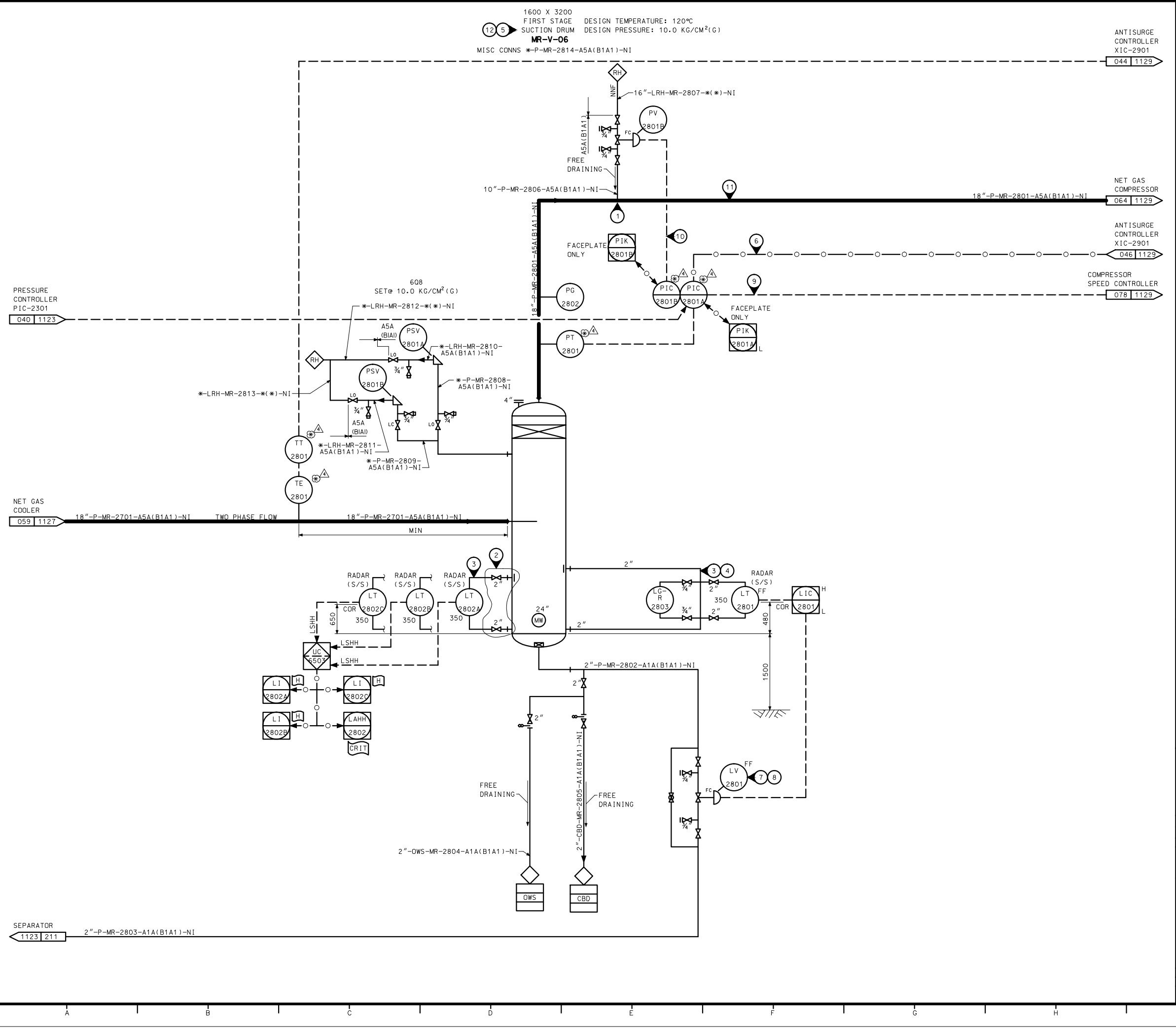

NOTES:

1. MAKE CONNECTION ON TOP OF PIPE
2. 1 SHOWN 3 REQUIRED
3. DETAIL "LVD", SEE DWG 9010434-10
4. SEE STD DWG 8-121
5. LOCATE AS CLOSE TO NET GAS COMPRESSORS AS POSSIBLE
6. LOW PRESSURE SIGNAL OPENS ANTISURGE VALVE
7. DETAIL "CVD", SEE DWG 9010434-10
8. LOCATE AT GRADE CLOSE TO FIRST STAGE SUCTION DRUM
9. HIGH PRESSURE SIGNAL INCREASES SPEED
10. HIGH PRESSURE SIGNAL OPENS THIS VALVE
11. DO NOT TRAP OR POCKET THIS LINE
12. EQUIPMENT IS DESIGNED FOR FULL VACUUM

COMPRESSOR RELATED NOTES:
(A) ALL INSTRUMENT IN THE SCOPE OF COMPRESSOR VENDOR ARE IDENTIFIED BY (✱).

Valve Tag Number	Body Size	Bypass Valve size
MR-LV-2801	1"	1-1/2"
MR-PV-2801B	12"	-

ALL INSTRUMENTS ARE PRE-FIXED WITH MR-P&ID FOR COMPRESSOR VENDOR SCOPE MARK ONLY

No.	DATE	REVISIONS	DRN	BY	CHKD	APPD.
4	02.11.17	COMPRESSOR VENDOR SCOPE MARKED	PB	DK	RMN	SA

ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

SCALE	JOB NO.	DEPT.	SECTN.	UNIT	DWG. No.	REV.
S	B034	79	41	MR	1128	4

GENERAL NOTES:

FOR GENERAL LEGEND, ABBREVIATIONS, NOMENCLATURE, INSTRUMENTATION, EQUIPMENT SYMBOLOGY AND GENERAL DETAILS
SEE DWG'S 9010434-01 THRU 9010434-10

REV	DFTR	CKR	APVD	DATE	REV	DFTR	CKR	APVD	DATE
1	VS	AG	PK	24APR17	3	AG	AG	PK	02JUN17
2	SK	AG	PK	15MAY17					

Honeywell UOP — UOP ENGINEERING DEPARTMENT

PIPING AND INSTRUMENT DIAGRAM
FIRST STAGE SUCTION DRUM
CCR PLATFORMING PROCESS UNIT

BHARAT PETROLEUM CORPORATION LIMITED-KOCHI REFINERY
BS-VI, MSBP
AMBALAMUGAL, KOCHI, KERALA, INDIA

CUSTOMER DWG NUMBER : 9010436-120-MR-1128

DFTR	CKR	APVD	DATE	PROJECT	TYPE	DWG NO	REV
KS	AMT	PK	20MAR 17	9010436-120-18-A1			3

QUALTRAX 14472

T300135

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FIRST STAGE NET GAS COMPRESSOR
MR-C-02

RATED VOLUMETRIC FLOW RATE: 14200M³/HR
DIFFERENTIAL PRESSURE/HEAD: 7.53 KG/CM²

EJECTOR
1126 | 052
*-P-MR-3011-B5A(B2A1)-NI SIZE BY OTHERS

SECOND STAGE NET GAS COMPRESSOR
1130 | 058
SIZE BY OTHERS *-P-MR-3011-B5A(B2A1)-NI

TROUBLE
SI 2901 | TI 2801 | FI 2901A | PI 2901A | UA 2901 | PI 2902A | TI 2902

SIZE BY OTHERS

SECOND STAGE ANTISURGE CONTROLLER XIC-3001
133 | 1130
*-P-MR-2904-B5A(B2A1)-NI

TEMPERATURE TRANSMITTER TT-2801
044 | 1128

PRESSURE CONTROLLER PIC-2801A
1128 | 046

3 XIK 2901 | 2 PIC | ANTISURGE XIC 2901

SECOND STAGE ANTISURGE CONTROLLER XIC-3001
136 | 1130

COMPRESSOR FI 2901B | FT 2901 | FE 2901

FIRST STAGE SUCTION DRAIN
064 | 1128
18"-P-MR-2801-A5A(B1A1)-NI (9)

¾" B5A (B2A1) | A5A (B1A1)

RECYCLE COMPRESSOR PURGE PIPING
051 | 1125
1½"-H-MR-2515-B5A(B2A1)-NI

SECOND STAGE NET GAS COMPRESSOR
134 | 1130
1½"-H-MR-2515-B5A(B2A1)-NI

450 MAX
B5A (B2A1) | A5A (B1A1)
A5A (B1A1) | B5A (B2A1)
¾" ¾"
¾"-AV-MR-2907-A5A(B1A1)-NI
¾"-H-MR-2906-B5A(B2A1)-NI

1½"-H-MR-2905-B5A(B2A1)-NI

SECOND STAGE NET GAS COMPRESSOR
135 | 1130
1"-AV-MR-2907-A5A(B1A1)-NI

PRESSURE CONTROLLER PIC-2801A
078 | 1128

PDT 2903 FF | PDI 2903 H

TI 2903A H | TI 2903B H | TI 2903C H

UC 6503 TSHH

TT 2903A | TT 2903B | TT 2903C TSHH

TE 2903A | TE 2903B | TE 2903C

TT 2902 | TE 2902

¾"-AV-MR-2909-A5A(B1A1)-NI

B5A (B2A1) | A5A (B1A1)
1½"-H-MR-2905-B5A(B2A1)-NI

¾"-H-MR-2908-B5A(B2A1)-NI

FIRST STAGE DISCHARGE COOLER
138 | 1131

COMPRESSOR PG 2901B | PT 2901

COMPRESSOR PG 2902B

COMPRESSOR PG 2904 | PG 2905 | PT 2902

CRIT TAHH 2903

COMPRESSOR

12"-P-MR-2901-B5A(B2A1)-NI

12"-P-MR-2901-B5A(B2A1)-NI

SCALED SPEED XI 2902

CONTROL CENTER-FIELD HS 2901

SIC | SI 2901

OTHERS VENDOR

18"-P-MR-2801-A5A(B1A1)-NI OTHERS VENDOR TO SECOND STAGE

(1) M

SPEED REFERENCE SIGNAL (NOTE-E)

450 MAX | 450 MAX

10"-P-MR-2902-B5A(B2A1)-NI

XV 2901

FREE DRAINING

(8) (7) UC

CRIT HA 2902 | UC 6503 | HS 2902 COMPRESSOR STOP

10"-P-MR-2903-A5A(B1A1)-NI

NET GAS COOLER
1127 | 063
10"-P-MR-2903-A5A(B1A1)-NI FREE DRAINING NNF

NOTES:

1. FURNISHED BY COMPRESSOR SUPPLIER
2. DISCHARGE PRESSURE HIGH LIMIT CONTROLLER
3. FACEPLATE ONLY
4. DETAIL "CV", SEE DWG 9010434-10
5. DUAL PLATE CHECK VALVE
6. HIGH PRESSURE SIGNAL INCREASES SPEED
7. SHUTDOWN SYSTEM (FURNISHED WITH COMPRESSOR)
8. TO MOTOR CONTROL CIRCUIT
9. DO NOT TRAP OR POCKET THIS LINE

COMPRESSOR RELATED NOTES:

(A) ALL INSTRUMENTS MARKED WITH (*) ARE IN SCOPE OF COMPRESSOR VENDOR.

(B) PSV (2NOS.) AT EACH STAGE COMPRESSOR DISCHARGE, IF REQUIRED, TO BE SUPPLIED BY COMPRESSOR VENDOR.

(C) SUCTION THROTTLE VALVE, IF REQUIRED, AT COMPRESSOR SUCTION TO BE SUPPLIED BY COMPRESSOR VENDOR.

(D) ALL UTILITIES, FLARE DISTRIBUTION / CONNECTION WITHIN VENDOR'S SCOPE BY VENDOR. UTILITIES / FLARE INTERCONNECTION WILL BE PROVIDED AT SINGLE POINT AT VENDOR BATTERY LIMIT.

(E) SPEED REFERENCE SIGNAL FROM VFD.

△4 ALL INSTRUMENTS ARE PRE-FIXED WITH MR-P&ID FOR COMPRESSOR VENDOR SCOPE MARK ONLY

Valve Tag Number	Body Size	Bypass Valve size
MR-XV-2901	8"	-

संख्या No.	तिथि DATE	संशोधन REVISIONS	इन DRN	द्वारा BY	जाँच CHKD	अनुमोदित APPD.
4	02.11.17	COMPRESSOR VENDOR SCOPE MARKED	PB	DK	RMN	SA

इंजिनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम)
ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

अनुमाप SCALE	कार्य संख्या JOB NO.	विभाग DEPT.	अनुभाग SECTN.	इकाई UNIT	आरेख संख्या DWG. No.	संशो. REV.
NTS	B034	79	41	MR	1129	4

GENERAL NOTES:

FOR GENERAL LEGEND, ABBREVIATIONS, NOMENCLATURE, INSTRUMENTATION, EQUIPMENT SYMBOLOGY AND GENERAL DETAILS
SEE DWG'S 9010434-01 THRU 9010434-10

REV	DFTR	CKR	APVD	DATE	REV	DFTR	CKR	APVD	DATE
1	VS	AG	PK	24APR17	3	AG	AG	PK	02JUN17
2	SK	AG	PK	15MAY17					

Honeywell UOP
UOP ENGINEERING DEPARTMENT

PIPING AND INSTRUMENT DIAGRAM
FIRST STAGE NET GAS COMPRESSOR
CCR PLATFORMING PROCESS UNIT

BHARAT PETROLEUM CORPORATION LIMITED-KOCHI REFINERY
BS-VI, MSBP
AMBALAMUGAL, KOCHI, KERALA, INDIA

CUSTOMER DWG NUMBER : 9010436-120-MR-1129

DFTR	CKR	APVD	DATE	PROJECT	TYPE	DWG NO	REV
KS	AMT	PK	20MAR 17	9010436-120-19-A1			3

QUALTRAX 14472

T300255

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SECOND STAGE NET GAS COMPRESSOR
MR-C-02

RATED VOLUMETRIC FLOW RATE: 6440M³/HR
DIFFERENTIAL PRESSURE/HEAD: 13.1 KG/CM²

EJECTOR
1129 | 058 — *-P-MR-3011-B5A(B2A1)-NI SIZE BY OTHERS

TROUBLE
TI 3201 | FI 3001A | PI 3001A | UA 3001 | PI 3002A | TI 3002

FACEPLATE ONLY
XIK 3001

FIRST STAGE ANTISURGE CONTROLLER XIC-2901
1129 | 133

PIC 3001 (1)
PIC 3001 (2)
ANTISURGE
XIC 3001

FIRST STAGE ANTISURGE CONTROLLER XIC-2901
136 | 1129

FIRST STAGE NET GAS COMPRESSOR VENT PIPING
135 | 1129 — 1"-AV-MR-2907-A5A(B1A1)-NI

RECYCLE COMPRESSOR PURGE PIPING
134 | 1129 — 1½"-H-MR-2515-B5A(B2A1)-NI

TEMPERATURE TRANSMITTER TT-3201
1132 | 140

COMPRESSOR
FI 3001B
FT 3001
FE 3001

SECOND STAGE SUCTION DRUM
1132 | 141
12"-P-MR-3202-B5A(B2A1)-NI

1"-AV-MR-2907-A5A(B1A1)-NI
1"-AV-MR-3007-A5A(B1A1)-NI
1"-AV-MR-3006-A1A(B1A1)-NI
1½"-H-MR-2515-B5A(B2A1)-NI
VENDOR | OTHERS
¾"-AV-MR-3009-A5A(B1A1)-NI
¾"-H-MR-3008-B5A(B2A1)-NI
B5A (B2A1) A5A (B1A1)
450 MAX
¾"
1½"

PDT 3003 FF
PDI 3003 H
TI 3003A H
TI 3003B H
TI 3003C H
UC 6503
TSHH
TT 3003A
TT 3003B
TT 3003C
TT 3002
TE 3003A
TE 3003B
TE 3003C
TE 3002
¾"-AV-MR-3007-A5A(B1A1)-NI
1½"-H-MR-2515-B1A(B2A1)-NI
¾"-H-MR-3010-B5A(B2A1)-NI

COMPRESSOR
PG 3001B
PT 3001
PG 3002B
PG 3004
PG 3005
PT 3002
CRIT
TAHH 3003
COMPRESSOR VENDOR ALARM
XA 3002

12"-P-MR-3202-B5A(B2A1)-NI
OTHERS | VENDOR
FROM FIRST STAGE
10"-P-MR-3001-B5A(B2A1)-NI
SECOND STAGE DISCHARGE COOLER
142 | 1134
10"-P-MR-3001-B5A(B2A1)-NI
450 MAX
8"-P-MR-3002-B5A(B2A1)-NI

*-N-MR-3004-A1A(B1A1)-NI
LO
RH 3
A1A(B1A1)
-LRH-MR-3005-(*)-NI
¾"-N-MR-3003-A1A(B1A1)-NI
¾"
N

XV 3001
FO
FREE DRAINING
FREE DRAINING
NNF 8"-P-MR-3002-B5A(B2A1)-NI
FIRST STAGE DISCHARGE COOLER
145 | 1131

MR-C-02 PACKAGE
OTHERS | VENDOR
(H")-A91A CW SUPPLY
(H")-A91A CW RETURN
2"(H)-A3A NITROGEN
2"(H)-A11A FLARE
2"(H)-A3A INST.AIR
1.5"(H)-A91A BCW SUPPLY
1.5"(H)-A91A BCW RETURN
2"(H)-A1A OWS
2"(H)-A1A CBD

NOTES:
1. SUCTION PRESSURE LOW LIMIT CONTROLLER
2. DISCHARGE PRESSURE HIGH LIMIT CONTROLLER
3. SEAL GAS VENT (SIZE BY COMPRESSOR SUPPLIER)
4. DETAIL "CV", SEE DWG 9010434-10
5. DUAL PLATE CHECK VALVE
6. DRY GAS SEAL SYSTEM (FURNISHED WITH COMPRESSOR)
7. LOCATE OUTSIDE COMPRESSOR SHELTER
8. SEPARATE VENTS TO ATMOSPHERE AT SAFE LOCATION
9. DO NOT TRAP OR POCKET THIS LINE

COMPRESSOR RELATED NOTES:

REFER P&ID 9010436-120-MR-1129 FOR COMPRESSOR RELATED NOTES.

Valve Tag Number	Body Size	Bypass Valve size
MR-XV-3001	4"	-

ALL INSTRUMENTS ARE PRE-FIXED WITH MR-P&ID FOR COMPRESSOR VENDOR SCOPE MARK ONLY

संख्या No.	तिथि DATE	संशोधन REVISIONS	ड्रॉन DRN	द्वारा BY	जाँच CHKD	अनुमोदित APPD.
4	02.11.17	COMPRESSOR VENDOR SCOPE MARKED	PB	DK	RMN	SA

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम)
ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

जनुमाप SCALE	कार्य संख्या JOB NO.	विभाग DEPT.	अनुभाग SECTN.	इकाई UNIT	आरेख संख्या DWG. No.	संशो. REV.
NTS	B034	79	41	MR	1130	4

GENERAL NOTES:
FOR GENERAL LEGEND, ABBREVIATIONS, NOMENCLATURE, INSTRUMENTATION, EQUIPMENT SYMBOLOGY AND GENERAL DETAILS
SEE DWG'S 9010434-01 THRU 9010434-10

REV	DFTR	CKR	APVD	DATE	REV	DFTR	CKR	APVD	DATE
1	VS	AG	PK	24APR17	3	AG	AG	PK	02JUN17
2	SK	AG	PK	15MAY17					

Honeywell UOP — UOP ENGINEERING DEPARTMENT

PIPING AND INSTRUMENT DIAGRAM
SECOND STAGE NET GAS COMPRESSOR
CCR PLATFORMING PROCESS UNIT

BHARAT PETROLEUM CORPORATION LIMITED-KOCHI REFINERY
BS-VI, MSBP
AMBALAMUGAL, KOCHI, KERALA, INDIA

CUSTOMER DWG NUMBER : 9010436-120-MR-1130

DFTR	CKR	APVD	DATE	PROJECT	TYPE	DWG NO	REV
KS	AMT	PK	20MAR 17	9010436-120-20-A1			3

QUALTRAX 14472

T300260

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FIRST STAGE DISCHARGE COOLER
MR-E-05

EQUIPMENT TYPE: SHELL AND TUBE
RATED HEAT DUTY: 3.031 MMKCAL/HR
SHELL DESIGN PRESSURE: 17.0 KG/CM^2(G)
TUBE DESIGN PRESSURE: 13.5 KG/CM^2(G)
SHELL DESIGN TEMPERATURE: 170°C
TUBE DESIGN TEMPERATURE: 65°C

FIRST STAGE NET GAS COMPRESSOR
138 | 1129
12"-P-MR-2901-B5A(B2A1)-NI

SECOND STAGE NET GAS COMPRESSOR
145 | 1130
8"-P-MR-3002-B5A(B2A1)-NI
FREE DRAINING

900 MIN

12"-P-MR-2901-B5A(B2A1)-NI

1"-WCR-MR-3104-A3A(MS-1)-NI
BY OTHERS

*-WCR-MR-3106-A3A(MS-1)-NI
PSV BY OTHERS
S1
1
2
TG 3103

* -SS-MR-3105-A3A(MS-1)-NI
SS
LO
3/4"
1"
10"

WCR
10"-WCR-MR-3103-A3A(MS-1)-NI
8"
3
8"-WCS-MR-3107-A3A(MS-1)-NI

WCS
10"-WCS-MR-3102-A3A(MS-1)-NI
8"
SS

12"-P-MR-3101-B5A(B2A1)-NI
SECOND STAGE SUCTION DRUM
146 | 1132

12"-P-MR-3101-B5A(B2A1)-NI TWO PHASE FLOW

NOTES:
1. TO GROUND LEVEL
2. THIS ROUTING FACILITY WILL BE APPLICABLE FOR EXCHANGERS AT PLATFORM
3. THIS CONNECTION TO BE PROVIDED ONLY FOR EXCHANGERS AT PLATFORM (U2M OR ABOVE)
4. SHELL SIDE OF THE EQUIPMENT IS DESIGNED FOR FULL VACUUM

GENERAL NOTES:
FOR GENERAL LEGEND, ABBREVIATIONS, NOMENCLATURE, INSTRUMENTATION, EQUIPMENT SYMBOLOGY AND GENERAL DETAILS
SEE DWG'S 9010434-01 THRU 9010434-10

REV	DFTR	CKR	APVD	DATE
1	VS	AG	PK	24APR17
2	SK	AG	PK	15MAY17

Honeywell UOP
UOP ENGINEERING DEPARTMENT

PIPING AND INSTRUMENT DIAGRAM
FIRST STAGE DISCHARGE COOLER
CCR PLATFORMING PROCESS UNIT

BHARAT PETROLEUM CORPORATION LIMITED-KOCHI REFINERY
BS-VI, MSBP
AMBALAMUGAL, KOCHI, KERALA, INDIA

CUSTOMER DWG NUMBER : 9010436-120-MR-1131

DFTR	CKR	APVD	DATE	PROJECT	TYPE	DWG NO	REV
KS	AMT	PK	20MAR 17	9010436-120-21-A1			2

QUALTRAX 14472

T300265

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1300 X 3900
SECOND STAGE
SUCTION DRUM ◁4 10
_MR-V-07_
MISC CONNS *-P-MR-3211-B5A(B2A1)-NI
DESIGN TEMPERATURE: 145°C
DESIGN PRESSURE: 16.5 KG/CM²(G)

NET GAS COMPRESSOR SECOND STAGE
1130 | 141
12"-P-MR-3202-B5A(B2A1)-NI

4P6
SET@ 16.5 KG/CM²(G)
A5A (B1A1)
PSV 3201A
PSV 3201B
-LRH-MR-3209-(*)-NI
-LRH-MR-3210-(*)-NI
*-LRH-MR-3207-A5A(B1A1)-NI
*-P-MR-3205-B5A(B2A1)-NI
*-LRH-MR-3208-A5A(B1A1)-NI
*-P-MR-3206-B5A(B2A1)-NI
12"-P-MR-3202-B5A(B2A1)-NI
PT 3201 FF
PI 3201
PG 3202
TT 3201
TE 3201
RH
LO
LC
2"
4"

ANTISURGE CONTROLLER XIC-3001
1130 | 140

FIRST STAGE DISCHARGE COOLER
146 | 1131
12"-P-MR-3101-B5A(B2A1)-NI TWO PHASE FLOW
MIN

RADAR (S/S)
LT 3201C
LT 3201B
LT 3201A
COR
350
1500
LSHH
UC 6503
LI 3201A
LI 3201C
LI 3201B
LAHH 3201 CRIT
24" MW
LG-R 3203
LT 3202 FF
LIC 3202
1200
900
3100
COR

CONTROL VALVE LV-3202
098 | 1133

1"-P-MR-3305-B1A(B2A1)-NI
B1A(B2A1)-B5A(B2A1)

4"-P-MR-3201-B1A(B2A1)-NI
B1A (B1A1) (B2A1)
A1A (B1A1) (B2A1)
FREE DRAINING
2"-OWS-MR-3203-A1A(B1A1)-NI
2"-CBD-MR-3204-A1A(B1A1)-NI
OWS
CBD
M 9

SECOND STAGE SUCTION DRUM PUMPS
4"-P-MR-3201-B1A(B2A1)-NI
129 | 1133

SECOND STAGE SUCTION DRUM PUMPS
1"-P-MR-3305-B1A(B2A1)-NI
1133 | 350

NOTES:
1. SEE STD DWG 8-121
2. DETAIL "LVD", SEE DWG 9010434-10
3. 1 SHOWN 3 REQUIRED
4. LOCATE AS CLOSE TO COMPRESSORS AS POSSIBLE
5. DO NOT TRAP OR POCKET THIS LINE
9. INVENTORY ISOLATION VALVE (BY OTHERS), SAFETY REVIEW RECOMMENDED
10. EQUIPMENT IS DESIGNED FOR FULL VACUUM

COMPRESSOR RELATED NOTES:
(A) ALL INSTRUMENT IN THE SCOPE OF COMPRESSOR VENDOR ARE IDENTIFIED BY (*).
△A

ALL INSTRUMENTS ARE PRE-FIXED WITH MR- P&ID FOR COMPRESSOR VENDOR SCOPE MARK ONLY
△A

No.	DATE	REVISIONS	DRN	BY	CHKD	APPD.
3	02.11.17	COMPRESSOR VENDOR SCOPE MARKED	PB	DK	RMN	SA

इंजिनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम)
ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

SCALE	JOB NO.	DEPT.	SECTN.	UNIT	DWG. No.	REV.
NTS	B034	79	41	MR	1132	3

GENERAL NOTES:
FOR GENERAL LEGEND, ABBREVIATIONS, NOMENCLATURE, INSTRUMENTATION, EQUIPMENT SYMBOLOGY AND GENERAL DETAILS
SEE DWG'S 9010434-01 THRU 9010434-10

REV	DFTR	CKR	APVD	DATE	REV	DFTR	CKR	APVD	DATE
1	_VS	_AG	_PK	24APR17	_	---	---	---	-------
2	_SK	_AG	_PK	15MAY17	_	---	---	---	-------

Honeywell UOP
UOP ENGINEERING DEPARTMENT

PIPING AND INSTRUMENT DIAGRAM
SECOND STAGE SUCTION DRUM
CCR PLATFORMING PROCESS UNIT

BHARAT PETROLEUM CORPORATION LIMITED-KOCHI REFINERY
BS-VI, MSBP
AMBALAMUGAL, KOCHI, KERALA, INDIA

CUSTOMER DWG NUMBER : 9010436-120-MR-1132

DFTR	CKR	APVD	DATE	PROJECT	TYPE	DWG NO	REV
_KS	AMT	_PK	20MAR 17	9010436-120-22-A1			2

QUALTRAX 14472

T300225

VALVE SYMBOLS

- GATE
- CHECK
- GLOBE
- BALL
- PLUG
- BUTTERFLY
- NEEDLE
- DIAPHRAGM
- THREE WAY
- FOUR WAY
- ANGLE
- STOP CHECK
- INTERMITTENT BLOWDOWN (BLOW-OFF)
- CONTINUOUS BLOWDOWN
- GATE WITH BODY BLEED
- HYDRAULIC CONTROL
- FLOW CONTROL
- ACTUATED CONTROL VALVE

PIPING FITTINGS

- FLANGE
- FLANGE WITH BLIND FLANGE
- WELDED PIPE CAP
- CONCENTRIC (OR GENERIC) REDUCER
- ECCENTRIC REDUCER
- HOSE CONNECTION
- SPACER
- SPECTACLE BLIND
- VALVE WITH BLIND FLANGE
- VALVE WITH BLIND FLANGE
- VALVE WITH THREADED CAP

LETTERS AT INDIVIDUAL VALVES DESIGNATE

A	MONEL (ALLOY 400) TRIM (GREASE SEALED SEAT AND PACKING)
B	MONEL (ALLOY 400) VALVE (GREASE SEALED SEAT AND PACKING)
CC	CABLE CONTROL
CN	SOLID ALLOY VALVE
CSC	CAR SEAL CLOSED
CSO	CAR SEAL OPEN
FC	FAIL CLOSE
FL	FAILS LOCKED: VALVE POSITION DOES NOT CHANGE ON LOSS OF ACTUATING MEDIUM
FLC	FAILS LOCKED: VALVE POSITION DOES NOT CHANGE ON LOSS OF ACTUATING MEDIUM SUPPLY. (CLOSES ON MINIMUM SIGNAL TO VALVE ACTUATOR)
FLO	FAILS LOCKED: VALVE POSITION DOES NOT CHANGE ON LOSS OF ACTUATING MEDIUM SUPPLY. (OPENS ON MINIMUM SIGNAL TO VALVE ACTUATOR)
FO	FAIL OPEN
FP	FULL PORT
FS	FIRE SAFE
GM	GEAR OPERATED OR MOTORIZED VALVE
GO	GEAR OPERATED VALVE
H	HASTELLOY TRIM
LC	LOCK CLOSED
LO	LOCK OPEN
M	MONEL (ALLOY 400) TRIM
MN	MONEL (ALLOY 400) TRIM, CARBON STEEL VALVE IN COMPLIANCE WITH NACE MR0103
MN5	MONEL (ALLOY 400) TRIM, CARBON STEEL VALVE IN COMPLIANCE WITH NACE MR0175
MO	MOTOR OPERATED VALVE
MS	METAL SEAT
MSS	METAL SEAT STELLITE
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
OT	OVER TRAVEL
RTSV	ROTARY TIGHT SHUT-OFF VALVE
SS	STAINLESS STEEL
ST	STELLITE TRIM
T	MONEL (ALLOY 400) TRIM (TEFLON INSERT WITH GREASE SEALED PACKING)
TSO	TIGHT SHUT-OFF
V	V-PORT
X	TYPE 316 STAINLESS STEEL TRIM VALVE
XN	TYPE 316 STAINLESS STEEL TRIM VALVE IN COMPLIANCE WITH NACE MR0103
XX	18-8 STAINLESS STEEL TRIM VALVE

LETTERS AT STRAINERS DESIGNATE

XN	TYPE 316 STAINLESS STEEL INTERNALS IN COMPLIANCE WITH NACE MR0103
MN	MONEL (ALLOY 400) TRIM, CARBON STEEL VALVE IN COMPLIANCE WITH NACE MR0103

GENERAL NOTES

NOTE:
CONTRACTOR IS TO PROVIDE PLATFORM ACCESS FOR MANWAYS AND EQUIPMENT WHICH CANNOT BE ACCESSED FROM GRADE. PERMANENT PLATFORMS ARE REQUIRED WHEN THE PLATFORM STRUCTURAL SUPPORT MEMBER ALLOW A CLEARANCE OF 7'-3" (2200) OR GREATER ABOVE GRADE. TEMPORARY OR PORTABLE PLATFORMS ARE REQUIRED WHEN THE CLEARENCE BETWEEN PLATFORM STRUCTURAL SUPPORT MEMBERS AND GRADE WOULD BE LESS THAN 7'-3" (2200)

NOTE:
CONTRACTOR SHALL COORDINATE SUCH THAT MATING PIPING/VESSEL FLANGES USED FOR INSTRUMENT CONNECTION ARE THE SAME FLANGE CLASS AND FINISH AS THE FLANGES SPECIFIED FOR THE INSTRUMENTS.

NOTE:
FOR PROJECTS WHERE METRIC UNITS ARE SPECIFIED: ALL DIMENSIONS ARE IN MILLIMETERS UNLESS SPECIFICALLY NOTED OTHERWISE.

GENERAL PIPING SYMBOLS

- PRIMARY PIPING
- SECONDARY PIPING
- PIPING AND EQUIPMENT SHOWN ON OTHER P AND I DIAGRAMS
- FUTURE PIPING AND EQUIPMENT
- HEAT TRACE AND INSULATE TO MAINTAIN TEMPERATURE AS INDICATED IN DEGREES FAHRENHEIT OR CENTIGRADE
- JACKETED OR DOUBLE CONTAINMENT

MISCELLANEOUS SYMBOLS

- Y-TYPE STRAINER
- T-TYPE STRAINER
- BASKET STRAINER
- D — DETONATION ARRESTOR
- F — FLAME ARRESTOR
- T — STEAM TRAP
- MW — MANWAY
- RS — REMOVABLE SPOOL
- FLEXIBLE HOSE
- EXPANSION JOINT
- DAMPER
- VENT COVER
- EXHAUST HEAD
- SIGHT GLASS
- AGITATOR/MIXER
- DS — DESUPERHEATER
- FILTER
- STATIC MIXER
- EJECTOR/EDUCTOR
- S — SILENCER
- NOTE REFERENCE SYMBOL (XX = NOTE NUMBER, ROTATE ARROW AS REQUIRED)
- BATTERY LIMITS
- FREE DRAINING — FREE DRAINING REQUIREMENT DENOTES NON-POCKETED, GRAVITY FLOW LINE WITH INDICATED DIRECTION OF FLOW
- BASE LINE

OFF-PAGE & UTILITIES CONNECTORS

IN-UNIT CONNECTOR

DRAWING NUMBER
CONNECTOR NUMBER

DRAWING NUMBER
CONNECTOR NUMBER

OFF-UNIT CONNECTOR

DRAWING NUMBER
UOP UNIT TO/FROM UOP UNIT
PROJECT NUMBER

BY OTHERS — UOP UNIT TO/FROM NON-UOP UNIT

TO AND FROM UTILITIES

CLOSED DRAIN

XXXX ← CONNECTOR NUMBER (BY OTHERS)
XXX ← DESTINATION (SERVICE CODE)

OPEN DRAIN

XXXX ← CONNECTOR NUMBER (BY OTHERS)
XXX ← DESTINATION (SERVICE CODE)

NOTES:
1.

REV	DFTR	CKR	APVD	DATE	REV	DFTR	CKR	APVD	DATE
1	AG	AG	AM	24APR17					

Honeywell UOP
UOP ENGINEERING DEPARTMENT

PIPING AND INSTRUMENT DIAGRAM
LEGEND SHEET 1
SYMBOLS AND NOMENCLATURE

BHARAT PETROLEUM CORPORATION LIMITED-KOCHI REFINERY
BS-VI, MSBP
AMBALAMUGAL, KOCHI, KERALA, INDIA

DFTR	CKR	APVD	DATE	PROJECT	TYPE	DWG NO	REV
KS	AG	AM	20MAR 17	9010434-120-01-A1		1	

QUALTRAX 14453

L05000I

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GENERAL ABBREVATIONS

ATM	ATMOSPHERE
BL	BATTERY LIMIT
BTL	BOTTOM TANGENT LINE
CL	CENTERLINE
CONN	CONNECTION
COR	CENTER OF RANGE
DA	AERATION POINT USING AIR
DG	AERATION POINT USING GAS
DN	AERATION POINT USING NITROGEN
DS	AERATION POINT USING STEAM
DCS	DISTRIBUTED CONTROL SYSTEM
DES	DESIGN
DIA	DIAMETER
DP	DESIGN PRESSURE
DT	DESIGN TEMPERATURE
EIV	EMERGENCY ISOLATION VALVE
ESD	EMERGENCY SHUTDOWN
FLG	FLANGE
HH	HAND HOLE
HOA	HAND/OFF/AUTOMATIC
HP	HIGH PRESSURE
IAS	INSTRUMENT AIR SUPPLY
INT	INTERFACE
INS	INSULATE (2)
ISBL	INSIDE BATTERY LIMITS
LP	LOW PRESSURE
MAX	MAXIMUM
MIN	MINIMUM
MW	MANWAY
NNF	NORMALLY NO FLOW
O/C	OPEN/CLOSE
O/O	ON/OFF
OSBL	OUTSIDE BATTERY LIMITS
PLC	PROGRAMMABLE LOGIC CONTROLLER
PSV	PRESSURE RELIEF VALVE
PSE	RUPTURE DISC ASSEMBLY
PTP	PIPETAP PLUGGED
PWHT	POSTWELD HEAT TREAT
RO	RESTRICTION ORIFICE
RTD	RESISTANCE TEMP DETECTOR
SC	SAMPLE CONNECTION
SIS	SAFETY INSTRUMENTED SYSTEM
SO	STEAM OUT
SP	SET POINT
SS	STAINLESS STEEL
T/T	TANGENT TO TANGENT
TYP	TYPICAL
UC	UTILITY CONNECTION
WISI	WINTERIZE WITH HEAT TRACER BETWEEN SPACER AND INSULATION
1002	ONE OUT OF TWO VOTING
2002	TWO OUT OF TWO VOTING
2003	TWO OUT OF THREE VOTING

SERVICE CODES

◇ SERVICE CODE SYMBOL

RELIEF HEADER

ARH	ACID RELIELF HEADER
CRH	COLD RELIELF HEADER
HRH	HIGH PRESSURE RELIEF HEADER
LRH	LOW PRESSURE RELIEF HEADER
NRH	NON-ACID RELIELF HEADER
RH	RELIEF HEADER
SRH	SOUR GAS RELIEF HEADER

STEAM

SVH	VERY HIGH PRESSURE STEAM
SH	HIGH PRESSURE STEAM
LLS	LOW LOW PRESSURE STEAM
SL	LOW PRESSURE STEAM
SM	MEDIUM PRESSURE STEAM

CONDENSATE

C	CONDENSATE
CC	COLD CONDENSATE
CH	HIGH PRESSURE CONDENSATE
CVH	VERY HIGH PRESSURE CONDENSATE
CL	LOW PRESSURE CONDENSATE
CM	MEDIUM PRESSURE CONDENSATE
PC	PROCESS CONDENSATE
SC	STEAM CONDENSATE

WATER

WB	BOILER FEED WATER
WCS	COOLING WATER SUPPLY
WCR	COOLING WATER RETURN
BCS	BEARING COOLING WATER SUPPLY
BCR	BEARING COOLING WATER RETURN
WDM	DEMINERALIZED WATER
WF	FIRE WATER
POW	POTABLE WATER
PW	PROCESS WATER
WQ	QUENCH WATER
SWR	SEA WATER RETURN
SWS	SEA WATER SUPPLY
SW	SOUR WATER
WR	RAW WATER
WTR	TEMPERED WATER RETURN
WTS	TEMPERED WATER SUPPLY
WW	WASTE WATER
W	WATER (TYPE SPECIFIED AT P&ID)

SUMP

AS	AMINE SUMP
ASB	AMINE SUMP (BY OTHERS)
ARS	AROMATICS SUMP
SSU	SULFOLANE SUMP

VENT

AV	ATMOSPHERIC VENT
VD	VENT DRUM
VDR	VENT AND DRAIN RISER
VH	VENT HEADER

DRAIN

CDH	CLOSED DRAIN HEADER
CS	CHEMICAL SEWER
OWS	OILY WATER SEWER
NAS	CAUSTIC SEWER
SS	STORM SEWER

UTILITIES

DPA	DRY PLANT AIR
FG	FUEL GAS
FLO	FLUSHING OIL
FO	FUEL OIL
H	HYDROGEN
HTO	HOT OIL
HO	HYDRAULIC OIL
HFLO	HEAVY FLUSHING OIL
AI	INSTRUMENT AIR
LNG	LIQUIFIED NATURAL GAS
LO	LUBE OIL
LPG	LIQUIFIED PETROLEUM GAS
ME	METHANOL
N	NITROGEN
CA	CAUSTIC
ND	DRY NITROGEN
NG	NATURAL GAS
NH	AMMONIA
OX	OXYGEN
PA	PLANT AIR
PG	PURGE GAS

REFRIGERANT

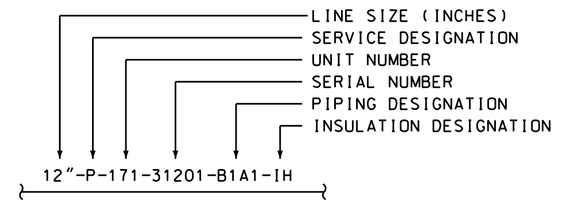
RP	PROPYLENE REFRIGERANT
RR	REFRIGERANT RETURN
RS	REFRIGERANT SUPPLY

MISCELLANEOUS

AG	ACID GAS
AL	LEAN AMINE
AR	RICH AMINE
CAT	CATALYST
GLR	GLYCOL RETURN
GLS	GLYCOL SUPPLY
P	GENERAL PROCESS

LINE LIST SERVICE CODES

LINE DATA IDENTIFICATION



IN THE FOUR-DIGIT LINE SERIAL NUMBER, THE DIGITS SHALL BE USED AS FOLLOWS
FIRST 2 DIGITS: SAME AS LAST 2 DIGITS OF P&ID SERIAL NUMBER.
LAST 2 DIGITS: SERIAL NUMBER STARTING FROM 01

BD	BLOWDOWN
BDC	BLOWDOWN CONTINUOUS
BDI	BLOWDOWN INTERMITTENT
CBD	CLOSED BLOWDOWN
CCBD	CAUSTIC CLOSED BLOWDOWN
IE	ELECTRICAL TRACED
IH	HOT INSULATION
IC	COLD INSULATION
NI	NON-INSULATED
PC	INSULATION TO PREVENT SURFACE CONDENSATION
IS	SAFETY INSULATION
IJ	STEAM JACKETED
IT	STEAM TRACED

NOTES:
1.

REV	DFTR	CKR	APVD	DATE
1	AG	AG	AM	24APR17
2	SK	AG	AM	12MAY17

Honeywell UOP
UOP ENGINEERING DEPARTMENT

PIPING AND INSTRUMENT DIAGRAM
LEGEND SHEET 2
NOMENCLATURE

BHARAT PETROLEUM CORPORATION LIMITED-KOCHI REFINERY
BS-VI, MSBP
AMBALAMUGAL, KOCHI, KERALA, INDIA

DFTR	CKR	APVD	DATE	PROJECT	TYPE	DWG NO	REV
KS	AG	AM	20MAR 17	9010434	120-02-A1	2	

QUALTRAX 14453

L050002

THIS P AND I DIAGRAM IS DIAGRAMMATIC ONLY. DESIGN OF PIPE LINES MUST BE INVESTIGATED FOR VENTING OF GAS AND VAPOR POCKETS IN PIPING AND EQUIPMENT, LOW POINTS IN PIPING, PUMPS AND EQUIPMENT FOR FREEZING AND DRAINING, AND ACCESSIBILITY OF ALL VALVES, FLANGES, INSTRUMENTS INCLUDING THERMOCOUPLES, ETC.

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INSTRUMENT LINE SYMBOLS

- INSTRUMENT SUPPLY OR CONNECTION TO PROCESS
- PNEUMATIC SIGNAL
- ELECTRIC SIGNAL
- HYDRAULIC SIGNAL
- CAPILLARY TUBING
- ELECTROMAGNETIC, SONIC, OPTICAL, OR NUCLEAR SIGNAL
- SOFTWARE OR DATA LINK
- ELECTRIC BINARY SIGNAL (ON-OFF)

GENERAL INSTRUMENT NUMBERING PHILOSOPHY

XXX-ABC-YYZZ

- INSTRUMENT SERIAL NUMBER (NUMBERED BY SPECIFIC CATEGORY)
- YY: SAME 2 DIGITS AS P&ID SHEET NUMBER
- ZZ: INSTRUMENT SERIAL NUMBER STARTING WITH "01" (SUFFIXED WITH A,B,C,D IF REQUIRED)
- INSTRUMENT DESIGNATION (e.g. FIC, PIC, LIC...)
- PREFIX - UNIT NUMBER (INDICATED IN INSTRUMENT SPECIFICATION)

INSTRUMENT ABBREVIATIONS

DISP	DISPLACEMENT TYPE LEVEL TRANSMITTER
D/P	DIFFERENTIAL PRESSURE TYPE LEVEL TRANSMITTER
FIF	FLOW INDICATOR FLOAT TYPE
LG-M	MAGNETIC LEVEL GAUGE - WHEN INDICATED, ACTUAL LENGTH SHOWN
LG-R	GAUGE GLASS REFLEX TYPE - WHEN INDICATED, MINIMUM VISIBLE LENGTH SHOWN
LG-RLT	GAUGE GLASS REFLEX TYPE - WHEN INDICATED, MINIMUM VISIBLE LENGTH SHOWN - LOW TEMPERATURE
LG-T	GAUGE GLASS TRANSPARENT TYPE - WHEN INDICATED, MINIMUM VISIBLE LENGTH SHOWN
LG-TG	GAUGE GLASS TRANSPARENT TYPE - WHEN INDICATED, MINIMUM VISIBLE LENGTH SHOWN - GRAFOIL
LG-TK	GAUGE GLASS TRANSPARENT TYPE - WHEN INDICATED, MINIMUM VISIBLE LENGTH SHOWN - KEL-F
LG-TLT	GAUGE GLASS TRANSPARENT TYPE - WHEN INDICATED, MINIMUM VISIBLE LENGTH SHOWN - LOW TEMPERATURE
MGV	MONEL (ALLOY 400) TRIM GAUGE VALVES
MNGV	MONEL (ALLOY 400) TRIM, CARBON STEEL GAUGE VALVES IN COMPLIANCE WITH NACE MR0103
MN5GV	MONEL (ALLOY 400) TRIM, CARBON STEEL GAUGE VALVES IN COMPLIANCE WITH NACE MR0175
OGV	OMIT GAUGE VALVES
RTD	RESISTANCE TEMPERATURE DETECTOR
SP	SET POINT
(S/B)	SIDE/BOTTOM
(S/S)	SIDE/SIDE
(T/B)	TOP/BOTTOM
(T/S)	TOP/SIDE
XGV	TYPE 316 STAINLESS STEEL TRIM GAUGE VALVES
XNGV	TYPE 316 STAINLESS STEEL TRIM GAUGE VALVES IN COMPLIANCE WITH NACE MR0103
●ZSH	VALVE OPEN POSITION SWITCH (● = THE MEASURED VARIABLE)
●ZSL	VALVE CLOSED POSITION SWITCH (● = THE MEASURED VARIABLE)

WHEN INSTRUMENTS ARE DESIGNATED WITH AN ALARM

DH	DIFFERENTIAL HIGH	LL	LOW-LOW (INTERLOCK)
DL	DIFFERENTIAL LOW	TD	TIME DELAY
H	INDICATES HIGH		
L	INDICATES LOW		
HH	HIGH-HIGH (INTERLOCK)		

PRIMARY ELEMENT SYMBOLS (FLOW)

- ORIFICE
- MAGNETIC
- TURBINE OR PROPELLER
- VORTEX
- AVERAGING PITOT TUBE
- CORIOLIS
- VENTURI
- WEDGE METER
- WEIR
- POSITIVE DISPLACEMENT
- ROTAMETER (FIF)
- RESTRICTION ORIFICE (FO)
- THERMAL MASS (ΔT)
- PREFABRICATED METER RUN — FURNISHED WITH PREFABRICATED METER RUN WHERE SPECIFIED. (NOT SHOWN ON P&ID)
- FLOW NOZZLE (I)

FUNCTION IDENTIFICATION

REFER TO LIST BELOW FOR IDENTIFICATION

Σ SUM	HIGH LIMITER	HIGH SELECTOR
÷ DIVIDE	LOW LIMITER	LOW SELECTOR
√ EXTRACT SQ RT	DIFFERENCE	MULTIPLY
%/t DERIVATIVE		

= INPUT/OUTPUT OF THE FOLLOWING

DESIGNATION	SIGNAL
A	ANALOG
D	DIGITAL
E	VOLTAGE (EMF)
I	CURRENT
N	HYDRAULIC
O	ELECTROMAGNETIC
P	PNEUMATIC
R	RESISTANCE

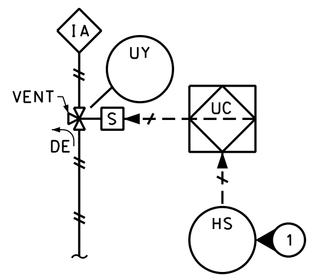
SELF-ACTUATED DEVICES

- RUPTURE DISC OR SAFETY HEAD FOR PRESSURE RELIEF (EXPLOSION PANEL)
- PRV - PRESSURE RELIEF VALVE SERVICE (SEE PROJECT SPECIFICATION 807 FOR DETAILED PRESSURE RELIEF VALVE REQUIREMENTS)
- PRESSURE REDUCING REGULATOR (SELF-CONTAINED)
- BACK PRESSURE REGULATOR (SELF-CONTAINED)
- LCV / T — STEAM TRAP - BALL FLOAT TYPE

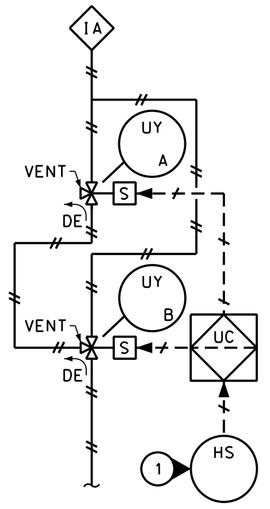
ACTUATOR SYMBOLS

- DIAPHRAGM
- DIAPHRAGM WITH HANDWHEEL
- ACTUATOR (TYPE BY CONTRACTOR)
- ACTUATOR WITH HANDWHEEL
- CYLINDER/PISTON
- CYLINDER/PISTON WITH HANDWHEEL
- MOTOR (M)

SOLENOID VALVING DETAILS



TYPICAL ARRANGEMENT FOR SINGLE SOLENOID VALVE WITH PUSH BUTTON RESET



TYPICAL ARRANGEMENT FOR DUAL SOLENOID VALVE WITH PUSH BUTTON RESET

DISTRIBUTED CONTROL-SHARED DISPLAY SYMBOLS

- SHARED DISPLAY DEVICE WITH LIMITED ACCESS TO ADJUSTMENTS
- SHARED DISPLAY INDICATOR, CONTROLLER, OR OTHER DEVICE WITH OPERATOR ACCESS TO ADJUSTMENTS
- H / L — SOFTWARE ALARMS WITH SHARED DISPLAY DEVICE
- H / L — CRITICAL SOFTWARE ALARM
- CRIT — CRITICAL SHUTDOWN ALARM

GENERAL INSTRUMENT SYMBOLS

- INSTRUMENT LOCATED IN FIELD
- INSTRUMENT MOUNTED ON LOCAL PANEL
- INSTRUMENT MOUNTED ON CONSOLE OR PANEL
- INSTRUMENT MOUNTED ON RACK OR BEHIND PANEL
- INSTRUMENT WITH DUAL FUNCTION (OR SERVICES)
- UC — LOGIC SYSTEM WITH LIMITED ACCESS TO ADJUSTMENTS
- CHEMICAL SEAL/DIAPHRAGM

FUNCTIONAL IDENTIFICATION OF INSTRUMENTS

	FIRST LETTER	SUBSEQUENT LETTERS		
	MEASURED VARIABLE	MODIFIER	READOUT	OUTPUT
A	ANALYSIS		ALARM	
B	BURNER FLAME			
C		COMPENSATED		CONTROL
D		DIFFERENTIAL		
E			PRIMARY ELEMENT	
F	FLOW	RATIO (FRACTION)		
G			GLASS, GAUGE	
H	HAND (MANUAL)			
I	CURRENT		INDICATE	
J	POWER	SCAN		
K		TIME RATE OF CHANGE	CONTROL STATION	
L	LEVEL		LIGHT	
M				
N				
O			ORIFICE	
P	PRESSURE, VACUUM		POINT (TEST CONNECTION)	
Q	QUANTITY	INTEGRATE, TOTALIZE		
R			RECORD	
S	SPEED, FREQUENCY	SAFETY		SWITCH
T	TEMPERATURE			TRANSMITTER
U	MULTIVARIABLE			
V	VIBRATION			VALVE
W	WEIGHT		WELL	
X		SKIN		
Y				RELAY, COMPUTE
Z	POSITION	POSITION		

NOTES:

1. RESET, LOCATE NEAR ASSOCIATED VALVE

REV	DFTR	CKR	APVD	DATE	REV	DFTR	CKR	APVD	DATE
1	AG	AG	AM	24APR17					

Honeywell UOP
UOP ENGINEERING DEPARTMENT

PIPING AND INSTRUMENT DIAGRAM
LEGEND SHEET 3
INSTRUMENTATION

BHARAT PETROLEUM CORPORATION LIMITED-KOCHI REFINERY
BS-VI, MSBP
AMBALAMUGAL, KOCHI, KERALA, INDIA

DFTR	CKR	APVD	DATE	PROJECT	TYPE	DWG NO	REV
KS	AG	AM	20MAR17	9010434-120-03-A1			1

QUALTRAX 14453

LOS0003

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SPECIFICATION FOR COMPRESSOR CONTROL SYSTEM (ANTISURGE, PERFORMANCE, LOADSHARING)

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INSTRUCTIONS TO BIDDERS:

a) Bidders are advised to contact BHEL for essential technical queries in writing within one week of issue of Enquiry. Offers with incomplete information will not be considered for evaluation, and are likely to be rejected without any further correspondence with the Bidder.

b) Unsolicited requests from bidders for alterations to their already submitted offer will not be permitted. These would not be taken cognizance, and offers will be evaluated without taking into account such requests/correspondence.

c) Any technical features over & above BHEL enquiry specification requirements proposed by Bidder will not be given preference for the purpose of evaluation.

d) Bidders shall comply BHEL specifications in total. Incomplete offers will be rejected. In case feasible deviations are proposed by the bidder and subsequently withdrawn, no commercial implications can be claimed by the bidder.

e) Bidders are advised to quote models and makes with proven track record of successful operation. Offers shall include supporting catalogue and published literature {duly highlighting, as appropriate, the offered variant} with complete de-codification of the offered models. In case of discrepancy between bidder's offer and published documents, details furnished in published documents will be taken for the purpose of evaluation.

f) In the event of any conflict between these specifications, data sheets, related standards, codes etc. the bidder shall refer the matter to the purchaser for clarifications and only after obtaining the same shall proceed with the manufacture/procurement of the items in question.

g) Bidder shall submit duly filled deviation format enclosed with this specification along with technical offer, otherwise, it will be presumed that there are no deviations from this specification. Offer without this deviation list will not be evaluated & shall be rejected. If, there are no deviations, bidder shall submit signed copy of deviation format, mentioning "No Deviations".

h) Changes if any made by BHEL during technical evaluation on the specification requirements or Bill of material, bidder is requested by the purchase to submit impact price (amount to be reduced or increased to the original offered price) for those changed items only, other items for which there are no technical changes, unit rates shall be maintained as it is.

i) Bidder has to quote for all the items required for implementation of Enquiry as a complete package, exclusion of any item is not acceptable and the offer will be rejected.

j) Bidder shall submit 'filled-in PQR document' if provided along with enquiry.

k) In case of any technical query, bidders may contact the following BHEL engineer:

Name: Sandhya
Designation: Senior Engineer
Deptt: TC Engineering
Phone: +91 40 2318 2961
Email: sandhya@bhel.in

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Ref. Doc

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9	TRAINING
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1. **SCOPE:**

a) Compressor Control System (CCS) mean Compressor Antisurge, Performance, Loadsharing etc. In some cases, Compressor Control applications / controllers like Performance, Loadsharing etc. may not be applicable. Please refer the Variant Table for Project Specific Controllers / Applications.

b) This Specification gives the requirement of Compressor Control System (Antisurge, Performance, Loadsharing etc.) for centrifugal compressor train. The scope of vendor shall include Design, Selection, Manufacture, Assembly, Testing, Packing, Supply and Documentation, Training (if specified), supervision of Erection and Commissioning of Compressor Control system for centrifugal compressor for use in fertilizer, petrochemical, refinery industries etc.

c) Vendor is solely responsible for Compressor Control System package items viz. engineering, procurement, and supply with documentation, submission of drawings / datasheets, and dispatch the material along with O&M manuals to site.

d) It is the responsibility of the vendor for engineering of the complete Compressor Control System package along with detailed Bill of material and model selection. If there is shortage or mismatch of any items identified at any stage up to commissioning the complete antisurge / performance system package, vendor shall rectify / replace / supply the items without any commercial or delivery implications.

e) Project Specific data like Process P&ID, Isometrics, Instrument datasheets shall be provided during detail engineering; however the number of Compressor Control applications / controllers (Antisurge, Performance, Loadsharing etc.) shall be as specified in Enquiry.

2. **TECHNICAL REQUIRMENTS:**

2.1 **TECHNICAL REQUIREMENTS- HARDWARE:**

a) The Compressor Control System shall be based on "CCC series 5 Vanguard / CCC Prodigy", or Equivalent hardware platform. It is the responsibility of the vendor to select and design the offered Compressor Control System package equivalent to "CCC series 5 Vanguard / CCC Prodigy". Comparative statement of the offered Compressor Control System package with respect to "CCC series 5 Vanguard / CCC Prodigy" shall be furnished along with the offer, Deviations if any of the offered Compressor Control System package with respect to "CCC series 5 Vanguard / CCC Prodigy" shall be listed out and furnished along with the offer.

b) If Redundant Compressor Control System is specified, vendor shall consider "CCC series 5 Vanguard / CCC Prodigy", or Equivalent hardware platform in Dual Redundant configuration with bumpless transfer for the IO's. BHEL supplied Field devices like pressure, flow and temperature transmitter & Antisurge valve shall be SINGLE only.

c) If specified, Compressor Control System shall be supplied with Operator interface system (HMI) with following features:

- The HMI screen shall be 21" (or 22") LED screen with keyboard (Table top mounted type).
- The HMI workstation shall DELL / IBM / HP make.
- HDD $\geq$ 1 TB, RAID 1 configuration.
- CPU: Intel Core i5 or better.
- RAM $\geq$ 8 GB

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- OS: Window 7 or higher version
- Ethernet: Dual Channel 10 / 100 Ethernet card.
- The operator interface system (HMI) shall be capable of following functions:
  - Engineering and configuration of Compressor Control System application software.
  - Loading / Unloading / backup of Compressor Control System application software.
  - Compressor Control System Graphic Screen (Compressor maps with operating point, surge / antisurge lines / margins. Vendor shall develop graphic screens required for monitoring, operation and annunciation purpose during detailed engineering stage and furnish the screens for approval.
  - Compressor Control System Historian / SOE.
  - Capability to transfer / export Historian data / SOE to MS Excel.
- The HMI Workstation shall be supplied with applicable Compressor Control System software for the above listed functions shall be supplied with valid license. The software license shall not be time bound or limited to specific period of use (like valid for 1 year etc.). The software license shall not expire after a certain period.
- The HMI Workstation shall be supplied with antivirus software, valid for at least 3 years from date of activation. The Antivirus shall be activated during commissioning of compressor control system.
- The complete software backup image of As-Shipped HMI workstation shall be supplied in a USB.
- A second software backup image of the As-Commissioned HMI workstation shall be created after commissioning and a copy of the same shall be submitted to BHEL.

d) If specified, a laptop PC shall be supplied with Compressor Control System configuration (modification of setpoints, system tuning etc., uploading and unloading of controller application).

e) Vendor shall be fully responsible for the complete design of Compressor Control System. Vendor shall guarantee the performance of the machine with the offered system. Wherever required, Compressor Control System shall be designed in such a way that it is capable of correcting the compressor operating point so as to avoid surge in order to protect machine from possible damage, to minimize process upsets and to minimize recirculation, achieve the desired operating point and loadsharing (in case of parallel compressor trains, if applicable).

f) Vendor shall supply all the hardware and software related to the operation and safety of the compressor. This shall include but not limited to the following:

i. Design and operation of surge control loop, Performance & loadsharing (if specified) scheme based on offered compressor performance.

ii. Vendor shall supply all hardware in Compressor Control System including dedicated controller, programming system, software, communication converters, cables etc.; excluding the field devices like transmitters, measuring elements, final control elements etc., which shall be supplied by purchaser.

iii. Algorithm required for anti-surge, Performance & loadsharing control applications (as applicable).

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g) The compressor control system controller hardware shall be a dedicated single loop controller on proprietary Hardware Platform or single / multi loop controller of common hardware platform such as PLC. The compressor control system controller shall be dedicated controller for each AntiSurge, Performance and loadsharing control application / Tag. It should be possible to change / modify the CCS configuration from this facia / display. Incase vendor provides a display without keys / provision for configuration / setpoint modification, vendor shall include a laptop along with configuration software in its scope. A panel mount type configuration PC shall be preferred.

h) Compressor Control System should be able to accept 4-20 mA signal from field or from HIC at purchaser DCS or at LCP as a manual override (external setpoint like Remote Low Clamp for Antisurge etc.) with bump less transfer.

i) Auto-manual operation with bump less transfer shall be provided.

j) The controller response time (total time to read input, processing time and output) shall be as per the machine dynamics and safety and shall be maximum 40 milliseconds. Any faster response required based on machine dynamics shall be considered by vendor. The input sampling interval shall be as per machine dynamics within the controller response time as above. The processor cycle time shall be considered to meet the overall response time.

k) The Compressor Control System shall be field proven, specific to the make of machine and for the similar application in hydrocarbon industries. Vendor shall provide the proven track record for the offered system meeting the above criterion.

l) The Compressor Control System application algorithm shall be implemented using standard firmware in the controller / processor system.

m) If specified, Compressor Control System shall be based on redundant hardware on hot standby with bump less transfer.

n) The algorithm developed by vendor shall be specific for given application, surge control, performance, load sharing etc. and shall be field proven for the compressor make.

o) The algorithm implemented in the system shall be protected against any unauthorized modifications / changes.

p) The configuration shall be stored in non-volatile memory or battery back-up for configuration shall be provided (minimum 72 hours) in case of volatile memory along with battery drain indication.

q) Compressor Control System shall not be used for performing any other machine related protection interlocks / logics.

2.2 TECHNICAL REQUIREMENTS-GENERAL:

a) The input signals shall be 4-20mA, 2 wire and powered from the controller.

b) The controller shall monitor each transmitter input signal for high and low values. Alarm limits shall be set at 95% increasing and 5% decreasing signals. When a transmitter input signal exceeds the alarm limit, a relay will de-energise to actuate a command “transmitter out of range” alarm (alarm by others) in the control center. The controller output signal shall de-energise a relay at 95% decreasing value to actuate “Controller operating” alarm (by others) in the control room.

c) The controller shall monitor its output and initiate an alarm if output failure is detected.

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d) The controller shall be designed with a fail-safe mode to prevent a process upset caused by a transmitter or input failure. The controller vendor shall specify the fail-safe mode required for each specific installation.
e) The performance of system design that integrates process control, loadsharing etc. with antisurge control shall be the responsibility of the antisurge controller vendor.
f) One number of analog (4-20mA) output is required from each controller (configured identical to controller output to anti surge valve) for indication at Local control panel / DCS to achieve bumpless transfer in manual mode.
g) The inputs considered for Antisurge control: Suction Flow, Suction pressure and temperature, Discharge pressure and temperature. The algorithm shall be selected accordingly.
h) The inputs and outputs for Performance / loadsharing etc. if applicable, shall be decided as per the project requirements.

2.3 TECHNICAL REQUIREMENTS-IO SUMMARY:

a) The IO count listed below is the hardware IO's for **EACH** Compressor Control System Controller hardware. Each controller used for Compressor Control System (Antisurge, Performance / loadsharing etc.) shall have following number or a total No. of Inputs / Outputs minimum as follows.

Sl. No	Description	IO Count	Remarks
i	Digital Inputs (24V DC)	05	Minimum IO requirement for ASC / PERF / LSC etc. combined
ii	Digital Outputs (1A, 28VDC)	05	
iii	Analog Input (4-20 mA)	08*	Minimum IO for EACH ASC Control Application. IO for Perf / Loadsharing etc. to be indicated / added by Vendor
iv	Analog Output (4-20 mA)	02*	

b) The above I/O's do not include the no. of I/O's required redundancy module (if Compressor Control System is specified as dual-Redundant) & auto testing facility. Vendor shall include the IO Hardware (Redundancy Switch etc.) for redundant control system.
c) In case the vendor offer is considering higher IO based on the standard modules available, all the IO shall be wired up to terminal box in the panel with relay / barrier / isolator etc.
d) The above IO list DO NOT contain IO requirement for Performance Control / Loadsharing Control (if specified in RFQ). Vendor shall include the IO's required for Performance Control / Loadsharing Control (if applicable).

2.4 TECHNICAL REQUIREMENTS-SYSTEM PANEL:

a) Compressor Control System shall be supplied in fully assembled, wired and factory tested panel. The specifications for panel are as follows:

Sl. No.	Requirement	Description
1	Environment	a. Ambient Temp: 1-40℃ b. Humidity: 10-100% c. Hazardous Area classification: NA. Field Instruments are located in Hazardous area. d. Mounting location: Indoor, Air Conditioned. e. Ingress protection: IP55 for Panel.

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Sl. No.	Requirement	Description
2	Panel Construction	a. Make: Rittal TS8 series or Equivalent. Equivalent panel shall be similar to Rittal TS8 series. b. Door: front (with glass window) & rear c. MOC: CRCA d. Sheet thickness: i. Door: 2.0 mm ii. Sides: 1.5 mm iii. Gland plate: 3.00mm iv. Mounting plate: 3.0 mm e. Structure: As per make / model listed above. f. Base frame: Yes, 100 mm. g. Anti-vibration pads: Yes h. Lifting eyebolts: Yes, removable type i. Screws, door handles, hinges and other non-painted metallic parts: Stainless Steel j. Dimensions: 800mm(W) x 2100mm(H) x 800mm(D) k. Cable entry: bottom l. Document pocket: Yes
3	Painting	a. Pre-treatment: 7-tank dip, de-rusting, degreasing, phosphatation, passivation, sand blasting, grinding, chemical cleaning & surface finish. b. Primer: Two coats c. External colour: RAL7035. d. Internal colour: RAL7035. e. Base channel: Black
4	Major Equipment / rack mounting from bottom	~1300 mm and above
5	Main Name plate	a. Material: Acrylic (engraved) b. Letter: White c. Background: Black d. Fastening: Screwed
6	External Equipment Tag plate	a. Material: Acrylic (engraved) b. Letter: White c. Background: Black d. Fastening: Screwed
7	Instrument Tag Plate / Label	a. Material: Acrylic (engraved) b. Letter: White c. Background: Black d. Fastening: Screwed
8	Electrical	a) Panel wiring: FR PVC insulated 660 / 1100V grade, single core multi-strand, copper conductor. b) Conductor Size: 1.0 sq. mm for signal & 2.5 sq. mm for power. Pre-Fab cables as per manufacturer standard. c) Wiring colour code: provided during detail engineering. d) Ferrules: Cross ferruling with White / Yellow silicon

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Sl. No.	Requirement	Description
		type, printed. e) Terminals: screw less, clamp-on type (Wago, Phoenix, Weidmuller) f) Earth / Grounding: Yes, signal and power earth with Earth Bus Bar (6mm thick) and lugs. g) Incoming power: i. UPS: 110 or 240VAC-Redundant Feeder (provided during detail engineering) ii. Non-UPS: 240VAC-Single Feeder
9	Cable glands	SS / Nickel-Brass material and double compression type
10	Exhaust fans and louvers	Yes, back door / top mounted and louvers.
11	Installed Spare	20% for MCB, Power Supply, Power and Signal Terminals, Relays, Barriers etc.
12	Interposing Relays	Yes for DI & DO
13	Isolators / Barriers	Yes for AI / AO
14	Surge Protector	Yes for Power Supply and Communication

2.5 **TECHNICAL REQUIREMENTS- COMMUNICATION:**

a) Each CCS shall be interfaced with the customer's DCS via dual redundant RS485 MODBUS RTU or Modbus TCP (to be finalized during detail engineering) link. Vendor shall ensure that each controller shall be provided with TWO number of communication ports for above.

b) If HMI is specified, a dedicated communication port shall be provided on each controller for connection with HMI / programming & configuration PC. Vendor shall provide all communication hardware & software and other networking accessories like Ethernet Switch (if required) at both ends for redundant communication network with HMI PC.

c) In some cases, if the cable distance between Control System and HMI PC is very large, If HMI-PC communication may be specified as fiberoptic. Vendor shall provide TWO sets of DIN rail mount type Fiber Optic Converters with LIU and patch cords along with 24VDC power supply. The fiberoptic cable shall be single mode type, minimum 6 cores and orange colour, armoured type. The fiberoptic cable shall be routed through orange coloured HDPE conduit of size ¾".

2.6 **TECHINICAL REQUIREMENTS – INSPECTION & TESTING:**

a) Bidder to furnish the QA plan & FAT procedure along with the data sheets of all the equipment in line with BHEL specifications for approval after placement of order.

b) The controllers / fully assembled system (if applicable) shall be tested in an integral manner by simulation. Customer / Consultant / BHEL and/ or BHEL authorized representatives shall inspect the system at supplier works during factory acceptance test (FAT).

c) The latest certificates for use in hazardous areas shall be furnished for instruments / equipment (if applicable) by the vendor as specified below:

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i. Certificates from statutory authorities like BASEFA, FM, PTB, UL and LCIE etc. for items of foreign origin and from CIMFR etc. for items of Indian origin.
ii. Approval certificates from CCE (Chief Controller of Explosives)/ PESO for items to be installed Hazardous area in India, irrespective of country of origin and the same is mandatory. In case CCE certificate is not available for any item at the time of offer, vendor shall confirm that the certificate shall be furnished during detailed engineering and before dispatch.
iii. Approval certificate from BIS (Bureau of Indian Standards) for all flameproof instruments of Indian origin.

3. VENDOR SCOPE OF WORK / SUPPLY:

3.1 SCOPE OF SYSTEM ENGINEERING:

a) The Vendor Systems Engineer (SE) shall provide the system engineering for the project to assure that the control system.
b) This service includes: generation of the controller wiring drawings and control system diagrams (CSD's), the development and implementation of the control logic with Initial Controller Configuration Parameter Sets, sizing and recommendations on the control system components and system programming & testing.
c) A design audit of the completed control solution shall be made before shipment. This shall be in a form of presentation by the SE to the design audit team / BHEL; which reviews all aspects of the engineered solution.
d) It is mandatory to have only one set of configuration parameter for all operating conditions in the performance curves.

3.2 SYSTEM ENGINEERING:

a) SE shall review the control system design with the customer to ensure compatibility between the control system and the application.
b) Transmitters, flow measuring devices and antisurge valves associated with Antisurge control, Performance or Loadsharing Control etc. are evaluated for proper location and sizing.
c) The system engineering service shall include the following for each compressor control application, but not limited to the following:
   i. Preparation of Design Specifications.
   ii. Vetting of Antisurge Valve Sizing, Suction Throttle Valve Sizing etc.
   iii. Number of Unique Antisurge Valves – As (as per ASC Loops specified in variant Table).
   iv. Number of Compressor Maps to be analyzed per Valve
   v. Flow Measuring Device Calculations
   vi. Number of Unique Flow Measurement Devices (FMD's)
   vii. Number of Compressor Maps to be analyzed per FMD
   viii. Controller Configuration.
   ix. Transmitter Range Specification
   x. Preparation of Drawings.
   xi. Mod Bus Address mapping list for interfacing controller with DCS
   xii. System / Process configuration for Performance / Loadsharing (if applicable)

3.3 ENGINEERING MANUALS

a) The design and specifications shall be formally documented in the Engineering Manuals and provided in three hard copies and TWO CD/USB. This includes:

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i. Control system diagrams
ii. wiring and jumper list
iii. System description
iv. Controller / Panel dimensional drawings
v. Panel structural and layout drawings
vi. A bill of materials
vii. Controller instruction manuals
viii. Initial controller configuration parameters (refer Note-1)

b) Note-1: 'Initial Controller Configuration Parameter Sets' are calculated and prepared using project-specific data for channel assignments and functionality where possible. Gains, biases and control responses are necessarily maintained at conservative levels for safety reasons during initial start.

3.4 **COMMISSIONING OF THE SYSTEM**

a) The Control system representative from the nearest location from the site shall supervise the erection, Commissioning, configuration and tuning of the controller & accessories supplied by vendor.
b) The Field Engineer shall be responsible for on-site system integration and commissioning, to troubleshoot and correct any connectivity issues; and to tune the system in response to actual system dynamics.
c) FSE shall optimize the overall system with respect to appropriate integration and interface with customer's DCS etc.

4. **SPARES PHILOSOPHY:**

4.1 The system shall meet the following spare philosophy. This philosophy shall be applicable for items like IO's, barriers, isolators, relays, terminals, lamps, push buttons etc.

4.2 **SPARES:** Vendor shall include following spares in their scope of supply:

a) **INSTALLED ENGINEERING SPARES (part of main system):** Installed engineering spares shall be provided in each sub-system for each type of electronic module to enhance the specified system functional requirements by 20%. The basis of offering installed engineering spares shall include:
   i. For a system with conventional and / or smart analog input / output, discrete (contact) input / output, 20% spare input / output of each type shall be considered for calculating I/O modules and all other related accessories.
   ii. For all serial input / outputs to the system, 20% spare serial I/0 ports of each type of serial input / output shall be provided.
   iii. 20% spare accessories like relays, switches, lamps, fuses, circuit breakers, barriers, isolators, terminals etc.
   iv. The engineering spares shall be wired up to the field cable interface and shall be in ready-to-operate condition when field cable is connected to spare assigned terminals.
   v. Spare pairs of the incoming cables shall be terminated on spare terminals in the marshaling / barrier cabinets as applicable.
   vi. The system shall be fully engineered considering 20% installed engineering spares including processor loading.

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b) **SPARE SPACE REQUIREMENT:** In addition to installed engineering spares specified in ***Installed Engineering Spares*** of this specification, the system shall be provided with following spare space:

i. I/O racks of programmable logic controller shall have 10% usable spare space for installing additional I/O cards of each type in future. However internal wiring for the same shall be connected up to the I/O terminals.

ii. Processor system of programmable logic controller shall have capability to execute additional 20% logics.

iii. Each operator console shall contain 20% usable spare group and related display capability in addition to as specified in ***Installed Engineering Spares*** of this specification.

iv. The system shall have capability to extend its historical trending, logging and user's memory by 20% to meet future expansion with/without adding additional memory modules.

v. The communication sub-system shall have sufficient capacity to handle additional data contributed by addition of 20% I/O over and above installed engineering spares.

vi. Usable spare space in panels and cabinets to install 10% spare hardwired items like relays, switches, lamps, fuses, circuit breakers, barriers, isolators, terminals, and panel mounted instrument etc. in future.

c) **SPARE MEMORY REQUIREMENT:**

i. The system shall be provided with a minimum of 40% spare memory capacity, as required for application program and data base to meet specified functional requirements.

ii. It shall be possible to extend the memory by at least 20% over and above the actual requirement at a later date.

d) SPARE SOFTWARE CAPABILITY

i. Sufficient additional software capacity shall be available in the system to take care of spares requirement as specified in ***Installed Engineering Spares*** and ***Spare Space Requirement*** of this specification to meet all functional requirements of this specification.

ii. Unless specifically indicated otherwise, the offered system shall have software licenses to cover all the tag numbers indicated in the material requisition, including installed engineering spares and spare space indicated in this specification.

e) MANDATORY SPARES

i. Mandatory spares shall be ware-house spares and shall be supplied as loose items. Refer Variant table for quantity and details.

ii. Spare modules for all types of CPU cards, IO cards, Communication cards, power supplies, termination assemblies, pre-fab cables, signal conditioners, barriers, etc.

iii. Spare networking components like Ethernet switches, fiber optic converters, surge protection devices, patch cords, LIU etc.

iv. Spare power line filters, lamps, fuses (100%) and circuit breakers, Relay, Barrier, 24V DC PS, Fan, Filter etc.

f) COMMISSIONING SPARES:

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i. Vendor shall be responsible to supply any spares which are found necessary to replace failed modules, failed sub-systems, or corrupted / faulty software while performing pre-commissioning and commissioning activities.

ii. Against commissioning spares, a complement of commissioning spares such as CPU cards, IO cards, Power supplies, Isolators, Barriers, Termination assemblies, pre-fab cables, fuses, connectors, EEPROMs and any other item deemed necessary considering that the failure of any component of the system should not delay the commissioning of the system.

5. **DOCUMENTATION:**

a) Documentation shall be in three steps, during offer submission as response to BHEL Enquiry stage, drawing approval stage, and during delivery of items stage (as-built).

b) All the documents shall be preferably in A4 size (Drawings in Auto-CAD, and documentation in A4 Size PDF) shall be used for submission.

c) The documentation aesthetics shall be in line with international standards. Incomplete data, without title blocks, name of the item, document number, revision number, page number etc. will not be acceptable.

d) Vendor shall be responsible for creating, making and arranging complete documentation as per BHEL requirements at all stages.

e) During Technical offer submission:

i. Filled up check list as per clause 15.
ii. Catalogues of controller and other hardware.
iii. System Architecture diagrams.
iv. Communication interface diagram.
v. GA & Bill of material.
vi. Deviation list as per “deviation format clause 10" if any.
vii. Compliance certificate (duly signed & stamped copy of complete specification).
viii. Un-priced price schedule as per clause 17 with “QUOTED” against all applicable items.
ix. Reference list /PTR Record (mandatory) as per clause 12 for all the items.
x. Filled in Certificate of logistics support as per clause 13.

f) During drawing approval after PO placement: Soft Copy of the following:

i. Compressor control system description.
ii. Compressor control system diagram / Architecture.
iii. Antisurge control valve sizing verification / recommendation.
iv. IO List / Pressure / Flow / Temperature instrument range recommendation.
v. Recommendation regarding items in the antisurge loop (Piping length etc.)
vi. Compressor control General arrangement, BOM and Wiring Diagram
vii. MODBUS address list for serial communication
viii. Quality plan & FAT Procedure.
ix. Type Test & Statutory certificates.

g) It is the responsibility of the vendor to review the documents for total compliance with all the BHEL specifications furnished with the inquiry before submitting to BHEL.

h) The data sheets will be forwarded by BHEL to Customer/Consultant for approval, comments if any from Customer/Consultant shall be clarified and revise the data sheets if required by the vendor in line with BHEL / BHEL CLIENT specifications furnished with the inquiry.

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i) Vendor has to attend technical meeting with Customer / Consultant along with BHEL if required for technical discussions and obtaining approval of documents for the package items.

j) Along with material, final documentation in THREE copies shall be sent to project site and ONE number of soft copies in CD/USB with the following listed documents. However, one advance copy shall be handed over to BHEL- Engineering for approval before dispatching multiple sets to the project site.
   i. Packing list.
   ii. All the documents submitted during drawing approval.
   iii. Inspection reports,
   iv. Photo copies of BHEL Approved documents,
   v. Test certificates,
   vi. Warrantee certificates,
   vii. Operation & Maintenance manuals
   viii. Erection and commissioning procedure.

k) It is Vendors responsibility for obtaining approvals on drawings/documents from BHEL / Customer within time frame and dispatch material in time to project site office as per purchase order delivery schedule. Further vendor requests for any clarifications or approvals for delivery extensions etc. are not entertained at any stage.

l) Within 15 days after commissioning:
   i. Final reports giving details of commissioning data, its analysis and recommendations, if any.
   ii. Vendor shall supply the portion of system engineering document, which requires updating as per commissioning data, and TWO copies of it shall be furnished.

m) Vendor shall visit BHEL office within one week of PO/LOI to collect the project specific information (Tag no's, services, range, etc.) for engineering their drawings / documents.

n) The following documents shall be provided to vendor after PO placement. Vendor to check and inform if any additional data/ document is required and specify the same in its offer.
   i. Compressor Datasheet (pdf format).
   ii. Compressor Performance Maps (pdf format).
   iii. Compressor Process P&ID (pdf format).
   iv. Compressor Suction (or discharge) Flow Element Datasheet (pdf format).
   v. Antisurge Control Valve Datasheet (pdf format).
   vi. Suction Throttle Valve Datasheet (pdf format, if applicable).
   vii. Performance Controller Objective / Variable (if applicable).

6. GUARANTEE:

a) Vendor shall be responsible for all the items supplied in this package. i.e. vendor shall provide a guarantee certificate for trouble free performance of all the items for 18 months from date of supply or 12 months from the date of commissioning.

b) If any defect in the material is reported from site the same shall be replaced by vendor at site immediately without any commercial or delivery implications.

7. PACKING, MARKING & SHIPPING:

a) PACKING:

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i. All the items shall be packed in very good quality packing; the packing shall be such that the items should not be damaged during loading, unloading and transportation, the packing shall be suitable for 6 months of outdoor storage from the date of shipment.
ii. The operation and maintenance manuals of all the items 3 copies shall be included in the packing.
iii. One copy of the packing list shall be fixed on the packing with suitable protection to with stand loading, unloading, transportation and rain.
iv. Adequate amount of silica gel or equivalent shall be provided in each box before dispatch for the removal of moisture till installation.
v. All safety instructions for storage and handling shall be indicated on external surface of each box.

b) PACKING LIST:
i. Detailed packing list with description, quantity, tag nos, make and model no. etc. including the list of O&M manuals shall be prepared by vendor and submitted to BHEL before dispatch.
ii. All the items shall be shipped in a single shipment.
iii. It is the responsibility of the vendor to check that all the items are dispatched along all the accessories i.e. Cable glands, Mounting brackets, adapters etc. queries if any received from site regarding the ASC system package items shall be clarified by vendor immediately, malfunction or defects of any items reported from site within the guarantee period shall be replaced at site immediately without any commercial or delivery implications.
iv. Bidder to consider and include charges for one visit to site as part of the main package as and when informed by BHEL to resolve issues if any reported from site regarding material discrepancy of the ASC system package items.

c) Each device shall be identified with the following information as a minimum.
i. OEM name or identity
ii. Manufacturer's model and /or serial number
iii. instrument range
iv. Tag no.

The above information shall be in a permanent form on a stainless steel nameplate and permanently attached to the device/equipment.

8. **ERECTION AND COMMISSIONING:**

a) The erection of the Compressor Control System package items shall be by BHEL / Customer. However expert E&C services are required to commission the offered items and vendor to consider the supervision of E&C services in the offer.
b) Pre-commissioning activities for 6 days at site and two visits inclusive of Travel, boarding, lodging, and local conveyance shall be considered. Refer Price Schedule for Details.
c) Commissioning Assistance for 3 days at site and one visit inclusive of Travel, boarding, lodging, and local conveyance shall be considered. Refer Price Schedule for Details.

9. **TRAINING:**

The training shall offer training for configuration, operation and maintenance of the compressor control system package. The training shall be conducted at BHEL or site. All

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requisite training material for the said training shall be provided by the vendor during the training.

10. **DEVIATION FORMAT:**

Bidder shall submit duly filled deviation format (as given below) along with technical offer, otherwise, it will be presumed that there are no deviations from this specification. Offer without this deviation list will not be evaluated & shall be considered for rejection. If, there are no deviations, bidder shall submit signed copy of this format, mentioning "No Deviations".

Sl.No	Clause No. of Spec	Deviation	Reason for deviation	Deviation category	
				Product/design limitation	Optimization
1					
2					

11. **PROVEN TRACK RECORD:**

a) Bidder should have supplied & commissioned FIVE such CCS during last five years.
b) At least TWO of the FIVE mentioned CCS should have been installed and used for Centrifugal Compressor train in a Petroleum Refinery (Hazardous Area) environment and each CCS shall have well proven performance record of operating satisfactorily for a minimum of 8000 running Hours.
c) At least ONE of the TWO mentioned CCS should have been installed and used for TWO stage Centrifugal Compressor along with Performance Controller.
d) The above criteria shall be applicable to main equipment, sub- components as well as brought out items if any. Prototype equipment / instruments or instrument under phase out cycle shall not be offered or supplied.
e) Bidder shall submit necessary supporting documents / past users confirmation supporting to above PTR requirements along with technical offer.
f) Bidder to furnish the PTR details as per clause 12 and the Certificate for logistics support as per clause 13 along with the offer.

12. **PROVEN TRACK RECORD FORMAT**

a) Name of the Bidder
b) Whether manufacturer & supplier:
c) Whether System Integrator & Supplier:
d) Name of Packager:

Sl. No.	**PTR Requirement**	**Ref-1**	**Ref-2**	**Ref-3**	**Ref-4**
1	Description of the items offered				
2	Description of item as manufactured & Supplied/ engineered (identify bidder's scope of work)				
3	Purchaser's name, address, Tel no, Fax no, email and contact person				
4	Date of order placed				
5	Contractual completion date				

Sl. No.	PTR Requirement	Ref-1	Ref-2	Ref-3	Ref-4
6	Actual completion date/ month & year of commissioning				
7	Reasons of delay if any				
8	Details of major break down till date.				

13. **CERTIFICATE FOR LOGISTICS SUPPORT:**

(To be signed by Compressor Control System OEM's corporate level signatory on company letterhead and submitted along with offer)

I, on behalf of M/s _____confirm that the Compressor Control System Model No_____ for (Antisurge / Performance / Loadsharing Control) quoted by M/s _____for M/s <END USER> against M/s BHEL inquiry no _____shall continue to be supported by us. The quoted Items shall not become obsolete for a minimum of TEN (10) years from the date of placement of order. The quoted item shall not be withdrawn from Indian market in next three (3) years as a matter of our corporate policy.

I further confirm that in case of placement of order by M/s BHEL on us, we shall continue to support in providing back-up engineering, maintenance support and spare part support to M/s <END USER> for a period of ten (10) years from the date of expiry of warranty.

SIGNATURE WITH SEAL
AUTHORISED, SENIOR MANAGEMENT LEVEL SIGNATORY

14. **TENDER EVALUATION CRITERIA**

a) The total price for the complete package i.e. **Main System, Mandatory spares, Supervision of erection & commissioning charges and training (if specified in Enquiry)** shall be considered for L1 evaluation.

b) Duly signed & stamped un-priced price schedule and unit prices shall be submitted along with technical offer by bidder as a token of concurrence that all items are quoted without which the offer will not be evaluated. For unpriced bid bidder to fill 'Quoted' for each item and submit (refer clause 17 for PRICE SCHEDULE).

15. **CHECK LIST:**

(TO BE FILLED BY BIDDER AND SUBMITTED ALONG WITH OFFER)

Sl. No.	Description	Vendor Confirmation	Remarks
1	Compressor Control System with panel located in the SRR and linked to its HMI (if specified in ENQUIRY) in MCR for control / engineering & configuration purpose.		
2	Offer for complete package as per BHEL specification (for items listed in ENQUIRY). Vendors shall furnish the complete bill of material offered against the respective material codes.		
3	Offer for Mandatory spares as per BHEL specification. Vendor shall furnish the bill of material of mandatory spares offered.		

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Sl. No.	Description	Vendor Confirmation	Remarks
4	Clause wise confirmation / deviation to BHEL specification (as per the deviation format clause 10) included in the offer.		
5	Reference list / PTR record for compressor control system & accessories satisfying the Proven track record requirement as per clause no 12 of BHEL specification included in the offer.		
6	Certificate of logistic support as per clause no 13 of BHEL specification included in the offer for compressor control system.		
7	Filled in Unpriced Price schedule as per clause 17 is included in the technical offer.		

(Signature and stamp of bidder with date)

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16. **VARIANT TABLES:**

a) TABLE-1: COMPRESSOR CONTROL SYSTEM-ANTISURGE CONTROL

Var No	Material Description	SAP Description	BHEL Matl Code
01	Compressor Control System as per following: a) Application: Antisurge Control for One Stage Compressor b) Controller Hardware Redundancy: Dual Redundant c) Panel: YES d) Networking: Redundant Networking accessories like RS-485 surge protectors, Ethernet switches, fiber optic converters (single mode type), connectors, patch cords, LIU etc.	CCS-ASC-01NOS-REDUND & PANEL	TC9765267010

b) TABLE-2: COMPRESSOR CONTROL SYSTEM-ANTISURGE & PERFORMANCE CONTROL:

Var No	Description	SAP Description	BHEL Mat Code
02	Compressor Control System as per following: a) Application: Antisurge & Performance Control for One Stage Compressor b) Controller Hardware Redundancy: Dual Redundant c) Panel: YES d) Networking: Redundant Networking accessories like RS-485 surge protectors, Ethernet switches, fiber optic converters (single mode type), connectors, patch cords, LIU etc.	CCS-ASC-01NOS-PERF-REDUND & PANEL	TC9765267029
11	Compressor Control System as per following: a) Application: Antisurge & Performance Control for Two Stage Compressor b) Controller Hardware Redundancy: Dual Redundant c) Panel: YES d) Networking: Redundant Networking accessories like RS-485 surge protectors, Ethernet switches, fiber optic converters (single mode type), connectors, patch cords, LIU etc.	CCS-ASC-02NOS-PERF-REDUND & PANEL	TC9765267118

c) TABLE-3: COMPRESSOR CONTROL SYSTEM-HMI APPLICATION & CONFIGURATION SOFTWARE:

Var No	Description	SAP Description	BHEL Mat Code
51	HMI Application for One Stage Compressor	HMI APP-ONE STAGE COMPRESSOR	TC9765267517
52	HMI Application for Two Stage Compressor	HMI APP-TWO STAGE COMPRESSOR	TC9765267525
53	CCS Configuration software	CCS CONFIGURATION SOFTWARE	

d) TABLE-4: COMPRESSOR CONTROL SYSTEM-HMI PC AND COMMUNICATION ACCESSORIES

Var No	Description	SAP Description	BHEL Mat Code
04	Armoured Fiber Optic Cable (Orange Colour)	ARMOURED 6 CORE SIN MOD FO CABL ORANGE	TC9765267045
05	Orange HDPE Conduit for Armoured Fiberoptic Cable	HDPE CONDUIT ORANGE 3/4"	TC9765267053

Var No	Description	SAP Description	BHEL Mat Code
06	Armoured RS485 Serial Communication Cable	ARMOURED RS485 SERIAL COMM CABLE	TC9765267061
61	Desktop PC for HMI &/or Configuration	DESKTOP PC:- CCS HMI & CONFIG	TC9765267614
62	Desktop PC Communication Cable (Serial / Ethrnet)	DESKTOP PC COMM CABLE	TC9765267622
63	Ethernet switch / Serial Communication Card for HMI PC	COMMUNICATION CARD-HMI PC	TC9765267630
64	Fiberoptic Converter with LIU, Patch cords & Power supply for HMI PC communication	FO CONV, LIU, PATCH CORDS, PS:- HMI PC	TC9765267649
65	Fiberoptic Converter with LIU, Patch cords & Power supply for DCS communication	FO CONV, LIU, PATCH CORDS, PS:-DCS COMM	
66	Laptop PC for HMI &/or Configuration	LAPTOP PC:- CCS HMI & CONFIG	

e) TABLE-5: COMPRESSOR CONTROL SYSTEM-SPARES

Var No	Description	SAP Description	BHEL Mat Code
07	Spares for Compressor Control System with Dual Redundant Controller Hardware (for Dual-redundant Antisurge control): -Electronic cards like CPU, IO card, Power supply card, field IO termination (transition) modules, Engineering and Operator keypad / display, Selector Switch etc. -10% or minimum 01 no of each type	CCS-ASC-REDUNDANT SPARE	TC9765267070
09	Spares for Compressor Control System Panel: -Barriers, isolators, relays, MCB, terminals, IO termination assemblies, Bulk Power supplies etc.:-10% or minimum 01 no of each type	CCS-PANEL SPARES	TC9765267096
81	CCS Fuse 100%	CCC FUSE SPARE	TC9765267819
82	Spares for Compressor Control System with Dual Redundant Controller Hardware (for Dual-redundant Antisurge & Performance control): -Electronic cards like CPU, IO card, Power supply card, field IO termination (transition) modules, Engineering and Operator keypad / display, Selector Switch etc.:-10% or minimum 01 no of each type	CCS-ASC/PERF-REDUNDANT SPARE	TC9765267827

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17. **PRICE SCHEDULE (Refer ENQUIRY / RFQ document for applicable Quantity)**

Enquiry ref no. Date:
Offer ref no. Date:

A) Table-1: Material Supply

Sl No	Material Description	Material Code	QTY (as per RFQ)	Unit Price	Total Price
1	CCS-ASC-01NOS-REDUND & PANEL	TC9765267010			
2	CCS-ASC-01NOS-PERF-REDUND & PANEL	TC9765267029			
3	CCS-ASC-02NOS-PERF-REDUND & PANEL	TC9765267118			
4	HMI APP-ONE STAGE COMPRESSOR	TC9765267517			
5	HMI APP-TWO STAGE COMPRESSOR	TC9765267525			
6	CCS CONFIGURATION SOFTWARE				
7	ARMOURED 6 CORE SIN MOD FO CABL ORANGE	TC9765267045			
8	HDPE CONDUIT ORANGE 3/4"	TC9765267053			
9	ARMOURED RS485 SERIAL COMM CABLE	TC9765267061			
10	DESKTOP PC:- CCS HMI & CONFIG	TC9765267614			
11	DESKTOP PC COMM CABLE	TC9765267622			
12	COMMUNICATION CARD-HMI PC	TC9765267630			
13	FO CONV, LIU, PATCH CORDS, PS:- HMI PC	TC9765267649			
14	FO CONV, LIU, PATCH CORDS, PS:-DCS COMM				
15	LAPTOP PC:- CCS HMI & CONFIG				
16	CCS-ASC-REDUNDANT SPARE	TC9765267070			
17	CCS-PANEL SPARES	TC9765267096			
18	CCC FUSE SPARE	TC9765267819			
19	CCS-ASC/PERF-REDUNDANT SPARE	TC9765267827			

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B) Table-2: CCS-Site Services

Sl No	Service Description	Remarks	QTY (as per RFQ)	Unit Price	Total Price
1	Pre-Commissioning Assistance for 6 days **at site** and two visits inclusive of Travel, boarding, lodging, and local conveyance	Lumpsum	1 set		
1	Per-diem Rates for Pre-Commissioning Assistance at site inclusive of Travel, boarding, lodging, and local conveyance.	Optional price required	Per-diem		
2	Commissioning Assistance for 3 days **at site** and one visit inclusive of Travel, boarding, lodging, and local conveyance	Lumpsum	1 set		
3	Per-diem Rates for Commissioning Assistance at site inclusive of Travel, boarding, lodging, and local conveyance.	Optional price required	Per-diem		
4	Training for 3 days **at site** and one visit inclusive of Travel, boarding, lodging, and local conveyance	Lumpsum (if specified in RFQ), else please indicate Optional Price	1 set		
5	Per-diem Rates for Training inclusive of Travel, boarding, lodging, and local conveyance.	Optional price required	Per-diem		

Total Price for L1 Evaluation (A+B (as per RFQ)):_____

Notes:

a Vendor shall indicate unit price of all items of Price Schedule irrespective of RFQ Qty.
b The prices shall be valid for one year from the date of order.
c Any additional requirements which are essential for proper functioning of the control system, however not indicated in this specification shall be explicitly listed and included in the offer by vendor.

VENDOR SEAL & SIGNATURE.

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RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised By	Approved By
00	26.08.13	Issued	-	PSVS
01	31.01.14	Clause 2.1-q added	RAM	PSVS
02	15.12.17	Issued for BPCL GTU	CHPC	RAM
03	26.12.17	Dual redundancy re-defined for system &communications	CHPC	RAM
04	26.06.18	Specification revised and new variants added	RAM	PSVS

Ref. Doc.