



**REPORT
FOR
CAPACITY ASSESSMENT OF INTEGRATED/INTERCONNECTED
PIPELINE NETWORK
OF
M/S GAIL (INDIA) LIMITED**

**[IN LINE WITH PNGRB (DETERMINING CAPACITY OF PETROLEUM,
PETROLEUM PRODUCTS AND NATURAL GAS PIPELINE) REGULATIONS, 2010]**

This Report is prepared for M/s PNGRB and it is for use by M/s PNGRB or their assigned Representatives/ Organizations only. The matter contained in the Report is confidential.

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Abbreviations

PNGRB	:	Petroleum and Natural Gas Regulatory Board
EIL	:	Engineers India Limited
GAIL	:	GAIL (India) Limited
LOA	:	Letter of Award



1.0 EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

Petroleum and Natural Gas Regulatory Board (PNGRB) [hereby may also be referred as “Client” for the subject service] was constituted under The Petroleum and Natural Gas Regulatory Board Act, 2006 (NO. 19 OF 2006) notified via Gazette Notification dated 31st March, 2006.

By exercising its power under provision 2 (d) of the said regulation, PNGRB provided LOA PNGRB/Tech/10-CapNGPL-GAIL’s Integrated/(1)/2023(P-4233) Dated 30.05.2023 (Refer **ANNEXURE-VIII**) for carrying out the capacity assessment of existing GAIL’s Integrated/Interconnected network of M/s GAIL (India) Limited [hereinafter referred as an “Entity” also] for the given period of operation i.e. Year 2022-23 to 2023-24.

Role of EIL shall be to review the capacity assessment submitted by the operator & as determined by Entity in line with capacity determination criteria defined in the PNGRB (Determining capacity of Petroleum, Petroleum products and Natural Gas Pipeline) Regulations, 2010 [hereinafter referred as a “PNGRB Regulation” or “Regulation” also] (Refer **ANNEXURE-I**) and based on data/ inputs provided by Entity/ PNGRB.

This report presents the observations arrived at by the EIL for the data/ inputs furnished by Entity/ PNGRB w.r.t. provisions of applicable Petroleum and Natural Gas Regulatory Board (Determining capacity of Petroleum, Petroleum products and Natural Gas Pipeline) Regulations, 2010. Accordingly, following results are summarized based on capacity assessment for each year as carried out by EIL:

PNGRB regulation i.e. Petroleum and Natural Gas Regulatory Board (Determining capacity of Petroleum, Petroleum products and Natural Gas Pipeline) Regulations, 2010 defines the step wise methodology for the determination of Pipeline capacity. Hence, year wise methodology adopted by Entity has been reviewed by EIL against defined step wise methodology given in the regulation of capacity determination as clause no. 5.(5).

Entity data/ inputs has been verified by EIL w.r.t stepwise methodology given in Clause no. 5.(5) and supported data/ inputs submitted by Entity/ PNGRB.

Tabulated below are the comparative capacity assessment figures (rounded-off figures) at an interval of one year as carried out by entity & EIL:

Assessment years	Pipeline Capacity as determined by Entity (in MMSCMD)	Pipeline Capacity as assessed by EIL (in MMSCMD)	Remarks
	Entity	EIL	
	Software used - Pipeline Studio (TGNET)	Software used - Pipeline Studio (TGNET)	
2022-23	140	145	
2023-24	156	163.8	Addition of one source Dhamra, ten additional consumers and increase in network by 1435 Km approx. Refer annexure IX

Note –

- As the pipeline capacity was arrived as per PNGRB regulation [based on MAOP considerations], hence variation in determined capacity for various assessment years is due to change in sources and /or deliveries and / or network length and / or network configuration etc.
- Bokaro & Jharia sources are under construction & refer Annexure IX for capacity with these sources.
- "Tie-In Connectivity" from Natural Gas source of Jaya Fields (Jambusar, Gujarat) of M/s Vedanta Ltd. to South Gujarat Main sub-network of Gujarat Natural Gas Pipeline Network (GNGPN) of GAIL was not a part of Integrated pipeline network and South Gujarat Main sub-network provided by entity.
- Capacity given in table above is with Suvali tie in connectivity. Capacity without this source is 143 & 160.8 MMSCMD for assessment years 2022-23 & 2023-24 respectively.
- Impact of Dhamra connectivity is 14.35 MMSCMD for year 2023-24
- Impact of JHBDPL for 2022-23 is 13 MMSCMD

- Bokaro & Jharia sources are under construction & impact of these sources for 2023-24 are:
 - Bokaro :0.6 MMSCMD
 - Jharia: 0.6 MMSCMD
 - Bokaro & Jharia both :1.2 MMSCMD



2.0 INTRODUCTION

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The Petroleum and Natural Gas Regulatory Board (PNGRB) [hereby may also be referred as Client for the subject service] was constituted under The Petroleum and Natural Gas Regulatory Board Act, 2006 (NO. 19 OF 2006) notified via Gazette Notification dated 31st March, 2006.

The Act provides for the establishment of Petroleum and Natural Gas Regulatory Board to protect the interests of consumers and entities engaged in specified activities relating to petroleum, petroleum products and natural gas and to promote competitive markets and for matters connected therewith or incidental thereto.

In exercise of the powers conferred by section 61 of the Petroleum and Natural Gas Regulatory Act, 2006 (19 of 2006), the Petroleum and Natural Gas Regulatory Board has made the Regulation for determining the capacity of Petroleum, Petroleum products and Natural gas pipeline in year 2010. As per Petroleum and Natural Gas Regulatory Board (Determining capacity of Petroleum, Petroleum products and Natural Gas Pipeline) Regulations, 2010, the capacity assessment is carried out by EIL.

PNGRB has entrusted EIL vide Letter of Award (LOA) No.: PNGRB/Tech/10-CapNGPL-GAIL's Integrated/(1)/2023(P-4233) Dated 30.05.2023 for carrying out capacity determination which is [hereinafter referred as an "Entity"] for the given period of operation as mentioned above. Scope of work for EIL was to assess the capacity for the given period of operation as mentioned above in line with capacity determination criteria defined in the PNGRB (Determining capacity of Petroleum, Petroleum products and Natural Gas Pipeline) Regulations, 2010 as per the process given in clause 5.0.

EIL along with PNGRB have interacted with the Entity on the received procedure followed in capacity determination carried out by the Entity.

For capacity assessment purpose, Entity has considered operating condition and free flow. Further, Entity informed that while carrying out capacity determination exercise they have considered Clause no. 5.(5) of PNGRB Capacity Regulations and additional considerations

etc. It was requested to entity that capacity determination shall be carried out based on step wise methodology given under Clause no. 5.(5) of PNGRB Capacity Regulations only.

Hence, entities were requested to kindly submit capacity figures & supporting TGNET files based on step wise methodology given under Clause no. 5.(5) of PNGRB Capacity Regulations only for assessment purpose.

In absence of above, EIL carried out the assessment of the same based on the procedure detailed in the PNGRB Regulation for determining capacity of Petroleum, Petroleum products and Natural Gas Pipeline, 2010. For capacity assessment purpose, EIL has assumed gas at the entry point is unlimited & the selected software was run till limiting value as defined in regulation. The capacity at this juncture was considered as the maximum system capacity achievable in the pipeline system.

The observations and understanding of applicable Regulation have been presented to PNGRB. PNGRB has reviewed the approach which has been detailed out in following sections of the report.



3.0 EXISTING PIPELINE NETWORK DESCRIPTION

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GAIL's Integrated/Interconnected Network comprises of following pipelines-

1. Integrated HVJ Pipeline(Integrated HVJ)
2. Jagdishpur Haldia-Bokaro Dhamra including Barauni-Guwahati and Dhamra-Haldia Natural Gas Pipeline(Integrated JHBDPL)
3. Dadri-Bawana-Nangal Pipeline(DBNPL)
4. Chainsa Jhajjar Hissar Pipeline(CJHPL)
5. Dahej Uran-Dabhol-Panvel Pipeline(DUPL-DPPL)
6. Dabhol Bangalore Pipeline(DBPL)
7. South Gujarat sub-network of the Gujarat Regional Pipeline (SG)
8. Uran-Thal-Usar sub-network of the Mumbai Regional Pipeline Network(UTU)
9. Trombay-RFC sub-network of the Mumbai Regional Pipeline Network (Trombay RFC)

Basic details of the pipeline network are as under: -

- Name of Natural Gas Pipeline : Integrated Network of GAIL's interconnected Natural Gas Pipelines

Financial Year	Length considered in Simulation (km) for capacity assessment
2022-23	9951.2
2023-24	11386.6

Source List	
22-23	23-24
HAZIRA	HAZIRA
Dahej terminal	Dahej terminal
Ankot	Ankot
Phulpur source	Phulpur source
HLPL-2 { Hazira LNG Private Limited }	HLPL-2 { Hazira LNG Private Limited }
Mhaskal source	Mhaskal source
DT_DABHOL	DT_DABHOL
ONGCL Uran	ONGCL Uran
URAN	URAN
south-Guj low pressure network	south-Guj low pressure network
Suvali	DHAMRA
	Suvali
Total Length-9951.2	Total Length-11386.6

Note - Bokaro & Jharia sources are under construction. However, they are shown in integrated network provided by Entity.

22-23, deliveries	23-24, deliveries
VAGHODIA downstream	VAGHODIA downstream
GANDHAR_NTPC	GANDHAR_NTPC
VJP (VIJAYPUR)	VJP (VIJAYPUR)
JIPPL (JAGOTI-DEWAS-INDORE-PITHAMPUR)	JIPPL (JAGOTI-DEWAS-INDORE-PITHAMPUR)
SOUTH GUJ	SOUTH GUJ
KELARAS	KELARAS
DHOLPUR	DHOLPUR
CGD- Agra Frbd	CGD- Agra Frbd
MATHURA	MATHURA
NTPC FARIDABAD	NTPC FARIDABAD
DADRI NTPC	DADRI NTPC
BABRALA	BABRALA
AONLA	AONLA
KFL Shahjapur	KFL Shahjapur
NFL	NFL
CFCL1	CFCL1
ANTA	ANTA
CFCL2&3	CFCL2&3
Pata IC	Pata IC

NTPC AURAIYA	NTPC AURAIYA
KANPUR + Jhansi CGD	KANPUR + Jhansi CGD
LKO CITY GAS + Unnao + Faizabad	LKO CITY GAS + Unnao + Faizabad
JAGDISHPUR IGF	JAGDISHPUR IGF
PHULPUR	PHULPUR
GSPL	GSPL
DESU_NCR	DESU_NCR
SAMCORE	SAMCORE
CJHPL	CJHPL
KMKRPL (RUDRAPUR PIPELINE)	KMKRPL (RUDRAPUR PIPELINE)
KFCL Kanpur Fertilizers and Chemicals Limited	KFCL, Kanpur Fertilizers and Chemicals Limited
AGL Faridabad	AGL Faridabad
KHURJA	KHURJA
Agra Firozabad	Agra Firozabad
IFFCO	IFFCO
Jagdishpur others	Jagdishpur others
HPCL Shahjapur Budaun	HPCL Shahjapur Budaun
TGPL Auraiya	TGPL Auraiya
Allahabad Amethi Faizabad CGDs	Allahabad Amethi Faizabad CGDs
CGD Khurja Dadri	CGD Khurja Dadri
Sikandrabad customers	Sikandrabad customers
IGL G Noida BPCL	IGL G Noida BPCL
Mathura Sawariya	Mathura Sawariya
AGL Nuh Palwal	AGL Nuh Palwal
CGPL customers	CGPL customers
IOAGPL Bulandshahar	IOAGPL Bulandshahar
Dadri exit	Dadri exit
Kribhco - towards	Kribhco - towards
GPU Auraiya	GPU Auraiya
GPU Vaghodia+IC	GPU Vaghodia+IC
Hazira IC	Hazira IC
Vjp IC, Vijaypur	Vjp IC, Vijaypur
Khera IC	Khera IC
Jhabua IC	Jhabua IC
Auraiya IC	Auraiya IC
Dewas Indore	Dewas Indore
GPU Gandhar	GPU Gandhar
Chainsa IC	Chainsa IC
Kailaras IC	Kailaras IC
DCM Shriram	DCM Shriram
GGL Sonipat +DBNPL	GGL Sonipat +DBNPL

Hindalco	Hindalco
Ex-Hazira - NTPC-Arcelor etc	Ex-Hazira - NTPC-Arcelor etc
RCF TROMBAY	RCF TROMBAY
NPL Kalyan	NPL Kalyan
MGLTALOJA+DFPCL	MGLTALOJA+DFPCL
VVF+OWNR	VVF+OWNR
MGL MAHAPE	MGL MAHAPE
RGPPD DHABOL	RGPPD DHABOL
Tata Motor	Tata Motor
RIL PATALGANGA	RIL PATALGANGA
BOM+HIL	BOM+HIL
BHUSHAN+UTTAM+PARLE	BHUSHAN+UTTAM+PARLE
NITCO	NITCO
IIL Pen dolvi jsw + HRJ	IIL Pen dolvi jsw + HRJ
RCF THAL	RCF THAL
HPCL	HPCL
MGL AMBR	MGL AMBR
welspun/jindal salav	welspun/jindal salav
tata steel + tata wire tarapur	tata steel + tata wire tarapur
Filatex Nani	Filatex Nani
Alok	Alok
Bhilosa	Bhilosa
Sterlite	Sterlite
JSW VASIND	JSW VASIND
ASIAN COLORS	ASIAN COLORS
MSL Sukeli	MSL Sukeli
POSCO STEEL	POSCO STEEL
INOX AIR PRODUCT	INOX AIR PRODUCT
POSCO POWER	POSCO POWER
Pioneer Power	Pioneer Power
MSL vile bhagad	MSL vile bhagad
s.i.group	s.i.group
viraj1-2-5	viraj1-2-5
Precision+MUSCO	Precision+MUSCO
Venus	Venus
MNGL Talegaon	MNGL Talegaon
Mahesh gas	Mahesh gas
JSW tarapur	JSW tarapur
APAR Silvassa	APAR Silvassa
DBPL	DBPL

BPCL	BPCL
RIL Nagothane	RIL Nagothane
Guj Gas Tarapur	Guj Gas Tarapur
Asahi	Asahi
Kribhco	Kribhco
EWPL Mashkal	EWPL Mashkal
TPC	TPC
MGL Panvel	MGL Panvel
Saint Gobain+Atul+UPL Dahej	Saint Gobain+Atul+UPL Dahej
HPOIL	HPOIL
Su Petro	Su Petro
MGL Savroli	MGL Savroli
OPAL	OPAL
Mahindra Sanyo	Mahindra Sanyo
Adani	Adani
IOAGPL	IOAGPL
IOCL BD - trans	IOCL BD - trans
HPCL Transportation	HPCL Transportation
BGRL aurang	BGRL aurang
Torrent Mhaskal	Torrent Mhaskal
BPCL + GSPCL + Shell+NTPC	BPCL + GSPCL + Shell+NTPC
Hindalco-2	Hindalco-2
HRJ- prism	HRJ- prism
RT bangalore GAIL Gas	RT bangalore GAIL Gas
TKAP	TKAP
Paramount	Paramount
zuari	zuari
elveety	elveety
HINDUSTAN COCA COLA	HINDUSTAN COCA COLA
Brittania	Brittania
MEIL Belgaum	MEIL Belgaum
MEIL Tumkur	MEIL Tumkur
IOAGPL Dharwad	IOAGPL Dharwad
Fab+RP Metal	Fab+RP Metal
UEPL Ratnagiri	UEPL Ratnagiri
Goa NGPL	Goa NGPL
MNGL Ramanagar	MNGL Ramanagar
Saint Gobain	Saint Gobain
BGRL	BGRL
Goa Glass	Goa Glass
Other CGDs	Other CGDs

UEPL Chitradurga	UEPL Chitradurga
Murudeshwar	Murudeshwar
HPOIL-2	HPOIL-2
IOAGPL-2	IOAGPL-2
MNGL	MNGL
trombay local customers	trombay local customers
thal customers	thal customers
Initial0097	Initial0097
CGD-Bhil-Chit	CGD-Bhil-Chit
CGD Mainpuri Bareli Moradabad	CGD Mainpuri Bareli Moradabad
Bidadi customers	Bidadi customers
Talegaon-Pune-satara	Talegaon-Pune-satara
BARAUNI REF	HALDIA
PATNA	BARAUNI REF
GORAKHPUR	PATNA
BANARAS	PARADEEP
SINDRI	CUTTUCK
JAMSHEDPUR	JINDAL
north east	SAM PUR
MATIX	RANCHI
Bongaigaon_ref	GORAKHPUR
BARAUNI_FERT	BANARAS
	SINDRI
	JAMSHEDPUR
	KOLKATA
	IOCL
	north east
	MATIX
	Bongaigaon_ref
	BARAUNI_FERT
	Bhadrak others
	HPCL-2

Flow diagram given in annexure to be referred for pipeline schematic, supply & delivery points flow & process parameters etc. for respective capacity assessment years will be updated after receiving of presentation from entity.

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4.0 DATA/ INPUTS SUBMITTED BY ENTITY

4.0 DATA/ INPUTS SUBMITTED BY ENTITY

Entity has submitted requisite data along with the capacity to PNGRB in line with the assessment Regulations, as applicable:

- a. Pipeline Network simulation snapshot indicating pipeline sections, entry and exits points, compressor station etc.
- b. Simulation Input data for each pipe section such as length (km), inside diameter (mm), wall thickness (mm), pipe wall roughness (micron), ground elevation profile, subsoil temperature, pipeline efficiency etc.
- c. Simulation Input data including all gas sources, gas entry temperature & pressure, quality & composition of natural gas, minimum and maximum gas flow etc.
- d. Equipment data.
- e. Consumer and supply contracts with contractual pressure, flow, temperature, gas quality etc. at source and delivery nodes.
- f. Latest model files for simulation as created & used by entity i.e. Input & output files of simulations/ calculations of pipeline facilities.
- g. Design/ operational inputs/ information/ data which entity considered to be applicable for carrying out the capacity assessment of pipeline facilities.
- h. During meeting, Entity has submitted the following inputs to PNGRB as per regulation for capacity assessment of the pipeline:

- Presentation by Entity During meeting (Refer **ANNEXURE-VII**)
- Capacity Assessment Applications
- As-Built Data
- Input/ Output Data considered for Simulation
- Gas Contracts Extract
- Simulation Models
- Entry/ Exit Point Pressure

Further, In line with Sr. No. 12 & 13 of Schedule-A of PNGRB regulation, EIL requested Entity to submit "Maximum achievable capacity of the pipeline under steady state condition as determined under section 5 of these regulations" and "Section wise maximum achievable capacity of the pipeline as determined under section 5 of these regulations" respectively.

Further, as per Clause No. 5.(2), Entity was requested to submit the detailed calculations of the capacity. Accordingly, it was desired that Entity will submit the year wise & step wise calculations and results based on 10 steps methodology followed by them as given under Clause no. 5.(5) of PNGRB regulation. Moreover, wherever any particular option/ scenario/ parameter has been selected & considered by Entity for capacity determination purpose, the reason for the selection may also be provided for assessment purpose.

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5.0 METHODOLOGY

5.0 METHODOLOGY

PNGRB Act provide for the establishment of Petroleum and Natural Gas Regulatory Board to protect the interests of consumers and entities engaged in specified activities relating to petroleum, petroleum products and natural gas and to promote competitive markets and for matters connected therewith or incidental thereto.

By exercising its power under provision 2 (d) of the said regulation, PNGRB has planned to carry out the capacity determination for the given period of operation an Agency/ Consultant.

For the above purpose, PNGRB appointed EIL (i.e. an agency or consultant or experts) to carry out the capacity assessment in line with PNGRB (Determining capacity of Petroleum, Petroleum products and Natural Gas Pipeline) Regulations, 2010.

The following methodology was adopted for meeting the above objective:

- a. Kick off meeting of the job was conducted at PNGRB office
- b. Required data/ inputs of existing pipeline network were obtained through Kick-off meeting, site visits, e-mails, telephonic discussions with PNGRB etc.
- c. Entity was requested to submit the requisite data along with the capacity to PNGRB in line with the Regulations. PNGRB was requested to provide the same to EIL. The submissions inter alia include the following as a minimum:
 - Schematic diagram of the Pipeline Network indicating pipeline sections, entry and exits points, check valve etc. Consumer and supply contracts (for each requested period for assessment)
 - Simulations in terms of pressure, flow, temperature at all source and delivery nodes using Panhandle flow equation.
 - Input data for each pipe section data such as length (km), inside diameter (mm), wall thickness (mm), pipe wall roughness (micron), knot spacing, gas equation used, ground elevation profile, temperature, pipeline efficiency, drag factor etc.
 - Input data including gas sources, gas entry temperature, quality & composition of gas, minimum & maximum gas pressure, minimum and maximum gas flow etc.
 - Performance data, Datasheets, P&IDs etc.
 - Designed & Current operational data.

- Description of current Pipeline operation w.r.t. designed pipeline facilities.
 - Model files for pipeline simulation as created & used by entity i.e. Input & output files of simulations/ calculations of pipeline facilities in line with applicable PNGRB regulation.
 - Any other inputs/ information/ data, as applicable, for carrying out the capacity assessment of pipeline facilities.
- d. The data received from Entity was reviewed by EIL to check its completeness for capacity assessment purpose. Shortfall in the submission/ clarifications was estimated & informed to Entity/ PNGRB.
- e. Entity sent presentation to EIL & PNGRB on overview of pipeline facilities, capacity assessment applications on the capacity determination & limiting condition for capacity determination
- f. Model files for pipeline simulation created & used by entity for capacity determination of subject assessment years were reviewed in detail by EIL along with verification of relevant input / output parameters and considered flow equations.
- g. EIL reviewed the native files w.r.t the approach considered by entity for capacity assessment purpose
- h. During the meeting, EIL provided comprehensive list of additional data / clarifications required from Entity.
- i. Entity provided following response w.r.t step wise compliance based on 10 steps methodology followed as given under Clause no. 5.(5) of PNGRB Capacity Regulations. Entity reply as follow-
- The entire pipeline system was configured in the selected software package operating offline (Emerson's TNet 4.2). The steady state condition of the pipeline hydraulics with contractual flow parameters (pressure, temperature and flow) at entry and exit points were simulated in the selected software package.
 - At the originating point and at intermediate points in the direction of flow, the pressure is set as a fixed parameter corresponding to the maximum allowable operating pressure (MAOP) or available compression facilities (except for depleting sources) and the maximum pressure at all exit points with contractual flow was computed.
 - Thereafter, assuming gas at the entry point (single source of gas) is unlimited and volume maximized at critical customer location/ farthest point location, the selected software is run till

- -any customer connected to the system reaches limiting condition of pressure required at the respective exit point AND/OR
- The velocity of natural gas reaches limiting value.
- The capacity at this juncture would be the maximum system capacity achievable in the pipeline system and the customer at the exit point where pressure becomes limiting becomes the critical customer.
- The simulation is carried out fixing the major source at pressure as per above step and other sources are configured in TG Net software considering evacuation volume from these other sources. The capacity of the network then is as determined following limiting conditions mentioned in previous step.
- The section wise capacity is the volume throughput through the section as per the software simulation under capacity conditions determined in above steps.
- Scheduling of sources at entry points and delivery at exit points is being done to optimize the pipeline system capacity as described under serial no.4 above.
- Exit point pressures are mentioned in Schedule A and Entity has simulated steady state (using approved flow equations Pan A /B on TNet) ensuring all Exit points meeting contractual minimum pressure and flow requirements.
- Entity has estimated the same from simulation model of entire network
- Entity has submitted the maximum achievable system capacity and average section wise capacity of the natural gas pipeline so determined, under the steady state simulation with the details of variable or constant parameters, to the Board in the specified format at Schedule A along with system flow diagram for the pipeline system including compressor stations, metering and regulating stations as applicable

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6.0 RESULTS & ANALYSIS

6.0 RESULTS & ANALYSIS

6.1 Constant Parameters used under Steady State conditions for Determining Capacity of Pipeline are as below:

1. Pipeline Outside diameter: As per data submitted by entity in capacity applications
2. Weighted average wall thickness: As per data submitted by entity in capacity applications
3. Length of the pipeline: As per data submitted by entity in capacity applications
4. Roughness for trunk line: As per data submitted by entity in capacity applications
5. Friction factor equation: Panhandle – A Modified for < 24", Panhandle – B Modified for > 24"
6. Standard Temperature & Pressure: 1.01325 Barg & 15 Deg C
7. Allowable Max velocity in the pipeline: 20 m/s
8. Average Sub- Soil temperature: 25 - 30 Deg C
9. In case of contractual pressure at any entry & exit point is within a band, the arithmetic mean rounded up to first decimal shall be considered.
10. MAOP :

Entity Name	MAOP, kg/cm ² g	Reference
GAIL Integrated Network		
Integrated HVJ Pipeline (Integrated HVJ)	92	In house Data
Jagdishpur Haldia-Bokaro Dhamra including Barauni-Guwahati and Dhamra-Haldia Natural Gas Pipeline(Integrated JHBDPL)	92	In house Data
Dadri-Bawana-Nangal Pipeline (DBNPL)	99.93	In house Data
Chainsa Jhajjar Hissar Pipeline(CJHPL)	99.93	In house Data
Dahej Uran-Dabhol-Panvel Pipeline(DUPL-DPPL)	92	In house Data
Dabhol Bangalore Pipeline(DBPL)	92	In house Data
South Gujarat sub-network of the Gujarat Regional Pipeline(SG)	49	As per data provided by Entity for South Gujarat sub-network capacity assessment
Uran-Thal-Usar sub-network of the Mumbai Regional Pipeline Network(UTU)	49	In house Data
Trombay-RFC sub-network of the Mumbai Regional Pipeline Network	49	In house Data

(Trombay RFC)

6.2 Step wise methodology given for Capacity determination in Clause No. 5.(5) of PNGRB regulation

Capacity determination shall be carried out by Entity w.r.t. step wise methodology given for Capacity determination in Clause No. 5.(5) of PNGRB regulation.

Subsequently, all data/inputs & capacity determination carried out by Entity have been reviewed by EIL w.r.t. step wise methodology given for Capacity determination in Clause No. 5.(5) of PNGRB regulation.

In view of the same, EIL observations as below may be referred against year wise action taken by Entity for each step of methodology for capacity determination of Natural Gas Pipeline:

- (i) The entire pipeline system shall be configured in the selected software package operating offline. The steady state condition of the pipeline hydraulics with contractual flow parameters (pressure, temperature and flow) at entry and exit points shall be simulated in the selected software package.**

Entity Action:

Entity has configured the entire pipeline system operating offline on year wise basis in the selected software package.

EIL observation:

EIL during meeting observed that Entity has configured the entire pipeline system operating offline on year wise basis in the selected software package i.e. TGNET

- (ii) At the originating point and at intermediate points in the direction of flow, set the pressure as a fixed parameter corresponding to the maximum allowable operating pressure (MAOP) or available compression facilities and compute the maximum pressure at all exit points with contractual flow.**

Entity Action:

At the originating point, pressure was set in terms of operating conditions.

EIL observation:

As per regulation, at the originating point and at intermediate points in the direction of flow, the pressure should be set as a fixed parameter corresponding to the MAOP in one case and corresponding to the available compression facilities in another case.

(iii) Thereafter, assuming gas at the entry point (single source of gas) is unlimited, the selected software will be run till any customer connected to the system reaches limiting condition of pressure required at the respective exit point or maximum flow capacity is reached at entry or intermediate compressor stations (if installed in the system) or the velocity of natural gas reaches limiting value as defined in these regulations. The capacity at this juncture would be the maximum system capacity achievable in the pipeline system and the customer at the exit point where pressure becomes limiting shall be the critical customer.

Entity Action:

Entity has run the selected software with limiting operating conditions. The capacity at this juncture has been defined as maximum system capacity achievable in the pipeline system.

EIL observation:

As per regulation, for capacity assessment purpose, gas at the entry point has been assumed as unlimited with MAOP conditions & then the selected software was run till any customer connected to the system reaches limiting condition as defined in regulation.

(iv) Now simulate the flow from any other source considering the entry should take place at the pressure marginally higher than the available at that section. The exercise carried above shall be repeated to get threshold pressure limit at any location to calculate the flow exiting from each point in the entire pipeline system and the sum total of these flows shall be the pipeline capacity as determine by the

approved flow equation and selected software. This would be the system capacity for multi-source pipeline system.

Entity Action:

Entity has run the selected software till the limiting operating conditions.

EIL observation:

Considering unlimited gas availability from entry points at MAOP, flow at exit points was increased until limiting conditions are achieved as defined in regulation.

(v) The section wise capacity of the pipeline system shall be computed between an entry point and exit points. In case of multi entry, the section wise capacity may also be determined taking into account flow from each of the input points. Thus the first section is from first entry point to first exit point and second section shall be from first entry point to second exit point and another section and so on. This exercise shall be repeated for each of the entry point. However, in a real time working, the effect of each source will have to be workout on the pipeline capacity and the flow parameters at intermediate points shall not be allowed to reduce the system or section capacity. The procedure mentioned above shall be applicable for determining the capacity of specific section of the pipeline.

Entity Action:

Section wise maximum achievable capacity of the pipeline as determined under limiting operating conditions has been submitted.

EIL observation:

Section wise capacity has been simulated as per methodology described under sub clause 5.(5).a (v) of capacity regulation.

(vi) In a real time model of pipeline system, the flow at specific entry point shall be the actual available flow from that source. The gas supply from various sources at entry points and delivery at exit points shall be scheduled to optimize the pipeline system capacity.

Entity Action :

Scheduling of sources at entry points and delivery at exit points with operating conditions is being done to optimize the pipeline system capacity as described under 5.(5).a(vi) of capacity regulations.

EIL observation:

Scheduling of sources at entry points and delivery at exit points has been done to optimize the pipeline system capacity as described under 5.(5).a(vi) of capacity regulations.

(vii) The obligatory or contractual requirement of pressure at any exit point shall determine the possible capacity within a particular section serving that exit points. Provided further that maintainability of a particular steady state hydraulics condition at any exit point shall be mutually determined between capacity determining authority and the transporter within the flexibility available in the system. The section wise capacity thus calculated with single or multiple entry and exit points shall be run with the approved flow equation and selected software package offline in the steady state operation of the system to arrive at capacities of various sections.

Entity Action:

With operating conditions, Entity has simulated all Exit points for meeting contractual minimum pressure requirements.

EIL observation:

Considering unlimited gas availability from entry point at the prevailing MAOP conditions, flow at exit points is increased until limiting conditions are achieved as defined in regulation.

(viii) This exercise shall be continued for computing section wise capacity of the pipeline system including the spur lines. In case of spur lines the tap off point shall be designated as the source point or entry point for spur line and computable (to be fed to the flow computing formula) or contractual hydraulics shall be allowable pressure at that point after accounting for the pressure drop from the tap off point to the consumer point of the spur line or branch line.

Entity Action :

While doing section wise capacity determination, Entity has estimated the same from simulation model of entire network with operating conditions.

EIL observation:

Section wise capacity was estimated from the simulation model of P/L network with MAOP conditions.

(ix) For determining, de-rated MAOP of an existing pipeline, results based on the Instrumented pig survey shall be considered to calculate de-rating factor. In absence of results of the intelligent pig survey (IPS) in any pipeline, hydro testing shall be carried out to establish MAOP of that pipeline as per provisions in the relevant regulations on Technical Standard and Specifications including Safety Standards. Provided that in absence of hydro testing the entity may put up proposal for de-rating based on random thickness survey of the pipeline. Board reserves the right to check such survey data.

Entity Action:

Entity had informed that there is no derating of the Pipeline system. Hence, no section is considered with de-rated MAOP for capacity determination.

EIL observation:

Noted and found ok.

(x) The entity shall submit the details of maximum achievable system capacity and section wise capacity of the natural gas pipeline so determined, under the steady state simulation with the details of variable or constant parameters, to the Board in the specified format at Schedule A along with the hydraulic gradient and system flow diagram for the pipeline system including compressor stations, metering and regulating stations as applicable.

Entity Action:

The entity has submitted capacity so determined, in the specified format at Schedule A.

EIL observation:

Noted.

6.3 Results

Entity data / inputs has been verified by EIL w.r.t stepwise methodology given in Clause no. 5.(5) and supported data / inputs submitted by Entity/PNGRB. Tabulated below are the comparative capacity assessment figures (rounded-off figures) of pipeline (at an interval of one year) carried out by entity & EIL:

Assessment years	Pipeline Capacity as determined by Entity (in MMSCMD)	Pipeline Capacity as assessed by EIL (in MMSCMD)	Remarks
	Entity	EIL	
	Software used - Pipeline Studio (TGNET)	Software used - Pipeline Studio (TGNET)	
2022-23	140	145	
2023-24	156	163.8	Addition of one source Dhamra, ten additional consumers and increase in network by 1435 Km approx.. Refer annexure IX

Note –

- As the pipeline capacity was arrived as per PNGRB regulation [based on MAOP considerations], hence variation in determined capacity for various assessment years is due to change in sources and /or deliveries and / or network length and / or network configuration etc.
- Bokaro & Jharia sources are under construction & refer Annexure IX for capacity with these sources.
- "Tie-In Connectivity" from Natural Gas source of Jaya Fields (Jambusar, Gujarat) of M/s Vedanta Ltd. to South Gujarat Main sub-network of Gujarat Natural Gas Pipeline Network (GNGPN) of GAIL was not a part of Integrated pipeline network and South Gujarat Main sub-network provided by entity.
- Capacity given in table above is with Suvali tie in connectivity. Capacity without this source is 143 & 160.8 MMSCMD for assessment years 2022-23 & 2023-24 respectively.
- Impact of Dhamra connectivity is 14.35 MMSCMD for year 2023-24

- Impact of JHBDPL for 2022-23 is 13 MMSCMD
- Bokaro & Jharia sources are under construction & impact of these sources for 2023-24 are:
 - Bokaro :0.6 MMSCMD
 - Jharia: 0.6 MMSCMD
 - Bokaro & Jharia both :1.2 MMSCMD

□□□

7.0 SUMMARY

7.0 SUMMARY

This report presents the observations arrived at by the EIL for the data/inputs furnished by Entity/PNGRB w.r.t. provisions of applicable Petroleum and Natural Gas Regulatory Board (Determining capacity of Petroleum, Petroleum products and Natural Gas Pipeline) Regulations, 2010. Accordingly, following results are summarized based on capacity assessment carried out by EIL:

PNGRB regulation i.e. Petroleum and Natural Gas Regulatory Board (Determining capacity of Petroleum, Petroleum products and Natural Gas Pipeline) Regulations, 2010 defines the step wise methodology for the determination of Pipeline capacity.

Hence, year wise methodology adopted by Entity has been reviewed by EIL against defined step wise methodology given in the regulation of capacity determination as clause no. 5.(5).

Entity was requested to determine the capacity following the stepwise methodology given in Clause no. 5.(5) (methodology for calculation of pipeline capacity).

Entity data / inputs has been verified by EIL w.r.t stepwise methodology given in Clause no. 5.(5) and supported data / inputs submitted by Entity/PNGRB. Tabulated below are the comparative capacity assessment figures (rounded-off figures) of pipeline (at an interval of one year) carried out by entity & EIL:

Assessment years	Pipeline Capacity as determined by Entity (in MMSCMD)	Pipeline Capacity as assessed by EIL (in MMSCMD)	Remarks
	Entity	EIL	
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2022-23	140	145	
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Note –

- As the pipeline capacity was arrived as per PNGRB regulation [based on MAOP considerations], hence variation in determined capacity for various assessment years is due to change in sources and /or deliveries and / or network length and / or network configuration etc.
- Bokaro & Jharia sources are under construction & refer Annexure IX for capacity with these sources.
- "Tie-In Connectivity" from Natural Gas source of Jaya Fields (Jambusar, Gujarat) of M/s Vedanta Ltd. to South Gujarat Main sub-network of Gujarat Natural Gas Pipeline Network (GNGPN) of GAIL was not a part of Integrated pipeline network and South Gujarat Main sub-network provided by entity.
- Capacity given in table above is with Suvali tie in connectivity. Capacity without this source is 143 & 160.8 MMSCMD for assessment years 2022-23 & 2023-24 respectively.
- Impact of Dhamra connectivity is 14.35 MMSCMD for year 2023-24
- Impact of JHBDPL for 2022-23 is 13 MMSCMD
- Bokaro & Jharia sources are under construction & impact of these sources for 2023-24 are:
 - Bokaro :0.6 MMSCMD
 - Jharia: 0.6 MMSCMD
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□□□

Annexure-I

PETROLEUM AND NATURAL GAS REGULATORY BOARD

NOTIFICATION

New Delhi, the 7th June, 2010

G.S.R. 476(E).---In exercise of the powers conferred by Section 61 of the Petroleum and Natural Gas Regulatory Act, 2006 (19 of 2006), the Petroleum and Natural Gas Regulatory Board hereby makes the following regulations, namely:-

1. Short title and commencement.

- (1) These regulations may be called the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Regulations, 2010.
- (2) They shall come into force on the date of their publication in the Official Gazette.

2. Definitions.

- (1) In these regulations, unless the context otherwise requires,-
 - (a) “Act” means the Petroleum and Natural Gas Regulatory Board Act, 2006;
 - (b) “appointed day” means the date of October 1, 2007 when the Central Government notified the establishment of the Petroleum and Natural Gas Regulatory Board;
 - (c) “Board” means the Petroleum and Natural Gas Regulatory Board established under sub-section (1) of section 3 of the Act;
 - (d) “capacity assessment group” means a group comprising representatives of two transporters other than the entity of which the pipeline system capacity is to be certified and a representative of the Board, as decided by the Board on case to case basis or any agency or entity or authorized person or any approved third party authorized by the Board for determining the capacity of the petroleum, petroleum products and natural gas pipeline;
 - (e) “critical customer” means a customer whose withdrawal conditions in the pipeline system could affect the capacity of the pipeline;
 - (f) “extension of pipeline” means increase in length of pipelines in either direction for transportation of natural gas from an existing transmission or trunk pipeline or sub-transmission pipeline or spur line to another geographical location without increase in authorized capacity of the pipeline;
 - (g) “expansion of pipeline” means increase in the capacity of existing pipeline beyond its previously authorized capacity due to installation of additional facilities such as compression facilities, addition of compressor stations or loop lines or extension to new sources of gas to tap additional volumes etc. Expansion of pipeline may also include extension of the existing pipeline in either direction

as long as it increases the capacity of the pipeline and in that case it may be treated as expansion of the pipeline not extension;

- (h) “marginally higher pressure” means an entry point pressure at any intermediate location in the pipeline system which is higher than the system pressure at that location so that flow from new source can commence without disturbing existing upstream conditions in the pipeline system;
- (i) “Natural Gas Pipeline” means the pipeline as defined under the Petroleum and Natural Gas Regulatory Board (Authorizing Entities to Lay, Build, Operate or Expand Natural Gas Pipelines) Regulations, 2008;
- (j) “petroleum, petroleum products pipeline” means any pipeline including a branch or spur line for transport of petroleum, petroleum products and includes all connected infrastructure such as pumps, metering units, storage facilities at originating, delivery, tap off points, terminal station and the like connected to the common carriers or contract carriers including line balancing tanks and tankage required for unabsorbed interface essential for operating a pipeline system but excluding pipelines:

which are dedicated for supply of petroleum products to a specific consumer which are not for resale;

Provided that the transporter may own, hire, outsource or use on hospitality basis such connected facilities on non discriminatory basis;

Provided further for the purpose of capacity determination, these regulations shall apply to all petroleum, petroleum products pipelines including dedicated pipelines;

- (k) “capacity for the pipeline system” means the maximum quantity of petroleum, petroleum products or natural gas that can be injected into the system or off taken from the system at specific points, meeting all the technical and operational parameters fixed in each pipeline section in a steady state conditions , that is, all parameters like flow, pressure, temperature are in harmony and vary only along the length of pipeline but not with time;
- (l) “declared capacity of pipeline” means the volume of natural gas in MMSCMD (million standard cubic meters per day) that a pipeline is capable of transporting under the steady state operating conditions. For liquid pipeline the declared capacity of pipeline shall be the quantity of petroleum, petroleum products in MMTPA ¹[(Million Metric Tonne Per Annum), the pipeline is capable of transporting under the operating steady state conditions. Provided that the capacity has been determined based on the approved flow equation and the selected software package;

¹ Subs. by Cl. (i) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

- (m) “section” means a portion of pipeline between any entry point to any exit point or any other entry point in the direction of flow. Provided the computation of successive section shall start from second entry point and so on;
- (n) “selected software package” means the software package used by the entity for determination of capacity of the pipeline system or the pipeline section;
- (o) “spur-line” means a pipeline necessarily originating or branching out from the trunk or transmission pipeline or sub-transmission line or another spur line or from a terminal station on the existing transmission or trunk pipeline with diameter and capacity not greater than the trunk or transmission pipeline but having no compression facility for supply of natural gas to one or more consumers. Any pipeline having a separate gas source or a compressor shall not be treated as a spur-line. The length of spur-line may not depend upon the length of the trunk pipeline. A spur-line must use the capacity of trunk pipeline in order to transport gas. Spur line includes branch line also;
- (p) “section capacity” means the capacity of a particular section of the pipeline which contains a supply source or a delivery source or both. In other words, the section capacity is the maximum flow that could be handled by the specific section without disturbing the connected supply or delivery condition of the shippers;
- (q) “steady state condition” means calculation carried out based on time-invariant pressure, temperature and flow profiles throughout a pipeline using specified boundary conditions. In other words, the steady-state run calculates the hydraulic state of a pipeline system operating at equilibrium with input and output balance;
- (2) Words and expressions used and not defined in these regulations, but defined in the Act or in the rules or regulations made thereunder, shall have the meanings respectively assigned to them in the Act or in the rules or regulations, as the case may be.

3. Applicability.

- (1) These regulations shall apply to an entity:-
 - (a) which is laying, building, operating or expanding or which proposes to lay, build, operate or expand a petroleum, petroleum products and natural gas pipeline;
 - (b) which proposes to lay a dedicated pipeline or is directed by the Board to convert a dedicated pipeline for supply of petroleum, petroleum products and natural gas into a common or contract carrier petroleum, petroleum products and natural gas pipeline; or
 - (c) which proposes extension or expansion of pipeline resulting into increase in capacity of the petroleum, petroleum products and natural gas pipeline.
- (2) These regulations cover the procedure, parameters both constant and variable and frequency of declaration of pipeline capacity in MMSCMD for Natural Gas pipeline or in MMTPA for petroleum and petroleum products pipeline.

4. Intent.

(1) It is intended to apply these regulations to all new and existing petroleum, petroleum products and natural gas pipelines including dedicated pipelines for the purpose of ²[determination or] declaration of capacity of the pipeline under steady state conditions.

(2) ³[****]

(3) ⁴[****]

5. Determining capacity of a Petroleum, Petroleum Products and Natural Gas Pipeline.

(1) The determination of capacity for the pipeline system and for each section of the petroleum, petroleum products and natural gas pipeline shall be based on selected software package and flow equation approved by the Board under this regulation. It is not necessary for the entities to buy and install any specific software package. As long as the software supports the flow equation approved by the Board, the entities may continue to use or operate the system based on the previously installed software but shall have to determine the capacity of the system based on the flow equation approved by the Board in any of the compatible software package for the purpose of these regulations.

(2) The entity while submitting the capacity of the pipeline system to the Board shall furnish a declaration that the capacity has been calculated using the approved flow equation. The entity shall also submit the detailed calculations of the capacity and the software used for the purpose within thirty days of the notification of these regulations and thereafter as per the periodicity for determining capacity of a Petroleum, Petroleum Products and Natural Gas pipeline defined in regulation 7 of these regulations.

(3) The parameters for the steady state simulation for determining the pipeline capacity shall be considered as given below, namely: -

(a) **Constant parameters** in the unit as specified in the approved flow equation as per sub-clause (v) of this clause.

(i) **Internal diameter** – The internal diameter shall be determined based on weighted average of internal diameters based on different pipe thicknesses used in different sections in the pipeline system.

(ii) **Length** – The actual length (for already installed pipeline) or proposed length (for yet to be installed pipeline) of the pipe in the pipeline system.

² Ins. by Sub. Cl. (a) of Cl. (ii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

³ The words specified sub-clause (2) & (3) are omitted by sub-cl (b) of Cl. (ii) of Reg. (2), the Petroleum and Natural Gas Regulatory Board (Authorising Entities to Lay, Build, Operate or Expand City or Local Natural Gas Distribution Networks) Amendment Regulations, 2022 (w.e.f. 18.11.2022).

⁴ The words specified sub-clause (3) are omitted by Supra 3 (w.e.f. 18.11.2022).

- (iii) **Roughness** – This is a fixed value for a pipe which determines the unevenness inside a pipe. Depending on the pipe material the below given value for roughness factor shall be used :

Type of Material	Roughness (micron)
Steel – New Pipe	
- With internal coating	10-15
- Without internal coating	35-40
Steel – old Pipe (more than ten years)	
- With internal coating	15-20
- Without internal coating	40-45

For old pipelines already operating, roughness factor shall be determined by duly calibrating actual field data in the approved flow equation. These factors shall be assessed by the capacity assessment group. For new pipelines, roughness factor used shall be decided keeping in view the operating conditions and pipeline feature like bends, valves, or any other restrictions present in the system:

Provided that the entity shall declare in advance the roughness factor considered for the pipes with relevant operating data to support the value chosen in case it is different from the above values.

- (iv) **Efficiency factor** –Efficiency factor within the range of 0.85 to 1.0 shall be used. For old pipelines already operating, efficiency factor shall be determined by duly calibrating actual field data in the approved flow equation. These factors shall be assessed by the capacity assessment group. For new pipelines efficiency factor used shall be decided keeping in view the operating conditions and pipeline feature like bends, valves, life of pipeline or any other restrictions present in the system:

Provided that the entity shall declare in advance the efficiency factor considered for the pipes with relevant operating data to support the value chosen in case it is different from the above values giving complete analysis. The Board may direct the entity to improve upon such design.

- (v) **Formula** – For determination of friction factor in the pipeline the following flow equation shall be used;

Type of Pipeline	Name of Flow equation
Natural Gas	Panhandle Modified Panhandle A for Pipe size ≤ 24 " Panhandle B for Pipe size > 24 "
Petroleum and Petroleum Products	Colebrook White

Explanation: For the determination of capacity of petroleum and petroleum products pipelines, the roughness factor shall be used. For natural gas pipelines, the efficiency factor shall be used.

- (vi) **Velocity** – The maximum allowable velocity of natural gas or petroleum product in the pipeline shall be 20 m/sec in case of natural gas pipeline and ⁵[3 m/sec] in case of petroleum product pipelines or as per relevant regulations on Technical Standards and Specifications including Safety Standards whichever is lower, if specified.

- (vii) **STP** – ⁶[****]:

Standard pressure	:	1.01325 bar.
Standard temperature	:	15 °C

- (viii) ⁷[(viii) Maximum Allowable Operating Pressure (MAOP) - The pipeline capacity shall be determined at the designed MAOP or de-rated MAOP due to any condition, for the petroleum, petroleum products or natural gas pipelines.]

(b) Variable parameters-

- (i) **Operating temperature** – This is the actual temperature that a pipe is exposed to throughout the year. This temperature will be considered, for the purpose of determining capacity, as per the table below:

Country Region	Temperature (°C)	
	Winter	Summer
Tropical area such as North and North West India	20	30
Rest of India	30	30

- (ii) **Inlet temperature** – This is the inlet temperature of the petroleum, petroleum products and natural gas from the source into the pipeline.

- (iii) **Outlet temperature** – This is the outlet temperature of the petroleum, petroleum products and natural gas at the delivery point.

- (iv) **Inlet pressure** – The maximum pressure that is available at the entry point to the pipeline system.

⁵ Subs. by Sub. Cl. (a) of Cl. (iii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

⁶ The words specified are deleted by Sub. Cl. (b) of Cl. (iii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

⁷ Ins. by Sub. Cl. (c) of Cl. (iii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

- (v) **Outlet pressure** – The minimum pressure that is required by the customer at the delivery or exit point as per access arrangement entered into by the shipper and the transporter.
- (vi) **Source Supply flow** - This is the maximum flow that can be available from the source.
- (vii) **Delivery flow** – This is the maximum flow that is required by the customer at the exit point as per access arrangement entered into by the shipper and the transporter.
- (viii) **Elevation difference** – Depending on the terrain of the ground profile, this factor will be considered from the mean sea level of the area.
- (ix) **Gas composition** – The gas composition indicating all components totaling 100% by volume is to be given with the level of impurities as per Schedule II of the Petroleum and Natural Gas Regulatory Board (Access Code for common or contract carrier Natural Gas Pipelines) Regulations, ⁸[2008]. From this, necessary input to the flow equation shall be worked out.

In case of more than one source, the weighted average composition of comingled natural gas beyond the second source of entry point shall be considered. Notwithstanding interdependency of various parameters, the gas parameters as described in Schedule II of regulations of Access Code shall be declared before hand with reference to gas properties.

⁹["In case of natural gas pipeline, the gas quality at exit point shall be as per the Petroleum and Natural Gas Regulatory Board (Access Code for common or contract carrier Natural Gas Pipelines) Regulations, 2008."]

- (x) ¹⁰[In case of petroleum products, the entry point parameters shall be such that the deliveries of products at delivery point or tap off point or exit points shall be as per the prevalent BIS specifications applicable.

(4) All entities shall declare to the Board the constant parameters and the variable parameters for the pipeline: -

- (i) On first working day of April ¹¹[every year for next financial year.]; or

⁸ Subs. by Sub. Cl. (d) of Cl. (iii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

⁹ Ins. by Sub. Cl. (d) of Cl. (iii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

¹⁰ Del. by Sub. Cl. (e) of Cl. (iii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

¹¹ Subs. by Sub. Cl. (a) of Cl. (iv) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

- (ii) Whenever there is any addition or deletion of the supply source of petroleum, petroleum products or natural gas.

¹²[The entities shall also provide on first working day of April every year (for next financial year) the hydraulic gradient and system flow diagram for the pipeline.

(5) The methodology for calculation of pipeline capacity shall be as under:

(a) Natural Gas Pipelines:

- (i) The entire pipeline system shall be configured in the selected software package operating offline. The steady state condition of the pipeline hydraulics with contractual flow parameters (pressure, temperature and flow) at entry and exit points shall be simulated in the selected software package.
- (ii) At the originating point and at intermediate points in the direction of flow, set the pressure as a fixed parameter corresponding to the maximum allowable operating pressure (MAOP) or available compression facilities and compute the maximum pressure at all exit points with contractual flow.
- (iii) Thereafter, assuming gas at the entry point (single source of gas) is unlimited, the selected software will be run till any customer connected to the system reaches limiting condition of pressure required at the respective exit point or maximum flow capacity is reached at entry or intermediate compressor stations (if installed in the system) or the velocity of natural gas reaches limiting value as defined in these regulations. The capacity at this juncture would be the maximum system capacity achievable in the pipeline system and the customer at the exit point where pressure becomes limiting shall be the critical customer.
- (iv) Now simulate the flow from any other source considering the entry should take place at the pressure marginally higher than the available at that section. The exercise carried above shall be repeated to get threshold pressure limit at any location to calculate the flow exiting from each point in the entire pipeline system and the sum total of these flows shall be the pipeline capacity as determined by the approved flow equation and selected software. This would be the system capacity for multi source pipeline system.
- (v) The section wise capacity of the pipeline system shall be computed between an entry point and exit points. In case of multi entry, the section wise capacity may also be determined taking into account flow from each of the input points. Thus the first section is from first entry point to first exit point and second section shall be from first entry point to second exit point and another section and so on. This exercise shall be repeated for each of the entry point. However, in a real time working, the effect of each source will have to be worked out on the pipeline capacity and the flow parameters at intermediate points shall not be

¹² Subs. by Sub. Cl. (b) of Cl. (iv) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

allowed to reduce the system or section capacity. The procedure mentioned above shall be applicable for determining the capacity of specific section of the pipeline.

- (vi) In a real time model of pipeline system, the flow at specific entry point shall be the actual available flow from that source. The gas supply from various sources at entry points and delivery at exit points shall be scheduled to optimize the pipeline system capacity.
- (vii) The obligatory or contractual requirement of pressure at any exit point shall determine the possible capacity within a particular section serving that exit points. Provided further that maintainability of a particular steady state hydraulics condition at any exit point shall be mutually determined between capacity determining authority and the transporter within the flexibility available in the system. The section wise capacity thus calculated with single or multiple entry and exit points shall be run with the approved flow equation and selected software package offline in the steady state operation of the system to arrive at capacities of various sections.
- (viii) This exercise shall be continued for computing section wise capacity of the pipeline system including the spur lines. In case of spur lines the tap off point shall be designated as the source point or entry point for spur line and computable (to be fed to the flow computing formula) or contractual hydraulics shall be allowable pressure at that point after accounting for the pressure drop from the tap off point to the consumer point of the spur line or branch line.
- (ix) For determining, de-rated MAOP of an existing pipeline, results based on the Instrumented pig survey shall be considered to calculate de-rating factor. In absence of results of the intelligent pig survey (IPS) in any pipeline, hydro testing shall be carried out to establish MAOP of that pipeline as per provisions in the relevant regulations on Technical Standard and Specifications including Safety Standards. Provided that in absence of hydro testing the entity may put up proposal for de-rating based on random thickness survey of the pipeline. Board reserves the right to check such survey data.
- (x) The entity shall submit the details of maximum achievable system capacity and section wise capacity of the natural gas pipeline so determined, under the steady state simulation with the details of variable ¹³[and] constant parameters, to the Board in the specified format at Schedule A along with the hydraulic gradient and system flow diagram for the pipeline system including compressor stations, metering and regulating stations as applicable.

(b) Petroleum Product Pipelines:

- (i) In a multi-product pipeline, the maximum achievable capacity shall be determined based on the characteristics of High Speed Diesel (HSD) whereas

¹³ Subs. by Sub. Cl. (a) of Cl. (v) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

for pipelines dedicated for transportation of single product like LPG, Naphtha or ATF etc., characteristics of that product only shall be considered.

- (ii) The entire pipeline system shall be configured in the selected software package operating offline. The steady state of hydraulics of the pipeline shall be entered into the system.
- (iii) At the originating point and at intermediate points in the direction of flow set the pressure as a fixed parameter corresponding to maximum allowable operating pressure (MAOP) or pumping facilities available at these locations, as the case may be, and compute the maximum possible flow in the pipeline system. This shall be the capacity of the pipeline system under prevailing facilities and conditions.
- (iv) Thereafter, assuming products at the entry points as unlimited, the Station Discharge Head (SDH) at the pump station equal to Maximum Allowable Operating Pressure (MAOP) of the pipeline, the entire pipeline system shall be configured in the selected software package operating offline. The steady state of hydraulics of the pipeline shall be entered into the system for computing the maximum achievable flow in the pipeline system using the selected software and approved flow equation
- (v) At the first and subsequent withdrawal points in the direction of flow getting the required pressure or SDH as a fixed parameter, the maximum possible flow within that section shall be computed based on the methodology specified above. Similarly, the possible volume flow shall be calculated from section to section and tabulated up to the last exit point taking into account the quantity available from other injection points.
- (vi) If the capacity of a pipeline have been downgraded or decreased due to de-rating of the MAOP of the pipeline due to factors like metal loss, the de-rated capacity of such pipelines shall be determined considering results of Instrumented pig survey. In the absence of results of IPS in any pipeline, hydro testing shall be carried out to establish MAOP of that pipeline as per provisions in the relevant regulations on Technical Standard and Specifications including Safety Standards. Provided that in absence of hydro testing the entity may put up proposal for de-rating based on random thickness survey of the pipeline. Board reserves the right to check such survey data.
- (vii) The requirement of a pressure or SDH at any exit point shall determine the possible capacity within a particular section serving that exit points. Provided further that maintainability of a particular hydraulics condition at any exit point shall be mutually determined between capacity determining authority and the transporter within the flexibility available in the system. The section wise capacity thus calculated with single or multiple entry and exit points shall be run with the selected software package offline in the steady state operation of the system to arrive at capacities of various sections.
- (viii) The entity shall submit the maximum achievable pipeline capacity as well as section wise capacity of the product pipeline so determined, under the steady

state simulation with the details of variable ¹⁴[and] constant parameters, to the Board in the specified format at Schedule B along with the hydraulic gradient and system flow diagram for the pipeline system.

- (c) In case the contractual pressure at any entry and exit point is within a band, the arithmetic mean rounded up to first decimal point shall be considered.
- (d) The annual capacity of pipeline system and sections shall be as per the operation days specified in the Access Code for respective system.
- (e) ¹⁵[The capacity of integrated or interconnected pipeline network shall be determined in line with methodology as specified above.
- (f) Reduction of pipeline capacity shall not be permitted except in case of de-rating with prior approval from Board.
- (g) Wherever there is any change in the capacity of natural gas pipeline in the past or in future due to reason(s) as approved by the PNGRB's Board, in such cases entity shall submit the revised capacity of the natural gas pipeline, separately due to each such reasons, to PNGRB in terms of these regulations for capacity determination and approval of the Board.]

6. Declaring capacity of Petroleum, Petroleum Products and Natural Gas pipeline by the Board.

- (a) The Board, after having satisfied with the data submitted by the entity regarding capacity of the pipeline, shall decide-
 - (i) to reject the capacity so determined and direct the entity to revise the capacity calculations based on the revised parameters; or
 - (ii) to go ahead with the proposal with or without modification:
- (b) The capacity so determined shall be declared by the Board as the declared capacity of pipeline system and specific sections and the same shall be available to the shippers or consumers. The Board shall declare the section wise capacity of the system in the format specified at Schedule C.
- (c) The entity, after declaring the pipeline capacity and section wise capacities by the Board, shall publish the same in line with the provisions of the relevant regulations on the Access Code for such pipeline as and when notified, on their website.

7. Periodicity for determining capacity of a Petroleum, Petroleum Products and Natural Gas pipeline.

¹⁴ Subs. by Sub. Cl. (b) of Cl. (v) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

¹⁵ Ins. by Sub. Cl. (c) of Cl. (v) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

- (i) The capacity of a pipeline shall be determined on first working day of April every year ¹⁶[for next financial year”] or whenever ¹⁷[there is an aggregate change of plus or minus 10% in capacity due to the following factors] -
 - (a) there is a major change in the injected quantity or off taken quantity of petroleum, petroleum products and natural gas;
 - (b) contract carrier quantity period expires;
 - (c) there is a change of plus or minus ten percent in gas composition or product quality or in other operating parameters from the operating conditions of the pipeline system within the parameters defined under the relevant regulations on the access code ¹⁸[;];
 - (d) there is addition or deletion of entry or exit point; or
 - (e) there is addition or deletion of facilities, for example, compressor or pumping station, loop lines or any other facility;
- (ii) The entity shall submit the details of the so re-determined capacity of the pipeline ¹⁹[(as per regulation 5)] to the Board in line with the provisions of these regulations for the purpose of declaration of capacity.

8. Provisions relating to dedicated pipelines for transport of Petroleum, Petroleum Products and Natural Gas.

- (1) In respect of existing dedicated pipelines, the following provisions shall apply, namely:-
 - (a) entity having dedicated pipeline to transport petroleum, petroleum products and natural gas to a specific customer and which is not for resale before the appointed day shall submit details of the pipeline capacity as determined based on the provisions of these regulations to the Board within thirty days of notification of these regulations;
 - (b) the Board may, based on the examination of the information received, declare the capacity of such pipeline as capacity of dedicated pipeline.

9. Miscellaneous.

¹⁶ Ins. by Pt. (i) of Sub. Cl. (a) of Cl. (vi) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

¹⁷ Ins. by Pt. (ii) of Sub. Cl. (a) of Cl. (vi) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

¹⁸ Omitted by Sub. Cl. (b) of Cl. (vi) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

¹⁹ Ins. by Sub. Cl. (c) of Cl. (vi) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

²⁰[(1) If any question arises as to interpretation of these regulations, the same shall be decided by the Board.]

- (2) The Board may, either suo moto or on a complaint, refer the issue of determination of the capacity in a pipeline, to any external consultant or expert. Cost in this regard shall be borne by the entity or the complainant or as deemed fit by the Board on a case specific basis. However, the recommendation of the consultant or expert shall be advisory in nature to the Board and shall not be binding;
- (3) The Board may validate the computed capacity with actual capacity as per the flow regime of the pipeline with actual flow conditions as and when desired.

²⁰ Subs. by reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2014, for sub reg. 1 of reg. 9, (w.e.f. 01.01.2015).

Schedule A

[see regulation 5(5)(a)(x)]

Format for furnishing information regarding determining capacity of
Natural Gas Pipeline

²¹[Financial Year: 20.... - 20....]

1	Name of Entity	
2	Address & Contact details of Entity	
3	Name of Natural Gas Pipeline	
4	Name of Software package used	
5	Approved Flow equation used (mention name of flow equation)	
6	Details of injection/entry point and delivery/exit points and sections on the pipeline	
7	Composition of natural gas	
8	Entity agrees to have considered the Technical standards, specifications and safety standards as specified by the Board	Yes/ No
9	Entity agrees to have considered the relevant provisions of Petroleum and Natural Gas Regulatory Board Regulations	Yes/ No
10	Constant and variable parameters used under steady state conditions for determining capacity of the pipeline	
11	Capacity of the pipeline under existing operating conditions	
12	Maximum achievable Capacity of the pipeline under steady state conditions as determined under ²² [regulation5] of these regulations	
13	Section wise maximum achievable capacity of the pipeline as determined under ²³ [regulation] 5 of these regulations	
14	Expected addition of entry points and exit points scheduled in near future	

Note: ²⁴[(i) Submit the system flow diagram, hydraulic gradient and simulation files of software package used for capacity determination.

²¹ Ins. by Sub. Cl. (a) of Cl. (vii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

²² Subs. by Sub. Cl. (b) of Cl. (vii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

²³ Subs. by Sub. Cl. (b) of Cl. (vii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

²⁴ Subs. by Sub. Cl. (c) of Cl. (vii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

(ii) Above information shall be approved by person authorized by the board of entity.”]

Schedule B

[see regulation 5(5)(b)(viii)]

Format for furnishing information regarding determining capacity of Petroleum and
Petroleum Products Pipeline

²⁵[Financial Year: 20.... - 20....]

1	Name of Entity	
2	Address and Contact details of Entity	
3	Name of Petroleum and Petroleum Products Pipeline	
4	Name of Software package used for determining capacity	
5	Approved Flow equation used (mention name of flow equation)	
6	Details of injection/entry point and delivery/exit points and sections on the pipeline	
7	Quality of various products being transported in the pipeline	
8	Constant and variable parameters used under steady state conditions for determining capacity of the pipeline	
9	Entity agrees to have considered the Technical standards, specifications and safety standards as specified by the Board	Yes/ No
10	Entity agrees to have considered the relevant provisions of Petroleum and Natural Gas Regulatory Board Regulations	Yes/ No
11	Quality specifications considered for the purpose of capacity determination	
12	Capacity of the pipeline under existing operating conditions	
13	Maximum achievable Capacity of the pipeline under steady state conditions as determined under ²⁶ [regulation] 5 of these regulations	
14	Section wise maximum achievable capacity of the pipeline as determined under ²⁷ [regulation] 5 of these regulations	
²⁸ [15]	Expected addition of entry points and exit points scheduled in near future	

²⁵ Ins. by Sub. Cl. (a) of Cl. (viii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

²⁶ Subs. by Sub. Cl. (c) of Cl. (viii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

²⁷ Subs. by Sub. Cl. (c) of Cl. (viii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

²⁸ Ins. by Sub. Cl. (d) of Cl. (viii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

Note: ²⁹[(i) Submit the system flow diagram, hydraulic gradient and simulation files of software package used for capacity determination.

(ii) Above information shall be approved by person authorized by the board of entity.”]

²⁹ Subs. by Sub. Cl. (b) of Cl. (viii) of Reg.2, the Petroleum and Natural Gas Regulatory Board (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Amendment Regulation, 2022, (w.e.f. 18.11.2022).

Schedule C

[see regulation 6(b)]

Format for declaring capacity of Petroleum, Petroleum Products and Natural Gas Pipeline
by the Petroleum and Natural Gas Regulatory Board

Date of declaration of capacity by the Board:

1	Name of Entity	
2	Address and Contact details of Entity	
3	Name of Pipeline	
4	Details of injection/entry point and delivery/exit points and sections on the pipeline	
5	Name of the software package used by the entity	
6	Flow equation used for the purpose	
7	Product Quality specifications/gas Parameters considered for the purpose of capacity determination	
8	Maximum achievable capacity of the pipeline under steady state conditions	
9	Section wise maximum achievable capacity of the pipeline	

Secretary
Petroleum and Natural Gas Regulatory Board

[F. No. S-Admn/II/8/2010]
RATAN P. WATAL, Secy.

Foot Note: Principal regulations were notified *vide* G.S.R. 476(E) dated 07/06/2010 and amended *vide* F. No. L-MISC/VI/I/2007 dated 01.01.2015 and F. No. PNGRB/Tech/10-Cap/NGPL&PPPL/(2)/2022(P-3745) dated 18th November, 2022.

Annexure-II

SCHEDULE A

Format for furnishing information regarding determining capacity of Natural Gas Pipeline (Financial Year: 2022-23)

S. No.	Description	GAIL Submission/ Remarks
1.	Name of Entity	GAIL (India) Ltd.
2.	Address and contact details of Entity	GAIL Bhawan, 16, Bhikaiji Cama Place, R.K. Puram, New Delhi - 110066
3.	Name of Natural Gas Pipeline	Integrated Network of GAIL's Interconnected Natural Gas Pipelines i.e. Integrated HVJ, DUPL-DPPL, DBPL, DBNPL, CJHPL & JHBDPL (Phase I), Uran-Thal-Usar & Trombay RCF sub-networks of Mumbai Regional NGPL Network and Baroda (South Gujarat) sub-network of Gujarat Regional NGPL Network
4.	Name of Software package used	Pipeline Studio TNet (ver. 4.2)
5.	Approved Flow equation used (mention name of flow equation)	Panhandle – A for $\leq 24''$ $\varnothing$ pipelines Panhandle – B for $> 24''$ $\varnothing$ pipelines (As per PNGRB Regulations)
6.	Details of Injection/Entry Points Details of Delivery/Exit Points	As in Annexure I&II
7.	Composition of Natural gas	As in Annexure II
8.	Entity agrees to have considered the technical standards, specifications and safety standards as specified by the board	YES
9.	Entity agrees to have considered the relevant provisions of Petroleum and Natural Gas Regulatory Board regulations	YES
10.	Constant and variable parameters used under steady state conditions for determining capacity of pipelines	As in Annexure I&II
11.	Capacity of the pipeline under existing operating conditions	-
12.	Maximum achievable capacity of the pipeline under steady state conditions as determined under regulation 5 of these regulations	140 MMSCMD
13.	Section-wise maximum achievable capacity of the pipeline as determined under regulation 5 of these regulations	As per simulation sheet and attached table
14.	Expected addition of entry points and exit points scheduled in near future	Future entry and exit points will be informed as and when these are finalized

Throughput through pipe section 2022

Pipe Name	Dia (inside)	Flow (Head)	Flow (Tail)
	in	inch	MMSCMD
55-2	3.996	0.147	0.147
63-2	3.996	0.008	0.008
20-3	3.996	0.010	0.010
58-2	3.996	0.052	0.052
18-3	3.996	0.035	0.035
69	3.996	0.000	0.000
24-3	3.996	0.013	0.013
60-2	3.996	0.036	0.036
56-2	3.996	0.114	0.114
62-2	3.996	0.000	0.000
57-3	3.996	0.157	0.157
54-2	3.996	0.057	0.057
23-3	3.996	0.013	0.013
61-2	3.996	0.057	0.057
19-3	3.996	0.027	0.027
53-2	3.996	0.234	0.234
59-2	3.996	0.000	0.000
52-2	6.122	0.058	0.058
68	8.000	0.371	0.371
44	8.122	0.204	0.204
48-2	8.122	0.157	0.157
51-2	8.122	0.326	0.326
45-3	8.122	0.191	0.191
49-2	8.122	0.963	0.963
25-3	8.122	0.087	0.087
46-2	8.122	0.000	0.000
22-3	8.122	0.002	0.002
21-3	8.122	0.013	0.013
47-2	8.122	0.000	0.000
50-2	8.122	0.000	0.000
47-3	8.122	0.533	0.533
43	10.020	0.467	0.467
66	10.020	1.651	1.651
67	10.020	0.017	0.017
64-7	10.248	0.821	0.821
64-8	12.248	0.821	0.821
65	12.248	0.294	0.294
42-2	12.248	0.186	0.186
40	12.248	0.186	0.186
37-2	12.248	0.027	0.027
41-2	12.248	0.029	0.029
64-5	12.248	0.139	0.139
64-6	12.248	1.915	1.915
39	12.248	0.459	0.459
64	12.248	0.302	0.302
GKP SPL-2	12.248	0.000	0.000
36-2	12.248	0.281	0.281
63	12.248	1.572	1.572
64-4	12.248	0.123	0.123

Throughput through pipe section 2022

33-2	12.248	2.161	2.161
34-2	12.248	1.120	1.120
38	12.248	0.186	0.186
35-2	12.248	1.120	1.120
61	13.248	1.572	1.572
62	13.248	1.809	1.809
60	15.390	0.139	0.139
60-4	15.390	0.139	0.139
60-3	15.390	0.139	0.139
51-5	15.390	1.075	1.075
64-3	15.496	0.422	0.422
64-2	15.496	0.545	0.545
31-2	17.370	1.335	1.335
28-2	17.370	2.650	2.650
30-2	17.370	0.440	0.440
29-2	17.370	0.693	0.693
32-2	17.370	0.609	0.609
57-4	17.433	6.275	6.275
59	17.433	2.065	2.065
56	17.433	4.340	4.340
53	17.433	1.329	1.329
54	17.433	1.623	1.623
58	17.433	4.712	4.712
50	17.433	2.666	2.666
52	17.433	2.666	2.666
15-4	17.433	0.420	0.420
57	17.433	2.010	2.010
GKP SPL	17.433	2.200	2.200
16-4	17.433	0.420	0.420
48	17.433	2.276	2.276
49	17.433	2.276	2.276
17-4	17.433	0.420	0.420
55	17.433	0.601	0.601
PATNA SPUR	17.433	0.100	0.100
51-3	17.433	2.059	2.059
51	17.433	5.333	5.333
26-2	23.268	4.523	4.523
24-2	23.268	3.914	3.914
13-6	23.268	1.200	1.200
42	23.268	9.470	9.470
47	23.268	7.344	7.344
13-4	23.268	1.179	1.179
57-2	23.268	4.265	4.265
27-2	23.268	1.170	1.170
46	23.268	5.429	5.429
12-4	23.268	1.218	1.218
14-4	23.268	1.165	1.165
11-4	23.268	1.305	1.305
13-3	23.268	3.180	3.180
25-2	23.268	3.857	3.857
45	23.268	-0.183	-0.183

Throughput through pipe section 2022

41	23.268	1.886	1.886
BANARAS SPL	23.268	0.100	0.100
13-7	23.268	1.200	1.200
45-2	23.268	9.179	9.179
13-5	23.268	3.080	3.080
13-8	23.268	0.000	0.000
4-2	29.126	1.724	1.724
14-2	29.126	0.505	0.505
11-2	29.126	0.031	0.031
22-2	29.126	0.031	0.031
16-2	29.126	6.375	6.375
21-2	29.126	5.247	5.247
20-2	29.126	5.282	5.282
15-2	29.126	1.219	1.219
6-2	29.126	6.316	6.316
18-2	29.126	5.946	5.946
3-2	29.126	5.479	5.479
13-2	29.126	4.652	4.652
8-2	29.126	3.155	3.155
10-2	29.126	0.182	0.182
19-2	29.126	5.946	5.946
23-2	29.126	-0.250	-0.250
7-2	29.126	5.631	5.631
20-4	29.126	6.879	6.880
5-2	29.126	5.369	5.369
21-4	29.126	3.700	3.700
37	29.126	10.240	10.240
2-2	29.126	1.219	1.219
1-2	29.126	4.556	4.556
17-2	29.126	6.190	6.190
23-4	29.126	1.500	1.500
19-4	29.126	6.979	6.979
4-4	29.126	10.064	10.064
24-4	29.126	1.500	1.500
9-4	29.126	9.904	9.904
8-4	29.126	9.917	9.917
10-4	29.126	9.484	9.484
22-4	29.126	3.700	3.700
18-4	29.126	9.179	9.179
7-4	29.126	10.018	10.018
12-2	29.126	6.561	6.561
6-4	29.126	10.024	10.024
5-4	29.126	10.051	10.051
9-2	29.126	4.548	4.548
22-5	29.126	3.700	3.700
29	34.858	7.418	7.418
34	34.858	31.388	31.388
35	34.858	29.088	29.088
24	34.858	12.900	12.900
28	34.858	7.418	7.418
33	34.858	32.960	32.960

Throughput through pipe section 2022

31	34.858	2.852	2.852
27	34.858	9.392	9.392
3-4	34.858	11.369	11.369
37-3	34.858	9.179	9.179
36	34.858	29.103	29.103
32	34.858	29.048	29.048
23	34.858	13.219	13.219
25	34.858	12.917	12.917
30	34.858	11.201	11.201
1-4	34.858	11.434	11.435
26	34.858	9.392	9.392
2-4	34.858	11.410	11.409
13	40.756	26.919	26.919
21	40.756	26.442	26.442
20	40.756	26.460	26.460
16	40.756	26.127	26.127
14	40.756	26.926	26.926
18	40.756	26.197	26.197
22	40.756	4.500	4.500
19	40.756	26.199	26.198
15	40.756	26.918	26.918
17	40.756	27.490	27.490
7	46.614	37.836	37.836
4	46.614	37.828	37.828
12	46.614	43.817	43.817
3	46.614	36.733	36.733
1	46.614	38.614	38.614
8	46.614	36.793	36.793
6	46.614	36.791	36.791
11	46.614	37.835	37.835
2	46.614	43.637	43.637
5	46.614	42.336	42.336
9	46.614	37.093	37.093
10	46.614	37.220	37.220

Annexure II
Integrated Capacity

1.	TG networking sheets for capacity working of this pipeline network along-with soft copy	Attached at Annexure 1- capacity 139.99* MMSCMD (~ 140 MMSCMD) for integrated network consisting of HVJ-DVPL integrated network , DUPL-DPPL , DBPL, JHBDPL (Phase I), Mumbai and connected Gujarat regional networks.
2	Diameter and length of each section of pipeline including that for each customer.	As per Annexure I
3	Basis for the assumptions for future deliveries (if any) i.e. pressure and flow assumed as well as copy of contracts in support of same	Future deliveries (free flow) has been considered at farthest end of pipeline based on the current pressure profile sought by fertiliser plants / major consumers. It is assumed that whatever flow can be delivered at the farthest end of network can be delivered anywhere along the network.

I. CONSTANT PARAMETERS

Table 1: CONSTANT PARAMETER- SECTION CONFIGURATION

As per Annexure I

Table 2: CONSTANT PARAMETER -CONTRACTUAL REQUIREMENT OF CUSTOMER

As per Annexure I

II. VARIABLE PARAMETERS

Table 3: VARIABLE PARAMETERS -OPERATING PARAMETERS AT SOURCES

Serial No.	Source	Volume (MMSCMD)	Pressure (kg/cm ² g)
1	Hazira	33.11	45
2	Dahej terminal	72.42	88
3	Ankot	1.89	86.19
4	Phulpur source	0.67	52
5	Hlpl-2	3.16	86.83
6	Mhaskal source	0.97	83.19
7	Dt_dabhol	18	85.35
8	Ongcl uran	5.8	22-26
10	South-Gujarat low pressure network sources	3.14	20

11	Suvali	0.82	42

Table 4 : VARIABLE PARAMETER - GAS COMPOSITION CONSIDERED AT SOURCE

Source Name	Carbon Dioxide	Methane	Ethane	Propane	iButane	nButane	iPentane	nPentane	Hexane	Heptane	Heptane+	Octane	Nitrogen
Hazira	4.19	84.38	6.56	3.20	0.58	0.58	0.15	0.14	0.09	0.02	0.00	0.01	0.09
Dahej	-	94.55	3.85	1.04	0.13	0.19	0.01	0.01	0.00	-	-	-	0.22
Ankot	0.21	99.10	0.24	0.15	0.04	0.02	0.01	0.01	0.03	-	-	-	0.20
South-Guj low pressure network sources	3.91	74.38	8.88	7.43	2.07	1.77	0.49	0.42	0.46	-	-	-	0.19
Phulpur source	-	94.07	4.59	1.07	0.18	-	-	-	-	-	-	-	0.09
Dabhol	-	87.05	10.6	1.47	0.09	0.13	0.00	0.00	-	-	-	-	0.65
Uran	0.00	97.93	1.69	0.09	0.01	0.01	0.00	0.00	0.00	-	-	-	0.25
Mhaskal	0.23	98.95	0.34	0.18	0.04	0.03	0.01	0.02	-	-	-	-	0.21
HLPL-2	-	92.31	5.79	1.18	0.17	0.24	0.01	0.00	-	-	-	-	0.30
Suvali	4.19	84.38	6.56	3.20	0.58	0.58	0.15	0.14	0.09	0.02	0.00	0.01	0.09

SCHEDULE A

Format for furnishing information regarding determining capacity of Natural Gas Pipeline (Financial Year: 2023-24)

S. No.	Description	GAIL Submission/ Remarks
1.	Name of Entity	GAIL (India) Ltd.
2.	Address and contact details of Entity	GAIL Bhawan, 16, Bhikaiji Cama Place, R.K. Puram, New Delhi - 110066
3.	Name of Natural Gas Pipeline	Integrated Network of GAIL's Interconnected Natural Gas Pipelines i.e. Integrated HVJ, DUPL-DPPL, DBPL, DBNPL, CJHPL & JHBDPL, Uran-Thal-Usar & Trombay RCF sub-networks of Mumbai Regional NGPL Network and Baroda (South Gujarat) sub-network of Gujarat Regional NGPL Network
4.	Name of Software package used	Pipeline Studio TNet (ver. 4.2)
5.	Approved Flow equation used (mention name of flow equation)	Panhandle – A for $\leq 24''$ Ø pipelines Panhandle – B for $> 24''$ Ø pipelines (As per PNGRB Regulations)
6.	Details of Injection/Entry Points Details of Delivery/Exit Points	As in Annexure I&II
7.	Composition of Natural gas	As in Annexure II
8.	Entity agrees to have considered the technical standards, specifications and safety standards as specified by the board	YES
9.	Entity agrees to have considered the relevant provisions of Petroleum and Natural Gas Regulatory Board regulations	YES
10.	Constant and variable parameters used under steady state conditions for determining capacity of pipelines	As in Annexure I&II
11.	Capacity of the pipeline under existing operating conditions	-
12.	Maximum achievable capacity of the pipeline under steady state conditions as determined under regulation 5 of these regulations	156 MMSCMD
13.	Section-wise maximum achievable capacity of the pipeline as determined under regulation 5 of these regulations	As per simulation sheet and attached table
14.	Expected addition of entry points and exit points scheduled in near future	Future entry and exit points will be informed as and when these are finalized

Throughput through pipe section 2023 (Considering CBM sources)

Pipe Name	Dia (inside)	Flow (Head)	Flow (Tail)
	inch	MMSCMD	MMSCMD
23-3	3.996	0.013	0.013
20-3	3.996	0.010	0.010
19-3	3.996	0.027	0.027
18-3	3.996	0.035	0.035
61-2	3.996	0.057	0.057
24-3	3.996	0.013	0.013
54-2	3.996	0.057	0.057
55-2	3.996	0.147	0.147
60-2	3.996	0.036	0.036
63-2	3.996	0.008	0.008
58-2	3.996	0.052	0.052
57-3	3.996	0.156	0.156
62-2	3.996	0.000	0.000
56-2	3.996	0.114	0.114
69	3.996	0.000	0.000
53-2	3.996	0.234	0.234
59-2	3.996	0.000	0.000
52-2	6.122	0.058	0.058
68	8.000	0.371	0.371
51-2	8.122	0.326	0.326
44	8.122	0.204	0.204
48-2	8.122	0.156	0.156
49-2	8.122	0.963	0.963
50-2	8.122	0.000	0.000
25-3	8.122	0.087	0.087
22-3	8.122	0.002	0.002
Pipe0002	8.122	0.000	0.000
47-3	8.122	0.533	0.533
21-3	8.122	0.013	0.013
45-3	8.122	0.191	0.191
Pipe0002-2	8.122	0.600	0.600
47-2	8.122	0.000	0.000
46-2	8.122	0.000	0.000
67	10.020	0.017	0.017
43	10.020	0.467	0.467
66	10.020	1.651	1.651
64-7	10.020	0.821	0.821
64-8	12.248	0.821	0.821
40	12.248	0.186	0.186
41-2	12.248	0.029	0.029
64-6	12.248	1.915	1.915
42-2	12.248	0.186	0.186
64-5	12.248	0.139	0.139
ONGC Bokaro line	12.248	0.600	0.600

Throughput through pipe section 2023 (Considering CBM sources)

37-2	12.248	0.027	0.027
65	12.248	0.294	0.294
64	12.248	0.302	0.302
GKP SPL-2	12.248	2.418	2.418
33-2	12.248	2.161	2.161
35-2	12.248	1.120	1.120
63	12.248	1.572	1.572
39	12.248	0.459	0.459
34-2	12.248	1.120	1.120
36-2	12.248	0.281	0.281
64-4	12.248	0.123	0.123
38	12.248	0.186	0.186
62	13.248	1.809	1.809
61	13.248	1.572	1.572
60	15.390	0.139	0.139
51-5	15.390	1.075	1.075
60-4	15.390	0.139	0.139
60-3	15.390	0.139	0.139
64-3	15.496	0.422	0.422
64-2	15.496	0.545	0.545
28-2	17.370	2.650	2.650
30-2	17.370	0.440	0.440
31-2	17.370	1.335	1.335
29-2	17.370	0.693	0.693
32-2	17.370	0.609	0.609
25-6	17.433	3.800	3.800
34-8	17.433	0.200	0.200
53	17.433	1.329	1.329
50	17.433	2.666	2.666
34-5	17.433	3.360	3.360
54	17.433	1.623	1.623
59	17.433	2.065	2.065
57-4	17.433	6.275	6.275
58	17.433	4.712	4.712
56	17.433	4.340	4.340
52	17.433	2.666	2.666
17-4	17.433	0.420	0.420
34-9	17.433	0.200	0.200
PATNA SPUR	17.433	0.100	0.100
48	17.433	2.276	2.276
49	17.433	2.276	2.276
51	17.433	5.333	5.333
57	17.433	2.010	2.010
16-4	17.433	0.420	0.420
15-4	17.433	0.420	0.420
51-3	17.433	2.059	2.059
34-4	17.433	5.500	5.500
34-6	17.433	3.160	3.160
55	17.433	0.601	0.601

Throughput through pipe section 2023 (Considering CBM sources)

GKP SPL	17.433	2.200	2.200
47	23.268	7.346	7.346
42	23.268	9.472	9.472
12-4	23.268	1.218	1.218
27-2	23.268	1.170	1.170
25-5	23.268	0.840	0.840
13-6	23.268	3.247	3.247
46	23.268	5.431	5.431
11-4	23.268	1.305	1.305
14-4	23.268	1.165	1.165
24-2	23.268	3.914	3.914
57-2	23.268	4.265	4.265
26-2	23.268	4.523	4.523
13-4	23.268	1.179	1.179
25-2	23.268	3.857	3.857
13-8	23.268	2.047	2.047
13-7	23.268	3.247	3.247
45	23.268	-0.181	-0.181
13-3	23.268	5.747	5.747
41	23.268	1.888	1.888
13-5	23.268	5.647	5.647
BANARAS SPL	23.268	0.100	0.100
45-2	23.268	7.289	7.289
30-3	29.126	7.115	7.115
19-4	29.126	5.089	5.089
27-3	29.126	6.715	6.715
10-2	29.126	0.182	0.182
19-2	29.126	5.946	5.946
20-4	29.126	4.989	4.989
7-2	29.126	5.631	5.631
21-4	29.126	-0.757	-0.757
5-2	29.126	5.369	5.369
6-2	29.126	6.316	6.316
18-2	29.126	5.946	5.946
2-2	29.126	1.219	1.219
1-2	29.126	4.556	4.556
3-2	29.126	5.479	5.479
17-2	29.126	6.190	6.190
20-2	29.126	5.282	5.282
21-2	29.126	5.247	5.247
22-2	29.126	0.031	0.031
11-2	29.126	0.031	0.031
37	29.126	10.238	10.238
14-2	29.126	0.505	0.505
4-2	29.126	1.724	1.724
16-2	29.126	6.375	6.375
15-2	29.126	1.219	1.219
13-2	29.126	4.652	4.652
8-2	29.126	3.155	3.155

Throughput through pipe section 2023 (Considering CBM sources)

23-4	29.126	2.540	2.540
23-2	29.126	-0.250	-0.250
5-4	29.126	10.051	10.051
8-4	29.126	9.917	9.917
10-4	29.126	9.484	9.484
9-4	29.126	9.904	9.904
4-4	29.126	10.064	10.064
22-5	29.126	7.157	7.157
6-4	29.126	10.024	10.024
29-3	29.126	6.915	6.915
7-4	29.126	10.018	10.018
27-4	29.126	7.315	7.315
28-3	29.126	6.915	6.915
18-4	29.126	7.289	7.289
12-2	29.126	6.561	6.561
9-2	29.126	4.548	4.548
25-4	29.126	1.040	1.040
22-4	29.126	6.557	6.557
24-4	29.126	2.540	2.540
31-3	29.126	7.215	7.215
29	34.858	7.418	7.418
31	34.858	2.852	2.852
33	34.858	32.959	32.959
35	34.858	29.087	29.087
34	34.858	31.387	31.386
24	34.858	12.900	12.900
28	34.858	7.418	7.418
34-3	34.858	16.275	16.275
33-3	34.858	7.415	7.415
32-3	34.858	7.215	7.215
2-4	34.858	11.409	11.410
1-4	34.858	11.434	11.434
3-4	34.858	11.370	11.369
36	34.858	29.101	29.101
37-3	34.858	7.289	7.289
32	34.858	29.047	29.047
23	34.858	13.219	13.219
25	34.858	12.917	12.917
30	34.858	11.201	11.201
27	34.858	9.392	9.392
26	34.858	9.392	9.392
34-7	34.858	12.914	12.915
20	40.756	25.669	25.669
14	40.756	26.134	26.134
21	40.756	25.651	25.651
13	40.756	26.127	26.127
16	40.756	25.335	25.335
18	40.756	25.407	25.407
17	40.756	26.698	26.698
22	40.756	4.500	4.500

Throughput through pipe section 2023 (Considering CBM sources)

15	40.756	26.126	26.126
19	40.756	25.409	25.409
12	46.614	43.818	43.817
5	46.614	42.338	42.338
2	46.614	43.638	43.638
1	46.614	37.501	37.501
6	46.614	35.682	35.682
3	46.614	35.620	35.620
4	46.614	36.715	36.715
8	46.614	35.684	35.684
11	46.614	36.722	36.722
7	46.614	36.723	36.723
9	46.614	35.985	35.985
10	46.614	36.106	36.106

Annexure II
Integrated Capacity

1.	TG networking sheets for capacity working of this pipeline network along-with soft copy	Attached at Annexure 1- capacity 155.55* MMSCMD (~ 156 MMSCMD) for integrated network consisting of HVJ-DVPL integrated network , DUPL-DPPL , DBPL, JHBDPL, Mumbai and connected Gujarat regional networks.
2	Diameter and length of each section of pipeline including that for each customer.	As per Annexure I
3	Basis for the assumptions for future deliveries (if any) i.e. pressure and flow assumed as well as copy of contracts in support of same	Future deliveries (free flow) has been considered at farthest end of pipeline based on the current pressure profile sought by fertiliser plants / major consumers. It is assumed that whatever flow can be delivered at the farthest end of network can be delivered anywhere along the network.

I. CONSTANT PARAMETERS

Table 1: CONSTANT PARAMETER- SECTION CONFIGURATION

As per Annexure I

Table 2: CONSTANT PARAMETER -CONTRACTUAL REQUIREMENT OF CUSTOMER

As per Annexure I

II. VARIABLE PARAMETERS

Table 3: VARIABLE PARAMETERS -OPERATING PARAMETERS AT SOURCES

Serial No.	Source	Volume (MMSCMD)	Pressure (kg/cm2g)
1	Hazira	33.11	45
2	Dahej terminal	70.51	88
3	Ankot	1.89	86
4	Phulpur source	0.67	52
5	Hlpl-2	3.16	87
6	Mhaskal source	0.97	83
7	Dt_dabhol	18.00	85
8	Ongcl uran	5.80	22-26
10	South-Guj low pressure network sources	3.14	20

11	Dhamra	16.26	88
12	Suvali	0.82	42
13	Bokaro-CBM	0.60	72
14	Jharia-CBM	0.60	72

Table 4 : VARIABLE PARAMETER - GAS COMPOSITION CONSIDERED AT SOURCE

Source Name	Carbon Dioxide	Methane	Ethane	Propane	iButane	nButane	iPentane	nPentane	Hexane	Heptane	Heptane+	Octane	Nitrogen
Hazira	4.19	84.38	6.56	3.20	0.58	0.58	0.15	0.14	0.09	0.02	0.00	0.01	0.09
Dahej	-	94.55	3.85	1.04	0.13	0.19	0.01	0.01	0.00	-	-	-	0.22
Ankot	0.21	99.10	0.24	0.15	0.04	0.02	0.01	0.01	0.03	-	-	-	0.20
South-Guj low pressure network sources	3.91	74.38	8.88	7.43	2.07	1.77	0.49	0.42	0.46	-	-	-	0.19
Phulpur source	-	94.07	4.59	1.07	0.18	-	-	-	-	-	-	-	0.09
Dhamra	-	90.28	6.13	1.94	0.40	0.46	0.45	-	-	-	-	-	0.34
Dabhol	-	87.05	10.6	1.47	0.09	0.13	0.00	0.00	-	-	-	-	0.65
Uran	0.00	97.93	1.69	0.09	0.01	0.01	0.00	0.00	0.00	-	-	-	0.25
Mhaskal	0.23	98.95	0.34	0.18	0.04	0.03	0.01	0.02	-	-	-	-	0.21
HLPL-2	-	92.31	5.79	1.18	0.17	0.24	0.01	0.00	-	-	-	-	0.30
Jharia/Bokaro	0.30	97.00	0.20	-	-	-	-	-	-	-	-	-	2.50
Suvali	4.19	84.38	6.56	3.20	0.58	0.58	0.15	0.14	0.09	0.02	0.00	0.01	0.09

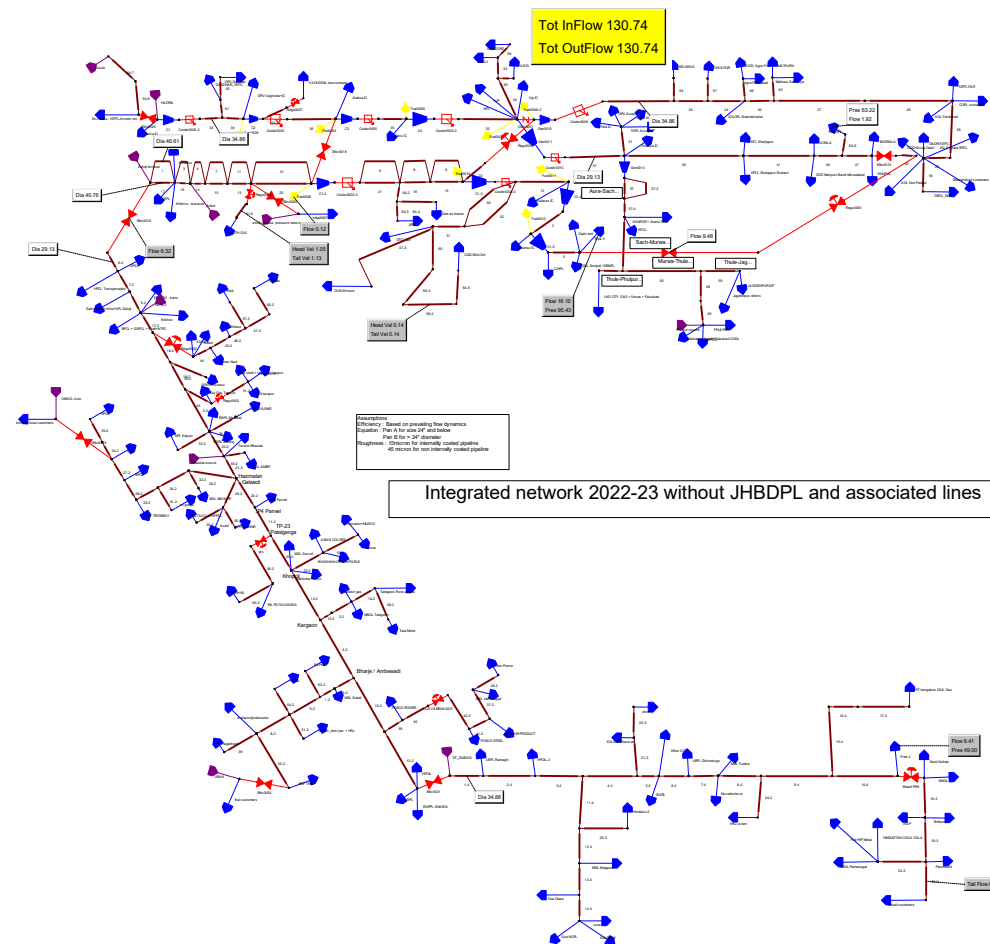
Annexure-III

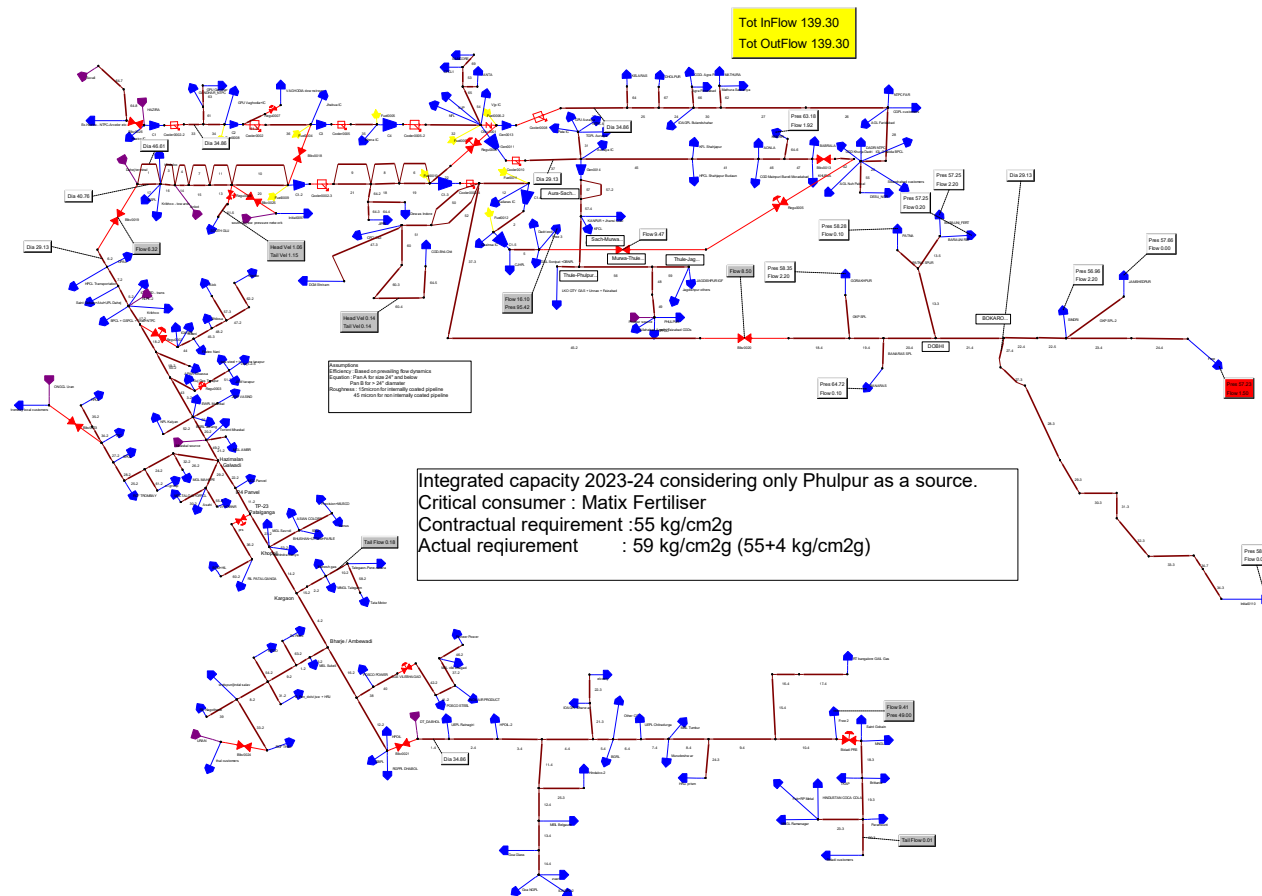
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Impact

Name	Date modified	Type	Size
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Annexure-IV

Assessment Year (2023-24)

	Customer node description(AS per simulation file)	Contracted Quantity of flow	Contractual pressure	Contractual temperature	Gas Quality/Composition	Extract of Gas contract provided(Yes/No)	Remarks
GMS_GGS1_4	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C	Gas Contract Extracts already submitted		
GMS_GNAQH	South Gujarat local	0.01	1 Kg/cm2	Up to 55 deg C			
GMS_GNAQOWN	South Gujarat local	0.01	1 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_GNAQH	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_GNAQOWN	South Gujarat local	0.01	1 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_GNAQOWN	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_GGS1_4	South Gujarat local	0.00	1.6 Kg/cm2	Up to 55 deg C			
GMS_GNAQH	South Gujarat local	0.01	1.6 Kg/cm2	Up to 55 deg C			
GMS_GNAQOWN	South Gujarat local	0.01	1.6 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.00	1.6 Kg/cm2	Up to 55 deg C			
GMS_GGS1_4	South Gujarat local	0.00	1-2 Kg/cm2	Up to 55 deg C			
GMS_GNAQH	South Gujarat local	0.00	1-2 Kg/cm2	Up to 55 deg C			
GMS_GNAQOWN	South Gujarat local	0.01	1-2 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.00	1-2 Kg/cm2	Up to 55 deg C			
GMS_GGS1_4	South Gujarat local	0.00	2 -3 Kg/cm2	Up to 55 deg C			
GMS_GNAQH	South Gujarat local	0.00	2 -3 Kg/cm2	Up to 55 deg C			
GMS_GNAQOWN	South Gujarat local	0.00	2 -3 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.00	2 -3 Kg/cm2	Up to 55 deg C			
GMS_GGS1_4	South Gujarat local	0.00	4 Kg/cm2	Up to 55 deg C			
GMS_GNAQH	South Gujarat local	0.01	4 Kg/cm2	Up to 55 deg C			
GMS_GNAQOWN	South Gujarat local	0.01	4 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.01	4 Kg/cm2	Up to 55 deg C			
GMS_GGS1_4	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_GNAQH	South Gujarat local	0.01	1 Kg/cm2	Up to 55 deg C			
GMS_GNAQOWN	South Gujarat local	0.01	1 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.04	4 Kg/cm2	Up to 55 deg C			
GMS_GGS1_4	South Gujarat local	0.03	15 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.00	15 Kg/cm2	Up to 55 deg C			
GMS_NG-NAPM-WOS	South Gujarat local	0.01	15 Kg/cm2	Up to 55 deg C			
GMS_RLNG	South Gujarat local	0.40	15 Kg/cm2	Up to 55 deg C			
GMS_GGS1_4	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_GNAQH	South Gujarat local	0.01	1 Kg/cm2	Up to 55 deg C			
GMS_GNAQOWN	South Gujarat local	0.01	1 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_GGS1_4	South Gujarat local	0.01	2 Kg/cm2	Up to 55 deg C			
GMS_GNAQH	South Gujarat local	0.01	2 Kg/cm2	Up to 55 deg C			
GMS_GNAQOWN	South Gujarat local	0.01	2 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_GGS1_4	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_GNAQH	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_GNAQOWN	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C			
GMS_GGS1_4	South Gujarat local	0.00	2 Kg/cm2	Up to 55 deg C			
GMS_GNAQH	South Gujarat local	0.01	2 Kg/cm2	Up to 55 deg C			
GMS_GNAQOWN	South Gujarat local	0.01	2 Kg/cm2	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.00	2 Kg/cm2	Up to 55 deg C			
GMS_GNAQOWN	South Gujarat local	0.00	3 to 4 Kg/cm2 g	Up to 55 deg C			
GMS_NCG	South Gujarat local	0.00	3 to 4 Kg/cm2 g	Up to 55 deg C			
GMS_GGS1_4	South Gujarat local	0.00	2 Kg/cm2	Up to 55 deg C			
GMS_GNAQH	South Gujarat local	0.01	2 Kg/cm2	Up to 55 deg C			

GMS_GNAQOWN	South Gujarat local	0.01	2 Kg/cm2	Up to 55 deg C		
GMS_NCG	South Gujarat local	0.00	2 Kg/cm2	Up to 55 deg C		
GMS_GNAQOWN	South Gujarat local	0.00	4 Kg/cm2 g	Up to 55 deg C		
GMS_NCG	South Gujarat local	0.00	4 Kg/cm2 g	Up to 55 deg C		
GMS_GGS1_4	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C		
GMS_GNAQH	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C		
GMS_GNAQOWN	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C		
GMS_NCG	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C		
GMS_GGS1_4	South Gujarat local	0.00	3.5 Kg/cm2	Up to 55 deg C		
GMS_GNAQH	South Gujarat local	0.00	3.5 Kg/cm2	Up to 55 deg C		
GMS_GNAQOWN	South Gujarat local	0.00	3.5 Kg/cm2	Up to 55 deg C		
GMS_NCG	South Gujarat local	0.00	3.5 Kg/cm2	Up to 55 deg C		
GMS_NG-MDP	South Gujarat local	0.01	3.5 Kg/cm2	Up to 55 deg C		
GMS_GNAQOWN	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C		
GMS_NCG	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C		
GMS_GNAQH	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C		
GMS_GNAQOWN	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C		
GMS_NCG	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C		
GMS_NG-MDP	South Gujarat local	0.01	1 Kg/cm2	Up to 55 deg C		
GMS_NG-MDP	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C		
GMS_GGS1_4	South Gujarat local	0.00	4 - 4.5 kg/cm2	Up to 55 deg C		
GMS_GNAQH	South Gujarat local	0.00	4 - 4.5 kg/cm2	Up to 55 deg C		
GMS_GNAQOWN	South Gujarat local	0.00	4 - 4.5 kg/cm2	Up to 55 deg C		
GMS_NCG	South Gujarat local	0.00	4 - 4.5 kg/cm2	Up to 55 deg C		
GMS_GGS1_4	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C		
GMS_GNAQH	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C		
GMS_GNAQOWN	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C		
GMS_NCG	South Gujarat local	0.00	1 Kg/cm2	Up to 55 deg C		
GMS_NCG	South Gujarat local	0.08	4 - 5 kg/cm2	Up to 55 deg C		
GMS_GNAQOWN	South Gujarat local	0.01	3.5 Kg/cm2	Up to 55 deg C		
GMS_GGS1_4	South Gujarat local	0.00	3 Kg/cm2	Up to 55 deg C		
GMS_GNAQH	South Gujarat local	0.01	3 Kg/cm2	Up to 55 deg C		
GMS_GNAQOWN	South Gujarat local	0.01	3 Kg/cm2	Up to 55 deg C		
GMS_NCG	South Gujarat local	0.00	3 Kg/cm2	Up to 55 deg C		
GMS_GNAQOWN	South Gujarat local	0.02	3 Kg/cm2	Up to 55 deg C		
GMS_NG-MDP	South Gujarat local	0.00	3 Kg/cm2	Up to 55 deg C		
	South Gujarat local	0.25	As available			
	South Gujarat local	2.00	As available			
GMS_NG	CJHPL	0.01	4-5Bar(a)	Up to 55 deg C		
GMS_NG-NAPM-WOS	CJHPL	0.01	4-5Bar(a)	Up to 55 deg C		
GMS_NG	CJHPL	0.00	4-5Bar(a)	Up to 55 deg C		
GMS_NG-NAPM-WOS	CJHPL	0.04	4-5Bar(a)	Up to 55 deg C		
GMS_NG TRANS	CJHPL	0.05	4-5Bar(a)	Up to 55 deg C		
GMS_RLNG	CJHPL	0.00	4-5Bar(g)	Up to 55 deg C		
GMS_RLNG-(MIDTERM)	CJHPL	0.03	1.5-3Bar(a)	Up to 55 deg C		
GMS_RLNG	CJHPL	0.01	1.5-3Bar(a)	Up to 55 deg C		
GMS_RLNG-(MIDTERM)	CJHPL	0.04	1.5-3Bar(a)	Up to 55 deg C		
GMS_RLNG-(MIDTERM)	CJHPL	0.00	2-3Bar(g)	Up to 55 deg C		
GMS_SPOTRLNG	CJHPL	0.00	2-3Bar(g)	Up to 55 deg C		
GMS_NG TRANS-BPCL	CJHPL	0.10	6 to 15Bar(g)	Up to 55 deg C		
GMS_RLNG	CJHPL	0.02	6 to 15Bar(g)	Up to 55 deg C		
GMS_RLNG-(MIDTERM)	CJHPL	0.08	6 to 15Bar(g)	Up to 55 deg C		
GMS_RLNG-(MIDTERM)	CJHPL	0.00	1-2Bar(g)	Up to 55 deg C		
GMS_SPOTRLNG	CJHPL	0.01	1-2Bar(g)	Up to 55 deg C		
GMS_RLNG	CJHPL	0.01	4Bar (a)	Up to 55 deg C		
GMS_NG	CJHPL	0.00	4Bar (a)	Up to 55 deg C		
GMS_NG-NAPM-WOS	CJHPL	0.00	4Bar (a)	Up to 55 deg C		
GMS_RLNG	CJHPL	0.03	19Kg/cm2	Up to 55 deg C		
GMS_RLNG-(MIDTERM)	CJHPL	0.01	3-4Bar (a)	Up to 55 deg C		

GMS_SPOTRLNG	CJHPL	0.00	3-4Bar (a)	Up to 55 deg C
GMS_RLNG	CJHPL	0.02	28-30Kg/Cm2	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	28-30Kg/Cm2	Up to 55 deg C
GMS_NG	CJHPL	0.03	28-30Kg/Cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	CJHPL	0.06	28-30Kg/Cm2	Up to 55 deg C
GMS_RLNG	CJHPL	0.00	28-30Kg/cm2	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	28-30Kg/cm2	Up to 55 deg C
GMS_NG	CJHPL	0.06	28-30Kg/cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	CJHPL	0.03	28-30Kg/cm2	Up to 55 deg C
GMS_RLNG	CJHPL	0.03	28Bar (g)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.07	28Bar (g)	Up to 55 deg C
GMS_RLNG	CJHPL	0.02	10Bar (a)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	10Bar (a)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	5-6Bar(a)	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	5-6Bar(a)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.02	2Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	2Bar	Up to 55 deg C
GMS_RLNG	CJHPL	0.01	1.5-2Bar (a)	Up to 55 deg C
GMS_RLNG	CJHPL	0.01	2-3Bar(a)	Up to 55 deg C
GMS_RLNG	CJHPL	0.01	5Bar (a)	Up to 55 deg C
GMS_NG TRANS-D6	CJHPL	0.01	5Bar (a)	Up to 55 deg C
GMS_RLNG	CJHPL	0.01	2- 3Bar(g)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	2- 3Bar(g)	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	2- 3Bar(g)	Up to 55 deg C
GMS_NG TRANS-IOCL	CJHPL	0.00	10Bar (a)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	10Bar (a)	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	10Bar (a)	Up to 55 deg C
GMS_RLNG	CJHPL	0.03	4Bar(g)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	6 Bar	Up to 55 deg C
GMS_RLNG	CJHPL	0.01	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	6 Bar	Up to 55 deg C

GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	6 Bar	Up to 55 deg C
GMS_NG TRANS	CJHPL	0.03	6 Bar	Up to 55 deg C
GMS_NG TRANS	CJHPL	0.01	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG	CJHPL	0.00	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CJHPL	0.01	6 Bar	Up to 55 deg C
GMS_RLNG	GPU Gandhar	0.004	6 Bar	Up to 55 deg C
GMS_RLNG	PHULPUR	0.002	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	PHULPUR	0.000	6 Bar	Up to 55 deg C
GMS_RLNG	GPU Gandhar	0.001	6 Bar	Up to 55 deg C
GMS_RLNG	GPU Gandhar	0.000	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GPU Gandhar	0.002	6 Bar	Up to 55 deg C
GMS_RLNG	GPU Gandhar	0.010	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GPU Gandhar	0.002	6 Bar	Up to 55 deg C
GMS_SPOTRLNG	GPU Gandhar	0.000	6 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GPU Gandhar	0.000	Greater than 19	Up to 55 deg C
GMS_NG AND GMS_NG-NAPM-WOS	GPU Gandhar	0.000	Greater than 19	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GPU Gandhar	0.178	6-17	Up to 55 deg C
GMS_SPOTRLNG	GPU Gandhar	0.000	6-17	Up to 55 deg C
GMS_NG AND GMS_NG-NAPM-WOS	GPU Gandhar	0.009	6-17	Up to 55 deg C
GMS_NG AND GMS_NG-NAPM-WOS	GPU Gandhar	0.006	Greater than 19	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GPU Gandhar	0.025	Greater than 19	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GPU Gandhar	0.012	17-27	Up to 55 deg C
GMS_NG AND GMS_NG-NAPM-WOS	GPU Gandhar	0.114	17-27	Up to 55 deg C
GMS_NG TRANS	GPU Gandhar	0.022	17-27	Up to 55 deg C
GMS_RLNG	GPU Gandhar	0.004	6 Bar	Up to 55 deg C
GMS_RLNG	GPU Gandhar	0.035	6 Bar	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	0.00	4-5Bar(a)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.01	6-10Kg/Cm1	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.05	6-10Kg/Cm2	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.00	6-10Kg/Cm2	Up to 55 deg C
GMS_SPOTRLNG	GGL Sonipat +DBNPL	0.00	6-10Kg/Cm2	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.01	6-10Kg/Cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.01	6-10Kg/Cm2	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.00	2-6Kg/Cm2(g)	Up to 55 deg C
GMS_NG TRANS-IOCL	GGL Sonipat +DBNPL	0.06	2-6Kg/Cm2(g)	Up to 55 deg C
GMS_SPOTRLNG	GGL Sonipat +DBNPL	0.02	2-6Kg/Cm2(g)	Up to 55 deg C
GMS_NG TRANS-BPCL	GGL Sonipat +DBNPL	0.00	19Kg/Cm2(g)	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.01	19Kg/Cm2(g)	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.00	19Kg/Cm2(g)	Up to 55 deg C

GMS_NG TRANS	GGL Sonipat +DBNPL	0.02	19Kg/Cm2(g)	Up to 55 deg C
GMS_NG TRANS-BPCL	GGL Sonipat +DBNPL	0.00	19Kg/Cm2(g)	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	0.00	4Bar	Up to 55 deg C
GMS_SPOTRLNG	GGL Sonipat +DBNPL	0.00	4Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.00	14Kg/Cm2	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.00	14Kg/Cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.01	14Kg/Cm2	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	0.20	19Kg/Cm2(g)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.37	19Kg/Cm2(g)	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.08	19Kg/Cm2(g)	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.13	19Kg/Cm2(g)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.03	14Kg/Cm2	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.03	14Kg/Cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.01	14Kg/Cm2	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.00	14Kg/Cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.00	14Kg/Cm2	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	0.01	8Bar(a)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.01	8Bar(a)	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	0.02	4Bar	Up to 55 deg C
GMS_NG TRANS-D6	GGL Sonipat +DBNPL	0.04	4Bar	Up to 55 deg C
GMS_NG TRANS-PLL	GGL Sonipat +DBNPL	0.04	4Bar	Up to 55 deg C
GMS_NG TRANS-GSPCL	GGL Sonipat +DBNPL	0.03	4Bar	Up to 55 deg C
GMS_NG TRANS-ONGC	GGL Sonipat +DBNPL	0.01	4Bar	Up to 55 deg C
GMS_NG TRANS-PLL	GGL Sonipat +DBNPL	0.01	4Bar	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.01	4Bar	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.00	4Bar	Up to 55 deg C
GMS_NG TRANS-D6	GGL Sonipat +DBNPL	0.07	4Bar	Up to 55 deg C
GMS_NG TRANS-D6	GGL Sonipat +DBNPL	0.04	19-22Kg/Cm2	Up to 55 deg C
GMS_NG TRANS-GRNG	GGL Sonipat +DBNPL	0.19	19-22Kg/Cm2	Up to 55 deg C
GMS_NG TRANS-IOCL	GGL Sonipat +DBNPL	0.01	19-22Kg/Cm2	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	0.20	19-22Kg/Cm2	Up to 55 deg C
GMS_SPOTRLNG	GGL Sonipat +DBNPL	0.00	19-22Kg/Cm2	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.19	19-22Kg/Cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.19	19-22Kg/Cm2	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.01	4-5Bar(a)	Up to 55 deg C
GMS_SPOTRLNG	GGL Sonipat +DBNPL	0.00	4-5Bar(a)	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	0.00	40Bar(g)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	1.50	40Bar(g)	Up to 55 deg C
GMS_SPOTRLNG	GGL Sonipat +DBNPL	0.00	40Bar(g)	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.00	40Bar(g)	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	1.56	40Bar(g)	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	0.00	6Bar	Up to 55 deg C
GMS_NG TRANS-D6	GGL Sonipat +DBNPL	0.01	6Bar	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	0.01	2-3Bar(a)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.01	2-3Bar(a)	Up to 55 deg C
GMS_SPOTRLNG	GGL Sonipat +DBNPL	0.00	2-3Bar(a)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.01	4Bar(a)	Up to 55 deg C
GMS_SPOTRLNG	GGL Sonipat +DBNPL	0.00	4Bar(a)	Up to 55 deg C
GMS_NG TRANS	GGL Sonipat +DBNPL	0.01	5Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.00	5Bar	Up to 55 deg C
GMS_SPOTRLNG	GGL Sonipat +DBNPL	0.00	5Bar	Up to 55 deg C
Natural Gas-HVJ	GGL Sonipat +DBNPL	0.07	19 kg/cm2	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	GGL Sonipat +DBNPL	0.06	19 kg/cm2	Up to 55 deg C
RLNG	GGL Sonipat +DBNPL	0.02	19 kg/cm2	Up to 55 deg C
MID TERM RLNG -FIRM	GGL Sonipat +DBNPL	0.02	19 kg/cm2	Up to 55 deg C
Natural Gas-HVJ	GGL Sonipat +DBNPL	0.02	25 to 35 Kg/cm2(g)	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	GGL Sonipat +DBNPL	0.02	25 to 35 Kg/cm2(g)	Up to 55 deg C
Natural Gas-HVJ	GGL Sonipat +DBNPL	0.00	19 to 25 Kg/cm2(g)	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	GGL Sonipat +DBNPL	0.00	19 to 25 Kg/cm2(g)	Up to 55 deg C

GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.00	not Less than 2 bar	Up to 55 deg C
GMS_SPOTRLNG	GGL Sonipat +DBNPL	0.00	not Less than 2 bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.01	not Less than 2 bar	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	1.05	40 Kg/cm2	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	1.07	40 Kg/cm2	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.02	not Less than 2 bar	Up to 55 deg C
GMS_SPOTRLNG	GGL Sonipat +DBNPL	0.00	not Less than 2 bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.00	not Less than 2 bar	Up to 55 deg C
GMS_SPOTRLNG	GGL Sonipat +DBNPL	0.00	not Less than 2 bar	Up to 55 deg C
GMS_NG TRANS	GGL Sonipat +DBNPL	0.02	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.04	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.04	40 - 45 Kg/cm2	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.05	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.00	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.00	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG TRANS	GGL Sonipat +DBNPL	0.03	25-30 Kg/cm2	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.02	25-30 Kg/cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.01	25-30 Kg/cm2	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.04	25-30 Kg/cm2	Up to 55 deg C
GMS_NG TRANS	GGL Sonipat +DBNPL	0.18	25-30 Kg/cm2	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.00	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.00	40 - 45 Kg/cm2	Up to 55 deg C
GMS_SPOTRLNG	GGL Sonipat +DBNPL	0.00	19 Kg/cm2	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.00	30-35 Kg/cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.00	30-35 Kg/cm2	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	0.00	not Less than 2 bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.00	not Less than 2 bar	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.00	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.00	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG TRANS	GGL Sonipat +DBNPL	0.02	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.04	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.02	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG TRANS	GGL Sonipat +DBNPL	0.01	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG TRANS	GGL Sonipat +DBNPL	0.00	40 - 45 Kg/cm2	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.01	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.00	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.00	40 - 45 Kg/cm2	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.01	40 - 45 Kg/cm2	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.01	25-30 Kg/cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.01	25-30 Kg/cm2	Up to 55 deg C
GMS_NG TRANS	GGL Sonipat +DBNPL	0.02	25-30 Kg/cm2	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.00	25-30 Kg/cm3	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.00	25-30 Kg/cm4	Up to 55 deg C
GMS_NG TRANS	GGL Sonipat +DBNPL	0.01	25-30 Kg/cm5	Up to 55 deg C
GMS_NG TRANS	GGL Sonipat +DBNPL	0.03	25-30 Kg/cm6	Up to 55 deg C
GMS_NG TRANS	GGL Sonipat +DBNPL	0.00	25-30 Kg/cm7	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.03	25-30 Kg/cm8	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.02	25-30 Kg/cm9	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.03	25-30 Kg/cm10	Up to 55 deg C
GMS_NG TRANS	GGL Sonipat +DBNPL	0.02	25-30 Kg/cm11	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.01	25-30 Kg/cm12	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.01	25-30 Kg/cm13	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.00	25-30 Kg/cm14	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.00	25-30 Kg/cm15	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.00	25-30 Kg/cm16	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.00	25-30 Kg/cm17	Up to 55 deg C
GMS_NG TRANS	GGL Sonipat +DBNPL	0.00	25-30 Kg/cm18	Up to 55 deg C
GMS_NG	GGL Sonipat +DBNPL	0.01	25-30 Kg/cm19	Up to 55 deg C
GMS_NG-NAPM-WOS	GGL Sonipat +DBNPL	0.00	25-30 Kg/cm20	Up to 55 deg C

GMS_NG TRANS	GGL Sonipat +DBNPL	0.02	25-30 Kg/cm21	Up to 55 deg C
GAIL RLNG	Bidadi customers	0.003	6 Bar	Up to 55 deg C
GAIL RLNG	Bidadi customers	0.005	5 to 6 Bar	Up to 55 deg C
GAIL RLNG	Brittania	0.01	4 to 5 Bar	Up to 55 deg C
GAIL RLNG	Bidadi customers	0.001	4 to 5 Bar	Up to 55 deg C
GAIL RLNG	Bidadi customers	0.001	<1 Bar	Up to 55 deg C
GAIL RLNG	RT bangalore GAIL Gas	0.319		Up to 55 deg C
GAIL RLNG	RT bangalore GAIL Gas	0.079	16 to 20 Bar	Up to 55 deg C
APM	RT bangalore GAIL Gas	0.012		Up to 55 deg C
NAPM	RT bangalore GAIL Gas	0.011		Up to 55 deg C
GAIL RLNG	Hindalco	0.036	5 to 9 Bar	Up to 55 deg C
D 6 GAS	Hindalco	0.051	5 to 9 Bar	Up to 55 deg C
GAIL RLNG	Hindalco	0.001	2 to 5 Bar	Up to 55 deg C
GAIL RLNG	IOAGPL Dharwad	0.005		Up to 55 deg C
APM	IOAGPL Dharwad	0.003	upto 25 Bar	Up to 55 deg C
NAPM	IOAGPL Dharwad	0.003		Up to 55 deg C
GAIL RLNG	Hindalco	0.001	4 to 5 Bar	Up to 55 deg C
RLNG	MEIL Tumkur	0.043		Up to 55 deg C
APM	MEIL Tumkur	0.003	19 Bar	Up to 55 deg C
NAPM	MEIL Tumkur	0.003		Up to 55 deg C
RLNG	MEIL Belgaum	0.030	19 Bar	Up to 55 deg C
APM	MEIL Belgaum	0.005		Up to 55 deg C
NAPM	MEIL Belgaum	0.005	19 Bar	Up to 55 deg C
GAIL RLNG	MNGL Ramanagar	0.002		Up to 55 deg C
APM	MNGL Ramanagar	0.004	19 Bar	Up to 55 deg C
NAPM	MNGL Ramanagar	0.003		Up to 55 deg C
GAIL RLNG	Paramount	0.004	4 Bar	Up to 55 deg C
GAIL RLNG	elveety	0.002	4-6 Bar	Up to 55 deg C
GAIL RLNG	HRJ- prism	0.013	20 Bar	Up to 55 deg C
GAIL RLNG	Fab+RP Metal	0.003	1 to 4 Bar	Up to 55 deg C
GAIL RLNG	Saint Gobain	0.033	4 to 6 kg/cm2	Up to 55 deg C
GAIL RLNG	TKAP	0.000	5 to 9 Bar	Up to 55 deg C
APM	UEPL Chitradurga	0.003		Up to 55 deg C
NAPM	UEPL Chitradurga	0.003	upto 25 Bar	Up to 55 deg C
GAIL RLNG	Murudeshwar	0.051	1-4 bar	Up to 55 deg C
GAIL RLNG	HINDUSTAN COCA COLA	0.001	5 kg/cm2	Up to 55 deg C
APM	Other CGDs	0.002	upto 25 Bar	Up to 55 deg C
NAPM	Other CGDs	0.002		Up to 55 deg C
APM	Other CGDs	0.001	upto 25 Bar	Up to 55 deg C
NAPM	Other CGDs	0.001		Up to 55 deg C
APM	Other CGDs	0.002	upto 25 Bar	Up to 55 deg C
NAPM	Other CGDs	0.002		Up to 55 deg C
APM	Other CGDs	0.003	upto 25 Bar	Up to 55 deg C
NAPM	Other CGDs	0.002		Up to 55 deg C
APM	Other CGDs	0.003	upto 25 Bar	Up to 55 deg C
NAPM	Other CGDs	0.003		Up to 55 deg C
GMS_NG	BGRL	0.000	33-44 KG/CM2	Up to 55 deg C
GMS_NG-NAPM-WOS	BGRL	0.000	33-34 BAR	Up to 55 deg C
GMS_NG TRANS	BGRL	0.007	35-40 kg/cm2	Up to 55 deg C
GMS_NAPM-MUM	BGRL	0.000	33-34 BAR	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Goa Glass	0.013	1 to 4 bar	Up to 55 deg C
GMS_NG TRANS -GAPM	Goa NGPL	0.003	20-22 bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Goa NGPL	0.007	20-22 bar	Up to 55 deg C
GMS_NG TRANS -GAPM	Goa NGPL	0.003	20-22 bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Goa NGPL	0.017	19-20 KG/CM2	Up to 55 deg C
GMS_NG	HPOIL-2	0.012	40-49 KG/CM2	Up to 55 deg C
GMS_NG-NAPM-WOS	HPOIL-2	0.010	40-49 KG/CM2	Up to 55 deg C
GMS_NAPM-MUM	HPOIL-2	0.001	40-49 KG/CM2	Up to 55 deg C
GMS_NGMUM	HPOIL-2	0.002	40-49 KG/CM2	Up to 55 deg C

GMS_RLNG-(MIDTERM)	HPOIL-2	0.015	40-49 KG/CM3	Up to 55 deg C
GMS_RLNG-(MIDTERM)	IOAGPL-2	0.006	20-22 bar	Up to 55 deg C
GMS_NG TRANS -GAPM	IOAGPL-2	0.007	20-22 bar	Up to 55 deg C
GMS_NG	MNGL	0.004	33-35 kg/cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	MNGL	0.002	33-35 kg/cm2	Up to 55 deg C
GMS_NG	UEPL Ratnagiri	0.000	40 - 49 bar	Up to 55 deg C
GMS_NGMUM	UEPL Ratnagiri	0.007	40-49 kg/cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	UEPL Ratnagiri	0.004	40-49 kg/cm2	Up to 55 deg C
GMS_NAPM-MUM	UEPL Ratnagiri	0.000	40-49 kg/cm2	Up to 55 deg C
GMS_SPOTRLNG	UEPL Ratnagiri	0.001	40 - 49 bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	UEPL Ratnagiri	0.013	not less than 38 kg/cm2	Up to 55 deg C
GMS_RLNG	zuari	1.122	43-45 kg/cm2	Up to 55 deg C
GMS_RLNG	Alok	0.157	43-45	Up to 55 deg C
GMS_RLNG	Asahi	0.005		15 Up to 55 deg C
GMS_RLNG-(MIDTERM)	Asahi	0.020		15 Up to 55 deg C
GMS_RLNG-(MIDTERM)	Asahi	0.064		15 Up to 55 deg C
GMS_NG TRANS	Asahi	0.017		15 Up to 55 deg C
GMS_RLNG	ASIAN COLORS	0.027	8-10	Up to 55 deg C
GMS_RLNG-(MIDTERM)	ASIAN COLORS	0.048	8-10	Up to 55 deg C
GMS_RLNG-(MIDTERM)	ASIAN COLORS	0.029	8-10	Up to 55 deg C
GMS_NG	BGRL aurang	0.011	33-35	Up to 55 deg C
GMS_NG-NAPM-WOS	BGRL aurang	0.010	40-42	Up to 55 deg C
GMS_NG TRANS	BGRL aurang	0.003	35-40	Up to 55 deg C
GMS_NG	Talegaon-Pune-satara	0.001	33-44	Up to 55 deg C
GMS_NG-NAPM-WOS	Talegaon-Pune-satara	0.001	33-44	Up to 55 deg C
GMS_NG	Talegaon-Pune-satara	0.000	33-44	Up to 55 deg C
GMS_NG-NAPM-WOS	Talegaon-Pune-satara	0.000	33-44	Up to 55 deg C
GMS_NG	BPCL	0.00000	18-22	Up to 55 deg C
GMS_NG TRANS-BPCL	BPCL	1.12479	35-40	Up to 55 deg C
GMS_NG TRANS-BPCL	BPCL	0.35520	35-40	Up to 55 deg C
GMS_RLNG	Bhilosa	0.034	6-10	Up to 55 deg C
GMS_RLNG	MGLTALOJA+DFPCL	0.10	30	Up to 55 deg C
GMS_RLNG-(MIDTERM)	MGLTALOJA+DFPCL	0.20	30	Up to 55 deg C
GMS_SPOTRLNG	MGLTALOJA+DFPCL	0.09	30	Up to 55 deg C
GMS_NG TRANS-SHELL	MGLTALOJA+DFPCL	0.05	30	Up to 55 deg C
GMS_RLNG	Filatex Nani	0.013	5-6	Up to 55 deg C
GMS_NG TRANS-GSPCL	RCF TROMBAY	0.458	35-40	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Guj Gas Tarapur	0.022	19-26	Up to 55 deg C
GMS_NG	Guj Gas Tarapur	0.016	14-19	Up to 55 deg C
GMS_NG-NAPM-WOS	Guj Gas Tarapur	0.009	14-19	Up to 55 deg C
GMS_NAPM-MUM	Guj Gas Tarapur	0.003	14-19	Up to 55 deg C
GMS_NG TRANS-ONGC	Guj Gas Tarapur	0.046	13-20	Up to 55 deg C
GMS_NG TRANS-GSPCL	Guj Gas Tarapur	0.046	50-70	Up to 55 deg C
GMS_NGMUM	Talegaon-Pune-satara	0.000	25-30	Up to 55 deg C
GMS_RLNG	Talegaon-Pune-satara	0.000	25-30	Up to 55 deg C
GMS_RLNG	BOM+HIL	0.008	15	Up to 55 deg C
GMS_NG TRANS-SHELL	HPCL	0.367	35-40	Up to 55 deg C
GMS_NG TRANS-BPCL	HPCL	0.528	35-40	Up to 55 deg C
GMS_NG TRANS-ONGC	HPCL	0.028	35-40	Up to 55 deg C
GMS_NG TRANS-D6	HPCL	0.197	35-40	Up to 55 deg C
GMS_NG	HPOIL	0.004	33-35	Up to 55 deg C
GMS_NG-NAPM-WOS	HPOIL	0.001	40-42	Up to 55 deg C
GMS_NAPM-MUM	HPOIL	0.000	40-42	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Talegaon-Pune-satara	0.001	76	Up to 55 deg C
GMS_NG	Talegaon-Pune-satara	0.000	70-95	Up to 55 deg C
GMS_NG-NAPM-WOS	Talegaon-Pune-satara	0.000	95	Up to 55 deg C
GMS_RLNG	INOX AIR PRODUCT	0.002	11-13	Up to 55 deg C
GMS_RLNG-(MIDTERM)	JSW VASIND	0.048	17-22	Up to 55 deg C
GMS_RLNG-(MIDTERM)	JSW VASIND	0.066	10-15	Up to 55 deg C

GMS_RLNG-(MIDTERM)	JSW tarapur	0.077	10-15	Up to 55 deg C
GMS_RLNG	welspun/jindal salav	0.061	18	Up to 55 deg C
GMS_RLNG-(MIDTERM)	welspun/jindal salav	0.474	25-30	Up to 55 deg C
GMS_RLNG	IIL Pen_dolvi jsw + HRJ	0.117	20	Up to 55 deg C
GMS_RLNG-(MIDTERM)	IIL Pen_dolvi jsw + HRJ	0.606	25-30	Up to 55 deg C
GMS_PFMDP	IIL Pen_dolvi jsw + HRJ	0.473	25-30	Up to 55 deg C
GMS_PFMDP	IIL Pen_dolvi jsw + HRJ	0.100	25-30	Up to 55 deg C
GMS_NGMUM	MGL MAHAPE	0.026	50	Up to 55 deg C
GMS_NGMUM	MGL MAHAPE	0.583	50	Up to 55 deg C
GMS_NG-NAPM-WOS	MGL AMBR	0.153	19	Up to 55 deg C
GMS_NAPM-MUM	MGL AMBR	0.009	19	Up to 55 deg C
GMS_NAPM-MUM	MGL AMBR	0.195	19	Up to 55 deg C
GMS_NG-NAPM-WOS	MGL AMBR	0.009	19	Up to 55 deg C
GMS_NG-NAPM-WOS	MGL AMBR	0.105	19	Up to 55 deg C
GMS_PFMDP	MGL AMBR	0.408	17.5-18.5	Up to 55 deg C
GMS_NG TRANS-D6	MGL AMBR	0.084	17.5-18.5	Up to 55 deg C
GMS_RLNG	MNGL Talegaon	0.009	18-22	Up to 55 deg C
GMS_NGMUM	MNGL Talegaon	0.324	17-19	Up to 55 deg C
GMS_RLNG-(MIDTERM)	MNGL Talegaon	0.153	22	Up to 55 deg C
GMS_NAPM-MUM	MNGL Talegaon	0.142	17-19	Up to 55 deg C
GMS_NG-NAPM-WOS	MNGL Talegaon	0.077	17-19	Up to 55 deg C
GMS_RLNG-(MIDTERM)	MNGL Talegaon	0.204	22	Up to 55 deg C
GMS_RLNG-(MIDTERM)	MNGL Talegaon	0.128	22	Up to 55 deg C
GMS_SPOTRLNG	MNGL Talegaon	0.000	18-22	Up to 55 deg C
GMS_SPOTRLNG	MNGL Talegaon	0.000	18-22	Up to 55 deg C
GMS_NG	Talegaon-Pune-satara	0.006	33-35	Up to 55 deg C
GMS_NG-NAPM-WOS	Talegaon-Pune-satara	0.003	33-35	Up to 55 deg C
GMS_NAPM-MUM	Talegaon-Pune-satara	0.000	33-35	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Talegaon-Pune-satara	0.023	33-35	Up to 55 deg C
GMS_NG	Talegaon-Pune-satara	0.001	33-35	Up to 55 deg C
GMS_NG-NAPM-WOS	Talegaon-Pune-satara	0.000	33-35	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Talegaon-Pune-satara	0.008	33-35	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Talegaon-Pune-satara	0.007	33-35	Up to 55 deg C
GMS_RLNG	MSL Sukeli	0.019	3-5	Up to 55 deg C
GMS_RLNG-(MIDTERM)	MSL Sukeli	0.076	3-5	Up to 55 deg C
GMS_RLNG-(MIDTERM)	MSL Sukeli	0.001	3-5	Up to 55 deg C
GMS_SPOTRLNG	MSL Sukeli	0.000	3-5	Up to 55 deg C
GMS_RLNG	MSL vile bhagad	0.009	3-5	Up to 55 deg C
GMS_RLNG-(MIDTERM)	MSL vile bhagad	0.013	3-5	Up to 55 deg C
GMS_RLNG-(MIDTERM)	MSL vile bhagad	0.000	3-5	Up to 55 deg C
GMS_SPOTRLNG	MSL vile bhagad	0.005	3-5	Up to 55 deg C
GMS_NG	Talegaon-Pune-satara	0.037	33-35	Up to 55 deg C
GMS_NAPM-MUM	Talegaon-Pune-satara	0.002	35	Up to 55 deg C
GMS_NG-NAPM-WOS	Talegaon-Pune-satara	0.002	35	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Talegaon-Pune-satara	0.006	35	Up to 55 deg C
GMS_RLNG	Mahindra Sanyo	0.020	6-10	Up to 55 deg C
GMS_RLNG	NPL Kalyan	0.057	38	Up to 55 deg C
GMS_RLNG-(MIDTERM)	NPL Kalyan	0.002	38	Up to 55 deg C
GMS_RLNG	NITCO	0.057	14-19	Up to 55 deg C
GMS_RLNG-(MIDTERM)	VVF+OWNR	0.029	10-12	Up to 55 deg C
GMS_RLNG-(MIDTERM)	VVF+OWNR	0.015	10-12	Up to 55 deg C
GMS_RLNG	BHUSHAN+UTTAM+PARLE	0.007	2	Up to 55 deg C
GMS_RLNG	POSCO STEEL	0.025	10-15	Up to 55 deg C
GMS_RLNG-(MIDTERM)	POSCO STEEL	0.074	10-15	Up to 55 deg C
GMS_RLNG-(MIDTERM)	POSCO STEEL	0.013	10-15	Up to 55 deg C
GMS_RLNG-(MIDTERM)	POSCO STEEL	0.039	10-15	Up to 55 deg C
GMS_SPOTRLNG	POSCO STEEL	0.006	10-15	Up to 55 deg C
GMS_RLNG	IIL Pen_dolvi jsw + HRJ	0.039	17	Up to 55 deg C
GMS_RLNG	RCF THAL	0.585	37	Up to 55 deg C

GMS_NG	GPU Gandhar	0.045	19 - 49 Kg/cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	GPU Gandhar	0.114	19 - 49 Kg/cm2	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GPU Gandhar	0.030	19 - 49 Kg/cm2	Up to 55 deg C
GMS_RLNG	GPU Gandhar	0.005	1-2 Kg/cm2	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GPU Gandhar	0.007	1-2 Kg/cm2	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GSPL	0.025	GSPL-PLL	Up to 55 deg C
GMS_SPOTRLNG	GSPL	0.001	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.033	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.030	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.024	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.022	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.328	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.303	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.019	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.119	GSPL-PLL	Up to 55 deg C
GMS_NG TRANS	GSPL	0.009	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.110	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.048	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.044	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.021	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.005	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.005	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.056	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.051	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.059	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.055	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.044	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.041	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.056	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.051	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.007	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.006	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.016	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.015	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.017	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.016	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.042	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.039	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.049	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.045	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.010	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.009	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.006	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.006	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.010	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.009	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.006	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.005	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.051	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.055	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.010	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.009	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.274	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.254	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.003	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.003	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.022	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.021	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.003	GSPL-PLL	Up to 55 deg C

GMS_NG-NAPM-WOS	GSPL	0.003	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.013	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.012	GSPL-PLL	Up to 55 deg C
GMS_NG	GSPL	0.008	GSPL-PLL	Up to 55 deg C
GMS_NG-NAPM-WOS	GSPL	0.008	GSPL-PLL	Up to 55 deg C
GMS_NG TRANS	GSPL	0.175	GSPL-PLL	Up to 55 deg C
GMS_RLNG	GPU Gandhar	0.051	2-4 Kg/cm2	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	0.00	2-3 Kg/cm2	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.00	2-3 Kg/cm2	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	0.00	2-3 Kg/cm2	Up to 55 deg C
GMS_RLNG-(MIDTERM)	GGL Sonipat +DBNPL	0.01	2-3 Kg/cm2	Up to 55 deg C
GMS_NG TRANS	GGL Sonipat +DBNPL	0.08	38-42 Kg/cm2	Up to 55 deg C
GMS_NG TRANS	GPU Gandhar	0.735	38-42 Kg/cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	NFL	0.090	40-45 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	NFL	0.921	40-45 KG/CM2 (g)	Up to 55 deg C
GMS_NG TRANS-IOCL	NFL	0.306	40-45 KG/CM2 (g)	Up to 55 deg C
GMS_NG TRANS-IOCL	NFL	0.767	40-45 KG/CM2 (g)	Up to 55 deg C
GMS_NG TRANS-BPCL	NFL	2.064	40-45 KG/CM2 (g)	Up to 55 deg C
HCC	JIPPL	0.00	Less than 7.0 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	JIPPL	0.00	Less than 7.0 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	JIPPL	0.01	Less than 7.0 KG/CM2 (g)	Up to 55 deg C
GMS_SPOTRLNG	JIPPL	0.00	Less than 7.0 KG/CM2 (g)	Up to 55 deg C
HH (12M)	JIPPL	0.00	Less than 7.0 KG/CM2 (g)	Up to 55 deg C
HCC	JIPPL	0.00	Less than 7.0 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	JIPPL	0.04	Less than 3 KG/CM2 (g)	Up to 55 deg C
GMS_SPOTRLNG	KELARAS	0.00	02 KG/CM2	Up to 55 deg C
GMS_RLNG	KELARAS	0.03	02 KG/CM2	Up to 55 deg C
GMS_RLNG	KELARAS	0.00	3.0 KG/CM2	Up to 55 deg C
HH RLNG	KELARAS	0.00	3.0 KG/CM2	Up to 55 deg C
GMS_SPOTRLNG	KELARAS	0.00	3.0 KG/CM2	Up to 55 deg C
GMS_NG	JIPPL	0.05	20 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	JIPPL	0.05	21 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	JIPPL	0.00	22 KG/CM2 (g)	Up to 55 deg C
HH RLNG	JIPPL	0.01	23 KG/CM2 (g)	Up to 55 deg C
HCC	JIPPL	0.10	24 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	JIPPL	0.00	Less than 5 KG/CM2 (g)	Up to 55 deg C
GMS_SPOTRLNG	JIPPL	0.00	Less than 5 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	JIPPL	0.00	Less than 5 KG/CM2 (g)	Up to 55 deg C
GMS_NG	Dewas Indore	0.010	20 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	Dewas Indore	0.009	20 KG/CM2 (g)	Up to 55 deg C
HKM	Dewas Indore	0.006	20 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	Dewas Indore	0.044	20 KG/CM2 (g)	Up to 55 deg C
HH RLNG	Dewas Indore	0.053	20 KG/CM2 (g)	Up to 55 deg C
GMS_NG	KELARAS	0.02	20 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	KELARAS	0.02	20 KG/CM2 (g)	Up to 55 deg C
HCC	KELARAS	0.01	20 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	KELARAS	0.00	20 KG/CM2 (g)	Up to 55 deg C
HH RLNG	KELARAS	0.02	20 KG/CM2 (g)	Up to 55 deg C
HCC RLNG	KELARAS	0.01	20 KG/CM2 (g)	Up to 55 deg C
GMS_NG	JIPPL	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	JIPPL	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
HCC	JIPPL	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
HH RLNG	JIPPL	0.00	14-18 KG/CM2 (g)	Up to 55 deg C
HH (12M)	JIPPL	0.00	14-18 KG/CM2 (g)	Up to 55 deg C
HH RLNG	KELARAS	0.00	20 KG/CM2 (g)	Up to 55 deg C
GMS_NG	KELARAS	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	KELARAS	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_SPOTRLNG	KELARAS	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_NG	KELARAS	0.00	20-30 KG/CM2 (g)	Up to 55 deg C

GMS_NG-NAPM-WOS	KELARAS	0.00	20-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG	KELARAS	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	KELARAS	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_SPOTRLNG	KELARAS	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_NG	KELARAS	0.00	19-21 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	KELARAS	0.00	19-21 KG/CM2 (g)	Up to 55 deg C
GMS_NG	KELARAS	0.00	19-21 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	KELARAS	0.00	19-21 KG/CM2 (g)	Up to 55 deg C
HH (1M)	KELARAS	0.00	19-21 KG/CM2 (g)	Up to 55 deg C
GMS_NG	KELARAS	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	KELARAS	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG	KELARAS	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	KELARAS	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG	KELARAS	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	KELARAS	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG	KELARAS	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	KELARAS	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG	JIPPL	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG TRANS	JIPPL	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	JIPPL	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG	JIPPL	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	JIPPL	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG	JIPPL	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG TRANS	JIPPL	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	JIPPL	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
HCC	JIPPL	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
HCC	JIPPL	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_NG	JIPPL	0.01	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	JIPPL	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_SPOTRLNG	JIPPL	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_NG	JIPPL	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	JIPPL	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_NG	JIPPL	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_NG-NAPM-WOS	JIPPL	0.00	25-45 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	JIPPL	0.01	Less than 6 KG/CM2 (g)	Up to 55 deg C
HH_RLNG	JIPPL	0.01	Less than 6 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	JIPPL	0.01	Less than 7 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	JIPPL	0.02	Less than 7 KG/CM2 (g)	Up to 55 deg C
HH_RLNG	JIPPL	0.03	4.0 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	KELARAS	0.03	05 KG/CM2	Up to 55 deg C
GMS_SPOTRLNG	KELARAS	0.00	6 KG/CM2	Up to 55 deg C
GMS_RLNG	JIPPL	0.00	Less than 7 KG/CM2 (g)	Up to 55 deg C
HH_RLNG	JIPPL	0.00	Less than 7 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	JIPPL	0.01	Less than 5 bar (a)	Up to 55 deg C
HH_RLNG	JIPPL	0.00	Less than 5 bar (a)	Up to 55 deg C
GMS_SPOTRLNG	JIPPL	0.00	Less than 5 bar (a)	Up to 55 deg C
GMS_RLNG	JIPPL	0.00	Less than 7 KG/CM2 (g)	Up to 55 deg C
GMS_SPOTRLNG	JIPPL	0.00	Less than 7 KG/CM2 (g)	Up to 55 deg C
HH_RLNG	JIPPL	0.01	Less than 7 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	KELARAS	0.07	06-10 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	JIPPL	0.00	Less than 5 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	KELARAS	0.00	05 KG/CM2	Up to 55 deg C
GMS_SPOTRLNG	KELARAS	0.00	05 KG/CM2	Up to 55 deg C
GMS_RLNG	KELARAS	0.01	5 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	JIPPL	0.00	5 KG/CM2 (g)	Up to 55 deg C
GMS_RLNG	KELARAS	0.01	5 KG/CM2 (g)	Up to 55 deg C
GMS_SPOTRLNG	KELARAS	0.00	5 KG/CM2 (g)	Up to 55 deg C
HH_RLNG	KELARAS	0.01	5 bar (a)	Up to 55 deg C
HH_RLNG	KELARAS	0.01	5 bar (a)	Up to 55 deg C

GMS_NG TRANS-IOCL	KELARAS	0.00	40-70 KG/CM2 (g)	Up to 55 deg C
GMS_NG TRANS-IOCL	KELARAS	0.00	Less than 5 bar	Up to 55 deg C
GMS_SPOTRLNG	KELARAS	0.00	Less than 5 bar	Up to 55 deg C
GMS_NG	KELARAS	0.00	25-30 KG/CM2 (g)	Up to 55 deg C
GMS_NG	CFCL1	0.000	40-45 Bar	Up to 55 deg C
GMS_NG-NAPM-WOS	CFCL1	0.018	40-45 Bar	Up to 55 deg C
GMS_RLNG	CFCL1	0.730	40-45 Bar	Up to 55 deg C
GMS_SPOTRLNG	CFCL1	0.000	40-45 Bar	Up to 55 deg C
GMS_NG TRANS	CFCL1	0.581	40-45 Bar	Up to 55 deg C
GMS_RLNG	CFCL2&3	0.400	40-45 Bar	Up to 55 deg C
GMS_SPOTRLNG	CFCL2&3	0.000	40-45 Bar	Up to 55 deg C
GMS_NG TRANS	CFCL2&3	1.148	40-45 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CFCL2&3	1.913	40-45 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CFCL2&3	1.200	40-45 Bar	Up to 55 deg C
GMS_NG-NAPM-WOS	DCM Shriram	0.003	More than 41 Bar	Up to 55 deg C
GMS_RLNG	DCM Shriram	0.485	More than 41 Bar	Up to 55 deg C
GMS_SPOTRLNG	DCM Shriram	0.046	More than 41 Bar	Up to 55 deg C
GMS_NG	ANTA	0.000	20 to 30 Bar	Up to 55 deg C
GMS_RLNG	ANTA	0.292	20 to 30 Bar	Up to 55 deg C
GMS_SPOTRLNG	ANTA	0.002	21 to 30 Bar	Up to 55 deg C
GMS_RLNG	CGD-Bhil-Chit	0.000	>10 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CGD-Bhil-Chit	0.014	>10 Bar	Up to 55 deg C
GMS_SPOTRLNG	CGD-Bhil-Chit	0.011	>10 Bar	Up to 55 deg C
GMS_NG AND GMS_NG-NAPM-WOS	CGD-Bhil-Chit	0.025	> 19 Bar	Up to 55 deg C
GMS_SPOTRLNG	CGD-Bhil-Chit	0.001	> 19 Bar	Up to 55 deg C
GMS_RLNG	CGD-Bhil-Chit	0.010	> 19 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CGD-Bhil-Chit	0.010	> 19 Bar	Up to 55 deg C
GMS_NG AND GMS_NG-NAPM-WOS	CGD-Bhil-Chit	0.022	30-49 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CGD-Bhil-Chit	0.002	30-49 Bar	Up to 55 deg C
GMS_NG AND GMS_NG-NAPM-WOS	CGD-Bhil-Chit	0.006	40-49 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CGD-Bhil-Chit	0.001	40-49 Bar	Up to 55 deg C
GMS_SPOTRLNG	CGD-Bhil-Chit	0.004	40-49 Bar	Up to 55 deg C
GMS_NG AND GMS_NG-NAPM-WOS	CGD-Bhil-Chit	0.008	40-49 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CGD-Bhil-Chit	0.002	40-49 Bar	Up to 55 deg C
GMS_SPOTRLNG	CGD-Bhil-Chit	0.024	40-49 Bar	Up to 55 deg C
GMS_NG AND GMS_NG-NAPM-WOS	DHOLPUR	0.02	30-49 Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	DHOLPUR	0.00	30-49 Bar	Up to 55 deg C
Natural Gas-HVJ	AONLA	0.000	40 to 45Kg/cm2 g	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	AONLA	0.092	40 to 45Kg/cm2 g	Up to 55 deg C
RLNG	AONLA	2.300	40 Kg/cm2 g	Up to 55 deg C
SPOT RLNG	AONLA	0.000	40 Kg/cm2 g	Up to 55 deg C
Transmission EPMC	AONLA	0.878	40 Kg/cm2 g	Up to 55 deg C
Natural Gas-HVJ	BABRALA	0.00	25 to 45 Kg/cm2 g	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	BABRALA	0.02	25 to 45 Kg/cm2 g	Up to 55 deg C
RLNG	BABRALA	1.10	25 to 45 Kg/cm2 g	Up to 55 deg C
Transmission (IOCL RLNG)	BABRALA	1.01	25 to 45 Kg/cm2 g	Up to 55 deg C
Natural Gas-HVJ	JAGDISHPUR IGF	0.00	45 Kg/cm2 g	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	JAGDISHPUR IGF	0.00	45 Kg/cm2 g	Up to 55 deg C
RLNG	JAGDISHPUR IGF	1.81	43 Bar (a)	Up to 55 deg C
Transmission (IOCL RLNG)	JAGDISHPUR IGF	0.24	43 Bar (a)	Up to 55 deg C
Natural Gas-HVJ	KFL Shahjapur	0.000	25 to 45 Kg/cm2 g	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	KFL Shahjapur	0.036	25 to 45 Kg/cm2 g	Up to 55 deg C
RLNG	KFL Shahjapur	0.300	25 to 45 Kg/cm2 g	Up to 55 deg C
SPOT RLNG	KFL Shahjapur	0.030	25 to 45 Kg/cm2 g	Up to 55 deg C
Transmission (RLNG GSPC +RLNG BPCL+EPMC)	KFL Shahjapur	1.687	25 to 45 Kg/cm2 g	Up to 55 deg C
RLNG*	IFFCO	2.850	40 Kg/cm2 g	Up to 55 deg C
SPOT RLNG	IFFCO	0.011	40 Kg/cm2 g	Up to 55 deg C
RLNG (Firm +FB)*	KFCL	1.170	42.5 Bar (a)	Up to 55 deg C
Natural Gas-HVJ	NTPC AUR	0.000	20 to 30 Kg/cm2 g	Up to 55 deg C

Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	NTPC AUR	0.080	20 to 30 Kg/cm2 g	Up to 55 deg C
RLNG	NTPC AUR	0.590	25 +5 Kg/cm2 g	Up to 55 deg C
Transmission	MATHURA	1.690	40 to 45Kg/cm2 g	Up to 55 deg C
RLNG	Jagdishpur others	0.011	3.92) Bar (a)	Up to 55 deg C
SPOT RLNG	Jagdishpur others	0.001	3.92) Bar (a)	Up to 55 deg C
Natural Gas-HVJ	KANPUR + Jhansi CGD	0.08	19 to 21 Kg/cm2 g	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	KANPUR + Jhansi CGD	0.08	19 to 21 Kg/cm2 g	Up to 55 deg C
RLNG	KANPUR + Jhansi CGD	0.01	18.63 Bar (a)	Up to 55 deg C
MID TERM RLNG -FIRM + FB	KANPUR + Jhansi CGD	0.19	18.63 Bar (a)	Up to 55 deg C
SPOT RLNG	KANPUR + Jhansi CGD	0.02	18.63 Bar (a)	Up to 55 deg C
Natural Gas-HVJ	CGD Mainpuri Bareli Moradaba	0.032	19 to 21 Kg/cm2 g	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	CGD Mainpuri Bareli Moradaba	0.029	19 to 21 Kg/cm2 g	Up to 55 deg C
SPOT RLNG	CGD Mainpuri Bareli Moradaba	0.016	19 to 21 Kg/cm2 g	Up to 55 deg C
Natural Gas-HVJ	KANPUR + Jhansi CGD	0.00	19 to 21 Kg/cm2 g	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	KANPUR + Jhansi CGD	0.00	19 to 21 Kg/cm2 g	Up to 55 deg C
SPOT RLNG	KANPUR + Jhansi CGD	0.00	19 to 21 Kg/cm2 g	Up to 55 deg C
Natural Gas-HVJ	LKO CITY GAS + Unnao + Faizaba	0.09	19 to 21 Kg/cm2 g	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	LKO CITY GAS + Unnao + Faizaba	0.08	19 to 21 Kg/cm2 g	Up to 55 deg C
RLNG (Firm +FB)	LKO CITY GAS + Unnao + Faizaba	0.01	19 to 21 Kg/cm2 g	Up to 55 deg C
MID TERM RLNG -FIRM	LKO CITY GAS + Unnao + Faizaba	0.16	19 to 21 Kg/cm2 g	Up to 55 deg C
Natural Gas-HVJ	Agra Firozabad	0.085	10 to 15.5 Bar (g)	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	Agra Firozabad	0.078	10 to 15.5 Bar (g)	Up to 55 deg C
MID TERM RLNG -FIRM	Agra Firozabad	0.010	10 to 15.5 Bar (g)	Up to 55 deg C
Natural Gas-HVJ	CGD Mainpuri Bareli Moradaba	0.043	19 to 22 Bar (g)	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	CGD Mainpuri Bareli Moradaba	0.026	19 to 22 Bar (g)	Up to 55 deg C
RLNG	CGD Mainpuri Bareli Moradaba	0.001	19 to 22 Bar (g)	Up to 55 deg C
MID TERM RLNG -FIRM	CGD Mainpuri Bareli Moradaba	0.035	19 to 22 Bar (g)	Up to 55 deg C
Transmission (IOCL CT)	CGD Mainpuri Bareli Moradaba	0.015	19 to 22 Bar (g)	Up to 55 deg C
Natural Gas-HVJ	Mathura Sawariya	0.045	19 to 21 Kg/cm2 g	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	Mathura Sawariya	0.021	19 to 21 Kg/cm2 g	Up to 55 deg C
MID TERM RLNG -FIRM + FB	Mathura Sawariya	0.053	19 to 21 Kg/cm2 g	Up to 55 deg C
Gas Transmission (GAIL-APM)	Agra Firozabad	1.050	10-18 Kg/cm2g	Up to 55 deg C
Gas Transmission (GAIL-RLNG)	Agra Firozabad	0.270	10 to 15.5 Bar g	Up to 55 deg C
Gas Transmission (GAIL-APM)	Agra Firozabad	0.131	10-18 Kg/cm2g	Up to 55 deg C
Gas Transmission (GAIL-RLNG)	Agra Firozabad	0.027	10-18 Kg/cm2g	Up to 55 deg C
Natural Gas-HVJ	Allahabad Amethi Faizabad CGD	0.016	19 to 26 Kgcm2	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	Allahabad Amethi Faizabad CGD	0.015	19 to 26 Kgcm2	Up to 55 deg C
MID TERM RLNG	Allahabad Amethi Faizabad CGD	0.008	19 to 26 Kgcm2	Up to 55 deg C
Transmission	Allahabad Amethi Faizabad CGD	0.003	19 to 26 Kgcm2	Up to 55 deg C
Natural Gas-HVJ	Allahabad Amethi Faizabad CGD	0.007	26 kg/cm2 (g)	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	Allahabad Amethi Faizabad CGD	0.007	26 kg/cm2 (g)	Up to 55 deg C
Transmission	Allahabad Amethi Faizabad CGD	0.027	26 kg/cm2 (g)	Up to 55 deg C
RLNG	Jagdishpur others	0.002	2 to 4 Kg	Up to 55 deg C
RLNG	Jagdishpur others	0.002	2 to 4 Kg	Up to 55 deg C
Natural Gas-HVJ	NTPC AUR	0.063	19 kg/cm2 (g)	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	NTPC AUR	0.028	19 kg/cm2 (g)	Up to 55 deg C
Mid Term RLNG	NTPC AUR	0.001	19 kg/cm2 (g)	Up to 55 deg C
Natural Gas-HVJ	LKO CITY GAS + Unnao + Faizaba	0.02	30 kg/cm2	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	LKO CITY GAS + Unnao + Faizaba	0.01	30 kg/cm2	Up to 55 deg C
Natural Gas-HVJ	CGD Mainpuri Bareli Moradaba	0.025	20 kg/cm2	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	CGD Mainpuri Bareli Moradaba	0.011	20 kg/cm2	Up to 55 deg C
Natural Gas-HVJ	LKO CITY GAS + Unnao + Faizaba	0.00	19 kg/cm2	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	LKO CITY GAS + Unnao + Faizaba	0.00	19 kg/cm2	Up to 55 deg C
Natural Gas-HVJ	Allahabad Amethi Faizabad CGD	0.003	19 kg/cm2	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	Allahabad Amethi Faizabad CGD	0.003	19 kg/cm2	Up to 55 deg C
Natural Gas-HVJ	KANPUR + Jhansi CGD	0.00	26 to 45 kg/cm2(g)	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	KANPUR + Jhansi CGD	0.00	26 to 45 kg/cm2(g)	Up to 55 deg C
Mid Term RLNG	KANPUR + Jhansi CGD	0.01	26 to 45 kg/cm2(g)	Up to 55 deg C
Natural Gas-HVJ	CGD Mainpuri Bareli Moradaba	0.003	25 kg/cm2	Up to 55 deg C

Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	CGD Mainpuri Bareli Moradaba	0.003	25 kg/cm2	Up to 55 deg C
Transmission	CGD Mainpuri Bareli Moradaba	0.006	25 kg/cm2	Up to 55 deg C
Natural Gas-HVJ	CGD Mainpuri Bareli Moradaba	0.003	32 kg/cm2	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	CGD Mainpuri Bareli Moradaba	0.003	32 kg/cm2	Up to 55 deg C
Transmission	CGD Mainpuri Bareli Moradaba	0.011	32 kg/cm2	Up to 55 deg C
Natural Gas-HVJ	CGD Mainpuri Bareli Moradaba	0.003	40 Kg/cm2 (g)	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	CGD Mainpuri Bareli Moradaba	0.003	40 Kg/cm2 (g)	Up to 55 deg C
Transmission	CGD Mainpuri Bareli Moradaba	0.004	40 Kg/cm2 (g)	Up to 55 deg C
Natural Gas-HVJ	HPCL Shahjapur Budaun	0.003	42 Kg/cm2 (g)	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	HPCL Shahjapur Budaun	0.003	42 Kg/cm2 (g)	Up to 55 deg C
Transmission	HPCL Shahjapur Budaun	0.010	42 Kg/cm2 (g)	Up to 55 deg C
Natural Gas-HVJ	LKO CITY GAS + Unnao + Faizabad	0.00	30 to 36 kg/cm2(g)	Up to 55 deg C
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	LKO CITY GAS + Unnao + Faizabad	0.00	30 to 36 kg/cm2(g)	Up to 55 deg C
Transmission	LKO CITY GAS + Unnao + Faizabad	0.00	30 to 36 kg/cm2(g)	Up to 55 deg C
GMS_NG	AGL Nuh Palwal	0.041	4-5Bar(a)	Up to 55 deg C
GMS_NG-NAPM-WOS	AGL Nuh Palwal	0.028	4-5Bar(a)	Up to 55 deg C
GMS_NG	CGD Khurja Dadri	0.02	4-5Bar(a)	Up to 55 deg C
GMS_NG-NAPM-WOS	CGD Khurja Dadri	0.02	4-5Bar(a)	Up to 55 deg C
GMS_NG TRANS-ATPL	AGL Faridabad	0.306	4-5Bar(a)	Up to 55 deg C
GMS_NG TRANS-D6	AGL Faridabad	0.083	4-5Bar(a)	Up to 55 deg C
GMS_NG TRANS-ATPL	CGD Khurja Dadri	0.11	4-5Bar(a)	Up to 55 deg C
GMS_RLNG	KMKRPL	0.008	4Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	KMKRPL	0.003	3Bar	Up to 55 deg C
GMS_SPOTRLNG	KMKRPL	0.001	3Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CGD Khurja Dadri	0.00	3Bar	Up to 55 deg C
GMS_SPOTRLNG	CGD Khurja Dadri	0.00	3Bar	Up to 55 deg C
GMS_NG	CGD Khurja Dadri	0.01	3Bar	Up to 55 deg C
GMS_NG-NAPM-WOS	CGD Khurja Dadri	0.00	3Bar	Up to 55 deg C
GMS_RLNG	KMKRPL	0.003	2-3Bar	Up to 55 deg C
GMS_SPOTRLNG	KMKRPL	0.001	2-3Bar	Up to 55 deg C
GMS_NG TRANS-IOCL	Sikandrabad customers	0.004	2Kg/Cm2	Up to 55 deg C
GMS_RLNG	CGPL customers	0.130	19Bar(a)	Up to 55 deg C
GMS_SPOTRLNG	CGPL customers	0.000	19Bar(a)	Up to 55 deg C
GMS_RLNG	CGPL customers	0.056	19Bar(a)	Up to 55 deg C
GMS_SPOTRLNG	CGPL customers	0.000	19Bar(a)	Up to 55 deg C
GMS_RLNG	CGPL customers	0.050	19Bar (a)	Up to 55 deg C
GMS_SPOTRLNG	CGPL customers	0.000	19Bar (a)	Up to 55 deg C
GMS_SPOTRLNG	Sikandrabad customers	0.006	4Bar(a)	Up to 55 deg C
GMS_RLNG	Sikandrabad customers	0.009	3Bar	Up to 55 deg C
GMS_SPOTRLNG	Sikandrabad customers	0.004	3Bar	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	0.40	3Bar	Up to 55 deg C
GMS_RLNG	GGL Sonipat +DBNPL	0.20	3Bar	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Sikandrabad customers	0.002	2-3Bar(a)	Up to 55 deg C
GMS_SPOTRLNG	Sikandrabad customers	0.005	2-3Bar(a)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Sikandrabad customers	0.004	2-3Bar(a)	Up to 55 deg C
GMS_SPOTRLNG	Sikandrabad customers	0.005	2-3Bar(a)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Sikandrabad customers	0.006	2-3Bar(a)	Up to 55 deg C
GMS_SPOTRLNG	Sikandrabad customers	0.005	2-3Bar(a)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	CGPL customers	0.259	18Bar	Up to 55 deg C
GMS_SPOTRLNG	CGPL customers	0.051	18Bar	Up to 55 deg C
GMS_RLNG	CGPL customers	0.060	19Kg/Cm2	Up to 55 deg C
GMS_RLNG	Sikandrabad customers	0.009	1Bar(a)	Up to 55 deg C
GMS_SPOTRLNG	Sikandrabad customers	0.003	1Bar(a)	Up to 55 deg C
GMS_NG TRANS-PLL	Sikandrabad customers	0.001	4Bar	Up to 55 deg C
GMS_RLNG	Dadri exit	0.017	3Bar(a)	Up to 55 deg C
GMS_SPOTRLNG	Dadri exit	0.000	3Bar(a)	Up to 55 deg C
GMS_NG TRANS-PLL	KMKRPL	0.006	19kg/cm2(g)	Up to 55 deg C
GMS_NG	KMKRPL	0.001	19kg/cm2(g)	Up to 55 deg C
GMS_NG-NAPM-WOS	KMKRPL	0.031	19kg/cm2(g)	Up to 55 deg C

GMS_NG	KMKRPL	0.001	19kg/cm2(g)	Up to 55 deg C
GMS_NG-NAPM-WOS	KMKRPL	0.005	19kg/cm2(g)	Up to 55 deg C
GMS_NG TRANS-IOCL	Dadri exit	1.450	28-30Kg/Cm2	Up to 55 deg C
GMS_NG TRANS-IOCL	Dadri exit	4.936	50-70Bar(g)	Up to 55 deg C
GMS_NG TRANS-ATPL	KMKRPL	0.003	28-30Bar(g)	Up to 55 deg C
GMS_NG TRANS-GSPCL	KMKRPL	0.084	28-30Bar(g)	Up to 55 deg C
GMS_RLNG	KMKRPL	0.006	28-30Bar(g)	Up to 55 deg C
GMS_NG	KMKRPL	0.010	28-30Bar(g)	Up to 55 deg C
GMS_NG-NAPM-WOS	KMKRPL	0.010	28-30Bar(g)	Up to 55 deg C
GMS_NG TRANS-BPCL	IGL G Noida BPCL	0.200	2-6Kg/Cm2(g)	Up to 55 deg C
GMS_NG TRANS-IOCL	IGL G Noida BPCL	0.221	19-22Kg/Cm2	Up to 55 deg C
GMS_RLNG	IGL G Noida BPCL	0.200	19-22Kg/Cm2	Up to 55 deg C
GMS_SPOTRLNG	IGL G Noida BPCL	0.002	19-22Kg/Cm2	Up to 55 deg C
GMS_NG	IGL G Noida BPCL	2.264	19-22Kg/Cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	IGL G Noida BPCL	2.011	19-22Kg/Cm2	Up to 55 deg C
GMS_RLNG	DESU_NCR	0.60	20Kg/Cm2(g)	Up to 55 deg C
GMS_NG	DESU_NCR	0.00	20Kg/Cm2(g)	Up to 55 deg C
GMS_NG-NAPM-WOS	DESU_NCR	0.00	20Kg/Cm2(g)	Up to 55 deg C
GMS_RLNG	CGD Khurja Dadri	0.01	19-22Kg/Cm2	Up to 55 deg C
GMS_NG	CGD Khurja Dadri	0.03	19-22Kg/Cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	CGD Khurja Dadri	0.00	19-22Kg/Cm2	Up to 55 deg C
GMS_NG TRANS-BPCL	IGL G Noida BPCL	0.200	2-6Kg/Cm2(g)	Up to 55 deg C
GMS_NG TRANS-D6	IGL G Noida BPCL	0.018	24-26Kg/Cm2	Up to 55 deg C
GMS_NG TRANS-GRLNG	IGL G Noida BPCL	0.038	24-26Kg/Cm2	Up to 55 deg C
GMS_NG TRANS-IOCL	IGL G Noida BPCL	0.191	24-26Kg/Cm2	Up to 55 deg C
GMS_RLNG	IGL G Noida BPCL	0.200	24-26Kg/Cm2	Up to 55 deg C
GMS_SPOTRLNG	IGL G Noida BPCL	0.001	24-26Kg/Cm2	Up to 55 deg C
GMS_NG	IGL G Noida BPCL	0.254	24-26Kg/Cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	IGL G Noida BPCL	0.002	24-26Kg/Cm2	Up to 55 deg C
GMS_NG	AGL Faridabad	0.130	24-26Kg/Cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	AGL Faridabad	0.255	24-26Kg/Cm2	Up to 55 deg C
GMS_RLNG	CGPL customers	0.005	19Kg/Cm2	Up to 55 deg C
GMS_NG	CGPL customers	0.130	19Kg/Cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	CGPL customers	0.130	19Kg/Cm2	Up to 55 deg C
GMS_NG	IOAGPL Bulandshahar	0.000	19Kg/Cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	IOAGPL Bulandshahar	0.000	19Kg/Cm2	Up to 55 deg C
GMS_NG TRANS-GSPCL	IOAGPL Bulandshahar	0.011	19Kg/Cm2	Up to 55 deg C
GMS_NG	IOAGPL Bulandshahar	0.013	19Kg/Cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	IOAGPL Bulandshahar	0.012	19Kg/Cm2	Up to 55 deg C
GMS_NG	IOAGPL Bulandshahar	0.004	19Kg/Cm2	Up to 55 deg C
GMS_NG-NAPM-WOS	IOAGPL Bulandshahar	0.007	19Kg/Cm2	Up to 55 deg C
GMS_RLNG	Dadri exit	0.009	3Bar(a)	Up to 55 deg C
GMS_RLNG	Dadri exit	0.042	3Bar(a)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Dadri exit	0.029	3Bar(a)	Up to 55 deg C
GMS_RLNG	KMKRPL	0.001	2Bar(a)	Up to 55 deg C
GMS_RLNG	Dadri exit	0.016	19Kg/Cm2(g)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Dadri exit	0.203	19Kg/Cm2(g)	Up to 55 deg C
GMS_NG	Dadri exit	0.002	19Kg/Cm2(g)	Up to 55 deg C
GMS_RLNG	KMKRPL	0.001	2Bar	Up to 55 deg C
GMS_SPOTRLNG	KMKRPL	0.001	2Bar	Up to 55 deg C
GMS_RLNG	KMKRPL	0.001	2Bar	Up to 55 deg C
GMS_SPOTRLNG	KMKRPL	0.001	2Bar	Up to 55 deg C
GMS_RLNG	Sikandrabad customers	0.004	3Bar(a)	Up to 55 deg C
GMS_RLNG	DADRI NTPC	0.30	20-30Bar(a)	Up to 55 deg C
GMS_SPOTRLNG	DADRI NTPC	0.00	20-30Bar(a)	Up to 55 deg C
GMS_RLNG	NTPC FAR	0.200	20Kg/Cm2(g)	Up to 55 deg C
GMS_SPOTRLNG	NTPC FAR	0.130	20Kg/Cm2(g)	Up to 55 deg C
GMS_RLNG	Sikandrabad customers	0.079	5Bar(a)	Up to 55 deg C
GMS_RLNG-(MIDTERM)	Sikandrabad customers	0.073	5Bar(a)	Up to 55 deg C

GMS_NG TRANS-IOCL	Dadri exit	0.010	5Bar(a)	Up to 55 deg C			
GMS_RLNG	Dadri exit	0.011	3Bar(a)	Up to 55 deg C			
GMS_RLNG	Dadri exit	0.018	3Bar(a)	Up to 55 deg C			
GMS_RLNG	Dadri exit	0.800	24-26Kg/Cm2	Up to 55 deg C			
GMS_SPOTRLNG	Dadri exit	0.074	24-26Kg/Cm2	Up to 55 deg C			
GMS_NG	Dadri exit	0.000	24-26Kg/Cm2	Up to 55 deg C			
GMS_NG-NAPM-WOS	Dadri exit	0.000	24-26Kg/Cm2	Up to 55 deg C			
GMS_RLNG	Dadri exit	0.018	5Bar(a)	Up to 55 deg C			
GMS_NG TRANS-IOCL	KMKRPL	0.001	5Kg/Cm2(g)	Up to 55 deg C			
GMS_RLNG	Sikandrabad customers	0.080	3Bar(a)	Up to 55 deg C			
GMS_RLNG	Sikandrabad customers	0.004	5Kg/Cm2 Bar (a)	Up to 55 deg C			
GMS_RLNG	Sikandrabad customers	0.001	3.5Bar(a)	Up to 55 deg C			
GMS_SPOTRLNG	Sikandrabad customers	0.022	3.5Bar(a)	Up to 55 deg C			
GMS_RLNG	Sikandrabad customers	0.010	3Bar(a)	Up to 55 deg C			
GMS_NG TRANS-GRLNG	KMKRPL	0.840	25-30Kg/Cm2(g)	Up to 55 deg C			
GMS_NG TRANS-GRLNG	KMKRPL	0.900	25-30Kg/Cm2(g)	Up to 55 deg C			
GMS_NG	CGD Khurja Dadri	0.03	50-70 Kg/cm2 or as availbale at Dadri	Up to 55 deg C			
GMS_NG-NAPM-WOS	CGD Khurja Dadri	0.03	50-70 Kg/cm2 or as availbale at Dadri	Up to 55 deg C			
GMS_NG TRANS	CGD Khurja Dadri	0.02	50-70 Kg/cm2 or as availbale at Dadri	Up to 55 deg C			
GMS_NG	CGD Khurja Dadri	0.00	24-26Kg/Cm2	Up to 55 deg C			
GMS_NG-NAPM-WOS	CGD Khurja Dadri	0.00	24-26Kg/Cm2	Up to 55 deg C			
	GPU Vaghodia+IC	0.018					
	Vjp IC	0.873					
	Auriaya IC	0.688					
	VJP	2.889					
	Pata IC	2.089					
	Hazira IC	0.150					
	GPU Vaghodia+IC	0.209					
	Jhabua IC	0.014					
	Khera IC	0.040					
	Vjp IC	0.556					
	Auriaya IC	0.242					
	Kailaras IC	0.080					
	Chainsa IC	0.032					
Natural Gas-HVJ	GORAKHPUR	0.016	30 kg/cm2	Up to 55 deg C			
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	GORAKHPUR	0.008	30 kg/cm2	Up to 55 deg C			
Natural Gas-HVJ	GORAKHPUR	0.009	20 kg/cm2 & 30 kg/cm2	Up to 55 deg C			
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	GORAKHPUR	0.008	20 kg/cm2 & 30 kg/cm2	Up to 55 deg C			
Natural Gas-HVJ	GORAKHPUR	0.029	20 kg/cm2	Up to 55 deg C			
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	GORAKHPUR	0.008	20 kg/cm2	Up to 55 deg C			
RLNG-(MIDTERM)	GORAKHPUR	0.000	20 kg/cm2	Up to 55 deg C			
Natural Gas-HVJ	GORAKHPUR	0.096	19 kg/cm2	Up to 55 deg C			
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	GORAKHPUR	0.003	19 kg/cm2	Up to 55 deg C			
RLNG-(MIDTERM)	GORAKHPUR	0.004	19 kg/cm2	Up to 55 deg C			
Natural Gas-HVJ	PATNA	0.00	20 kg/cm2	Up to 55 deg C			
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	PATNA	0.00	20 kg/cm2	Up to 55 deg C			
RLNG-(MIDTERM)	PATNA	0.00	20 kg/cm2	Up to 55 deg C			
RLNG-(MIDTERM)	GORAKHPUR	2.020	45 Bar (a)	Up to 55 deg C			
RLNG-(MIDTERM)	BARAUNI_FERT	2.20	45 Bar (a)	Up to 55 deg C			
Natural Gas-HVJ	BANARAS	0.004	26 kg/cm2	Up to 55 deg C			
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	BANARAS	0.004	26 kg/cm2	Up to 55 deg C			
RLNG-(MIDTERM)	BANARAS	0.005	26 kg/cm2	Up to 55 deg C			
Natural Gas-HVJ	PATNA	0.00	26 kg/cm2	Up to 55 deg C			
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	PATNA	0.00	26 kg/cm2	Up to 55 deg C			
Natural Gas-HVJ	PATNA	0.00	35 kg/cm2	Up to 55 deg C			
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	PATNA	0.00	35 kg/cm2	Up to 55 deg C			
Transmission	PATNA	0.00	35 kg/cm2	Up to 55 deg C			
Natural Gas-HVJ	PATNA	0.00	25 -44 kg/cm2	Up to 55 deg C			
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	PATNA	0.00	25 -44 kg/cm2	Up to 55 deg C			

Gas Contract Extracts already submitted

Natural Gas-HVJ	PATNA	0.00	25 -44 kg/cm2	Up to 55 deg C			
Natural Gas-NG- NAPM-WEST&NTH OFF SHORE	PATNA	0.00	25 -44 kg/cm2	Up to 55 deg C			
	BANARAS	0.088					
	PATNA	0.08					
RLNG	MATIX	1.500	Min 55 Kg/cm2	Up to 55 deg C	Gas Contract Extracts already submitted		
RLNG-(MIDTERM)	SINDRI	2.200	45 Bar (a)	Up to 55 deg C			
	Haldia	0.200	Future Delivery				
	BARAUNI REF	0.200	Future Delivery				
	PARADEEP	5.5000	Future Delivery				
	JAMSHEDPUR	2.418	Future Delivery				
	KOLKATA	0.200	Future Delivery				
	north east	1.300	Future Delivery				
	Bongaigaon_ref	1.200	Future Delivery				
	Bhadrak_others	0.200	Future Delivery				
	RANCHI	0.200	Future Delivery				
	CUTTUCK	0.200	Future Delivery				
	JINDAL	0.100	Future Delivery				
	SAM_PUR	0.200	Future Delivery				
	IOCL	3.800	Future Delivery				
GMS_RLNG	thal customers	0.069	GREATER THAN OR EQUAL TO 18 BAR	Up to 55 deg C	Gas Contract Extracts already submitted		
GMS_RLNG-(MIDTERM)	thal customers	0.127	25 - 30 KG/CM2	Up to 55 deg C			
GMS_RLNG-(MIDTERM)	thal customers	0.072	25 - 30 KG/CM2	Up to 55 deg C			
GMS_RLNG-(MIDTERM)	thal customers	0.467	25 - 30 KG/CM2	Up to 55 deg C			
GMS_RLNG-(MIDTERM)	thal customers	0.102	25 - 30 KG/CM2	Up to 55 deg C			
GMS_NGMUM	thal customers	0.017	not more than17 kg/cm2	Up to 55 deg C			
GMS_RLNG	thal customers	0.046	not more than17 kg/cm2	Up to 55 deg C			
GMS_NGMUM	thal customers	0.018	29 - 32 kg/cm2	Up to 55 deg C			
GMS_NGMUM	thal customers	0.573	29 - 32 kg/cm2	Up to 55 deg C			
GMS_NAPM-MUM	thal customers	0.413	29 - 32 kg/cm2	Up to 55 deg C			
GMS_NAPM-MUM	thal customers	0.083	29 - 32 kg/cm2	Up to 55 deg C			
GMS_NG TRANS	thal customers	0.089	24 - 26 kg/cm2	Up to 55 deg C			
GMS_NG TRANS	thal customers	0.403	24 - 26 kg/cm2	Up to 55 deg C			
GMS_RLNG-(MIDTERM)	thal customers	0.256	upto 50 kg/cm2 (Mahape,Taloja,Amb)	Up to 55 deg C			
GMS_NAPM-MUM	thal customers	0.001	24 - 26 kg/cm2	Up to 55 deg C			
GMS_NGMUM	thal customers	0.003	24 - 26 kg/cm2	Up to 55 deg C			
GMS_NAPM-MUM	thal customers	0.001	24 - 26 kg/cm2	Up to 55 deg C			
GMS_NGMUM	thal customers	0.003	24 - 26 kg/cm2	Up to 55 deg C			
GMS_NAPM-MUM	thal customers	0.007	24 - 26 kg/cm2	Up to 55 deg C			
GMS_NGMUM	thal customers	0.031	24 - 26 kg/cm2	Up to 55 deg C			
GMS_NGMUM	thal customers	0.018	24 - 26 kg/cm2	Up to 55 deg C			
GMS_NGMUM	trombay local customers	0.018	30-35 kg/cm2	Up to 55 deg C			
GMS_NGMUM	trombay local customers	0.697	NOT LESS THAN 19 KG/CM2	Up to 55 deg C			
GMS_RLNG-(MIDTERM)	trombay local customers	0.255	upto 50 kg/cm2 (Mahape,Taloja,Amb)	Up to 55 deg C			
GMS_NAPM-MUM	trombay local customers	0.644	NOT LESS THAN 19 KG/CM2	Up to 55 deg C			
GMS_NGMUM	trombay local customers	0.624	8-10 kg/cm2	Up to 55 deg C			
GMS_NAPM-MUM	trombay local customers	0.037	8-10 kg/cm2	Up to 55 deg C			
GMS_NGMUM	trombay local customers	0.724	8-10 kg/cm2	Up to 55 deg C			

Future likely customers in
JHBDPL

Annexure-V

[illegible]

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
1990	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
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Date										Time										Location										Activity										Notes										Weather										Temperature										Humidity										Wind Speed										Wind Direction										Pressure										Visibility										Clouds										Precipitation										Moon Phase										Lunar Illumination										Tide Level										Tide Type										Water Level										Current Speed										Current Direction										Salinity										pH										Dissolved Oxygen										Water Quality										Air Quality										Noise Level										Air Pollution										Soil Moisture										Soil Temperature										Soil pH										Plant Growth										Animal Activity										Human Activity										Other Observations										Remarks										Signature										Date										Time										Location										Activity										Notes										Weather										Temperature										Humidity										Wind Speed										Wind Direction										Pressure										Visibility										Clouds										Precipitation										Moon Phase										Lunar Illumination										Tide Level										Tide Type										Water Level										Current Speed										Current Direction										Salinity										pH										Dissolved Oxygen										Water Quality										Air Quality										Noise Level																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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km										50%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%										100%	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Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099
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Source List	
22-23	23-24
HAZIRA	HAZIRA
Dahej terminal	Dahej terminal
Ankot	Ankot
Phulpur source	Phulpur source
HLPL-2	HLPL-2
Mhaskal source	Mhaskal source
DT_DABHOL	DT_DABHOL
ONGCL Uran	ONGCL Uran
URAN	URAN
south-Guj low pressure network	south-Guj low pressure network
Suvali	DHAMRA
	Suvali
	Bokaro-2
	Jharia-2
Total Length-9951.22	Total Length-11386.62

22-23, deliveries	pipe length(km),22-23
VAGHODIA downstream	114.22
GANDHAR_NTPC	40.4
VJP	149
JIPPL	173.94
SOUTH GUJ	167.99
KELARAS	25
DHOLPUR	36
CGD- Agra Frbd	0.5
MATHURA	7.9
NTPC FAR	37.2
DADRI NTPC	149
BABRALA	151.2
AONLA	168.2
KFL Shahjapur	23.2
NFL	228.43
CFCL1	47.17
ANTA	59.29
CFCL2&3	24.62
Pata IC	72.24
NTPC AUR	25.276
KANPUR + Jhansi CGD	20
LKO CITY GAS + Unnao + Faizabad	20
JAGDISHPUR IGF	105.2
PHULPUR	40
GSPL	89.4
DESU_NCR	143.7
SAMCORE	0.01
CJHPL	110
KMKRPL	14.5
KFCL	110
AGL Faridabad	352.14
KHURJA	35.5
Agra Firozabad	76.55
IFFCO	27.98
Jagdishpur others	42.2
HPCL Shahjapur Budaun	71
TGPL Auraiya	68.9
Allahabad Amethi Faizabad CGDs	30
CGD Khurja Dadri	35.8
Sikandrabad customers	39.6
IGL G Noida BPCL	29.4
Mathura Sawariya	46.95
AGL Nuh Palwal	30
CGPL customers	5.5
IOAGPL Bulandshahar	37.44
Dadri exit	72
Kribhco - towards	30
GPU Auraiya	52.75
GPU Vaghodia+IC	14

Hazira IC	30
Vjp IC	0.5
Khera IC	39.6
Jhabua IC	7.9
Auriaya IC	35.8
Dewas Indore	37.2
GPU Gandhar	149
Chainsa IC	151.2
Kailaras IC	23.2
DCM Shriram	168.2
GGL Sonipat +DBNPL	228.43
Hindalco	228.43
Ex-Hazira - NTPC-Arcelor etc	40
Free 3	110
RCF TROMBAY	42.08
NPL Kalyan	35.5
MGLTALOJA+DFPCL	315
VVF+OWNR	21
MGL MAHAPE	113.81
RGPPL DHABOL	14
Tata Motor	10.24
RIL PATALGANGA	19.14
BOM+HIL	9.716
BHUSHAN+UTTAM+PARLE	14.88
NITCO	10.22
IIL Pen_dolvi jsw + HRJ	22.83
RCF THAL	25
HPCL	10
MGL AMBR	10
welspun/jindal salav	11.11
tata steel + tata wire tarapur	56.9
Filatex Nani	9.4
Alok	16.6
Bhilosa	16.1
Sterlite	1.8
JSW VASIND	4.9
ASIAN COLORS	3.17
MSL Sukeli	6.3
POSCO STEEL	3.52
INOX AIR PRODUCT	5.5
POSCO POWER	1.3
Pioneer Power	5.46
MSL vile bhagad	0.4
s.i.group	2.6
viraj1-2-5	19.5
Precision+MUSCO	5.4
Venus	4.7
MNGL Talegaon	2.5
Maresh gas	1.4
JSW tarapur	0.4

APAR Silvassa	1.4
DBPL	2.5
BPCL	20
RIL Nagothane	49.16
Guj Gas Tarapur	8.5
Asahi	1.1
Kribhco	16.78
EWPL Mashkal	0.519
TPC	0.8
MGL Panvel	0.58
Saint Gobain+Atul+UPL Dahej	0.8
HPOIL	20
Su Petro	1.2
MGL Savroli	0.3
OPAL	2
Mahindra Sanyo	3
Adani	7.5
IOAGPL	1.7
IOCL BD - trans	106.7
HPCL Transportation	5
BGRL aurang	19.5
Torrent Mhaskal	32
BPCL + GSPCL + Shell+NTPC	5.5
Hindalco-2	23
HRJ- prism	32
RT bangalore GAIL Gas	55.15
TKAP	2.5
Paramount	0.2
zuari	38.5
elveety	9.51
HINDUSTAN COCA COLA	60
Brittania	28.6
MEIL Belgaum	0.4
MEIL Tumkur	83
IOAGPL Dharwad	29
Fab+RP Metal	25.8
UEPL Ratnagiri	17
Goa NGPL	15.2
MNGL Ramanagar	30
Saint Gobain	6
BGRL	3
Goa Glass	0.53
Other CGDs	2.45
UEPL Chitradurga	70
Murudeshwar	1.02
HPOIL-2	89.4
IOAGPL-2	50
MNGL	46
Free 2	7.65
trombay local customers	37

[illegible]

[illegible]

23-24,deliveries	pipe length(km),23-24
VAGHODIA downstream	114.22
GANDHAR_NTPC	40.4
VJP	149
JIPPL	173.94
SOUTH GUJ	167.99
KELARAS	25
DHOLPUR	36
CGD- Agra Frbd	0.5
MATHURA	7.9
NTPC FAR	37.2
DADRI NTPC	149
BABRALA	151.2
AONLA	168.2
KFL Shahjapur	23.2
NFL	228.43
CFCL1	47.17
ANTA	59.29
CFCL2&3	24.62
Pata IC	72.24
NTPC AUR	25.276
KANPUR + Jhansi CGD	20
LKO CITY GAS + Unnao + Faizabad	20
JAGDISHPUR IGF	105.2
PHULPUR	40
GSPL	89.4
DESU_NCR	143.7
SAMCORE	0.01
CJHPL	110
KMKRPL	14.5
KFCL	110
AGL Faridabad	352.14
KHURJA	35.5
Agra Firozabad	76.55
IFFCO	27.98
Jagdishpur others	42.2
HPCL Shahjapur Budaun	71
TGPL Auraiya	68.9
Allahabad Amethi Faizabad CGDs	30
CGD Khurja Dadri	35.8
Sikandrabad customers	39.6
IGL G Noida BPCL	29.4
Mathura Sawariya	46.95
AGL Nuh Palwal	30
CGPL customers	5.5
IOAGPL Bulandshahar	37.44
Dadri exit	72
Kribhco - towards	30
GPU Auraiya	52.75
GPU Vaghodia+IC	14

Hazira IC	30
Vjp IC	0.5
Khera IC	39.6
Jhabua IC	7.9
Auriaya IC	35.8
Dewas Indore	37.2
GPU Gandhar	149
Chainsa IC	151.2
Kailaras IC	23.2
DCM Shriram	168.2
GGL Sonipat +DBNPL	228.43
Hindalco	228.43
Ex-Hazira - NTPC-Arcelor etc	40
Free 3	110
RCF TROMBAY	42.08
NPL Kalyan	35.5
MGLTALOJA+DFPCL	315
VVF+OWNR	21
MGL MAHAPE	113.81
RGPPL DHABOL	14
Tata Motor	10.24
RIL PATALGANGA	19.14
BOM+HIL	9.716
BHUSHAN+UTTAM+PARLE	14.88
NITCO	10.22
IIL Pen_dolvi jsw + HRJ	22.83
RCF THAL	25
HPCL	10
MGL AMBR	10
welspun/jindal salav	11.11
tata steel + tata wire tarapur	56.9
Filatex Nani	9.4
Alok	16.6
Bhilosa	16.1
Sterlite	1.8
JSW VASIND	4.9
ASIAN COLORS	3.17
MSL Sukeli	6.3
POSCO STEEL	3.52
INOX AIR PRODUCT	5.5
POSCO POWER	1.3
Pioneer Power	5.46
MSL vile bhagad	0.4
s.i.group	2.6
viraj1-2-5	19.5
Precision+MUSCO	5.4
Venus	4.7
MNGL Talegaon	2.5
Mahesh gas	1.4
JSW tarapur	0.4

APAR Silvassa	1.4
DBPL	2.5
BPCL	20
RIL Nagothane	49.16
Guj Gas Tarapur	8.5
Asahi	1.1
Kribhco	16.78
EWPL Mashkal	0.519
TPC	0.8
MGL Panvel	0.58
Saint Gobain+Atul+UPL Dahej	0.8
HPOIL	20
Su Petro	1.2
MGL Savroli	0.3
OPAL	2
Mahindra Sanyo	3
Adani	7.5
IOAGPL	1.7
IOCL BD - trans	106.7
HPCL Transportation	5
BGRL aurang	19.5
Torrent Mhaskal	32
BPCL + GSPCL + Shell+NTPC	5.5
Hindalco-2	23
HRJ- prism	32
RT bangalore GAIL Gas	55.15
TKAP	2.5
Paramount	0.2
zuari	38.5
elveety	9.51
HINDUSTAN COCA COLA	60
Brittania	28.6
MEIL Belgaum	0.4
MEIL Tumkur	83
IOAGPL Dharwad	29
Fab+RP Metal	25.8
UEPL Ratnagiri	17
Goa NGPL	15.2
MNGL Ramanagar	30
Saint Gobain	6
BGRL	3
Goa Glass	0.53
Other CGDs	2.45
UEPL Chitradurga	70
Murudeshwar	1.02
HPOIL-2	89.4
IOAGPL-2	50
MNGL	46
Free 2	7.65
trombay local customers	37

thal customers	100
Initial0097	143
CGD-Bhil-Chit	32
CGD Mainpuri Bareli Moradabad	112
Bidadi customers	90
Talegaon-Pune-satara	352.14
HALDIA	85.3
BARAUNI REF	14.4
PATNA	244.7
PARADEEP	188
CUTTUCK	35
JINDAL	15.3
SAM_PUR	100
RANCHI	131
GORAKHPUR	83.4
BANARAS	86.7
SINDRI	69
JAMSHEDPUR	174
KOLKATA	92
IOCL	120
north east	80
MATIX	100
Bongaigaon_ref	20
BARAUNI_FERT	60
Bhadrak_others	163.2
HPCL-2	80
Free 1	118
	350
	230
	65
	123
	120
	75
	90
	162
	10
	33
	19
	0.4
	30
	45.3
	45.3
	20
	72.4
	58
	40
	7.8
	32.4
	35.5
	102.4

	32.4
	6.5
	7.5
	23
	23
	10
	6
	11386.621

Annexure-VI

Throughput through pipe section 2022

Pipe Name	Dia (inside)	Flow (Head)	Flow (Tail)
	in	inch	MMSCMD
55-2	3.996	0.147	0.147
63-2	3.996	0.008	0.008
20-3	3.996	0.010	0.010
58-2	3.996	0.052	0.052
18-3	3.996	0.035	0.035
69	3.996	0.000	0.000
24-3	3.996	0.013	0.013
60-2	3.996	0.036	0.036
56-2	3.996	0.114	0.114
62-2	3.996	0.000	0.000
57-3	3.996	0.157	0.157
54-2	3.996	0.057	0.057
23-3	3.996	0.013	0.013
61-2	3.996	0.057	0.057
19-3	3.996	0.027	0.027
53-2	3.996	0.234	0.234
59-2	3.996	0.000	0.000
52-2	6.122	0.058	0.058
68	8.000	0.371	0.371
44	8.122	0.204	0.204
48-2	8.122	0.157	0.157
51-2	8.122	0.326	0.326
45-3	8.122	0.191	0.191
49-2	8.122	0.963	0.963
25-3	8.122	0.087	0.087
46-2	8.122	0.000	0.000
22-3	8.122	0.002	0.002
21-3	8.122	0.013	0.013
47-2	8.122	0.000	0.000
50-2	8.122	0.000	0.000
47-3	8.122	0.533	0.533
43	10.020	0.467	0.467
66	10.020	1.651	1.651
67	10.020	0.017	0.017
64-7	10.248	0.821	0.821
64-8	12.248	0.821	0.821
65	12.248	0.294	0.294
42-2	12.248	0.186	0.186
40	12.248	0.186	0.186
37-2	12.248	0.027	0.027
41-2	12.248	0.029	0.029
64-5	12.248	0.139	0.139
64-6	12.248	1.915	1.915
39	12.248	0.459	0.459
64	12.248	0.302	0.302
GKP SPL-2	12.248	0.000	0.000
36-2	12.248	0.281	0.281
63	12.248	1.572	1.572
64-4	12.248	0.123	0.123

Throughput through pipe section 2022

33-2	12.248	2.161	2.161
34-2	12.248	1.120	1.120
38	12.248	0.186	0.186
35-2	12.248	1.120	1.120
61	13.248	1.572	1.572
62	13.248	1.809	1.809
60	15.390	0.139	0.139
60-4	15.390	0.139	0.139
60-3	15.390	0.139	0.139
51-5	15.390	1.075	1.075
64-3	15.496	0.422	0.422
64-2	15.496	0.545	0.545
31-2	17.370	1.335	1.335
28-2	17.370	2.650	2.650
30-2	17.370	0.440	0.440
29-2	17.370	0.693	0.693
32-2	17.370	0.609	0.609
57-4	17.433	6.275	6.275
59	17.433	2.065	2.065
56	17.433	4.340	4.340
53	17.433	1.329	1.329
54	17.433	1.623	1.623
58	17.433	4.712	4.712
50	17.433	2.666	2.666
52	17.433	2.666	2.666
15-4	17.433	0.420	0.420
57	17.433	2.010	2.010
GKP SPL	17.433	2.200	2.200
16-4	17.433	0.420	0.420
48	17.433	2.276	2.276
49	17.433	2.276	2.276
17-4	17.433	0.420	0.420
55	17.433	0.601	0.601
PATNA SPUR	17.433	0.100	0.100
51-3	17.433	2.059	2.059
51	17.433	5.333	5.333
26-2	23.268	4.523	4.523
24-2	23.268	3.914	3.914
13-6	23.268	1.200	1.200
42	23.268	9.470	9.470
47	23.268	7.344	7.344
13-4	23.268	1.179	1.179
57-2	23.268	4.265	4.265
27-2	23.268	1.170	1.170
46	23.268	5.429	5.429
12-4	23.268	1.218	1.218
14-4	23.268	1.165	1.165
11-4	23.268	1.305	1.305
13-3	23.268	3.180	3.180
25-2	23.268	3.857	3.857
45	23.268	-0.183	-0.183

Throughput through pipe section 2022

41	23.268	1.886	1.886
BANARAS SPL	23.268	0.100	0.100
13-7	23.268	1.200	1.200
45-2	23.268	9.179	9.179
13-5	23.268	3.080	3.080
13-8	23.268	0.000	0.000
4-2	29.126	1.724	1.724
14-2	29.126	0.505	0.505
11-2	29.126	0.031	0.031
22-2	29.126	0.031	0.031
16-2	29.126	6.375	6.375
21-2	29.126	5.247	5.247
20-2	29.126	5.282	5.282
15-2	29.126	1.219	1.219
6-2	29.126	6.316	6.316
18-2	29.126	5.946	5.946
3-2	29.126	5.479	5.479
13-2	29.126	4.652	4.652
8-2	29.126	3.155	3.155
10-2	29.126	0.182	0.182
19-2	29.126	5.946	5.946
23-2	29.126	-0.250	-0.250
7-2	29.126	5.631	5.631
20-4	29.126	6.879	6.880
5-2	29.126	5.369	5.369
21-4	29.126	3.700	3.700
37	29.126	10.240	10.240
2-2	29.126	1.219	1.219
1-2	29.126	4.556	4.556
17-2	29.126	6.190	6.190
23-4	29.126	1.500	1.500
19-4	29.126	6.979	6.979
4-4	29.126	10.064	10.064
24-4	29.126	1.500	1.500
9-4	29.126	9.904	9.904
8-4	29.126	9.917	9.917
10-4	29.126	9.484	9.484
22-4	29.126	3.700	3.700
18-4	29.126	9.179	9.179
7-4	29.126	10.018	10.018
12-2	29.126	6.561	6.561
6-4	29.126	10.024	10.024
5-4	29.126	10.051	10.051
9-2	29.126	4.548	4.548
22-5	29.126	3.700	3.700
29	34.858	7.418	7.418
34	34.858	31.388	31.388
35	34.858	29.088	29.088
24	34.858	12.900	12.900
28	34.858	7.418	7.418
33	34.858	32.960	32.960

Throughput through pipe section 2022

31	34.858	2.852	2.852
27	34.858	9.392	9.392
3-4	34.858	11.369	11.369
37-3	34.858	9.179	9.179
36	34.858	29.103	29.103
32	34.858	29.048	29.048
23	34.858	13.219	13.219
25	34.858	12.917	12.917
30	34.858	11.201	11.201
1-4	34.858	11.434	11.435
26	34.858	9.392	9.392
2-4	34.858	11.410	11.409
13	40.756	26.919	26.919
21	40.756	26.442	26.442
20	40.756	26.460	26.460
16	40.756	26.127	26.127
14	40.756	26.926	26.926
18	40.756	26.197	26.197
22	40.756	4.500	4.500
19	40.756	26.199	26.198
15	40.756	26.918	26.918
17	40.756	27.490	27.490
7	46.614	37.836	37.836
4	46.614	37.828	37.828
12	46.614	43.817	43.817
3	46.614	36.733	36.733
1	46.614	38.614	38.614
8	46.614	36.793	36.793
6	46.614	36.791	36.791
11	46.614	37.835	37.835
2	46.614	43.637	43.637
5	46.614	42.336	42.336
9	46.614	37.093	37.093
10	46.614	37.220	37.220

Throughput through pipe section 2023 (Considering CBM sources)

Pipe Name	Dia (inside)	Flow (Head)	Flow (Tail)
	inch	MMSCMD	MMSCMD
23-3	3.996	0.013	0.013
20-3	3.996	0.010	0.010
19-3	3.996	0.027	0.027
18-3	3.996	0.035	0.035
61-2	3.996	0.057	0.057
24-3	3.996	0.013	0.013
54-2	3.996	0.057	0.057
55-2	3.996	0.147	0.147
60-2	3.996	0.036	0.036
63-2	3.996	0.008	0.008
58-2	3.996	0.052	0.052
57-3	3.996	0.156	0.156
62-2	3.996	0.000	0.000
56-2	3.996	0.114	0.114
69	3.996	0.000	0.000
53-2	3.996	0.234	0.234
59-2	3.996	0.000	0.000
52-2	6.122	0.058	0.058
68	8.000	0.371	0.371
51-2	8.122	0.326	0.326
44	8.122	0.204	0.204
48-2	8.122	0.156	0.156
49-2	8.122	0.963	0.963
50-2	8.122	0.000	0.000
25-3	8.122	0.087	0.087
22-3	8.122	0.002	0.002
Pipe0002	8.122	0.000	0.000
47-3	8.122	0.533	0.533
21-3	8.122	0.013	0.013
45-3	8.122	0.191	0.191
Pipe0002-2	8.122	0.600	0.600
47-2	8.122	0.000	0.000
46-2	8.122	0.000	0.000
67	10.020	0.017	0.017
43	10.020	0.467	0.467
66	10.020	1.651	1.651
64-7	10.020	0.821	0.821
64-8	12.248	0.821	0.821
40	12.248	0.186	0.186
41-2	12.248	0.029	0.029
64-6	12.248	1.915	1.915
42-2	12.248	0.186	0.186
64-5	12.248	0.139	0.139
ONGC Bokaro line	12.248	0.600	0.600

Throughput through pipe section 2023 (Considering CBM sources)

37-2	12.248	0.027	0.027
65	12.248	0.294	0.294
64	12.248	0.302	0.302
GKP SPL-2	12.248	2.418	2.418
33-2	12.248	2.161	2.161
35-2	12.248	1.120	1.120
63	12.248	1.572	1.572
39	12.248	0.459	0.459
34-2	12.248	1.120	1.120
36-2	12.248	0.281	0.281
64-4	12.248	0.123	0.123
38	12.248	0.186	0.186
62	13.248	1.809	1.809
61	13.248	1.572	1.572
60	15.390	0.139	0.139
51-5	15.390	1.075	1.075
60-4	15.390	0.139	0.139
60-3	15.390	0.139	0.139
64-3	15.496	0.422	0.422
64-2	15.496	0.545	0.545
28-2	17.370	2.650	2.650
30-2	17.370	0.440	0.440
31-2	17.370	1.335	1.335
29-2	17.370	0.693	0.693
32-2	17.370	0.609	0.609
25-6	17.433	3.800	3.800
34-8	17.433	0.200	0.200
53	17.433	1.329	1.329
50	17.433	2.666	2.666
34-5	17.433	3.360	3.360
54	17.433	1.623	1.623
59	17.433	2.065	2.065
57-4	17.433	6.275	6.275
58	17.433	4.712	4.712
56	17.433	4.340	4.340
52	17.433	2.666	2.666
17-4	17.433	0.420	0.420
34-9	17.433	0.200	0.200
PATNA SPUR	17.433	0.100	0.100
48	17.433	2.276	2.276
49	17.433	2.276	2.276
51	17.433	5.333	5.333
57	17.433	2.010	2.010
16-4	17.433	0.420	0.420
15-4	17.433	0.420	0.420
51-3	17.433	2.059	2.059
34-4	17.433	5.500	5.500
34-6	17.433	3.160	3.160
55	17.433	0.601	0.601

Throughput through pipe section 2023 (Considering CBM sources)

GKP SPL	17.433	2.200	2.200
47	23.268	7.346	7.346
42	23.268	9.472	9.472
12-4	23.268	1.218	1.218
27-2	23.268	1.170	1.170
25-5	23.268	0.840	0.840
13-6	23.268	3.247	3.247
46	23.268	5.431	5.431
11-4	23.268	1.305	1.305
14-4	23.268	1.165	1.165
24-2	23.268	3.914	3.914
57-2	23.268	4.265	4.265
26-2	23.268	4.523	4.523
13-4	23.268	1.179	1.179
25-2	23.268	3.857	3.857
13-8	23.268	2.047	2.047
13-7	23.268	3.247	3.247
45	23.268	-0.181	-0.181
13-3	23.268	5.747	5.747
41	23.268	1.888	1.888
13-5	23.268	5.647	5.647
BANARAS SPL	23.268	0.100	0.100
45-2	23.268	7.289	7.289
30-3	29.126	7.115	7.115
19-4	29.126	5.089	5.089
27-3	29.126	6.715	6.715
10-2	29.126	0.182	0.182
19-2	29.126	5.946	5.946
20-4	29.126	4.989	4.989
7-2	29.126	5.631	5.631
21-4	29.126	-0.757	-0.757
5-2	29.126	5.369	5.369
6-2	29.126	6.316	6.316
18-2	29.126	5.946	5.946
2-2	29.126	1.219	1.219
1-2	29.126	4.556	4.556
3-2	29.126	5.479	5.479
17-2	29.126	6.190	6.190
20-2	29.126	5.282	5.282
21-2	29.126	5.247	5.247
22-2	29.126	0.031	0.031
11-2	29.126	0.031	0.031
37	29.126	10.238	10.238
14-2	29.126	0.505	0.505
4-2	29.126	1.724	1.724
16-2	29.126	6.375	6.375
15-2	29.126	1.219	1.219
13-2	29.126	4.652	4.652
8-2	29.126	3.155	3.155

Throughput through pipe section 2023 (Considering CBM sources)

23-4	29.126	2.540	2.540
23-2	29.126	-0.250	-0.250
5-4	29.126	10.051	10.051
8-4	29.126	9.917	9.917
10-4	29.126	9.484	9.484
9-4	29.126	9.904	9.904
4-4	29.126	10.064	10.064
22-5	29.126	7.157	7.157
6-4	29.126	10.024	10.024
29-3	29.126	6.915	6.915
7-4	29.126	10.018	10.018
27-4	29.126	7.315	7.315
28-3	29.126	6.915	6.915
18-4	29.126	7.289	7.289
12-2	29.126	6.561	6.561
9-2	29.126	4.548	4.548
25-4	29.126	1.040	1.040
22-4	29.126	6.557	6.557
24-4	29.126	2.540	2.540
31-3	29.126	7.215	7.215
29	34.858	7.418	7.418
31	34.858	2.852	2.852
33	34.858	32.959	32.959
35	34.858	29.087	29.087
34	34.858	31.387	31.386
24	34.858	12.900	12.900
28	34.858	7.418	7.418
34-3	34.858	16.275	16.275
33-3	34.858	7.415	7.415
32-3	34.858	7.215	7.215
2-4	34.858	11.409	11.410
1-4	34.858	11.434	11.434
3-4	34.858	11.370	11.369
36	34.858	29.101	29.101
37-3	34.858	7.289	7.289
32	34.858	29.047	29.047
23	34.858	13.219	13.219
25	34.858	12.917	12.917
30	34.858	11.201	11.201
27	34.858	9.392	9.392
26	34.858	9.392	9.392
34-7	34.858	12.914	12.915
20	40.756	25.669	25.669
14	40.756	26.134	26.134
21	40.756	25.651	25.651
13	40.756	26.127	26.127
16	40.756	25.335	25.335
18	40.756	25.407	25.407
17	40.756	26.698	26.698
22	40.756	4.500	4.500

Throughput through pipe section 2023 (Considering CBM sources)

15	40.756	26.126	26.126
19	40.756	25.409	25.409
12	46.614	43.818	43.817
5	46.614	42.338	42.338
2	46.614	43.638	43.638
1	46.614	37.501	37.501
6	46.614	35.682	35.682
3	46.614	35.620	35.620
4	46.614	36.715	36.715
8	46.614	35.684	35.684
11	46.614	36.722	36.722
7	46.614	36.723	36.723
9	46.614	35.985	35.985
10	46.614	36.106	36.106

Annexure-VII

Entity has not submitted the Presentation

Annexure-VIII



पेट्रोलियम एवं प्राकृतिक गैस विनियामक बोर्ड
Petroleum and Natural Gas Regulatory Board

प्रथम तल, वर्ल्ड ट्रेड सेंटर, बाबर रोड, नई दिल्ली - 110001

1st Floor, World Trade Centre, Babar Road, New Delhi - 110 001

PNGRB

फोन नं./Phone No. 011-23457700, ई-मेल /E-mail: contact@pngrb.gov.in

PNGRB/Tech/10-CapNGPL-GAIL's Integrated/(1)/2023(P-4233)

20th February 2023

To

Shri Raj Kumar Rathi

Executive Director-Business Development

Engineers India Limited

1, Bhikaji Cama Place, New Delhi - 110 066

Subject: Capacity Assessment of GAIL's Integrated/Interconnected Pipeline Network as per PNGRB (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Regulations, 2010

Sir,

This has reference to Memorandum of Understanding (MoU) signed on 05.04.2022 between PNGRB and EIL, for Capacity Assessment of Natural Gas Pipeline(s). It has been decided to carry out year-wise capacity assessment of GAIL's Integrated/Interconnected Pipeline Network comprises of following pipelines:

- a. Integrated HVJ Pipeline (Integrated HVJ)
- b. Jagdishpur Haldia - Bokaro Dhamra including Barauni-Guwahati and Dhamra-Haldia Natural Gas Pipeline (Integrated JHBDPL)
- c. Dadri-Bawana-Nangal Pipeline (DBNPL)
- d. Chainsa Jhajjar Hissar Pipeline (CJHPL)
- e. Dahej Uran-Dabhol-Panvel Pipeline (DUPL-DPPL)
- f. Dabhol Bangalore Pipeline (DBPL)
- g. South Gujarat sub-network of the Gujarat Regional Pipeline (SG)
- h. Uran-Thal-Usar sub-network of the Mumbai Regional Pipeline Network (UTU)
- i. Trombay-RCF sub-network of the Mumbai Regional Pipeline Network (Trombay RCF)

Also, section wise capacity for the year 2023-24 shall be determined for above GAIL's Integrated/Interconnected Pipeline Network. Accordingly, you are requested to submit a lump-sum amount for the same, by 28th February 2023.

2. Basic details of the pipeline network are as under: -

(i) Name of Natural Gas Pipeline	: Integrated Network of GAIL's interconnected Natural Gas Pipelines
(ii) Total Length (KM)	: 13,355.97
(iii) Capacity to be assessed for the period	: 2022-23 and 2023-24

The Schedule A along with schematic diagram of inter-connected /integrated pipeline network for the year FY 2022-23 and FY2023-24, is attached at Annexure-I

Yours faithfully

Vandana Sharma
(Vandana Sharma)
Secretary

Annexure-IX

2022-2023

Supply	Flow
	MSM3/D
HAZIRA	43.641454
Dahej terminal	69.338482
Ankot	1.895
Phulpur source	0.67
HLPL-2	3.16
Mhaskal source	0.97
DT_DABHOL	13.075978
ONGCL Uran	3.9
URAN	3.64
south-Guj low pressure network	4.082
Suvali	1.06691

Deliveries	Flow
	MSM3/D
VAGHODIA downstream	2.6767
GANDHAR_NTPC	0
VJP	3.755479
JIPPL	0.54912
SOUTH GUJ	1.397006
KELARAS	0.39247
DHOLPUR	0.022347
CGD- Agra Frbd	0
MATHURA	2.197
NTPC FAR	0.4289259
DADRI NTPC	0.39
BABRALA	2.7632608
AONLA	4.251
KFL Shahjapur	2.6688015
NFL	5.392647
CFCL1	1.727193
ANTA	0.3822
CFCL2&3	6.058689
Pata IC	2.7163141
NTPC AUR	0.99125428
KANPUR + Jhansi CGD	0.5113641
LKO CITY GAS + Unnao + Faizabad	0.4828785
JAGDISHPUR IGF	2.665
PHULPUR	0.0026
GSPL	3.6322
DESU_NCR	0.78078
SAMCORE	0
CJHPL	1.495
KMKRPL	2.489955
KFCL	1.521
AGL Faridabad	1.0055955
KHURJA	0
Agra Firozabad	2.146248
IFFCO	2.5496776

Jagdishpur others	0.019058
HPCL Shahjapur Budaun	0.02053714
TGPL Auraiya	0
Allahabad Amethi Faizabad CGDs	0.10804661
CGD Khurja Dadri	0.4083768
Sikandrabad customers	0.4351113
IGL G Noida BPCL	7.54
Mathura Sawariya	0.1550731
AGL Nuh Palwal	0.08979399
CGPL customers	1.131
IOAGPL Bulandshahar	0.061761058
Dadri exit	9.926813
Kribhco - towards	0.46940952
GPU Auraiya	0
GPU Vaghodia+IC	0.2946463
Hazira IC	0.1949857
Vjp IC	1.8585925
Khera IC	0.05219578
Jhabua IC	0.018316766
Auriaya IC	1.2093058
Dewas Indore	0.1599
GPU Gandhar	2.043912
Chainsa IC	0.042124514
Kailaras IC	0.1045013
DCM Shriram	0.6933524
GGL Sonipat +DBNPL	11.869
Hindalco	0.1157
Ex-Hazira - NTPC-Arcelor etc	1.06691
RCF TROMBAY	1.5691
NPL Kalyan	0.075932938
MGLTALOJA+DFPCL	0.57199776
VVF+OWNR	0.1911
MGL MAHAPE	0.7917
RGPL DHABOL	0
Tata Motor	0.06770179
RIL PATALGANGA	0.31831579
BOM+HIL	0.0468
BHUSHAN+UTTAM+PARLE	0.1703
NITCO	0.074605263

IIL Pen_dolvi jsw + HRJ	1.7355
RCF THAL	2.8093
HPCL	1.455668
MGL AMBR	1.2517548
welspun/jindal salav	0.69561947
tata steel + tata wire tarapur	0.1547
Filatex Nani	0.016965033
Alok	0.20345
Bhilosa	0.044464736
Sterlite	0
JSW VASIND	0.14765873
ASIAN COLORS	0.13440177
MSL Sukeli	0.1248
POSCO STEEL	0.20409481
INOX AIR PRODUCT	0.002403947
POSCO POWER	0
Pioneer Power	0
MSL vile bhagad	0.034969368
s.i.group	0.074042105
viraj1-2-5	0.169
Precision+MUSCO	0
Venus	0
MNGL Talegaon	1.3480056
Mahesh gas	0
JSW tarapur	0.09967263
APAR Silvassa	0
DBPL	0
BPCL	1.9239869
RIL Nagothane	0.5968421
Guj Gas Tarapur	0.18413655
Asahi	0.13806
Kribhco	3.0409874
EWPL Mashkal	0
TPC	0.065
MGL Panvel	0
Saint Gobain+Atul+UPL Dahej	0.3406
HPOIL	0.005897862
Su Petro	0.010557894
MGL Savroli	0

OPAL	0.89058915
Mahindra Sanyo	0.026526315
Adani	0.015283806
IOAGPL	0.036486379
IOCL BD - trans	0
HPCL Transportation	0
BGRL aurang	0.0320674
Torrent Mhaskal	0.055383517
BPCL + GSPCL + Shell+NTPC	0
Hindalco-2	0.11271
HRJ- prism	0.01733745
RT bangalore GAIL Gas	0.54613
TKAP	0.00016575
Paramount	0.00580125
zuari	1.4589474
elveety	0.00314925
HINDUSTAN COCA COLA	0.001326
Brittania	0.00977925
MEIL Belgaum	0.051662949
MEIL Tumkur	0.063881045
IOAGPL Dharwad	0.014304225
Fab+RP Metal	0.0043095
UEPL Ratnagiri	0.0325
Goa NGPL	0.038413752
MNGL Ramanagar	0.010805243
Saint Gobain	0.043095
BGRL	0.008621053
Goa Glass	0.017242105
Other CGDs	0.02704
UEPL Chitradurga	0.00767
Murudeshwar	0.0663
HPOIL-2	0.052
IOAGPL-2	0.01768
MNGL	0.00741
trombay local customers	3.9
thal customers	3.64
Initial0097	4.082
CGD-Bhil-Chit	0.1807
CGD Mainpuri Bareli Moradabad	0.3548974

Bidadi customers	0.013
Talegaon-Pune-satara	0.1688986
BARAUNI REF	0.26
PATNA	0.13
GORAKHPUR	2.7809959
BANARAS	0.13
SINDRI	2.2808171
JAMSHEDPUR	0
north east	0
MATIX	1.95
Bongaigaon_ref	1.56
BARAUNI_FERT	0.97353412

2023-2024

Supply	Flow
	MSM3/D
HAZIRA	43.640158
Dahej terminal	66.78641
Ankot	1.895
Phulpur source	0.67
HLPL-2	3.16
Mhaskal source	0.97
DT_DABHOL	13.675969
ONGCL Uran	3.9
URAN	3.64
south-Guj low pressure network	4.682
DHAMRA	19.352818
Suvali	1.06691

Deliveries	Flow
	MSM3/D
VAGHODIA downstream	2.6767
GANDHAR_NTPC	0
VJP	3.755479
JIPPL	0.54912
SOUTH GUJ	1.397006
KELARAS	0.39247
DHOLPUR	0.022347
CGD- Agra Frbd	0
MATHURA	2.197
NTPC FAR	0.4289259
DADRI NTPC	0.39
BABRALA	2.7632608
AONLA	4.251
KFL Shahjapur	2.6688015
NFL	5.392647
CFCL1	1.727193
ANTA	0.3822
CFCL2&3	6.058689
Pata IC	2.7163141
NTPC AUR	0.99125428
KANPUR + Jhansi CGD	0.5113641
LKO CITY GAS + Unnao + Faizabad	0.4828785
JAGDISHPUR IGF	2.665
PHULPUR	0.0026
GSPL	3.6322
DESU_NCR	0.78078
SAMCORE	0
CJHPL	1.495
KMKRPL	2.489955
KFCL	1.521
AGL Faridabad	1.0055955

KHURJA	0
Agra Firozabad	2.146248
IFFCO	2.5497055
Jagdishpur others	0.019058
HPCL Shahjapur Budaun	0.02053714
TGPL Auraiya	0
Allahabad Amethi Faizabad CGDs	0.10804661
CGD Khurja Dadri	0.4083768
Sikandrabad customers	0.4351113
IGL G Noida BPCL	7.54
Mathura Sawariya	0.1550731
AGL Nuh Palwal	0.08979399
CGPL customers	1.131
IOAGPL Bulandshahar	0.061761058
Dadri exit	9.926813
Kribhco - towards	0.46940952
GPU Auraiya	0
GPU Vaghodia+IC	0.2946463
Hazira IC	0.1949857
Vjp IC	1.8585925
Khera IC	0.05219578
Jhabua IC	0.018316766
Auraiya IC	1.2093058
Dewas Indore	0.1599
GPU Gandhar	2.043912
Chainsa IC	0.042124514
Kailaras IC	0.1045013
DCM Shriram	0.6933524
GGL Sonipat +DBNPL	11.869
Hindalco	0.1157
Ex-Hazira - NTPC-Arcelor etc	1.06691
RCF TROMBAY	1.5691
NPL Kalyan	0.075932938
MGLTALOJA+DFPCL	0.57199776
VVF+OWNR	0.1911
MGL MAHAPE	0.7917

RGPPL DHABOL	0
Tata Motor	0.06770179
RIL PATALGANGA	0.31831579
BOM+HIL	0.0468
BHUSHAN+UTTAM+PARLE	0.1703
NITCO	0.074605263
IIL Pen_dolvi jsw + HRJ	1.7355
RCF THAL	2.8093
HPCL	1.455668
MGL AMBR	1.2517548
welspun/jindal salav	0.69561947
tata steel + tata wire tarapur	0.1547
Filatex Nani	0.016965033
Alok	0.20345
Bhilosa	0.044464736
Sterlite	0
JSW VASIND	0.14765873
ASIAN COLORS	0.13440177
MSL Sukeli	0.1248
POSCO STEEL	0.20409481
INOX AIR PRODUCT	0.002403947
POSCO POWER	0
Pioneer Power	0
MSL vile bhagad	0.034969368
s.i.group	0.074042105
viraj1-2-5	0.169
Precision+MUSCO	0
Venus	0
MNGL Talegaon	1.3480056
Mahesh gas	0
JSW tarapur	0.09967263
APAR Silvassa	0
DBPL	0
BPCL	1.9239869
RIL Nagothane	0.5968421
Guj Gas Tarapur	0.18413655

Asahi	0.13806
Kribhco	3.0409874
EWPL Mashkal	0
TPC	0.065
MGL Panvel	0
Saint Gobain+Atul+UPL Dahej	0.3406
HPOIL	0.005897862
Su Petro	0.010557894
MGL Savroli	0
OPAL	0.89058915
Mahindra Sanyo	0.026526315
Adani	0.015283806
IOAGPL	0.036486379
IOCL BD - trans	0
HPCL Transportation	0
BGRL aurang	0.0320674
Torrent Mhaskal	0.055383517
BPCL + GSPCL + Shell+NTPC	0
Hindalco-2	0.11271
HRJ- prism	0.01733745
RT bangalore GAIL Gas	0.54613
TKAP	0.00016575
Paramount	0.00580125
zuari	1.4589474
elveety	0.00314925
HINDUSTAN COCA COLA	0.001326
Brittania	0.00977925
MEIL Belgaum	0.051662949
MEIL Tumkur	0.063881045
IOAGPL Dharwad	0.014304225
Fab+RP Metal	0.0043095
UEPL Ratnagiri	0.0325
Goa NGPL	0.038413752
MNGL Ramanagar	0.010805243
Saint Gobain	0.043095
BGRL	0.008621053

Goa Glass	0.017242105
Other CGDs	0.02704
UEPL Chitradurga	0.00767
Murudeshwar	0.0663
HPOIL-2	0.052
IOAGPL-2	0.01768
MNGL	0.00741
trombay local customers	3.9
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CGD-Bhil-Chit	0.1807
CGD Mainpuri Bareli Moradabad	0.3548974
Bidadi customers	0.013
Talegaon-Pune-satara	0.1688986
HALDIA	0.26
BARAUNI REF	0.26
PATNA	0.13
PARADEEP	7.15
CUTTUCK	0.26
JINDAL	0.13
SAM_PUR	0.26
RANCHI	0.26
GORAKHPUR	2.86
BANARAS	0.13
SINDRI	2.86
JAMSHEDPUR	0
KOLKATA	0.26
IOCL	4.94
north east	1.69
MATIX	1.95
Bongaigaon_ref	1.56
BARAUNI_FERT	2.86
Bhadrak_others	0.26
HPCL-2	0

2022-2023

[illegible]

2023-2024

[illegible]

PROCESS DESIGN BASIS FOR VIJAIPUR-DADRI-BAWANA PIPELINE AND COMPRESSOR STATIONS AT JHABUA & VIJAIPUR

APPROVED	
GAIL	EIL

2	22.09.09	Revised as marked & reissued for approval			
1	31.03.08	Revised based on GAIL's comments and MOM dated 24.03.08	MKA	AS	AS
0	20.12.07	COMMENTS INCORPORATED AND ISSUED FOR APPROVAL	AKL	AS	AS
A	16.11.07	ISSUED FOR COMMENTS/CONFIRMATION	AKL	AS	AS
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

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1.0 INTRODUCTION:

GAIL (India) Limited, have awarded EIL the Project Management Consultancy Services for capacity augmentation of existing Dahej-Vijaipur Pipeline (DVPL), laying of new 48" pipeline parallel to existing Vijaipur-Dadri Pipeline (GREP), new Dadri-Bawana Pipeline and Compressor Stations at Jhabua & Vijaipur.

The project broadly covers installation of compressor stations at Jhabua (270 Kms downstream of Dahej on DVPL) and at Vijaipur (612 Kms downstream of Dahej) and to lay a new 48" pipeline from Vijaipur to Dadri for additional gas volume transportation from Dahej and Ankot to Dadri via Vijaipur and also to lay a new 36" trunk line from Dadri to Bawana TOP (to be extended to Nangal in future) and 20" spur line from Bawana TOP to Bawana.

The Existing DVPL Pipeline has been laid parallel to HBJ pipeline having line size of 42" OD and around 612 Kms in length. Presently there is an available supply of Regassified Liquid Natural Gas (RLNG) from the PLL, LNG terminal at Dahej of approx 18 MMSCMD, of which 6 MMSCMD is delivered directly from LNG terminal at Dahej to local consumers in Gujarat. Of the remaining 12 MMSCMD, 4 MMSCMD is injected into HBJ pipeline at Khera and the rest reaches Vijaipur at 77 barg.

Approximately 14 MMSCMD is distributed along the GREP pipeline from Vijaipur with approximately 5.7 MMSCMD delivered at Dadri at a pressure of approximately 45 barg. The existing design capacities of DVPL and GREP pipelines are approximately 24 MMSCMD and 20 MMSCMD respectively at the design pressure of 92 kg/cm²g.

This design basis covers the design parameters for compressor station and pipelines.

Proposed final capacity Upgrade of DVPL and GREP pipeline are as under:

Gas flow	DVPL (MMSCMD)	GREP (MMSCMD)
Present Design Capacity	24	20
Present Utilization	12	14
Spare capacity Available	12	06
Additional gas delivery required	66	66
Total Capacity required	78	80
Additional Capacity Required	54	60 *

* New GREP line will be designed for 60 MMSCMD inclusive of fuel gas consumption in compressors (proposed/existing) as envisaged in DFR.

The upgradation will be undertaken in two phases as desired by GAIL. In Phase –1, DVPL capacity will be increased to 35 MMSCMD by installing compressors at Jhabua and GREP capacity will be increased to 33.25 MMSCMD by installing new 48" P/L parallel to the existing 36" pipeline and additional compressors at Vijaipur.

In Phase-2, the Capacity will be ultimately increased as per above table. GAIL has awarded EPCM Services to EIL for Phase-1 scope of work and also compressors for both Phase-I & II at Jhabua and Vijaipur.

2.0 BASIC PARAMETERS

2.1	Products to be transported	Gas									
2.2	Product properties/specifications	As per ANNEXURE-I.									
2.3	Pipeline Design Throughput	DVPL : 35.6 MMSCMD (phase-1) @ DVPL : 78.00 MMSCMD (phase-2) # GREP : 36.25 MMSCMD (phase-1)\$ GREP : 84.15 MMSCMD (phase-2) * @ Includes total 0.60 MMSCMD fuel gas consumed at Jhabua & Vijaipur CS as per DFR. # Includes fuel gas consumption in GTCs/GTGs at Jhabua, Vijaipur, CH 228.036 and CH457.049. \$ Includes 3 MMSCMD for Rajasthan sector. Balance 33.25 MMSCMD will flow through GREP pipelines. * Includes fuel gas consumed at intermediate CS on new GREP pipeline at Ch 228.036 & CH 457.049, 5 MMSCMD for Rajasthan Sector and additional capacity margin of 6 MMSCMD. Balance 79.15 MMSCMD will flow through GREP pipelines. Existing 36" GREP line has throughput of 19.15 MMSCMD both in Phase-I & II as per DFR prepared by J.P.Kenny. Balance 54 MMSCMD gas will flow through new line. However, new 48" GREP line will be designed for throughput of 60MMSCMD in view of additional capacity margin of 6 MMSCMD as desired by GAIL.									
2.4	Design codes	ASME B31.8 and OISD Guidelines will be followed as applicable. However, in case of contradictory stipulations, the more stringent conditions will prevail.									
2.5	Total compression capacity required	<table border="0"> <thead> <tr> <th></th> <th>PH-I</th> <th>PH-II</th> </tr> </thead> <tbody> <tr> <td>JHABUA</td> <td>: 35.31</td> <td>80</td> </tr> <tr> <td>VIJAIPUR</td> <td>: 17.1</td> <td>65</td> </tr> </tbody> </table> (Additional) PH-II capacity at Jhabua includes 2 MMSCMD of fuel gas for flexibility in		PH-I	PH-II	JHABUA	: 35.31	80	VIJAIPUR	: 17.1	65
	PH-I	PH-II									
JHABUA	: 35.31	80									
VIJAIPUR	: 17.1	65									

		operation. Also PH-I and PH-II capacity at Vijaipur includes 3 & 5 MMSCMD respectively of gas earmarked for Vijaipur-Kota pipeline which will be fed after pressure let down from 99.93 kg/cm ² g at compressor discharge to 92 kg/cm ² g which is design pressure of Vijaipur-Kota pipeline. In both phases 19.15 MMSCMD gas will continue to be compressed in existing 2+1 DVPL compressors and despatched through existing GREP pipeline.
2.6	Sparing philosophy for compressors	100% for Single compressors (1W+1S) 50% for two compressors (2W+1S) 33% for three compressors (3W+1S)
2.7	Type of compressor	Centrifugal
2.8	Type of driver	Gas Turbine
2.9	Type of intercooler and after cooler	Air cooler

3.0 PROJECT SCOPE AND BATTERY LIMITS

3.1 PROJECT SCOPE:

- 48" x 497.79 Km long gas pipeline between Vijaipur and Dadri
- 36" x 38.27 Km + 20" x 55.347 Km long gas pipelines between Dadri and Bawana
- Compressor Stations at Jhabua along with its auxiliaries, new gas filters and metering facilities.
- Despatch terminals at Vijaipur consisting of new gas filter, new compressors and their auxiliaries, check metering, and pig launching facilities.
- Intermediate pigging stations on new GREP line with launchers / receivers
- Dispatch terminal at Dadri consisting of pig launcher and check meter
- Receipt terminal at Dadri and Bawana with pig receiver, filtration, pressure regulation and transfer metering facilities for consumers.
- Tap-off station at Bawana TOP consisting of pig receiver, launcher, PRS and check meters.

3.2 BATTERY LIMITS :

- 3.2.1 Jhabua Compressor Station : From Tap-out in pig receiver bypass line to tap-in in pig launcher bypass line.
- 3.2.2 Despatch terminal at Vijaipur : From inlet manifold of new gas filters of new compressors including hook-up with inlet manifold of existing filters ,installation of new compressors with discharge header including

metering and pig launching facilities and interconnection at compressor discharge with existing GREP and VKPL.

- 3.2.3 Dadri receipt cum dispatch trml. : From pig receiver to pig launcher including metering skid.
- 3.2.4 Receipt terminal at Bawana : Consumer battery limit downstream of filter pressure regulation and metring skid.
- 3.2.5 Gas compositions : Annexure-I

4.0 PIPELINE PARAMETERS

4.1	Pipeline operating life	30 Years
4.2	Pipeline Length Gas lines (Vijaipur-Dadri)	497.79 Km
4.3	Pipeline Length Gas lines (Dadri-Bawana)	Dadri to Bawana TOP : 38.27 Km Bawana TOP-Bawana PP : 55.347 km
4.4	Basis for hydraulic Calculation	For Dahej-Vijaipur Gas Pipelines Hydraulic calculations will be based on pipeline section wise gas flow rates and operating conditions indicated in Annexure-III & IV and subsoil temperature of 25deg C. For Vijaipur-Dadri Gas Pipelines Hydraulic calculations will be based on pipeline section wise gas flow rates and operating conditions indicated in Annexure-III & IV and subsoil temperature of 25 deg C For Dadri-Bawana Gas Pipelines Hydraulic calculations will be based on section wise gas flow rates and operating conditions indicated in Annexure-III & IV and considering subsoil temperature of 25 deg.C. Arrival pressure at consumer terminals along Dadri-Bawana-Nangal pipeline shall be considered as 45-50 kg/cm²g upsteam of pressure regulation and metering skids.
4.5	Main Pipeline Diameter (Vijaipur-Dadri)	48" (Optimized line size as per DFR)
4.6	Main Pipeline Diameter (Dadri to Bawana)	Dadri-Bawana TOP : 36"X 38.27 KM (Optimized line size as per DFR) Bawana TOP--Bawana PPCL : 20"X 55.347 KM (Optimized line size as per DFR)

4.7	Pipeline roughness	45 micron for existing pipeline and 8 micron for new pipelines. (New pipelines shall be provided with internal coating as per GAIL)
4.8	Material of Construction for Pipelines	Carbon Steel
4.9	Pipeline Corrosion Allowance	0.5 mm (for existing pipelines) Nil for new pipelines as per GAIL considering gas composition and internal coating.
4.10	Pigging Facilities	Permanent pigging facilities suitable for “Intelligent Pigging” shall be provided.
4.11	Subsoil temperature	20-25 deg C throughout the entire length of the pipeline (1m below ground) Temperature at suction of compressor will be based on hydraulics. However the temperature shall be considered as 24 deg. C. as per GAIL operating feedback or hydraulics whichever is higher.
4.12	Design Pressure	99.93 kg/cm ² g (98 barg) for new Vijaipur-Dadri-Bawana pipelines.
4.13	Design temperature	-29 deg C to 60 deg C for all buried sections -29 deg C to 65 deg C for above ground portion
4.14	Pipeline laying	Buried
4.15	Burial Depth , m	1.2 – 1.5
4.16	Ground profile	Annexure-II
4.17	Pipeline corrosion protection system	Pipeline shall be protected from external corrosion by suitable external coating and impressed current cathodic protection.
4.18	Corrosion Monitoring System	Corrosion monitoring system will be provided as required.
4.19	Sectionalizing valves	Sectionalizing valves will be provided as per ASME B 31.8. All sectionalizing valves on the main pipeline shall be gas actuated. Sectionalizing valves on mainline coinciding with RR station shall have remote close/open capabilities in addition to local manual open/close capability. Other sectionalizing valves on the main pipeline shall have only local manual open/ close capabilities.
4.20	Design margin (for pipeline)	On flow : Nil On length : Nil

5.0 DESPATCH STATION PARAMETERS

5.1 Design Parameters (For Gas)

	For RLNG (at Dahej)	
5.1.1	Source of Gas	PLL at Dahej
5.1.2	Location	Dahej
5.1.3	Supply temperature, Deg C (min /nor/max) at B/L	0 / 8 -10 / _____
5.1.4	Supply pressure, kg/cm ² g (min./nor/max) at B/L	_____/87.0/ 92
5.1.5	Flow rate, MMSCMD	Ph-I : 25.0 Ph-II : 55.0
	For Lean Gas (At Ankot)	Ankot
5.1.6	Source	Reliance KG Basin
5.1.7	Supply temperature, Deg C (min /nor/max) at B/L	Reliance compressors discharge temperature is 52 deg.C and it is situated at a distance of 18 km from Ankot tap-off point and pipeline diameter is 30".Accordingly injection temperature will be arrived at by hydraulics.
5.1.8	Supply pressure, kg/cm ² g (min./nor/max) at B/L	To match pressure requirement for Ph-1&2 which will be based on hydraulics.
5.1.9	Flow rate, MMSCMD	Ph-I : 10.0 Ph-II : 23.0
	For Lean Gas (At Vijaipur)	Ex-LPG Unit
5.1.10	Source	Vijaipur
5.1.11	Supply temperature, Deg C (min /nor/max) at B/L	_____/40/_____
5.1.12	Supply pressure, kg/cm ² g (min./nor/max) at B/L	_____/54/_____
5.1.13	Flow rate, MMSCMD	Ph-I : 6.0 Ph-II : 6.0
	Dadri Dispatch Terminal (For Dadri-Bawana-Nangal P/L)	
5.1.14	Source	Dadri
5.1.15	Supply temperature, Deg C (min /nor/max) at B/L	As per hydraulics
5.1.16	Supply pressure, kg/cm ² g at B/L	Ph-1 : As per hydraulics Ph-2 : As per hydraulics
5.1.17	Flow rate, MMSCMD	Ph-I : 6.0 Ph-II : 31.0

5.2 Utility specification (At Jhabua Compressor station)

S.NO	Parameters	Plant Air	Instrument Air	Nitrogen	Service Water
5.2.1	Source	From, Air Compressor	From, Air Compressor	From PSA Unit	From GAIL's existing facility
5.2.2	Dew Point	—	-40°C at atm. Pr.	—	—
5.2.3	Pressure,Kg/cm2g (min/nor/design)	5.0/ 8.0 / 0.5	5.0/ 7.5 / 0.5	4.5	3.0
5.2.4	Temperature,Deg C	50.0	50.0	Ambient	Ambient
5.2.5	Storage requirement	5 minutes hold-up	20 minutes hold-up	—	—
5.2.6	Consumption	170 nm3/hr	Continuous- 743Nm3/hr Intermittent- 252Nm3/hr	90 Nm3/hr	5 m3/hr (intermittent)
5.2.7	Quality	Oil Free	Oil Free	99.5% pure	



5.3 Utility specification (At Vijaipur Compressor station)

S.NO	Parameters	Plant Air	Instrument Air	Nitrogen	Service Water
5.3.1	Source	From, Air Compressor	From, Air Compressor	From PSA Unit	From GAIL's existing facility
5.3.2	Dew Point	—	-40°C at atm. Pr.	—	—
5.3.3	Pressure,Kg/cm2g (min/nor/design)	5.0/ 8.0 / 10.5	5.0/ 7.5 / 10.5	4.5	3.0
5.3.4	Temperature,Deg C	50	50.0	Ambient	Ambient
5.3.5	Storage requirement	5 minutes hold-up	20 minutes hold-up	—	—
5.3.6	Consumption	170 nm3/hr	Continuous- 743Nm3/hr Intermittent- 252Nm3/hr	90 Nm3/hr	5 m3/hr (intermittent)
5.3.7	Quality	Oil Free	Oil Free	99.5% pure	



6.0 RECEIPT STATION PARAMETERS

6.1 Design Parameters of gas

	At Jhabua	
6.1.1	Battery limit pressure, kg/cm2 g	As per hydraulics
6.1.2	Battery limit Temperature, Deg C	As per hydraulics

	At Vijaipur	
6.1.3	Battery limit Pressure ,kg/cm ² g	As per hydraulics
6.1.4	Battery limit Temperature, Deg C	As per hydraulics
	At Dadri	
6.1.5	Battery limit pressure, kg/cm ² g	As per hydraulics
6.1.6	Battery limit Temperature, Deg C	As per hydraulics
	At Bawana	
6.1.7	Battery limit pressure, kg/cm ² g	Minimum 45 (Upstream of custody transfer skids)
6.1.8	Battery limit Temperature, Deg C	As per hydraulics

6.2 Utility specification (at Dadri and Bawana receipt station)

S.NO	Parameters	Plant Air	Instrument Air	Service Water
6.2.1	Source	From GAIL's existing facilities at Dadri & PPCL at Bawana	From GAIL's existing facilities at Dadri & PPCL at Bawana	From GAIL's existing facilities at Dadri & PPCL at Bawana
6.2.2	Dew Point	-	-40°C at atm. Pr.	
6.2.3	Pressure,Kg/cm ² g (min/nor/design)	5.0/ 8.0 / 11.5	5.0/ 7.5 / 11.5	3.0
6.2.4	Temperature,Deg C	50.0	50.0	Ambient
6.2.5	Consumption	170 NM ³ /hr (intermittent)	Not required	5m ³ /hr (intermittent)
6.2.6	Quality	Oil Free	Oil Free	

2

7.0 COMPRESSOR STATION PARAMETERS

7.1 Jhabua Compressor Station

Compressor suction pressure, Kg/cm²g : Ph.-I : 55 Ph.-II : 62 (As per DFR)
 Compressor discharge , Kg/cm²g : Ph.- I : Note.-1 Ph.-II : 92 Kg/cm²g
 Total flow rate ,MMSCMD : Ph.-I : 35.31 Ph.-II : 80
 Configuration : 2+1 (As confirmed by compressor vendor)

7.2 Vijaipur Compressor Station

Compressor suction pressure , Kg/cm²g : Ph.-I : Note-2 Ph.-II : 62 (As per DFR)
 Compressor discharge, Kg/cm²g : Ph-1 : As per Hydraulics ,Ph-2 : 99.93
 Total flow rate, MMSCMD : Ph.-I : 17.1 Note : 3 Ph.-II: 65
 Configuration : 2+1 (As confirmed by compressor vendor)

- Note-1. : Compressor vendor to compute the discharge pressure for Ph.-I for the compressor designed and optimized for Ph.-II conditions.
- Note-2 : Suction pressure for Ph.-I for Vijaipur compressor will be worked out based on hydraulics and the discharge pressure of Jhabua compressor computed by vendor for Ph.-I.
- Note-3 : Actual flow through compressor will be worked out considering diversion of some gas from existing GREP to new GREP due to discharge pressure limitations of existing DVPL compressors due to availability of lower suction pressure in Ph.-I.

8.0 INSTRUMENTATION

8.1	General	Adequate instrumentation and control system will be provided for safe and efficient operation. The pipelines shall be monitored and controlled through Supervisory Control and Data Acquisition (SCADA) system designed for remote monitoring and control application with leak detection facility for safe, efficient and economic pipeline operation. RTU/Flow computers shall be provided at terminals and compressor station for flow computation, signal transmission to SCADA and logic and control. All transmitters shall be smart transmitters.
8.2	Control Philosophy	
	At Dadri Dispatch and Bawana Receipt terminals	Panel based system shall be considered. Signals are also transmitted to SCADA.
	Vijaipur & Jhabua compressor station	Two levels of controls viz. PLC, & SCADA are envisaged. Individual compressor trains shall be operated from the respective unit PLC(only minimum critical parameters are available in Unit Control Panel (UCP)) Station facility and common equipment shall be operated from common PLC (only minimum critical parameters are available in Facility Control Panel (FCP)).
	Intermediate pigging stations	At intermediate pigging stations only local instruments will be provided. Remote monitoring and control shall be through SCADA.

8.3	Compressor Control	CCC or equivalent.
8.4	Interlock & Shut down	PLC based.
8.5	Safety valve isolation	Safety valve isolation will be provided wherever required These isolation valves should be locked open.
8.6	Block & by-pass valve for control valves	As per design.
8.7	Type of control	Electronic
8.8	Final control element	Gas/Instrument air actuated for control valves and line gas for AVs.

9.0 METERING SYSTEM

9.1	Flow meters	Ultrasonic type flow meters with one spare run shall be provided at despatch and receipt terminals for custody transfer as well as leak detection purpose in gas lines.

10.0 SCADA & TELECOMMUNICATION SYSTEM

SCADA and Telecommunication systems for the entire pipeline will be provided to ensure effective and reliable control, management and supervision of the pipeline from a centralized location using Remote Telemetry Units (RTU) along the pipeline route at suitable location.

- 10.1 SCADA monitoring: The SCADA master control station (SMCS) shall be located and control at NGMC,Noida.

11.0 LEAK DETECTION & OTHER APPS SYSTEM:

Real time leak detection system integrated with SCADA network will be provided. for new pipeline between Vijaipur & Dadri

12.0 METEOROLOGICAL DATA

Location	Ambient temp. °C		Design Rh	Altitude ,M above MSL	Air temp. considered for air cooler design,deg.C
	Min.	Max.			
Vijaipur	2	46			42
Dadri	2	46			—
Bawana		45			—
Jhabua					42

13.0 GENERAL PROJECT SPECIFICATIONS

13.1 Numbering system to be followed:

13.1.1	Equipments	As per EIL standard
13.1.2	Instruments	As per EIL standard
13.1.3	Drawings/Documents	As per EIL standard
13.1.4	Unit No.	Pipeline : 060 Jhabua CS : 052 Vijaipur CS : 057 IPS-1 : 061 IPS-2 CUM CS : 062 IPS-3 : 063 IPS-4 CUM CS : 064 DADRI : 065 BAWANA TOP : 066 BAWANA PP : 067

13.2 Units of Measurement: Metric, unless otherwise specified
Gas flow rate shall be in MMSCMD

14.0 Data/Documents Required from Client

- As –Built P&IDs of Jhabua station on DVPL.
- As Built P&IDs of Vijaipur compressor station (HVJ,GREP,DVPL)
- As Built P&IDs of existing GREP pipeline from Vijaipur to Dadri.
- Copy of report of GAIL's back-up consultant PLE Gmbh of HVJ upgradation.

15.0 Special Client requirements

- 15.1 12 MMSCMD RLNG will be available at Dahej directly after gasification for initial 2-3 years. Later this gas will be available after C2/C3 extraction proposed by ONGC. Balance gas at Dahej will be supplied from spot LNG.
- 15.2 No corrosion allowance to be taken on new pipelines.
- 15.2.1 Hydraulics of entire Dadri-Bawana-Nangal pipeline along with spurlines to Bawana PPCL, Sonipat, Yamunanagar and Bhatinda shall be carried out for Phase-2 conditions of DFR for this pipeline system in addition to hydraulics of Dadri-Bawana TOP--Bawana PPCL for Ph-1. For spur line from Bawana TOP to Bawana PP hydraulics needs to be checked for flow of 10 MMSCMD also. However basic engineering for only Dadri—Bawana TOP and Bawana TOP to Bawana PPCL (Phase-1 of DFR) is in the scope of this project.
- 15.2.2 Jhabua Compressor station shall be specified for suction pressure as per DFR and total compressor capacity shall be considered on higher side as 78 MMSCMD + Fuel Gas consumption for flexibility in operation.

- 15.2.3 Suitable interconnection both ways shall be provided between new GREP and existing GREP/VKPL at Vijaipur, Dadri only one way interconnection from existing to new GREP shall be provided. PRS shall be provided on interconnection between 98 barg system and 92 kg/cm²g systems.
- 15.2.4 Hydraulics for Dadri-Bawana TOP-Bawana PP will be checked for initial year also when compressors are not installed at Vijaipur and arrival pressure is low at Dadri. The flow for this initial phase will be as per DFR for Dadri-Bawana-Nangal pipelines.
- 15.3 While developing the P&IDs, necessary Tap-off of 30" for metering station may be provided at Dadri for feeding to IOCL pipeline.
- 15.8 A Pressure reduction system shall be installed at Bawana TOP which will be bypassed in Phase-1. In Phase-II total pressure drop between Bawana TOP and Bawana receipt terminal at power plant will be distributed between both PRS at TOP and PRS at Receipt terminals to avoid excessive temperature drop at Bawana PP in order to avoid installation of gas heater in future. Heating effect of soil will be utilized by dropping part of total pressure drop across PRS at TOP in Phase-II. However in Ph-I the pressure regulation system at Bawana TOP will be bypassed as Vijaipur compressor will be operating under backpressure of the pipeline system with battery limit pressure required at Bawana PP as 45 kg/cm²g.
- 15.9 Provide new utility systems for compressed air and nitrogen to cater to new compressors and provide interconnection between new and old systems for flexibility.
- 16.0 **Compressed Air system at compressor stations:**

JHABUA: Air compressor capacity required for VDBPL project is 1200 Nm³/hr, however Gail have advised to install two new compressors of 835 Nm³/hr capacity each and operate both new compressors simultaneously to meet total compressed air requirement of existing & new facilities. During this both existing HVJ air compressors of 391 Nm³/hr capacities shall remain as stand by machines. In case of failure of either operating machines both HVJ air compressor along with one new air compressor shall operate to meet the total compressed air requirement.

COMPRESSED AIR DEMAND Nm ³ /Hr		COMPRESSED AIR SUPPLY OPTIONS	
NEW FACILITY UNDER VDBPL	1200	1	Both new compressors operating and existing HVJ air compressors under stand by. i.e. (835+835= 1670) operating + (391+391=782) Nm ³ /hr stand by.
OLD FACILITIES (HVJ & GREP)	391		
TOTAL	1591	2	One new compressor with both HVJ air compressors operating and one new air compressor stand by i.e. (835+391+391=1617) operating + 835Nm ³ /hr stand by.

Compressed Air Dryers:

Two new air dryer shall be installed under VDBPL project of outlet capacity 523 x1.2 Nm³/Hr GAIL had advised to install dryer of capacity inline with existing Dryer installed under DVPL project at Vijaipur i.e. of similar capacity. Similar to compressors, drier shall also have option

to run in parallel simultaneous mode and meet the total complex requirement. Similarly when any one of these dryer is under maintenance, both existing driers will run in parallel along with one new drier to meet the total complex requirement. Necessary hook ups are needed to be identified in order to meet the above objective.

VIJAIPUR: Air compressor capacity required for VDBPL project is around **1200** nm³/hr, GAIL have advised to install new compressor of 835 nm³/hr in order to utilize existing stand by DVPL air compressors (57-KA-RP-001 A/B) of similar capacity as common stand by machine. In order to meet the shortfall, Gail have advised to use existing two air compressors procured under HVJ project of capacity 391 nm³/hr each along with new compressor.

Compressed Air Dryers:

One new dryer shall be installed under VDBPL project of outlet capacity 523 X 1.2 Nm³/hr. GAIL had advised to install dryer of capacity inline with existing Dryer installed under DVPL project at Vijaipur i.e. of similar capacity. Similar to compressors, drier shall also have option to utilize existing stand by DVPL air driers of similar capacity as common stand by. Necessary hook ups are needed to be identified in order to meet the above objective.

ANNEXURE I

COMPOSITIONS OF GAS

(A) RLNG AT DAHEJ

S.NO	Component	Gas Composition, Mol%		
		RLNG	RLNG Ex C2/C3 Plant	Spot LNG
1	C1	88.51	98.80	92.79
2	C2	7.72	0.86	5.41
3	C3	2.33	0.13	1.37
4	IC4	1.18 (Total C4)	0.00	0.32
5	NC4			
6	IC5	0.07 (Total C5)	0.0	0.0
7	NC5			
8	C6	0.0	0.0	0.0
9	N2	0.19	0.21	0.11
10	CO2	0.0	0.0	0.0
11	H2S	6ppmw	6.7ppmw	6ppmw
12	Total Sulphur	24ppmw	26.8 ppmw	24ppmw
13	Total	100	100	100

(B) RELIANCE GAS AT ANKOT EX-KG BASIN

S.NO	Name	Mol %
1	C1	94.0
2	C2	5.0
3	C3	1.0
4	IC4	0.0
5	NC4	0.0
6	IC5	0.0
7	NC5	0.0
8	C6	0.0
9	N2	0.0
10	CO2	0.0
11	H2S	N/A
12	Total Sulphur	N/A
	Total	100

(C) LEAN GAS EX-LPG UNIT AT VIJAIPUR

S.NO	Name	Mol %
1	C1	90.84
2	C2	5.02
3	C3	0.68
4	IC4	0.05 (total)
5	NC4	
6	IC5	0.0
7	NC5	0.0
8	C6	0.0
9	N2	0.11
10	CO2	3.30
11	H2S	N/A
12	Total Sulphur	N/A
	Total	100

ANNEXURE-II

GROUND PROFILE ALONG PIPELINE ROUTE

CHAINAGE	ELEVATION (ABOVE MSL)
On DVPL	12.2
(Vagodia)	55.0
(Jhabua)	333.0
(Khera)	494.0
(Vijaipur)	422.0

On new GREP Pipeline

Vijaipur (CH 0.0)	422.0
80.271	450.8
169.95 (Burdha)	387.4
252.85	299.93
334.85 (Bajhera)	169.39
425.506	193.03
Dadri	208.87
Bawana	

ANNEXURE-III

BREAK-UP OF SUPPLY & DEMAND ALONG DVPL, GREP AND DADRI-BAWANA PIPELINES

DVPL													
Chainage, km	Input						Output						
	Phase-1			Phase-2			Phase-1			Phase-2			Location
	Q	P	T	Q	P	T	Q	P	T	Q	P	T	
0	25	87	0	55	87	0	-	-	-	-	-	-	DAHEJ
40.1	10	Note-2	Note-2	23	Note-2	Note-2	-	-	-	-	-	-	ANKOT
269.1													JHABUA CS
420.3	-	-	-	-	-	-	0.75	Note-3	Note-3	1.50	Note-3	Note-3	JAGOTI
443.5	-	-	-	-	-	-	4.0	Note-3	Note-3	4.0	Note-3	Note-3	KHERA
611.7	6.0	54	40	6.0	54	40	3.0	Note-4	55	5.0	Note-4	55	VIJAIPUR

EXISTING GREP (Vijaipur-Dadri)P/L													
Input							Output						
Chainage, km	Existing			Phase-1/2			Existing			Phase-1/2			Location
	Q	P	T	Q	P	T	Q	P	T	Q	P	T	
0	14.0	91*	55	19.15	91*	55	-	-	-	-	-	-	VIJAIPUR
217	-	-	-	-	-	-	-	-	-	0.5	Note-3	Note-3	MALANPUR
278	-	-	-	-	-	-	1.5	Note-3	Note-3	1.5	Note-3	Note-3	DHOLPUR
335	-	-	-	-	-	-	1.1	Note-3	Note-3	1.50	Note-3	Note-3	AGRA
362	-	-	-	-	-	-	1.4	Note-3	Note-3	1.4	Note-3	Note-3	MATHURA
456.75	-	-	-	-	-	-	4.25	Note-3	Note-3	4.25	Note-3	Note-3	FARIDABAD & NCR
499	-	-	-	-	-	-	5.7	45 barg	Note-3	10	58-60 barg	Note-3	DADRI

NEW GREP (Vijaipur-Dadri) P/L													
Input							Output						
Chainage, km	Phase-1			Phase-2			Phase-1			Phase-2			Location
	Q	P	T	Q	P	T	Q	P	T	Q	P	T	
0	14.1	98.93*	55	60	98.93*	55	-	-	-	-	-	-	VIJAIPUR
228.036							-	-	-				INT. CS-1
457	-	-	-	-	-	-	8.4	Note-3	Note-3	35	Note-3	Note-3	INT.CS-2 / CHAINSA
497.79	-	-	-	-	-	-	5.7	Note-3	Note-3	25	Note-3	Note-3	DADRI

* This is pipeline inlet pressure after accounting for pressure drop of 1kg/cm² in compressor discharge piping & after cooler.

NEW DADRI-BAWANA P/L													
Input							Output						
Chainage, km	Phase-1			Phase-2			Phase-1			Phase-2			Location
	Q	P	T	Q	P	T	Q	P	T	Q	P	T	
0	6	Note-3	Note-3	31	Note-3	Note-3	-	-	-	-	-	-	DADRI
89	-	-	-	-	-	-	6	Note-3	Note-3	8.0	Note-3	Note-3	BAWANA TOP
89							-	-	-	4.4	Note-3	Note-3	SONIPAT TOP
123	-	-	-	-	-	-	6	45-50	Note-3	8.0	45-50	Note-3	PPCL BAWANA
137	-	-	-	-	-	-	-	-	-	1.5	Note-3	Note-3	NFL.PANIPAT
167	-	-	-	-	-	-	-	-	-	4.0	Note-3	Note-3	CHORKARSA
270	-	-	-	-	-	-	-	-	-	2.6	Note-3	Note-3	SANGRUR
344	-	-	-	-	-	-	-	-	-	6.0	Note-3	Note-3	LUDHIANA
418	-	-	-	-	-	-	-	-	-	4.5	Note-3	Note-3	NANGAL

Notes:

- Units of Q, P & T are MMSCMD, Kg/cm²g, & deg.C respectively.
- Gas will be available at desired pressure/temperature as dictated by hydraulics from Reliance. Compressor is outside scope of this project.
- Tap-off / Tap-in pressure / temperature shall be as per hydraulics.
- Tap-off will be from compressor discharge and pressure will be 98 barg.

ANNEXURE-IV

1.0 SECTION WISE THROUGHPUT OF PIPELINES

DVPL			
Section	Throughput (MMSCMD)		Length km
	Phase-1	Phase-2	
Dahej-Ankot	25	55	40.1
Ankot - Jhabua	35	78	229
Jhabua-Jagoti	35	78	151.2
Jagoti-Khera	34.25	76.5	23.2
Khera-Vijaipur	30.25	72.5	168.2
In Phase-I there is single line (existing) of size is 42” and in Ph.-II there is additional loop line of size 48” parallel to 42” line and connected with it.			
GREP NEW			
Section	Throughput (MMSCMD)		Length km
	Phase-1	Phase-2	
Vijaipur--ICS1	14.1	60	228.03
ICS1—ICS2 (Chainsa)	14.1	60	229.01
Chainsa TOP-- Dadri	5.70	25	40.741
Line Size is 48” throughout.			
GREP EXISTING			
Section	Throughput (MMSCMD)		Length km
	Existing	Phase-1/2	
Vijaipur-Kota		3.0/ 5.0	
Vijaipur-Malanpur	14.0	19.15	217
Malanpur--Dholpur	14.0	18.65	61
Dholpur--Agra	12.5	17.15	57
Agra--Mathura	11.4	15.65	27
Mathura—Faridabad & NCR	10.0	14.25	94.75
Faridabad & NCR-- Dadri	5.7	10	42.25
Line Size is 36” for Vijaipur-Dadri and 18” for Vijaipur-Kota pipelines.			
DADRI-BAWANA P/L			
Section	Throughput (MMSCMD)		Dia,inch/Length km
	Phase-1	Phase-2	
Main Line			
Dadri --- BawanaTOP	6.0	31	36” / 59
Bawana TOP –Panipat TOP	-	18.6	36” / 78
Panipat TOP-Chorkarsa	-	17.1	36” / 30
Chorkarsa – Sangrur TOP	-	13.1	30” / 103
Sangrur TOP--Ludhiana	-	10.5	30” / 74

Ludhiana TOP- Nangal	-	4.5	30" / 74
		Total length of trunk line	418 km
Spur Lines			
TOP—Bawana PPCL	6.0 @	8.0 @	20" / 35
TOP- Sonipat	-	4.4	12" / 8
Chorkarsa-Yamunanagar	-	4.0	18" / 86
Sangrur-Bhatinda	-	1.6	18" / 101
		Total length of spur lines	230 km

@ Hydraulics of spur line shall be checked also for 10 MMSCMD flow both for Ph.-I and Ph.-II. While checking hydraulics for 10 MMSCMD flow in spur line in Ph.-II flow to PSEB Dorha (at Ludhiana) shall be reduced from 6 MMSCMD to 4 MMSCMD to match the flows. Hydraulics will also be checked for initial years when no compressor is installed at Vijaipur and flow in new GREP line from Vijaipur is 12 MMSCMD (As per DFR).In this case flow in spur line will be considered as 3.5/4 MMSCMD and balance 8.5/8 MMSCMD will be tapped out at Chainsa.

PROCESS DESIGN BASIS FOR DABHOL-BANGALORE RLNG PIPELINE (Phase-I & Phase-II)

APPROVED	
GAIL	EIL

2	30.04.10	REVISED AS MARKED & REISSUED FOR APPROVAL	AB	MKA	AS
1	25.01.10	REVISED & REISSUED FOR APPROVAL	VKP	AS	AS
0	09.12.09	REVISED & REISSUED FOR APPROVAL	VKP	AS	AS
A	01.12.09	ISSUED FOR COMMENTS/APPROVAL	VKP	AS	AS
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

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1.0 INTRODUCTION

GAIL (India) Limited, have awarded EIL the Job for Project Management Consultancy (PMC) services for proposed Dabhol – Bidadi (Bangalore) Pipeline of size 36” dia up to 249.106 km from Dabhol & balance line upto Bidadi is 30” with design capacity of 16 MMSCMD gas. The system also includes spur lines for supply of gas at various locations viz. in Sangli, Ratnagiri, Kolhapur, Bijapur/Gulberga, Goa, Dharwad/Hubli, Devangere, Tumkur, Harihar and Bangalore. The pipeline is to be originated from Dabhol terminal with length of the main trunk line portion of size 36”, of approx. 249.106 km and length of remaining portion of size 30” as approx. 497.293 km, and Spur line of sizes 8”/10”/18”/24”, will be of approx. 666 km. The project will be executed in two phases, in phase-I the 36”/30” trunk line and 18”/24” spur lines for Bangalore and Goa and corresponding receipt terminals, intermediate pigging stations and consumer terminals for Zuari fertilizers at Goa, Power plant of KPCL at Bidadi and City Gate Station at Bangalore shall be executed. In phase-II balance facilities including spurlines, receipt terminals and consumer terminals shall be executed.

2.0 BASIC PARAMETERS

2.1 DABHOL Despatch Station

2.1.1	Products to be transported	Gas
2.1.2	Product properties/specifications	As per ANNEXURE-I.
2.1.3	Design codes	ASME B31.8 and OISD-226 Guidelines will be followed as applicable. However, in case of contradictory stipulations, the more stringent conditions will prevail.
2.1.4	Source of product(RLNG)	RLNG from Dabhol LNG terminal will be the gas supply source for this pipeline.
2.1.5	Pipeline design throughput (RLNG)	Pipeline hydraulics shall be carried out for following cases: (i) Design Throughput of 16.0 MMSCMD, considering RLNG from Dabhol terminal at a pressure of 92 kg/cm ² g. (ii) Maximum established throughput of 22.04 MMSCMD considering RLNG from Dabhol terminal at a pressure of 92 kg/cm ² g.

2.2 BIDADI Receipt Station

2.1.1	Products to be transported	Gas
2.1.2	Product properties/specifications	As per ANNEXURE-I.
2.1.3	Design codes	ASME B31.8 and OISD-226 Guidelines will be followed as applicable. However, in

		case of contradictory stipulations, the more stringent conditions will prevail.
2.1.4	Source of product(RLNG)	RLNG from 36"/30" Dabhol-Bidadi pipeline will be the gas supply source for this receipt station.
2.1.5	Pipeline design throughput (RLNG)	Pipeline hydraulics shall be carried out for following cases: (i) Design Throughput of 16 MMSCMD, considering RLNG from Dabhol terminal at a pressure of 92 kg/cm ² g. (ii) Maximum established throughput of 22.04 MMSCMD considering RLNG from Dabhol terminal at a pressure of 92 kg/cm²g.

3.0 PROJECT BATTERY LIMITS:

3.1 At Dabhol

RLNG from Dabhol RLNG terminal, hook-up with existing 18" tap-off provided at Dabhol terminal under Dabhol-Panvel pipeline project.

3.1.1 Battery limit conditions

Inlet flow rate, MMSCMD	:	16MMSCMD
Operating pressure, Kg/cm ² g	:	92.0 Kg/cm ² g
Operating temperature, ° C	:	-4 to +4 °

3.2 At Consumer receipt terminals downstream of metering skid

S.No.	Consumer	Location	Flow Rate MMSCMD	Required Delivery Pressure, Kg/cm ² g
1	Lote- Parshuram	Ratnagiri	0.343	35 – 40
2.	Finolex Industries	Ratnagiri		30 – 35
3.	Kolhapur	Kolhapur	0.218	35 – 40
4.	Sangli	Sangli	0.10	35 – 40
5.	KEI Energy	Bijapur	1.0	16 – 18
6.	Gokak Mills	Belgaum	0.1 Note:2	6 – 10
7.	Ashok Iron Works	Belgaum	0.12 Note:2	8 – 10
8.	Tata Power	Belgaum	0.64 Note:3	16 – 18
9.	Hindalco	Belgaum	0.6 Note:3	16 – 18

10.	Zuari Fertilizer & Others	Goa	1.1	40 – 45
11.	City Gas Distribution	Goa	1.5	-
12.	Industrial Demand	Goa	0.32, Note:1	25 – 35
13.	Murudeshwar Ceramics	Dharwar	0.2	6 – 10
14.	Aradhya Steel Wires Pvt. ltd & Others	Davangere	0.003	6 - 10
15.	Grasim Harihar & Others	Harihar	0.35	12 - 16
16.	H & R Johnson & Others	Tumkur	0.02	6 – 10
17.	Himatsingka Siede	Bangalore	0.04	12 – 16
18.	Sintex	Bangalore	0.002	6 – 10
19.	Mtr Foods	Bangalore	0.001	6 – 10
20.	Biocon	Bangalore	0.03	12 – 16
21.	Stump Schuele & Somappa	Bangalore	0.001	6 – 10
22.	Mother Diary	Bangalore	0.001	6 – 10
23.	Graphite India Limited	Banglore	0.042	10 – 12
24.	Industrial Cluster In Peenya	Peenya	0.05, NOTE:1	6 – 10
25.	Industrial Cluster In Bommasandra	Bommasan dra NOTE:1	0.05, NOTE:1	6 – 10
26.	ITPL Whitefield	Bangalore	0.1	16 – 18
27.	SKF Bommasandra	Bangalore	0.02	6 – 10
28.	City Gas Distribution	Bangalore	1.0	-
29.	KPCL	Bidadi	6.26	40-45

Note: 1 GAIL to quantify break-up of industrial demand with required flow rate consumer wise to assess number of skids required

Note :2 For Gokak Mills and Ashok Iron Works common tap-off with valve and blind flange shall be provided at Ch.10.93064km (from spur line tap-off) on spur line to Goa in Ph-I.

Note: 3 For Tata power and Hindalco common tap-off with valve will be provided on the spur line at Ch 56.10 Km.

Note : 4 At Bangalore only CGS will be installed under Ph.-I.A common tap-off will be provided with valve and blind flange from which take-off to other consumers will be made in Ph.-II.

Note-5: In addition to above consumers valved tap-off provision for CNG station and power plants shall be kept at location as per Annexure-II. The size of TOP has been provided considering power plant requirement of 5.75 MMSCMD for 1000mw plant and 1.0 MMSCMD for CNG station.

4.0 PIPELINE PARAMETERS

4.1 Dabhol - Bidadi pipeline and associated spur lines.

4.1.1	Pipeline operating life	25 Years
4.1.2	Pipeline Length	From Dabhol terminal total length of the main trunk line of size 36"/30" will be approx. 746.399 km, and Spur line of sizes 8"/10"/18"/24", will be of approx. 666km (refer annexure-III).
4.1.3	Pipeline roughness	10 micron for line size 18" and above (Internally coated). 45 micron for line size below 18" (Uncoated).
4.1.4	Material of construction for pipeline	Carbon Steel
4.1.5	Pipeline Corrosion Allowance	0.5 mm (on calculated thickness) for internally uncoated pipe. NIL (As per GAIL'S Recent jobs considering gas composition & internal coating) for internally coated pipe.
4.1.6	Subsoil temperature	20 - 30 °C throughout the entire length of the pipeline.
4.1.7	Design Pressure	92.0 Kg/cm ² (G).
4.1.8	Design temperature	-29 °C to 60 °C for all buried sections -29 °C to 65 °C for above ground portion
4.1.9	Pipeline laying	Buried
4.1.10	Burial Depth, m	Min. 1.0 m, as per OISD norms.
4.1.11	Ground profile	As per Annexure-IV
4.1.12	Pipeline corrosion protection system	Pipeline shall be protected from external corrosion by suitable external 3 layers PE coating and impressed current cathodic protection.
4.1.13	Corrosion Monitoring System	Corrosion monitoring system will be provided as required.

4.1.14	Design margin (for pipeline)	On flow : NIL On length : 3%
4.1.15	Sectionalizing Valves	Sectionalizing valves will be provided along the pipeline as per ASME B31.8. Tap-off provision with valve shall be kept at all SV stations for future consumers.

5.0 DISPATCH / RECEIPT STATION PARAMETERS

5.1 Dabhol despatch terminal design parameters.

5.1.1	Source of Gas	Regasified LNG from Dabhol LNG terminal.
5.1.2	Location	DABHOL Despatch terminal
5.1.3	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• -4 to +4 / 65 • -4 to +4 / 65
5.1.4	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• 92.0 / 92.0 • 92.0 / 92.0
5.1.5	Flow rate, MMSCMD	16.0 MMSCMD

5.2 Bidadi Receipt terminal

5.2.1 Bidadi receipt terminal design parameters

5.2.1.1	Source of Gas	Dabhol to Bidadi RLNG pipeline.
5.2.1.2	Location	Bidadi Receipt terminal
5.2.1.3	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65
5.2.1.4	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 92.0
5.2.1.5	Flow rate, MMSCMD	*7.347 MMSCMD (based on maximum achievable capacity of trunk line of 22.04 MMSCMD)

*Figure arrived at by gas balance.

5.2.2 Bidadi consumer terminal for KPCL design parameters.

5.2.2.1	Source of Gas	Dabhol to Bidadi RLNG pipeline.
5.2.2.2	Location	Bidadi receipt terminal
5.2.2.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.2.2.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 49.0
5.2.2.5	Flow rate, MMSCMD	6.26 MMSCMD

5.3 Bangalore receipt terminal design parameters.

5.3.1	Source of Gas	Regasified LNG from Bidadi to Bangalore RLNG pipeline.
5.3.2	Location	Bangalore Receipt terminal
5.3.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.3.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 49.0
5.3.5	Flow rate, MMSCMD	2.199 MMSCMD

5.4 Goa receipt terminal Design parameters(For Zuari fertilisers)

5.4.1	Source of Gas	Regasified LNG from Gokak to Goa RLNG pipeline.
5.4.2	Location	Goa Receipt terminal
5.4.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.4.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.4.5	Flow rate, MMSCMD	1.1 MMSCMD

Note: Spur line to Goa shall be terminated at Zuari Fertilizer and TOP provision for CGS, industrial consumer, CNG station and KPCL PP shall be provided separately.

5.5 Ratnagiri receipt terminal design parameters

5.5.1	Source of Gas	Regasified LNG from Sangameshwar TOP to Ratnagiri RLNG Pipeline.
5.5.2	Location	Ratnagiri Receipt terminal
5.5.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.5.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.5.5	Flow rate, MMSCMD	0.343 MMSCMD

5.6 Sangali receipt terminal design parameters

5.6.1	Source of Gas	Regasified LNG from Herli TOP to Sangali RLNG Pipeline.
5.6.2	Location	Sangali Receipt terminal
5.6.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.6.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.6.5	Flow rate, MMSCMD	0.1 MMSCMD

5.7 Kolhapur receipt terminal design parameters

5.7.1	Source of Gas	Regasified LNG from Herli TOP to Kolhapur RLNG Pipeline.
5.7.2	Location	Kolhapur Receipt terminal
5.7.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65

5.7.4	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 92.0
5.7.5	Flow rate, MMSCMD	0.218 MMSCMD

5.8 Bijapur/Gulberga receipt terminal design parameters

5.8.1	Source of Gas	Regasified LNG from Gokak TOP to Bijapur RLNG pipeline.
5.8.2	Location	Bijapur Receipt terminal
5.8.3	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65
5.8.4	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 92.0
5.8.5	Flow rate, MMSCMD	1.0 MMSCMD

5.9 Dharwad/Hubli receipt terminal design parameters

5.9.1	Source of Gas	Regasified LNG from Manoli TOP to Dharwad RLNG pipeline.
5.9.2	Location	Dharwad Receipt terminal
5.9.3	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65
5.9.4	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 92.0
5.9.5	Flow rate, MMSCMD	0.2 MMSCMD

5.10 Devangere (Receipt cum Despatch station for Harihar)

5.10.1 Devangere receipt terminal design parameters

5.10.1.1	Source of Gas	Regasified LNG from Jagalur TOP to Devangere RLNG pipeline.
5.10.1.2	Location	Devangere Receipt terminal
5.10.1.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.10.1.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.10.1.5	Flow rate, MMSCMD	0.353 MMSCMD

5.10.2 Devangere consumer terminal design parameters

5.10.2.1	Source of Gas	Regasified LNG from Jagalur TOP to Devangere RLNG pipeline.
5.10.2.2	Location	Devangere Receipt terminal
5.10.2.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.10.2.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.10.2.5	Flow rate, MMSCMD	0.003 MMSCMD

5.10.3 Devangere despatch terminal for Harihar design parameters

5.10.3.1	Source of Gas	Regasified LNG from Jagalur TOP to Devangere RLNG pipeline.
5.10.3.2	Location	Devangere despatch terminal
5.10.3.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65

5.10.3.4	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 92.0
5.10.3.5	Flow rate, MMSCMD	0.350 MMSCMD

5.11 Harihar receipt terminal design parameters

5.11.1	Source of Gas	Regasified LNG from Devangere to Harihar RLNG pipeline.
5.11.2	Location	Harihar Receipt terminal
5.11.3	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65
5.11.4	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 92.0
5.11.5	Flow rate, MMSCMD	0.350 MMSCMD

5.12 Tumkur receipt terminal design parameters

5.12.1	Source of Gas	Regasified LNG from Devanyadurga to Tumkur RLNG pipeline.
5.12.2	Location	Tumkur Receipt terminal
5.12.3	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65
5.12.4	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 92.0
5.12.5	Flow rate, MMSCMD	0.02 MMSCMD

Note: In addition to above receipt / despatch terminals there will be consumer terminals as per Para 3.2 consisting of filters (1+1), pressure regulation station, custody transfer meters (1+1) and flow control valves.

5.13 Utility specification at DABHOL despatch/BIDADI receipt cum dispatch station/consumer terminals.

S.NO	Parameters	Plant Air	Instrument Air	Service Water
5.13.3	Source	BY GAIL/ Consumers	BY GAIL/ Consumers	BY GAIL/ Consumers
5.13.2	Dew Point	-	-40 °C at atm. Pr.	-
5.13.3	Pressure,Kg/cm ² g (min/nor/design)	5.0/ 8.0 / 10.5	5.0/ 7.5 / 10.5	3.0
5.13.4	Temperature,° C	50.0	50.0	Ambient
5.13.5	Consumption	170 Nm ³ /hr (intermittent)	5 Nm ³ /hr (Max)	5 m ³ /hr (intermittent)
5.13.6	Quality	Oil Free	Oil Free	-

6.0 INSTRUMENTATION

6.1	General	Adequate instruments and control system shall be provided for safe and efficient operations. The pipe line shall be monitored and controlled through supervisory control and data acquisition (SCADA) system designed for remote monitoring and control for safe, efficient and economic operation of the pipeline will be provided. RTUs shall be provided at required locations for signal transmission to SCADA.
6.2	Control Philosophy:	Conventional control panel with receiver instrument and flow computers for local level control & monitoring shall be considered at Dabhol, Bidadi and manned consumer terminals. At unmanned stations monitoring will be from field and SCADA. Signals for SCADA are to be repeated to RTU's of the SCADA system.
6.3	Interlock & Shut down	Relay based interlocks
6.4	Safety valve isolation	Safety valve isolation will be provided wherever required These isolation valves should be locked open.
6.5	Block & by-pass valve for control valves	As per design.
6.6	Type of control	Electronic and/ or pneumatic
6.7	Final control element	Gas/Instrument air actuated

7.0 METERING SYSTEM

7.1	Flow meters	Turbine / Ultrasonic flow meters shall be provided at consumer terminals for custody transfer purpose, at Dabhol terminal and Bidadi terminal in the line going to Bangalore for gas reconciliation purpose. For metering system where delivery pressure & flow requires turbine meter of size higher than 6", Ultrasonic meter shall be considered. Turbine meter shall be considered upto 6" only. 1 working + 1standby meter for custody transfer metering and 1working + 0 standby for check metering or reconciliation metering to be considered. Reconciliation meter to be provided at Gokak TOP for Goa line and at TOP for Bangalore spur line. For custody metering system at consumer locations all meters upto size 12" are categorized as small and complete skid will be procured for these, wherever meter size goes beyond 12" instead of skids individual components will be procured separately. Moreover for locations wherever more than 16" size meters are required, it shall be limited to 16" only by increasing the number of runs.

8.0 SCADA & TELECOMMUNICATION SYSTEM

The SCADA system is to be provided for the pipeline facility to ensure effective and reliable control, management and supervision from SMCS at Bidadi and backup SMCS at Dabhol using Remote Telemetry Units (RTU) along the pipeline route at suitable location. Interface will be provided for APPS & other third party utility.

9.0 METEOROLOGICAL DATA

Location	Ambient temp. °C		Altitude, M above MSL
	Min.	Max.	
DABHOL	12	45	102.14
BIDADI	12	45	714.98

10.0 GENERAL PROJECT SPECIFICATIONS

10.1 Numbering system to be followed:

10.1.1	Equipments	As per EIL standard
10.1.2	Instruments	As per EIL standard
10.1.3	Drawings/Documents	As per EIL standard

10.1.4	Unit No.	Facilities	Unit No.
		Dabhol-Bidadi pipeline	010
		Gokak TOP-Goa Pipeline	017
		Dabhol despatch terminal	011
		Ratnagiri receipt terminal	012
		Bechenehalli-Banglore Pipeline	030
		Intermediate pigging station-1	013
		Sangli receipt terminal	014
		Kolhapur receipt terminal	015
		Intermediate Pigging station-2	016
		Goa receipt terminal	017
		Bijapur/Gulberga receipt terminal	018
		Intermediate pigging station on spur line -1(G) at Dhumrewadi	019
		Dharwad/Hubli receipt terminal	021
		Intermediate pigging station-3	022
		Intermediate pigging station-4	023
		Harihar receipt terminal	024
		Devangere receipt terminal	025
		Intermediate pigging station-5	026
		Tumkur receipt terminal	027
		Intermediate pigging station-6	028
		Bidadi receipt terminal	029
		Bangalore receipt terminal	030
		Intermediate pigging station-7	031

Note: Spur line shall have same unit numbers as corresponding last receipt terminal.

10.2 Units of Measurement: Metric, unless otherwise specified. Gas flow rate shall be in MMSCMD.

ANNEXURE-I

RLNG at Dabhol

S.NO	Component	Composition Mol%
1	C1	92.34
2	C2	5.47
3	C3	0.32
4	C4	0.027
5	C5	0.003
6	C6	-
7	CO2	-
8	N2	1.78
9	Total Sulphur	24PPM

ANNEXURE-II

SECTION WISE CHAINGASE DETAILS

1.1 Dabhol-Bidadi Pipeline.

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Dabhol	0.0	Despatch station
2	Dingnikuran	63.113	Tap-off point for Ratnagiri spur line
3	IPS-1	82.728	Intermediate pigging station-1
4	Herli	175.846	Tap-off point for Kolhapur & Sangli spur line
5	IPS-2	175.846	Intermediate pigging station-2
6	Gokak	249.106	Tap-off point for Goa spur line
7	Gokak	249.106	TOP for Bijapur/Gulberga Spurline
8	IPS-3	249.106	Intermediate pigging station-3
9	TOP for Ghatprabha PP	249.106	Tap-off point for Ghatprabha Power plant
10	IPS-4	335.801	Tap-off point for Dharwad/Hubli
11	IPS-4	335.801	Intermediate pigging station-4
12	TOP for PCKL PP	411.814	Tap-off point for PCKL Power plant
13	IPS-5	446.303	Intermediate pigging station-5
14	TOP for PCKL PP	446.303	Tap-off point for PCKL Power plant
15	Santemuddapur	520.157	Tap-off point for Harihar spur line
16	TOP for Jagalpur PP	520.157	Tap-off point for Jagalpur Power plant
17	IPS-6	544.99	Intermediate pigging station-6
18	TOP for CNG	544.99	Tap-off Point for CNG station
19	Kariyala	610.143	Tap-off Point for CNG station
20	IPS-7	641.755	Intermediate Pigging Station-7
21	TOP for CNG	641.755	Tap-off Point for CNG station
22	TOP for Tumkur PP	641.755	Tap-off point for Tumkur Power plant
23	Doddanarmangal	671.895	Tap-off point for Tumkur spur line
24	TOP for CNG	671.895	Tap-off Point for CNG station
25	TOP for CNG	708.615	Tap-off Point for CNG station
26	Bechenehalli	734.353	Tap-off point for Bangalore spur line
27	Bidadi	746.399	Receipt station
28	TOP for Future	746.399	Tap off point for future consumers

1.2. Bechenehalli TOP – Bangalore Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Bechenehalli	0.0	Despatch station
2	TOP for CNG & Peenya industrial area	24.5	Tap-off point for CNG station
3	TOP for Yahlanka PP	32.0	Tap off point for Yahlanka Power plant
4	TOP for Graphite, IPTL & Bhuvalka Power plant	49.5	Tap –off point
5	Bangalore	73.6	Receipt terminal
6	TOP for CNG	73.6	Tap-off point for CNG station

1.3. Gokak TOP –Belgaum - Goa Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Gokak	0.0	Tap-off point
2	TOP for CNG	56.10	Tap-off point for CNG station
3	Dhumrewadi	84.1	IPS on spur line-1G
4	TOP for CNG	141.7	Tap-off point for CNG station
5	TOP for CNG	163.5	Tap-off point for CNG station
6	Goa	175.328	Receipt terminal
7	TOP for KPCL PP & CNG station	175.328	Tap off point

1.4. Dingnikuran TOP – Ratnagiri Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Dingnikuran	0.0	Tap-off point
2	Ratnagiri	57.0	receipt terminal

1.5. Herli TOP – Sangli Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Herli	0.0	Tap-off point
2	Sangli	32.0	receipt terminal

1.6. Herli TOP – Kolhapur Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Herli	0.0	Tap-off point
2	Kolhapur	30.0	receipt terminal

1.7. Gokak TOP – Bijapur Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Gokak	0.0	Tap-off point
2	Bijapur/Gulberga	118.0	receipt terminal

1.8. Achmatti TOP – Dharwad Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Achmatti	0.0	Tap-off point
2	Dharwad/Hubli	65.0	receipt terminal

1.9. Santemuddapur TOP – Devangere - Harihar Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Santemuddapur	0.0	Tap-off point
2	Devangere	45.0	Receipt cum despatch terminal
3	Harihar	75.0	Receipt terminal

1.10. Doddanarmangal TOP – Tumkur Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Doddanarmangal	0.0	Tap-off point
2	Tumkur	40.0	receipt terminal

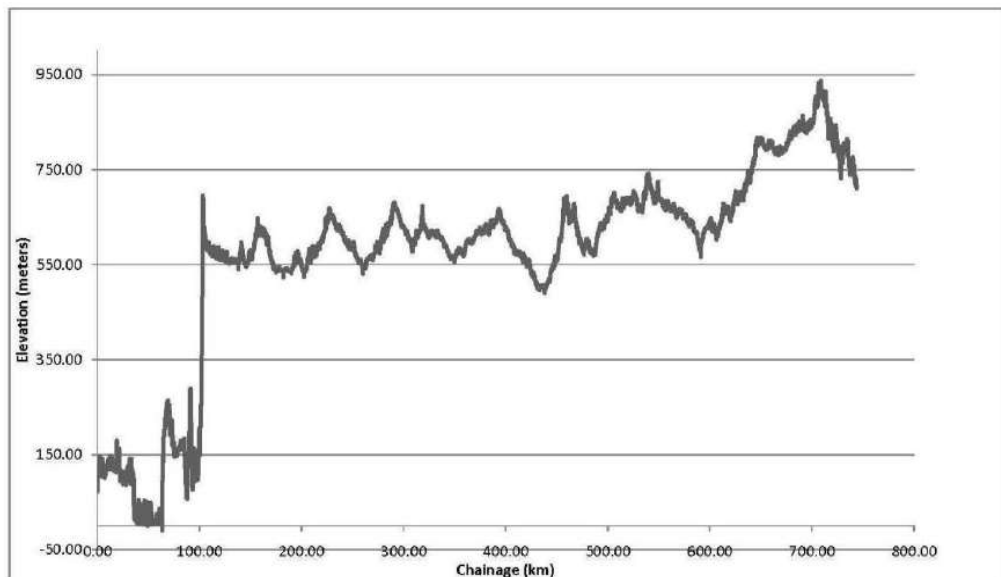
ANNEXURE-III

SECTION WISE PIPELINE DETAILS

1. Dabhol-Bidadi-Bangalore Pipeline and spur lines.

S.No.	Description of the pipeline section	Pipeline Size(inch)	Pipeline length(Km)
	Main trunk line		
1	Dabhol despatch to IPS-1	36"	249.106
2	IPS-1 to Bidadi receiving station	30"	497.293
	Spur lines		
3	Dingnikuran TOP to Ratnagiri receipt terminal	8"	57
4	Herli TOP to Sangali receipt terminal	8"	32
5	Herli TOP to Kolhapur receipt terminal	8"	30
6	Gokak TOP to Goa receipt terminal	24"	175.328
7	Gokak TOP to Bijapur receipt terminal	10"	118
8	Achmatti TOP to Dharwad receipt terminal	8"	65
9	Santemuddapur TOP to Devangere receipt terminal	8"	45
10	Devangere to Harihar receipt terminal	8"	30
11	Doddanarmangal TOP to Tumkur receipt terminal	8"	40
12	Bechenehalli TOP to Bangalore receipt terminal	18"	73.6

ANNEXURE-IV



PROCESS DESIGN BASIS FOR DABHOL-BANGALORE RLNG PIPELINE (Phase-I & Phase-II)

4	09.12.2011	REVISED FOR PH -II CONSUMERS & ISSUED FOR APPROVAL	AB / IA	AS	AS
3	29.07.11	REVISED FOR IPS-4 – MURUDESHWAR CERAMICS AND GOKAK-GOA SPUR LINE- PART OF PHASE-II & ISSUED FOR CLIENT'S APPROVAL	IA	GA	AS
2	30.04.10	REVISED AS MARKED & REISSUED FOR APPROVAL	AB	MKA	AS

1	25.01.10	REVISED & REISSUED FOR APPROVAL	VKP	AS	AS
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

GAIL

EIL

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ANNEXURE –I

COMPOSITION OF GAS

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1.0 INTRODUCTION

GAIL (India) Limited, have awarded EIL the Job for Project Management Consultancy (PMC) services for proposed Dabhol – Bidadi (Bangalore) Pipeline of size 36" dia. up to 248.610 km from Dabhol & balance line of 30" up to Bidadi with design capacity of 16 MMSCMD gas. The system also includes spur lines for supply of gas at various locations viz. in Sangli, Ratnagiri, Kolhapur, Bijapur/Gulberga, Goa, Dharwad/Hubli, Devangere, Tumkur, Harihar and Bangalore. The pipeline is to be originated from Dabhol terminal with length of the main trunk line portion of size 36" of approximately 248.610 km, length of remaining portion of size 30" as approximately 497.41 km, and Spur line of sizes 8"/10"/18"/24" will be of approximately 687km (Ph-I+II) and additional 82.5 km spur lines of size 4"/8" under Gokak Goa spur lines of phase-II. The project was envisaged to be executed in two phases. In Phase-I the 36"/30" trunk line and 18"/24" spur lines for Bangalore and Goa and corresponding receipt terminals, intermediate pigging stations and consumer terminals for Zuari fertilizers at Goa, Power plant of KPCL at Bidadi and City Gate Station at Bangalore, which is under the process of execution were envisaged. In Phase-II, balance facilities including spur lines, receipt terminals and consumer terminals shall be executed.

Apart from Phase-I facilities, this document shall form Basis of Design for the following facilities coming under part of Phase-II project of Dabhol –Bangalore Pipeline:

- 8" IPS-4-Murudeshwar Ceramics spur line of approximately 54km length.
- The new consumers on spur lines from Gokak-Goa pipeline.
- The new consumers from main trunk line from SV-21 and Bidadi receipt terminal.



2.0 BASIC PARAMETERS

2.1 DABHOL Despatch Station

2.1.1	Product to be transported	Gas
2.1.2	Product properties/specifications	As per ANNEXURE-I
2.1.3	Design codes	ASME B31.8 and OISD-226 Guidelines will be followed as applicable. However, in case of contradictory stipulations, the more stringent conditions will prevail.
2.1.4	Source of product(RLNG)	RLNG from Dabhol LNG terminal will be the gas supply source for this pipeline.
2.1.5	Pipeline design throughput (RLNG)	Pipeline hydraulics shall be carried out for following cases: (i) Design Throughput of 16.0 MMSCMD, considering RLNG from Dabhol terminal at a pressure of 92 kg/cm²g. (ii) Maximum established throughput of 22.04 MMSCMD considering RLNG from Dabhol terminal at a pressure of 92 kg/cm²g.

2.2 BIDADI Receipt Station

2.2.1	Product to be transported	Gas
2.2.2	Product properties/specifications	As per ANNEXURE-I.
2.2.3	Design codes	ASME B31.8 and OISD-226 Guidelines will be followed as applicable. However, in case of contradictory stipulations, the more stringent conditions will prevail.
2.2.4	Source of product (RLNG)	RLNG from 36"/30" Dabhol-Bidadi pipeline will be the gas supply source for this receipt station.
2.2.5	Pipeline design throughput (RLNG)	Pipeline hydraulics shall be carried out for following cases: (i) Design Throughput of 16 MMSCMD, considering RLNG from Dabhol terminal at a pressure of 92 kg/cm²g. (ii) Maximum established throughput of

		22.04 MMSCMD considering RLNG from Dabhol terminal at a pressure of 92 kg/cm ² g.

3.0 PROJECT BATTERY LIMITS:

3.1 At Dabhol

Hook-up with existing 20" tap-off provided at Dabhol terminal under the project
"Connectivity Between RGPPL RLNG Terminal with GAIL's Dabhol Terminal."

3.1.1 Battery limit conditions

Inlet flow rate, MMSCMD	:	16MMSCMD
Operating pressure, Kg/cm ² g	:	92.0 Kg/cm ² g
Operating temperature, ° C	:	-4 to +4

3.1.2 At IPS-4

Hook-up with existing 8" tap-off provided at IPS-4 under Phase-I of this project.

3.1.2.1 Battery limit conditions

Inlet flow rate, MMSCMD	:	0.2 MMSCMD (1.0 MMSCMD max.)
Operating pressure, kg/cm ² g	:	As per hydraulics
Operating temperature, ° C	:	As per hydraulics

3.2 At Consumer receipt terminals downstream of metering skid

S.No.	Consumers	Location	Flow Rate MMSCMD	Required Delivery Pressure, Kg/cm ² g	Required Delivery Temperature, Deg C
1	Lote- Parshuram	Ratnagiri	0.343	35 – 40	=
2.	Finolex Industries	Ratnagiri		30 – 35	=
3.	Kolhapur	Kolhapur	0.218	35 – 40	=
4.	Sangli	Sangli	0.10	35 – 40	=
5.	KEI Energy	Bijapur	1.0	16 – 18	=

6.	Gokak Mills	Belgaum	0.1 NOTE:2	6 – 10	=
7.	Ashok Iron Works	Belgaum	0.12 NOTE:2	8 – 10	=
8.	Tata Power	Belgaum	0.64 NOTE:3	16 – 18	=
9.	Hindalco	Belgaum	0.633 NOTE:3	16 – 18	15 (Minimum)
10.	Zuari Fertilizer & Others	Goa	1.1	40 – 45	As per hydraulics
11.	City Gas Distribution	Goa	1.5	-	
12.	Industrial Demand	Goa	0.32 NOTE:1	25 – 35	=
13.	Murudeshwar Ceramics	Dharwad	0.2	4 - 5	4 15 (Minimum)
14.	Aradhya Steel Wires Pvt. Ltd & Others	Davangere	0.003	6 - 10	=
15.	Grasim Harihar & Others	Harihar	0.35	12 - 16	=
16.	H & R Johnson & Others	Tumkur	0.0316 Note:14	20	15 (Minimum) Note:13
17.	Himatsingka Siede	Bangalore	0.04	12 – 16	=
18.	Sintex	Bangalore	0.002	6 – 10	=
19.	Mtr Foods	Bangalore	0.001	6 – 10	=
20.	Biocon	Bangalore	0.03	12 – 16	=
21.	Stump Schuele & Somappa	Bangalore	0.001	6 – 10	=
22.	Mother Dairy	Bangalore	0.001	6 – 10	=
23.	Graphite India Limited	Bangalore	0.042	10 – 12	=
24.	Industrial Cluster In Peenya	Peenya	0.05 NOTE:1	6 – 10	=
25.	Industrial Cluster In Bommasandra	Bommasandra NOTE:1	0.05 NOTE:1	6 – 10	=

26.	IPTL Whitefield	Bangalore	0.1	16 – 18	=
27.	SKF Bommasandra	Bangalore	0.02	6 – 10	=
28.	City Gas Distribution	Bangalore	1.0	-	As per hydraulics
29.	KPCL	Bidadi	6.26	40-45	As per hydraulics
30.	M/s Toyota Kirloskar	Bidadi NOTE:12	0.0211	5	15 (Minimum) Note:13
31. 30.	M/s Binani Glass Limited	Goa NOTE:6 & 7	0.020	2	15 (Minimum) Note:13
32. 31.	M/s Nestle	Goa NOTE:6 & 7	0.015	5-6	15 (Minimum) Note:13
33. 32.	M/s H.L Nathurmal	Goa NOTE:6 & 89	0.110	25	15 (Minimum) Note:13
34. 33.	M/s Sesa Goa	Goa NOTE:6 & 98	0.055	8-10	15 (Minimum) Note:13
35. 34.	M/s Syngenta India	Goa NOTE:6 & 99	0.035	5-6	15 (Minimum) Note:13
36. 35.	M/s Hindustan Unilever Limited	Goa NOTE:6 & 99	0.017	18-20	15 (Minimum) Note:13
37. 36.	M/s Mondovi Pellets	Goa NOTE:6 & 98	0.210	1.2-4	15 (Minimum) Note:13
38. 37.	M/s Finolex Cables Limited	Goa NOTE:6 & 98	0.012	2-8	15 (Minimum) Note:13
39.	M/s Nestle, Usgaon,	Goa	0.015	2-8	15

38.	Ponda	NOTE:6 & 98			(Minimum) Note:13
40. 39.	M/s Reliance Infrastructure Ltd.	Goa NOTE:6 —& 109	0.500	45	15 (Minimum) Note:13
41. 40.	M/s Umicore Anandeya Pvt Ltd. Zuarinagar	Goa NOTE:6 _& 119	0.010	8-10	15 (Minimum) Note:13

Note-1: GAIL to quantify break-up of industrial demand with required flow rate, consumer wise to assess number of skids required.

Note -2: -For Gokak Mills and Ashok Iron Works common tap-off with valve and blind flange shall be provided at Ch.10.93064km (from spur line tap-off) on spur line to Goa in Ph-I.

Note- 3: For Tata power and Hindalco common tap-off with valve will be provided on the spur line at Ch 56.10 Km.

Note-4: At Bangalore only CGS will be installed under Ph.-I. A common tap-off will be provided with valve and blind flange from which take-off to other consumers will be made in Ph.-II.

Note-5: In addition to above consumers valved tap-off provision for CNG station and power plants shall be kept at location as per Annexure-II. The size of TOP has been provided considering power plant requirement of 5.75 MMSCMD for 1000MW plant and 1.0 MMSCMD for CNG station.

Note-6: All PRS for the new consumers at tap-off location and PRS & metering skids at consumer end/terminals in the Goa region shall be supplied by GAIL.

Note-7: Existing 8" tap off at SV-4G shall be used for onward transfer of gas to M/s Binani Glass and M/s Nestle.

Note-8: New 4" tap-off for gas transfer to M/s Nathurmal & M/s Sesa goa shall be provided directly from existing Gokak-Goa spur line at chain age 149.76 km. ~~Existing 6" tap off at SV-5G shall be used for onward transfer of gas to M/s Mondovi Pallets, M/s Nestle & M/s Finolex.~~

Note-9: Existing 8" tap off at SV-5G shall be used for onward transfer of gas to M/s Mondovi

Pallets, M/s Nestle, ponda, M/s Finolex, M/s Syngenta, & M/s HUL.

New 4" tap-off for gas transfer to M/s Nathurmal & M/s Sesa goa shall be provided directly from existing Gokak Goa spur line or from branch lines tapped off from Gokak Goa spurline at chain age 149.76 km.

Note-10: Existing 8" tap off at Goa RT shall be used for onward transfer of gas to M/s Reliance.

Note-11: New 4" tap-off for gas transfer from existing 8" tap-off to M/s Umicore shall be provided at Goa RT.

Note-12: 4" tap-off from existing 12" tap-off at Bidadi RT shall be used to supply gas to M/s Toyota Kirloskar.

Note-13: GAIL confirmed to limit the consumers battery limit temp. to minimum 15 deg C.

Note-14: Existing 6" tap off at SV-5203 (SV-21) on main trunk line shall be used for onward transfer of gas to M/s HR Johnson.

4.0 PIPELINE PARAMETERS

4.1 Dabhol - Bidadi pipeline and associated spur lines.

4.1.1	Pipeline operating life	25 Years
4.1.2	Pipeline Length	From Dabhol terminal total length of the main trunk line of size 36"/30" will be approx. 746.020 km, and spur line of sizes 4"/8"/10"/18"/24", will be of approx. ~~723~~ <u>70</u> km. (Refer annexure-III).
4.1.3	Pipeline roughness	10 micron for line size 18" and above (Internally coated). 45 micron for line size below 18" (Uncoated).
4.1.4	Material of construction for pipeline	Carbon Steel
4.1.5	Pipeline Corrosion Allowance	0.5 mm (on calculated thickness) for internally uncoated pipe. NIL (As per GAIL'S Recent jobs considering gas composition & internal coating) for internally coated pipe.
4.1.6	Subsoil temperature	20 - 30 °C throughout the entire length of the pipeline.

4.1.7	Design Pressure	92.0 Kg/cm² (G) for Dabhol - Bidadi pipeline and associated spur lines. 92.0 Kg/cm² (G) for spur line to Reliance from Zuari RT. 49.0 Kg/cm² (G) for Goa Consumers Connectivity pipelines. 49.0 Kg/cm² (G) for Spurline from SV-21 to HR Johnson & from Bidadi RT to Toyota Kirloskar pipelines.
4.1.8	Design temperature	-29 °C to 60 °C for all buried sections -29 °C to 65 °C for above ground portion
4.1.9	Pipeline laying	Buried
4.1.10	Burial Depth, m	Min. 1.0 m, as per OISD norms.
4.1.11	Ground profile	As per Annexure-IV & Annexure-V
4.1.12	Pipeline corrosion protection system	Pipeline shall be protected from external corrosion by suitable external 3 layers PE coating and impressed current cathodic protection.
4.1.13	Corrosion Monitoring System	Corrosion monitoring system will be provided as required.
4.1.14	Design margin (for pipeline)	On flow : NIL On length : 3%
4.1.15	Sectionalizing Valves	Sectionalizing valves will be provided along the pipeline as per ASME B31.8. Tap-off provision with valve shall be kept at all SV stations for future consumers.

5.0 DISPATCH / RECEIPT STATION PARAMETERS

5.1 Dabhol dispatch terminal design parameters.

5.1.1	Source of Gas	Regasified LNG from Dabhol LNG Terminal.
5.1.2	Location	DABHOL Dispatch Terminal
5.1.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	-4 to +4 / 65 -4 to +4 / 65
5.1.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	92.0 / 92.0 92.0 / 92.0
5.1.5	Flow rate, MMSCMD	16.0 MMSCMD

5.2 Bidadi Receipt terminal

5.2.1 Bidadi receipt terminal design parameters

5.2.1.1	Source of Gas	Dabhol to Bidadi RLNG pipeline.
5.2.1.2	Location	Bidadi Receipt terminal
5.2.1.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.2.1.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.2.1.5	Flow rate, MMSCMD	*5.725 MMSCMD at present (based on maximum achievable capacity of trunk line of 22.04 MMSCMD)

*Figure arrived at by gas balance. However the Bidadi terminal has been designed to flow capacity of 7.347MMSCMD.

5.2.2 Bidadi consumer terminal for KPCL design parameters.

5.2.2.1	Source of Gas	Dabhol to Bidadi RLNG pipeline.
5.2.2.2	Location	Bidadi receipt terminal
5.2.2.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.2.2.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 49.0
5.2.2.5	Flow rate, MMSCMD	6.26 MMSCMD

5.3 Bangalore receipt terminal design parameters.

5.3.1	Source of Gas	Regasified LNG from Bidadi to Bangalore RLNG pipeline.
5.3.2	Location	Bangalore Receipt terminal
5.3.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.3.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 49.0
5.3.5	Flow rate, MMSCMD	2.199 MMSCMD

5.4 Goa receipt terminal Design parameters (For Zuari fertilizers)

5.4.1	Source of Gas	Regasified LNG from Gokak to Goa RLNG pipeline.
5.4.2	Location	Goa Receipt terminal
5.4.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.4.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0

5.4.5	Flow rate, MMSCMD	1.1 MMSCMD

Note: Spur line to Goa shall be terminated at Zuari Fertilizer and TOP provision for CGS, industrial consumers, CNG station and KPCL PP shall be provided separately.

5.5 Ratnagiri receipt terminal design parameters

5.5.1	Source of Gas	Regasified LNG from Sangameshwar TOP to Ratnagiri RLNG Pipeline.
5.5.2	Location	Ratnagiri Receipt terminal
5.5.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.5.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.5.5	Flow rate, MMSCMD	0.343 MMSCMD

5.6 Sangali receipt terminal design parameters

5.6.1	Source of Gas	Regasified LNG from Herli TOP to Sangali RLNG Pipeline.
5.6.2	Location	Sangali Receipt terminal
5.6.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.6.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.6.5	Flow rate, MMSCMD	0.1 MMSCMD

5.7 Kolhapur receipt terminal design parameters

5.7.1	Source of Gas	Regasified LNG from Herli TOP to Kolhapur RLNG Pipeline.
5.7.2	Location	Kolhapur Receipt terminal
5.7.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.7.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.7.5	Flow rate, MMSCMD	0.218 MMSCMD

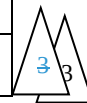
5.8 Bijapur/Gulberga receipt terminal design parameters

5.8.1	Source of Gas	Regasified LNG from Gokak TOP to Bijapur RLNG pipeline.
5.8.2	Location	Bijapur Receipt terminal
5.8.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.8.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.8.5	Flow rate, MMSCMD	1.0 MMSCMD

5.9 Murudeshwar Ceramic receipt terminal design parameters

5.9.1	Source of Gas	Regasified LNG from IPS4 to Murudeshwar RLNG pipeline.
5.9.2	Location	Dharwad Receipt terminal
5.9.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65

5.9.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 19.0
5.9.5	Flow rate, MMSCMD	~~0.075~~ 1.0 MMSCMD



5.10 Devangere (Receipt cum Dispatch station for Harihar)

5.10.1 Devangere receipt terminal design parameters

5.10.1.1	Source of Gas	Regasified LNG from Jagalur TOP to Devangere RLNG pipeline.
5.10.1.2	Location	Devangere Receipt terminal
5.10.1.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.10.1.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.10.1.5	Flow rate, MMSCMD	0.353 MMSCMD

5.10.2 Devangere consumer terminal design parameters

5.10.2.1	Source of Gas	Regasified LNG from Jagalur TOP to Devangere RLNG pipeline.
5.10.2.2	Location	Devangere Receipt terminal
5.10.2.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.10.2.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.10.2.5	Flow rate, MMSCMD	0.003 MMSCMD

5.10.3 Devangere dispatch terminal for Harihar design parameters

5.10.3.1	Source of Gas	Regasified LNG from Jagalur TOP to Devangere RLNG pipeline.
5.10.3.2	Location	Devangere despatch terminal
5.10.3.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.10.3.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.10.3.5	Flow rate, MMSCMD	0.350 MMSCMD

5.11 Harihar receipt terminal design parameters

5.11.1	Source of Gas	Regasified LNG from Devangere to Harihar RLNG pipeline.
5.11.2	Location	Harihar Receipt terminal
5.11.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.11.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.11.5	Flow rate, MMSCMD	0.350 MMSCMD

5.12 Tumkur receipt terminal design parameters

5.12.1	Source of Gas	Regasified LNG from Devanyadurga to Tumkur RLNG pipeline.
5.12.2	Location	Tumkur Receipt terminal
5.12.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65

5.12.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.12.5	Flow rate, MMSCMD	0.02 MMSCMD

5.13 HR Johnson receipt terminal design parameters

5.13.1	Source of Gas	Regasified LNG from TOP at SV-5203 (SV-21) to HR Johnson RLNG pipeline.
5.13.2	Location	HR Johnson Receipt terminal
5.13.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.13.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 49.0 - As per Hydraulics/ 49.0
5.13.5	Flow rate, MMSCMD	0.0316 MMSCMD

5.14 Toyota Kirloskar receipt terminal design parameters

5.14.1	Source of Gas	Regasified LNG from Bidadi RT to Toyota Kirloskar RLNG pipeline.
5.14.2	Location	Toyota Kirloskar Receipt terminal
5.14.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.14.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 49.0 - As per Hydraulics/ 19.0
5.14.5	Flow rate, MMSCMD	0.0211 MMSCMD

5.15 Hindalco receipt terminal design parameters

5.15.1	Source of Gas	Regasified LNG from TOP at SV-2502 (SV-2G) to Hindalco RLNG pipeline.
5.15.2	Location	Hindalco Receipt terminal
5.15.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.15.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 49.0 - As per Hydraulics/ 19.0
5.15.5	Flow rate, MMSCMD	0.33 MMSCMD

5.16 Binani Glass receipt terminal design parameters

5.16.1	Source of Gas	Regasified LNG from TOP at SV-3102 (SV-4G) to Binani Glass RLNG pipeline.
5.16.2	Location	Binani Glass Receipt terminal
5.16.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.16.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 49.0 - As per Hydraulics/ 19.0
5.16.5	Flow rate, MMSCMD	0.02 MMSCMD

5.17 Nestle receipt terminal design parameters

5.17.1	Source of Gas	Regasified LNG from Binani Glass RLNG pipeline.
5.17.2	Location	Nestle Receipt terminal
5.17.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65

5.17.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 49.0 - As per Hydraulics/ 19.0
5.17.5	Flow rate, MMSCMD	0.015 MMSCMD

5.18 NM Nathurmal receipt terminal design parameters

5.18.1	Source of Gas	Regasified LNG from TOP at Ch. 149.76 KM on Gokak-Goa spur line.
5.18.2	Location	NM Nathurmal Receipt terminal
5.18.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.18.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 49.0 - As per Hydraulics/ 49.0
5.18.5	Flow rate, MMSCMD	0.11 MMSCMD

5.19 Sesa Goa receipt terminal design parameters

5.19.1	Source of Gas	Regasified LNG from TOP NM Nathurmal pipeline.
5.19.2	Location	Sesa Goa Receipt terminal
5.19.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.19.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 49.0 - As per Hydraulics/ 19.0
5.19.5	Flow rate, MMSCMD	0.055 MMSCMD

5.20 Mondovi pellets receipt terminal design parameters

5.20.1	Source of Gas	Regasified LNG from TOP at Ch. 163.84 KM on Gokak-Goa spur line.

5.20.2	Location	Mondovi Pellets Receipt terminal
5.20.3	Battery limit temperature, °C (Normal/Design) at Inlet Outlet	As per hydraulics / 65 As per hydraulics / 65
5.20.4	Battery limit pressure, kg/cm2 g (Normal/Design) at Inlet Outlet	As per Hydraulics/ 49.0 As per Hydraulics/ 19.0
5.20.5	Flow rate, MMSCMD	0.21 MMSCMD

[5.21 Hindustan Unilever receipt terminal design parameters](#)

5.21.1	Source of Gas	Regasified LNG from TOP at Mondovi Pellets pipeline.
5.21.2	Location	HUL Receipt terminal
5.21.3	Battery limit temperature, °C (Normal/Design) at Inlet Outlet	As per hydraulics / 65 As per hydraulics / 65
5.21.4	Battery limit pressure, kg/cm2 g (Normal/Design) at Inlet Outlet	As per Hydraulics/ 49.0 As per Hydraulics/ 49.0
5.21.5	Flow rate, MMSCMD	0.017 MMSCMD

[5.22 Syngenta receipt terminal design parameters](#)

5.22.1	Source of Gas	Regasified LNG from TOP at Mondovi Pellets pipeline.
5.22.2	Location	Syngenta Receipt terminal
5.22.3	Battery limit temperature, °C (Normal/Design) at Inlet Outlet	As per hydraulics / 65 As per hydraulics / 65
5.22.4	Battery limit pressure, kg/cm2 g (Normal/Design) at Inlet Outlet	As per Hydraulics/ 49.0 As per Hydraulics/ 19.0
5.22.5	Flow rate, MMSCMD	0.035 MMSCMD

5.23 Nestle Ponda receipt terminal design parameters

5.23.1	Source of Gas	Regasified LNG from TOP at Mondovi Pellets pipeline.
5.23.2	Location	Nestle Ponda Receipt terminal
5.23.3	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65
5.23.4	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 49.0 • As per Hydraulics/ 19.0
5.23.5	Flow rate, MMSCMD	0.015 MMSCMD

5.24 Finolex receipt terminal design parameters

5.24.1	Source of Gas	Regasified LNG from TOP at Mondovi Pellets pipeline.
5.24.2	Location	Finolex Receipt terminal
5.24.3	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65
5.24.4	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 49.0 • As per Hydraulics/ 19.0
5.24.5	Flow rate, MMSCMD	0.012 MMSCMD

5.25 Reliance receipt terminal design parameters

5.25.1	Source of Gas	Regasified LNG from TOP at Goa receipt terminal.
5.25.2	Location	Reliance Receipt terminal
5.25.3	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65

5.25.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 49.0
5.25.5	Flow rate, MMSCMD	0.5 MMSCMD

5.26 Umicore receipt terminal design parameters

5.26.1	Source of Gas	Regasified LNG from TOP at Goa receipt terminal.
5.26.2	Location	Umicore Receipt terminal
5.26.3	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
5.26.4	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 49.0 - As per Hydraulics/ 19.0
5.26.5	Flow rate, MMSCMD	0.01 MMSCMD

Note: In addition to above receipt / dispatch terminals there will be consumer terminals as per Para 3.2 consisting of filters (1+1), pressure regulation station, custody transfer meters (1+1) and flow control valves.

5.27 Utility specification at DABHOL dispatch/BIDADI receipt cum dispatch station/consumer terminals.

S.NO	Parameters	Plant Air	Instrument Air	Service Water
5.13.1	Source	BY GAIL/ Consumers	BY GAIL/ Consumers	BY GAIL/ Consumers
5.13.2	Dew Point	-	-40 °C at atm. Pr.	-
5.13.3	Pressure, Kg/cm ² g (min/nor/design)	5.0/ 8.0 / 10.5	5.0/ 7.5 / 10.5	3.0
5.13.4	Temperature, ° C	50.0	50.0	Ambient
5.13.5	Consumption	170 Nm ³ /hr (intermittent)	5 Nm ³ /hr (Max)	5 m ³ /hr (intermittent)
5.13.6	Quality	Oil Free	Oil Free	-

6.0 INSTRUMENTATION

6.1	General	Adequate instruments and control system shall be provided for safe and efficient operations. The pipe line shall be monitored and controlled through supervisory control and data acquisition (SCADA) system designed for remote monitoring and control for safe, efficient and economic operation of the pipeline. RTUs shall be provided at required locations for signal transmission to SCADA.
6.2	Control Philosophy	Conventional control panel with receiver instrument and flow computers for local level control & monitoring shall be considered at Dabhol, Bidadi and manned consumer terminals. At unmanned stations monitoring will be from field and SCADA. Signals for SCADA are to be repeated to RTU's of the SCADA system.
6.3	Interlock & Shut down	Relay based interlocks
6.4	Safety valve isolation	Safety valve isolation will be provided wherever required. These isolation valves should be locked open.
6.5	Block & by-pass valve for control valves	As per design.
6.6	Type of control	Electronic and/ or pneumatic
6.7	Final control element	Gas/Instrument air actuated

7.0 METERING SYSTEM

7.1	Flow meters	Turbine / Ultrasonic flow meters shall be provided at consumer terminals for custody transfer purpose, at Dabhol terminal and Bidadi terminal in the line going to Bangalore for gas reconciliation purpose. For metering system where delivery pressure & flow requires turbine meter of size higher than 6", Ultrasonic meter shall be considered. Turbine meter shall be considered up to 6" only. 1 working + 1standby meter for custody transfer metering and 1working + 0 standby for check metering or reconciliation metering to be considered. Reconciliation meter to be provided at Gokak TOP for Goa line, at TOP for Bangalore spur line and at IPS-4 TOP for Murudeshwar spur line. For custody metering system at consumer locations all meters up to size 12" are categorized as small and complete skid will be procured for these. Wherever meter size goes beyond 12" instead of skids individual components will be procured separately. Moreover for locations wherever more than 16" size meters are required, it shall be limited to 16" only by increasing the number of runs.

3

8.0 SCADA & TELECOMMUNICATION SYSTEM

The SCADA system is to be provided for the pipeline facility to ensure effective and reliable control, management and supervision from SMCS at Bidadi and backup SMCS at Dabhol using Remote Telemetry Units (RTU) along the pipeline route at suitable location. Interface will be provided for APPS & other third party utility.

9.0 METEOROLOGICAL DATA

Location	Ambient temp. °C		Altitude, M above MSL
	Min.	Max.	
DABHOL	12	45	102.14
BIDADI	12	45	714.98

10.0 GENERAL PROJECT SPECIFICATIONS

10.1 Numbering system to be followed:

10.1.1	Equipments	As per EIL standard

10.1.2	Instruments	As per EIL standard
10.1.3	Drawings/Documents	As per EIL standard
10.1.4	Unit No.	N Facilities Unit No. Dabhol-Bidadi pipeline 010 Gokak TOP-Goa Pipeline 017 Dabhol despatch terminal 011 Ratnagiri receipt terminal 012 Bechenehalli-Bangalore Pipeline 030 Intermediate pigging station-1 013 Sangli receipt terminal 014 Kolhapur receipt terminal 015 Intermediate Pigging station-2 016 Goa receipt terminal 017 Bijapur/Gulberga receipt terminal 018 Intermediate pigging station 019 on spur line -1(G) at Dhumrewadi Dharwad/Hubli receipt terminal 021 Intermediate pigging station-3 022 Intermediate pigging station-4 023 Harihar receipt terminal 024 Devangere receipt terminal 025 Intermediate pigging station-5 026 Tumkur receipt terminal 027 Intermediate pigging station-6 028 Bidadi receipt terminal 029 Bangalore receipt terminal 030 Intermediate pigging station-7 031 Spur lines to M/s Binani Glass and 032 M/s Nestle Spur lines to <u>M/s Sesa Goa and M/s Goa Energy,</u> 033 <u>M/s Sesa Goa and M/s -N M Nathurmali</u> <u>Spur lines to M/s Hindalco</u> <u>035Spur lines to M/s Hindustan Lever, 034and</u> <u>M/s Syngenta</u> Spur lines to M/s Nestle Ponda, 036 <u>M/s MRF, M/s Finolex, M/s Syngenta,</u> <u>M/s Hindustan Unilever -and</u> <u>M/s Maandavi Pallets Spur lines to M/s Cipla, M/s</u> <u>Meta Copper 036M/s Birla Furukawa</u> Spur lines to M/s Reliance _____ and <u>M/s Unicorn 037</u> <u>Spur lines to M/s Umicore 038</u> <u>Spur lines to M/s HR Johnson 039</u> <u>Spur lines to M/s Toyota Kirloskar 040</u> <u>Spur lines to M/s Toyota Kirloskar 040</u>

ur line shall have unit numbers as corresponding last receipt terminal.

10.2 Units of Measurement: Metric, unless otherwise specified. Gas flow rate shall be in MMSCMD.

11.0 Special Client requirements

11.1 Scrubber, heater & PRS to be provided at all tap-off locations on Gokak-Goa spur line. However, PRS shall be in GAIL's scope whereas scrubber and heater shall be in EIL's scope.

11.2 GAIL confirmed to limit the consumers battery limit temp. to minimum 15 deg C.

11.3 All the scrapper traps wherever required for new consumers on Gokak-Goa line shall be temporary type.

11.4 One 12" tap-off with valve to be provided at Bangalore RT upstream of consumer terminal and one 12" tap-off after filter, meter & letdown skid for future interconnection with KKMBPL.

11.5 In the incoming high pressure line from RGPPL, A PCV with bypass shall be provided at Dabhol dispatch terminal and to be designed for the capacity of 5 MMSCMD and downstream pressure varying between 60-80 kg/cm2g to match arrival pressure of gas in Panvel-Dabhol Pipeline.

11.6 All new valves coming at Dabhol dispatch terminal to be of manual type.

11.7 All the valves at other locations coming in Gokak-Goa line in Ph.2 up to 8" size to be of manual type.

11.8 PRS at Dharwad tap-off to be designed for flow given in DFR for Dharwad line.

11.9 Provision for future tap-off at inlet & outlet of letdown skid at Dharwad tap-off to be provided with valve and blind.

11.10 Permanent scrapper traps to be provided for M/s HR Johnson.

11.11 An additional 8" tap-off is required in the bypass line of SV stations namely SV-4G & 5G under Phase-I of DBPL project.

11.12 Future Provision for installation of heater to be kept at Murudeshwar ceramics consumer terminal

skid.

ANNEXURE-I

RLNG at Dabhol

S.No.	Component	Composition mol%
1	C1	92.34
2	C2	5.47
3	C3	0.32
4	C4	0.027
5	C5	0.003
6	C6	-
7	CO2	-
8	N2	1.78
9	Total Sulphur	24PPM

ANNEXURE-II

SECTION WISE CHAINGASE DETAILS

1.1 Dabhol-Bidadi Pipeline.

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Dabhol	0.0	Despatch station
2	Dingnikuran	62.617	Tap-off point for Ratnagiri spur line
3	IPS-1	82.232	Intermediate pigging station-1
4	Herli	175.35	Tap-off point for Kolhapur & Sangli spur line
5	IPS-2	175.32	Intermediate pigging station-2
6	Gokak	248.610	Tap-off point for Goa spur line
7	Gokak	248.610	TOP for Bijapur/Gulberga spur line
8	IPS-3	248.610	Intermediate pigging station-3
9	TOP for Ghatprabha PP	248.610	Tap-off point for Ghatprabha Power plant
10	IPS-4	335.305	Tap-off point for Dharwad/Hubli
11	IPS-4	335.305	Intermediate pigging station-4
12	TOP for PCKL PP	411.318	Tap-off point for PCKL Power plant
13	IPS-5	445.807	Intermediate pigging station-5
14	TOP for PCKL PP	445.807	Tap-off point for PCKL Power plant
15	Santemuddapur	519.661	Tap-off point for Harihar spur line
16	TOP for Jagalpur PP	519.661	Tap-off point for Jagalpur Power plant
17	IPS-6	544.503	Intermediate pigging station-6

18	TOP for CNG	544.503	Tap-off Point for CNG station
19	Kariyala	609.647	Tap-off Point for CNG station
20	IPS-7	641.259	Intermediate Pigging Station-7
21	TOP for CNG	641.259	Tap-off Point for CNG station
22	TOP for Tumkur PP	641.259	Tap-off point for Tumkur Power plant
23	Doddanarmangal	671.399	Tap-off point for Tumkur spur line
24	TOP for CNG	671.399	Tap-off Point for CNG station
25	TOP for CNG	708.119	Tap-off Point for CNG station
26	Bechenehalli (Sulivara)	733.857	Tap-off point for Bangalore spur line
27	Bidadi	746.020	Receipt station
28	TOP for Future (12") and KPCL PP	746.020	Tap off point for future consumers
29	TOP for M/s Toyota Kirloskar	746.020	Tap off point

1.2. Bechenehalli TOP – Bangalore Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Bechenehalli	0.0	Dispatch station
2	TOP for CNG & Peenya industrial area	24.5	Tap-off point for CNG station
3	TOP for Yahlanka PP	32.0	Tap off point for Yahlanka Power plant
4	TOP for Graphite, IPTL & Bhuvalka Power plant	49.5	Tap –off point
5	Bangalore	70.3	Receipt terminal
6	TOP for CNG	70.3	Tap-off point for CNG station

1.3. Gokak TOP –Belgaum - Goa Pipeline

S. No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Gokak	0.0	Tap-off point
2	TOP for Gokak mills & Ashok Iron works	10.93	Tap-off point
3	TOP for Tata PP & Hindalco	56.10	Tap-off point

42	TOP for CNG	56.10	Tap-off point for CNG station	3
5.3	Dhumrewadi	84.1	IPS on spur line-1G	
6.4	TOP for CNG	141.7	Tap-off point for CNG station	
7.5	Top for ~~Goa Binani~~ Glass Fibre Limited & M/s Nestle	141.7	Tap-off point at SV-4G	3
8.6	Top for M/s NM Nathurmal, ~~M/s Goa Energy~~ & M/s Sesa Goa	149.76	Tap off point ~~on Gokak-Goa spur line~~	
9.7	TOP for CNG ~~Top for M/s Syngenta India & M/s Hindustan Lever~~	~~163.84~~ 158.2	~~Tap-off point for CNG station~~ Tap-off point	
10.8	TOP for M/s Mondovi Pallets, M/s Finolex Cables Ltd., M/s Nestle, ponda, M/s Hindustan Unilever, & M/s Syngenta. TOP for CNG	~~163.84~~ 163.5	Tap-off point at SV-5G ~~Tap-off point for CNG station~~	
11.9	~~Goa~~ Top for M/s Mondovi Pallets, M/s Finolex Cables Ltd., M/s Nestle & M/s MRF	~~175.32~~ 163.84	~~Receipt terminal~~ Tap-off point at SV-5G	
12.10	TOP for KPCL PP & CNG station ~~Top for M/s Mata Copper, M/s Cipla and M/s Birla Furukwa~~	~~175.32~~ 171.0	Tap off point ~~Tap-off point~~	3
13.11	Top for M/s Reliance Infrastructure Ltd. ~~Goa~~	Upstream of Zuari Fertilizer Terminal ~~175.328~~	Tap-off point ~~Receipt terminal~~	
13.12	Top for M/s Umicore Anandeya Pvt. Ltd. TOP for KPCL PP & CNG station	Upstream of Zuari Fertilizer Terminal ~~175.328~~	Tap-off point ~~Tap-off point~~	3
13	Top for M/s Reliance Infrastructure Ltd. & M/s Umicore Anandeya Pvt. Ltd.	Upstream of Zuari Fertilizer Terminal	Tap-off point	

1.4. Dingnikuran TOP – Ratnagiri Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Dingnikuran	0.0	Tap-off point
2	Ratnagiri	57.0	receipt terminal

1.5. Herli TOP – Sangli Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME

1	Herli	0.0	Tap-off point
2	Sangli	32.0	Receipt terminal

1.6. Herli TOP – Kolhapur Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Herli	0.0	Tap-off point
2	Kolhapur	30.0	Receipt terminal

1.7. Gokak TOP – Bijapur Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Gokak	0.0	Tap-off point
2	Bijapur/Gulberga	118.0	Receipt terminal

1.8. Achmatti TOP (IPS-4) – Murudeshwar Pipeline



S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Achmatti (IPS-4)	0.0	Tap-off point
2	Murudeshwar	54.0	Receipt terminal

1.9. Santemuddapur TOP – Devangere - Harihar Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Santemuddapur	0.0	Tap-off point
2	Devangere	45.0	Receipt cum dispatch terminal
3	Harihar	75.0	Receipt terminal

1.10. Doddanarmangal TOP – Tumkur Pipeline

S.No.	INSTALLATION	CHAINAGE(Km)	STATION NAME
1	Doddanarmangal	0.0	Tap-off point
2	Tumkur	40.0	receipt terminal

ANNEXURE-III

SECTION WISE PIPELINE DETAILS

1. Dabhol-Bidadi-Bangalore Pipeline and spur lines.

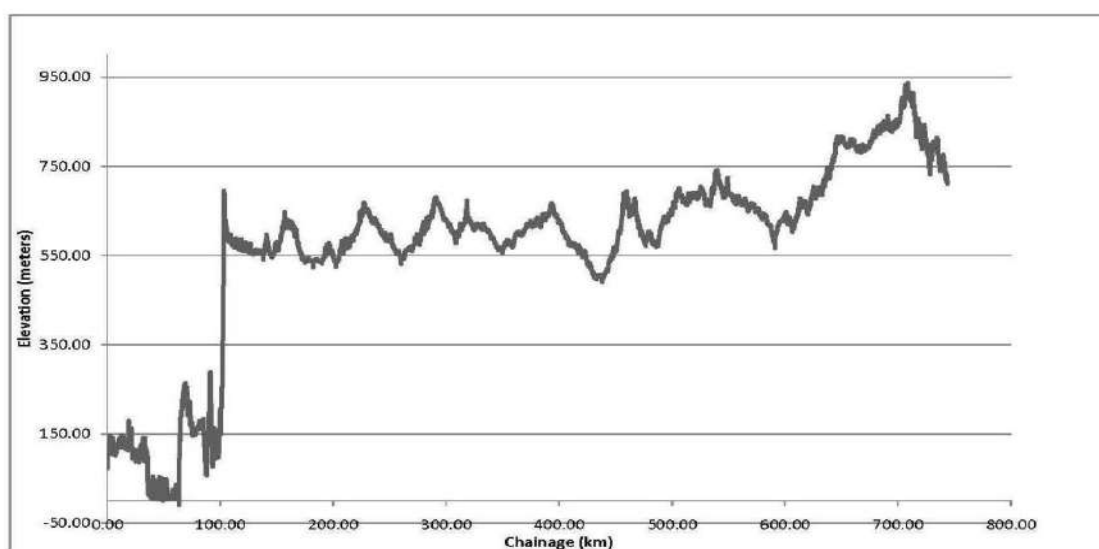
S.No.	Description of the pipeline section	Pipeline Size(inch)	Pipeline length(Km)
	Main trunk line		
1	Dabhol dispatch to IPS-1	36"	249.106
2	IPS-1 to Bidadi receiving station	30"	497.293
	Spur lines		

3	Dingnikuran TOP to Ratnagiri receipt terminal	8"	57
4	Herli TOP to Sangali receipt terminal	8"	32
5	Herli TOP to Kolhapur receipt terminal	8"	30
6	Gokak TOP to Goa receipt terminal	24"	175.328
<u>7</u>	<u>Gokak TOP to Bijapur receipt terminal</u>	<u>10"</u>	<u>118</u>
<u>8</u>	<u>Achmatti TOP to Murudeshwar receipt terminal</u>	<u>8"</u>	<u>54</u>
<u>9</u>	<u>Santemuddapur TOP to Devangere receipt terminal</u>	<u>8"</u>	<u>45</u>
<u>10</u>	<u>Devangere to Harihar receipt terminal</u>	<u>8"</u>	<u>30</u>
<u>11</u>	<u>Doddanarmangal TOP to Tumkur receipt terminal</u>	<u>8"</u>	<u>40</u>
<u>12</u>	<u>Bechenehalli TOP to Bangalore receipt terminal</u>	<u>18"</u>	<u>70.3</u>
<u>13</u>	<u>Tap-off from SV-21 to M/s HR Johnson</u>	<u>8"</u>	<u>16.77</u>
<u>14</u>	<u>Tap-off from Bidadi Receipt terminal to M/s Toyota kirloskar</u>	<u>4.5"</u>	<u>4.5</u>
<u>15</u>	<u>Tap off from chainage 56.10 km on Gokak- Goa P/L to M/s Hindalco</u>	<u>8"</u>	<u>0.55</u>
<u>166.1</u>	Tap off from SV-4G at chainage 141.7km on Gokak- Goa P/L to M/s Binani	4"	21.6
<u>176.1.1</u>	Tap off to M/s Nestle at chainage 4.18 km on P/L going to M/s Binani	4"	0.1
<u>186.2.</u>	Tap-off to M/s N M Nathurmal at chainage 149.76 km on Gokak-Goa P/L	4"	<u>8.65.7</u>
<u>186.2.1</u>	<u>Tap-off to M/s Goa Energy at chainage 1.61km on pipeline going to M/s N M Nathurmal</u>	<u>4"</u>	<u>0.1</u>
<u>196.2.2</u>	Tap-off to M/s Sesa Goa at chainage 1.28 <u>1</u> km on pipeline going to M/s N M Nathurmal	4"	0.1
<u>206.3</u>	Tap-off <u>from SV-5G</u> to M/s Syngenta India at chainage <u>15863.2084</u> km on Gokak-Goa P/L	4"	<u>11.145.5</u>
<u>216.4</u>	Tap-off <u>from SV-5G</u> to M/s Hindustan Unilever Ltd.- at chainage	8"	<u>10.444.8</u>

	~~163.84 km on Gokak-Goa P/L~~ <u>158.20 km on Gokak-Goa P/L</u>		
<u>226.5</u>	Tap-off from SV-5G to M/s Mondovi Peallets Ltd. at chainage 163.84 km on Gokak-Goa P/L	8"	14.4
<u>236.5.1</u>	Tap-off to M/s Finolex Cables Ltd. at chainage 5.864 km on P/L going to M/s Mondovi Peallets Ltd.	4"	10.8
<u>246.5.1.1</u>	Tap-off to M/s Nestle <u>ponda</u> -at chainage 10.4 km on P/L going to M/s Finolex Cables	4"	0.1
<u>6.5.1.2</u>	~~Tap-off to M/s MRF at chainage 9.803 km on P/L going to M/s Finolex Cables~~	<u>4"</u>	<u>0.1</u>
<u>6.6</u>	~~Tap-off to M/s Meta Copper at chainage 171.0 km on Gokak-Goa P/L~~	<u>8"</u>	<u>0.5</u>
<u>6.6.1</u>	~~Tap-off to M/s Cipla at upstream of terminal for M/s Meta Copper~~	<u>4"</u>	<u>4.5</u>
<u>6.6.1.1</u>	~~Tap-off to M/s Birla Furukawa at chainage 3.9km on pipeline to M/s Cipla~~	<u>4"</u>	<u>0.61</u>
<u>256.7</u>	Tap-off to M/s Reliance Infrastructure Ltd at ~~upstream of terminal for M/s Zuari Fertilizers on Goa receipt terminal~~ <u>Goka-Goa Pipeline</u>	8"	3.0
<u>266.7.1</u>	Tap-off to M/s Umicore Anandeya Pvt. Ltd at ~~chainage 1.0km on pipeline to M/s Reliance Ind.~~ <u>Goa receipt terminal</u>	4"	<u>10.5</u>
<u>7</u>	~~Gokak TOP to Bijapur receipt terminal~~	<u>10"</u>	<u>118</u>
<u>8</u>	~~Achmatti TOP to Murudeshwar receipt terminal~~	<u>8"</u>	<u>54</u>
<u>9</u>	~~Santemuddapur TOP to Devangere receipt terminal~~	<u>8"</u>	<u>45</u>
<u>10</u>	~~Devangere to Harihar receipt terminal~~	<u>8"</u>	<u>30</u>
<u>11</u>	~~Doddanarmangal TOP to Tumkur receipt terminal~~	<u>8"</u>	<u>40</u>
<u>12</u>	~~Bechenehalli TOP to Bangalore receipt terminal~~	<u>18"</u>	<u>70.3</u>

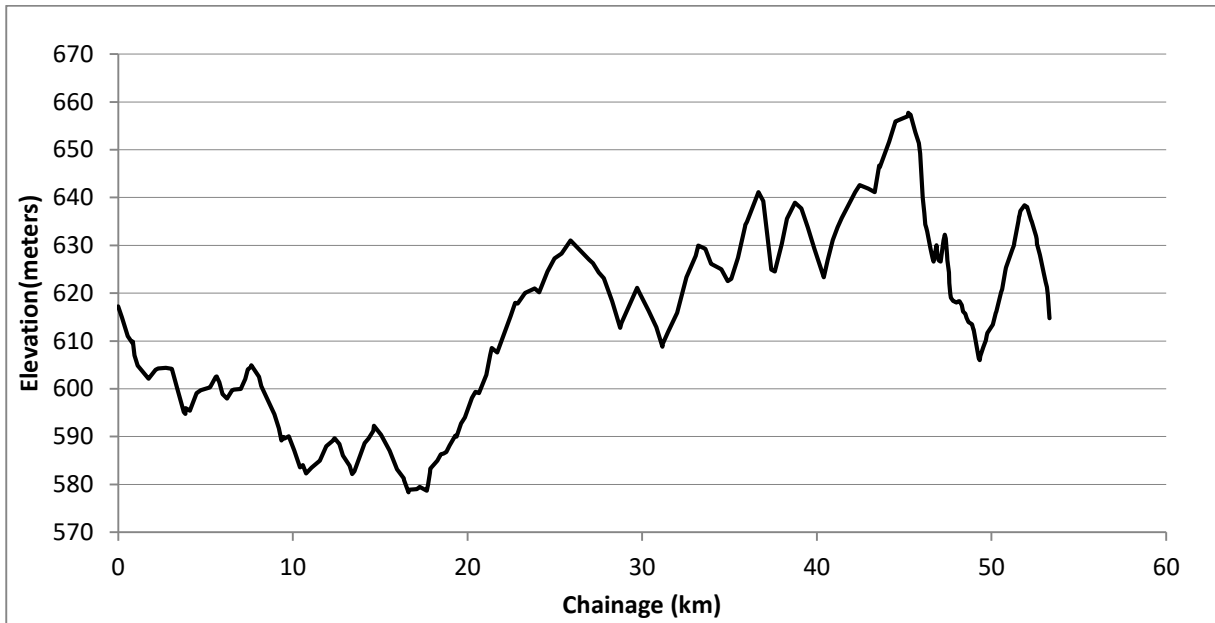
ANNEXURE-IV

GROUND PROFILE FOR DABHOL - BIDADI PIPELINE



ANNEXURE-V

GROUND PROFILE FOR ACHMATTI (IPS-4) – MURUDESHWAR SPUR LINE



3.0 BASIC DESIGN PARAMETERS

Following basic design parameters of existing pipelines shall be taken into consideration:

Pipeline size	HVJ : 36"	DVPL-I : 42"	DVPL -II : 48"	GREP : 36"	VDPL: 48"
Pipeline Length	Pipeline actual length shall be as per schematic arrangement of pipeline facilities. Refer annexure for details				
Pipeline roughness	15 microns (Internally coated) and 45 micron for without internal coating				
Material of construction for pipeline	Carbon Steel				
Pipeline Corrosion Allowance	0.5 mm				
Subsoil temperature	20 - 30 °C throughout the entire length of the pipeline network.				
Design Pressure, Kg/cm ² (g)	HVJ , DVPL I & II, GREP :92.0 VDPL : 99.93				
Design temperature	-29 °C to 60 °C for all buried sections -29 °C to 65 °C for above ground portion				
Pipeline laying	Buried				
Burial Depth, m	Min. 1.0 m				
Design margin (for pipeline)	On flow : NIL On length : NIL				
Max. operating parameters	Hazira	Dahej		Ankot	
Pressure	92.0	92.0		92.0	
Temperature	55	15		25	

In Year, 1987; HVJ pipeline project was executed. Along HVJ pipeline, four different compressor stations namely, Hazira, Jhabua, Vijaipur & Dibiyapur were installed. In each compressor station(s), Gas Turbine driven Compressor (GTC) units were installed for boosting gas pressure for onward transportation through the pipeline network. Details of those GTC Units are given below:

PROCESS DESIGN BASIS FOR PMC SERVICES FOR COMPRESSOR STATIONS WORKS AT KAILARAS AND CHAINSA FOR VIJAIPUR –DADRI PIPELINE PROJECT

APPROVED	
GAIL	EIL

B	18.03.09	CLIENT'S INPUTS INCORPORATED & REISSUED FOR APPROVAL			
A	20.1.09	ISSUED FOR COMMENTS/APPROVAL	MKA	AS	AS
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

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1.0	INTRODUCTION
2.0	BASIC PARAMETERS
3.0	PROJECT SCOPE AND BATTERY LIMITS
4.0	PIPELINE PARAMETERS
5.0	COMPRESSOR STATION PARAMETERS
6.0	INSTRUMENTATION
7.0	SCADA & TELECOMMUNICATION SYSTEM
8.0	METEOROLOGICAL DATA
9.0	GENERAL PROJECT SPECIFICATIONS
10.0	SPECIAL CUSTOMER REQUIREMENTS
ANNEXURE –I	COMPOSITION OF GAS

1.0 INTRODUCTION:

GAIL (India) Limited, have awarded EIL the Project Management Consultancy Services for installation of new compressor stations and associated facilities in the proposed 48" Vijaipur –Dadri Pipeline being currently executed under Vijaipur-Dadri-Bawana Pipeline Project at Kailaras and Chainsa.

The project broadly covers installation of compressor stations at Kailaras (228.036 Kms) downstream of Vijaipur near 2nd Intermediate Pigging Station) and at Chainsa(457.049 Kms) downstream of Vijaipur near 4th Intermediate Pigging Station) on new 48” Vijaipur-Dadri pipeline.

This design basis covers the design parameters for compressor stations.

2.0 BASIC PARAMETERS

2.1	Products to be transported	Gas
2.2	Product properties/specifications	As per Annexure-I.
2.3	Design codes	Latest edition of ASME B31.8 and OISD-226 Guidelines will be followed as applicable. However, in case of contradictory stipulations, the more stringent conditions will prevail.
2.4	Total compression capacity required	KAILARAS : 53.4–75 MMSCMD CHAINS A : 53.155 MMSCMD
2.5	Sparing philosophy for compressors	100% for Single compressors (1W+1S) 50% for two compressors (2W+1S) 33% for three compressors (3W+1S)
2.6	Type of compressor	Centrifugal
2.7	Type of driver	Gas Turbine
2.8	Type of intercooler and after cooler	Air cooler

3.0 PROJECT SCOPE AND BATTERY LIMITS

3.1 PROJECT SCOPE:

- Compressor Stations at Kailaras and Chainsa along with its auxiliaries, GTG/GEG/DEG etc.

3.2 BATTERY LIMITS :

3.2.1	Compressor Station at Kailaras	:	From/to existing 36” Tap-Offs provided at IPS-2 on 48” Vijaipur-Dadri pipeline.
3.2.2	Gas compositions	:	Annexure-I

3.2.3	Compressor Station at Chainsa	:	From/to existing 36” Tap-Offs provided at IPS-4 on 48” Vijaipur-Dadri pipeline.
3.2.4	Gas compositions	:	Annexure-I

4.0 PIPELINE PARAMETERS (UNDER EXECUTION)

4.1	Main pipeline diameter	:	48" NB
4.2	Pipeline Roughness	:	10 micron
4.3	Corrosion allowance	:	Nil
4.4	Subsoil temperature	:	20-25 deg. C (1 meter below surface)
4.5	Chainage of IPS-2 (Kailaras)	:	228.43036 km from Vijaipur
4.6	Chainage of IPS-4 (Chainsa)	:	456.7457049 km from Vijaipur

5.0 COMPRESSOR STATION PARAMETERS

5.1 Kailaras Compressor Station

Compressor suction pressure	:	As per hydraulics
Compressor suction temperature	:	As per hydraulics
Compressor discharge pressure	:	99.93 kg/cm ² _g
Total flow rate	:	~~53.4~~ <u>53.75</u> MMSCMD
Configuration	:	2+1 (To be confirmed by compressor vendor)

5.2 Chainsa Compressor Station

Compressor suction pressure	:	As per hydraulics
Compressor suction temperature	:	As per hydraulics
Compressor discharge pressure	:	99.93 kg/cm ² _g

Total flow rate : 53.1553.5 MMSCMD

Configuration : 2+1 (To be confirmed by compressor vendor)

5.3 Utility specification (At Kailaras Compressor station)

S.NO	Parameters	Plant Air	Instrument Air	Nitrogen	Service Water
5.3.1	Source	From. Air Compressor	From. Air Compressor	From PSA Unit	Borewell
5.3.2	Dew Point	—	-40°C at atm. Pr.	—	—
5.3.3	Pressure, kg/cm ² _g (min/nor/design)	5.0/ 8.0 / 11.5	5.0/ 7.5 / 11.5	4.5	3.0
5.3.4	Temperature, ° C	55.0	55.0	Ambient	Ambient
5.3.5	Storage requirement	5 minutes hold-up	20 minutes hold-up	—	—
5.3.6	Consumption	Note:1	Note:1	Note:1	5 m ³ /hr (intermittent)
5.3.7	Quality	Oil Free	Oil Free	99.5% pure	

Note 1: Data will be firm-up after the requirement is finalized by Compressor/GTC vendors during detailed engineering.

5.4 Utility specification (At Chainsa Compressor station)

S.NO	Parameters	Plant Air	Instrument Air	Nitrogen	Service Water
5.4.1	Source	From. Air Compressor	From. Air Compressor	From PSA Unit	Borewell
5.4.2	Dew Point	—	-40°C at atm. Pr.	—	—
5.4.3	Pressure, kg/cm ² _g (min/nor/design)	5.0/ 8.0 / 11.5	5.0/ 7.5 / 11.5	4.5	3.0
5.4.4	Temperature, ° C	55.0	55.0	Ambient	Ambient
5.4.5	Storage requirement	5 minutes hold-up	20 minutes hold-up	—	—
5.4.6	Consumption	Note:1	Note:1	Note:1	5 m ³ /hr (intermittent)
5.4.7	Quality	Oil Free	Oil Free	99.5% pure	

Note 1: Data will be firm-up after the requirement is finalized by Compressor/GTC vendors during detailed engineering.

6.0 INSTRUMENTATION

6.1	General	Adequate instrumentation and control system will be provided for safe and efficient operation. The compressor station shall be monitored and controlled through Supervisory Control and Data Acquisition (SCADA) of DVBPL currently being executed which is designed for remote monitoring and control application. RTU/Flow computers shall be provided at compressor station for flow computation, signal transmission to SCADA and logic and control. All transmitters shall be smart transmitters.
6.2	Control Philosophy At Kailaras & Chainsa compressor stations	Two levels of controls viz. PLC & SCADA are envisaged. Individual compressor trains shall be operated from the respective unit PLC(only minimum critical parameters are available in Unit Control Panel (UCP)) Station facility and common equipment shall be operated from common PLC (only minimum critical parameters are available in Facility Control Panel (FCP)).
6.3	Compressor Control	CCC ~~or equivalent.~~
6.4	Interlock & Shut down	PLC based.
6.5	Safety valve isolation	Safety valve isolation will be provided wherever required These isolation valves should be locked open.
6.6	Block & by-pass valve for control valves	As per design.
6.7	Type of control	Electronic
6.8	Final control element	Gas/Instrument air actuated for control valves and line gas for AVs.

B

7.0 SCADA & TELECOMMUNICATION SYSTEM

SCADA and Telecommunication systems being provided for Vijaipur–Dadri-Bawana Pipeline Project shall be extended to include compressor stations to ensure effective and reliable control, management and supervision of the compressor stations from a centralized location using Remote Telemetry Units (RTU).

7.1 SCADA monitoring and control: The SCADA master control station (SMCS) shall be located at NGMC, Noida.

8.0 METEOROLOGICAL DATA

Location	Ambient temp. °C		Design Rh	Altitude, M above MSL	Air temp. considered for air cooler design,deg.C
	Min.	Max.			
Kailaras	2	46	84%@45°C	190.3	42
Chainsa	2	46	90%@35°C	197.8	42

9.0 GENERAL PROJECT SPECIFICATIONS

9.1 Numbering system to be followed:

9.1.1	Equipments	As per EIL standard
9.1.2	Instruments	As per EIL standard
9.1.3	Drawings/Documents	As per EIL standard
9.1.4	Unit No.	Kailaras CS : 070 Chainsa CS : 071
9.1.5	P&ID No.	Kailaras CS : <u>1210 - 1219</u> Chainsa CS : <u>1220 - 1229</u>

9.2 Units of Measurement: Metric, unless otherwise specified Gas flow rate shall be in MMSCMD

10.0 SPECIAL CUSTOMER REQUIREMENTS

- 10.1 ~~Since the compressor stations are installed at almost equal distances the specifications for compressors (suction pressure and compression ratio) shall be kept same in order to have the advantage of common spares~~DELETED.
- 10.2 Line down stream of compressor station should be piggable.
- 10.3 ~~Vendor to check the compressors at Chainsa and Kailaras for flow rate of 60MMSCMD (Check Case) and furnish the maximum discharge pressure achievable at Kailaras and Chainsa and also ensure minimum discharge pressure of 92kg/cm2g at Chainsa by various options such as variation of speed, taking standby train in line and bypass of excess gas~~DELETED.

ANNEXURE I

COMPOSITIONS OF GAS

(A) Rich gas (W/O C2/C3 extraction at DAHEJ)

S.NO	Component	Gas Composition, Mol%
1	C1	92.49
2	C2	5.64
3	C3	1.41
4	IC4	0.20
5	NC4	0.15
6	IC5	---
7	NC5	0.01
8	C6	---
9	N ₂	0.09
10	CO ₂	----
11	H ₂ S	6ppmw
12	Total Sulfur	24ppmw
	Total	100

(B) LEAN GAS (With C2/C3 extraction at Dahej)

S.NO	Name	Mol %
1	C1	94.07
2	C2	4.59
3	C3	1.07
4	IC4	0.18
5	NC4	---
6	IC5	---
7	NC5	---
8	C6	---
9	N ₂	0.09
10	CO ₂	---

11	H ₂ S	6 ppmw
12	Total Sulfur	24ppmw
	Total	100

Rich gas is mixture of Dahej RLNG + Spot LNG + Reliance gas .Lean gas is a mixture of gas after extraction of C2/C3 from RLNG at Dahej +Spot LNG + Reliance gas.

TABLE 3-2

COMPRESSOR PERFORMANCE
GUARANTEE POINT ONLY

HAZIRA STATION

Operating Conditions

Model:	CDP-416	
Case:	Design	
Gas Handled:	Natural Gas	
MMSCFD (14.7 PSIA, 60°F, Dry)		
(SM ³ /HR at 1.033 kg/cm ² a 15°C):	80.484	(94791) S44
Weight Flow, lb/min (kg/hr):	3049.7	(82985)
Inlet Conditions:		
Pressure, PSIA (kg/cm ² A):	654.1	(46.0) ✓
Temperature, °F (°C):	104	(40)
Molecular Weight:	20.7	
Cp/Cv (K Avg):	1.255	
Compressibility (Z ₁):	0.90	
Inlet Volume (ICFM-Wet) (AM ³ /Hr):	1226	(2083)
Discharge Pressure:		
Pressure, PSIA (kg/cm ² A):	1228.6	(86.4) ✓
Temperature, °F (°C):	202	(94)
Cp/Cv (K Avg):	1.255	
Compressibility (Z ₂):	0.900	

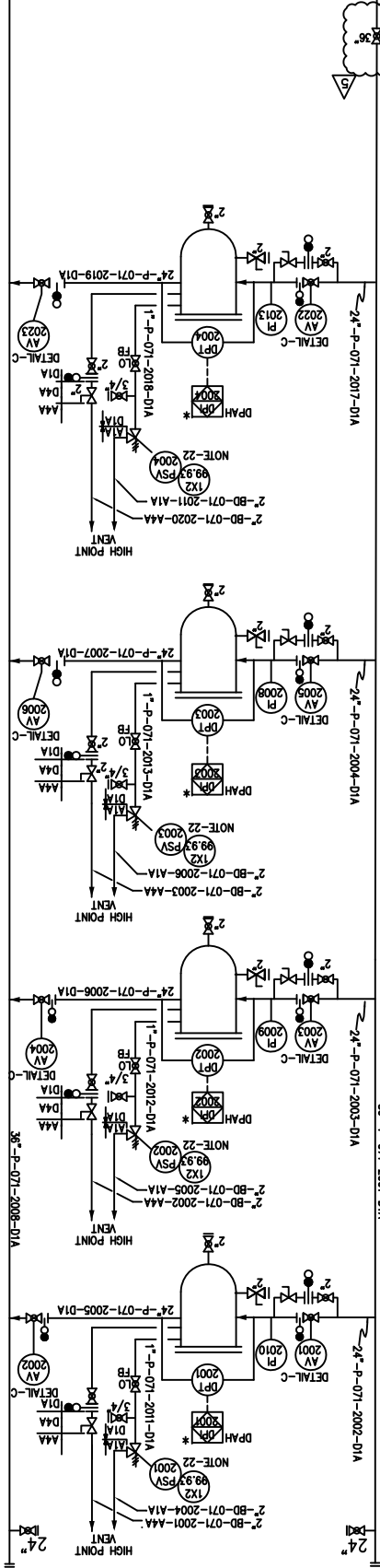
Performance

BHP required at compr cplg: (kw)	3125	(2330)
Speed, (RPM), approximate:	13172	
Max. continuous speed, RPM:	13830	
Overspeed Trip Setting, RPM:	14522	
Head (Ft): (metres) Poly:	25928	(7900)
Efficiency (%): Poly:	79.3	

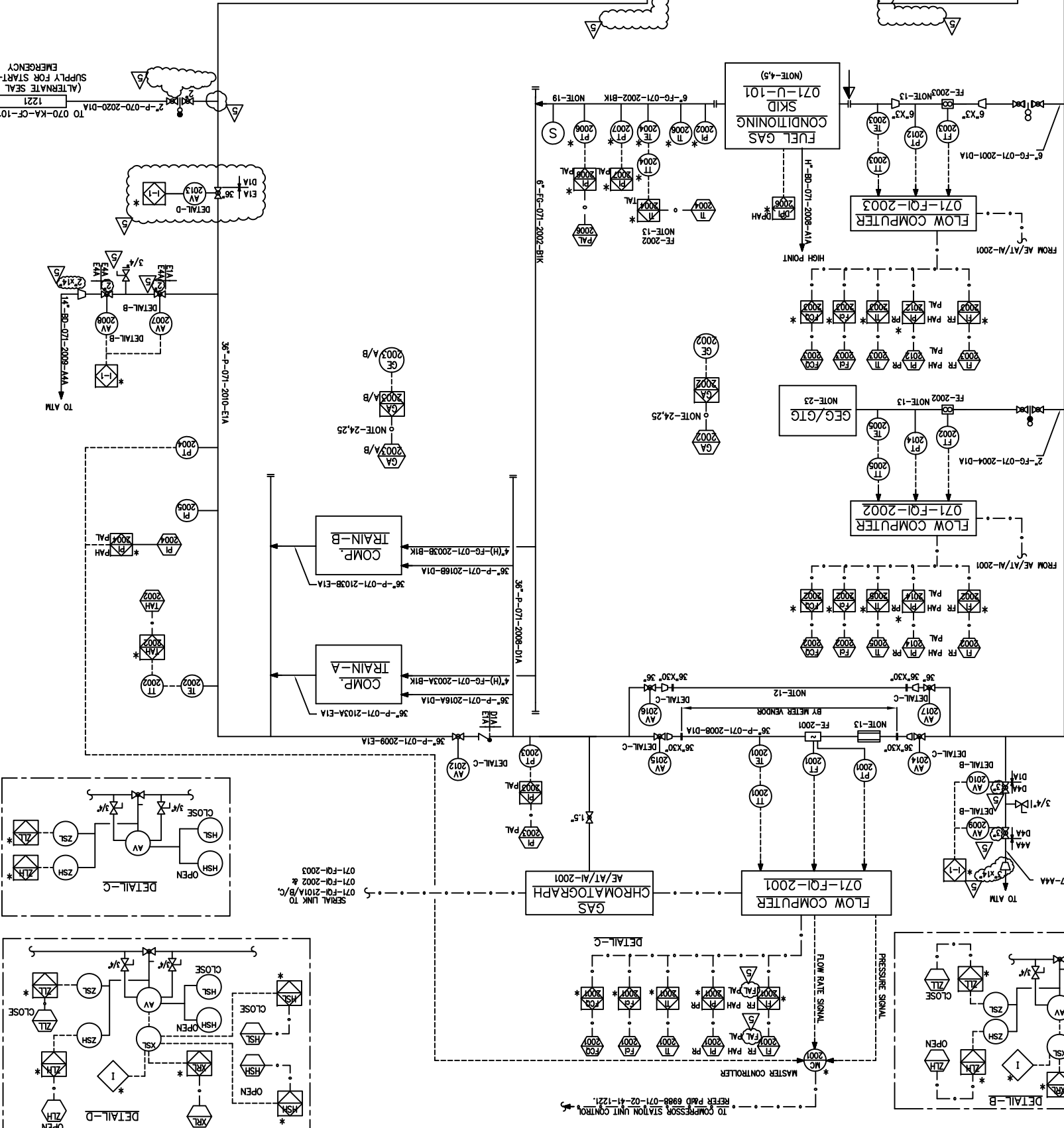
Guarantee

Compressor is guaranteed for head and inlet volume. Horsepower is guaranteed, subject to a tolerance of +4%.

071-GN-GT-101 A/B/C/D
GAS FILTERS



071-KA-CF-101 A/B
GAS TURBINE COMPRESSORS



LEGEND:
GTC VENDOR SCOPE
NEW LINE
EXISTING LINE
GTC VENDOR SCOPE

No.	Date	Revisions
0	10/11/10	ISSUED FOR COMMENTS/ENGINEERING
1	24/09/10	REVISED AS MARKED
2	16/09/10	REVISED AS MARKED
3	16/09/10	REVISED AS MARKED
4	25/10/10	REVISED AS MARKED
5	10/11/10	REVISED AS PER HAZOP RECOMMENDATIONS & DOW

- NOTES:
- SAFETY VALVE TO BE LOCALLY VENTED AT SAFE ELEVATION.
 - VENTS FROM COMPRESSOR STATION AND AT AN ELEVATION NOT LESS THAN 3M ABOVE THE HIGHEST OPERATING LEVEL IN THE COMPRESSOR STATION. ALL VENT LINES TO HAVE RAIN CAP AT TOP AND DRAIN AT BOTTOM.
 - ALL THE INDICATIONS/RECORDS OF INSTRUMENTS SHOWN IN THIS P&ID SHALL BE ON P.I.C. PANEL MOUNTED INSTRUMENTS TO BE PROVIDED BY GTC VENDOR AND SHALL BE DESIGNED FOR COMP. CONFIGURATION (1-1) CONSIDERING THE TOTAL FUEL GAS REQUIREMENT. VENDOR TO PROVIDE FLOW MEASUREMENT SYSTEM. FUEL GAS FLOW INDICATION TO BE PROVIDED IN THE CONTROL ROOM.
 - DPFT-2006 TO BE SUPPLIED BY GTC VENDOR.
 - MASTER CONTROL IS FUNCTIONALLY SHOWN & INDICATIVE ONLY. FINAL SCHEME SHALL BE IMPLEMENTED AS PER SPECIFICATION BY COMPRESSOR VENDOR.
 - ESD BUTTON SHALL BE PROVIDED IN (SCADA) MCC, STATION COMMON PANEL.
 - REFER P&ID 6988-071-02-41-1221 FOR TYPICAL DETAILS OF COMPRESSOR TRAIN.
 - DELETED.
 - INTERLOCK No.: ACTIVATED BY ACTION
 - STATION ESD ON SCADA/ OPEN 071-AV-2007 TRIP THE COMP. TRANS 071-KA-CF-101 A/B
 - ESD PUSH BUTTON COMMON PANEL
 - 071-AV-2008
 - 071-AV-2009
 - 071-AV-2010
 - 071-AV-2011
 - 071-AV-2013
 - ESD LOGIC SHOULD NOT RESET UNTIL AND UNLESS ALL DESIRED ACTIONS ARE ACHIEVED.
 - REFER LEGEND P&ID 6988-00-02-1201 FOR TYPICAL VALVES
 - PROVISION OF BYPASS LINE WITH SPOOL PIECE FOR INSTALLATION
 - STRAIGHT LENGTH AS PER INSTRUMENTATION REQUIREMENT.
 - FLOW COMPENSATION SHOULD BE DONE IN FLOW COMPUTER.
 - ANTI SURGE CONTROL, PERFORMANCE CONTROL AND MASTER CONTROL FUNCTIONALLY SHOWN AND INDICATIVE ONLY. FINAL SCHEME SHALL BE IMPLEMENTED AS PER SPECIFICATION BY COMPRESSOR VENDOR.
 - SIGNAL TO SCADA SHALL BE THROUGH SEPARATE SERIAL LINK FROM STATION P.I.C. & EACH TRAIN U.P.
 - COMPRESSOR STATION INLET & OUTLET CONNECTION TO BE TAKEN FROM PROVISION KEPT FOR FUTURE COMPRESSOR UNDER VOBPL PROJECT.
 - ALL INDICATIONS, RECORDING OF INSTRUMENTS, STATUS, CONTROLS & ALARMS INDICATED IN THE P&ID SHALL BE IN COMMON FACILITY CONTROL. P&ID/PANEL THE COMMON FACILITY PLC AND PANEL IS IN GTC PACKAGE VENDOR'S SCOPE.
 - FOR SAMPLE CONNECTION DETAILS REFER P&ID NO. 6921-02-41-00-1202.
 - HOOK UP TO BE TAKEN FROM SUCTION HEADER END FLANGE OF GREP COMPRESSORS.
 - HOOK UP TO BE TAKEN AT END FLANGE OF GREP KALARAS COMPRESSOR DISCHARGE HEADER.
 - FIRE CASE PSV ON GAS FILTER TO BE PROVIDED BY FILTER VENDOR.
 - GE6/GTC PACKAGE TO BE SUPPLIED BY VENDOR. VENDOR DRAWINGS SHALL BE REFERRED FOR DETAILS.
 - HYDROCARBON DETECTORS SHALL BE PROVIDED FOR ALARM AT SUITABLE STRATEGIC LOCATIONS TO MONITOR THE LEAKAGE OF FAILURE PRONE EQUIPMENT PARTS, ACCESSORIES, VALVES & PIPES DEPENDING UPON THE WIND DIRECTION AND GAS DENSITY.
 - GAS DETECTORS ARE TO BE PROVIDED AT DOWN WIND DIRECTIONS SIGNAL FROM GAS DETECTOR WILL BE TAKEN TO SMCs AND CONTROL ROOM.

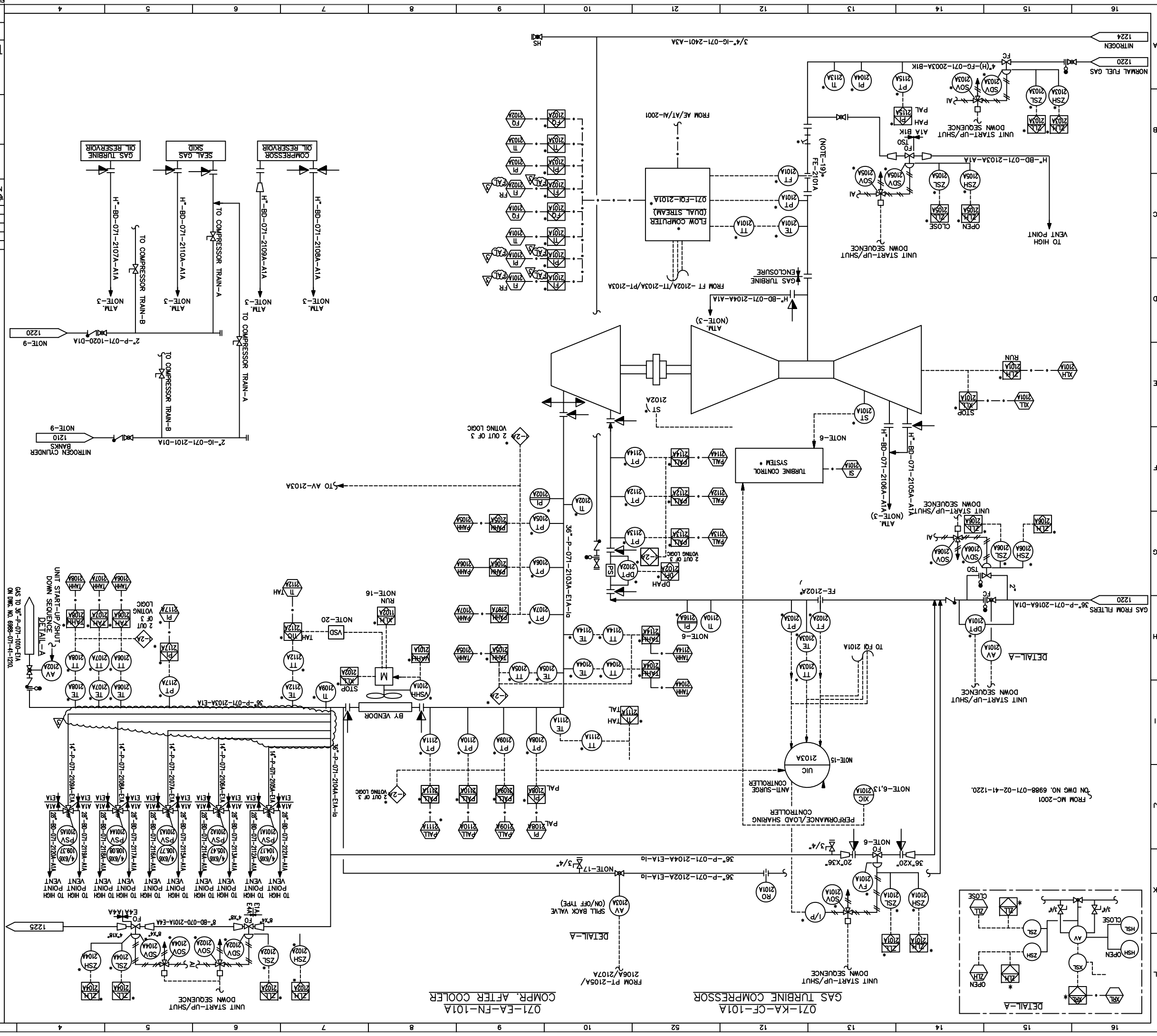
ENGINEERS INDIA LIMITED
(A Govt. of India Undertaking)

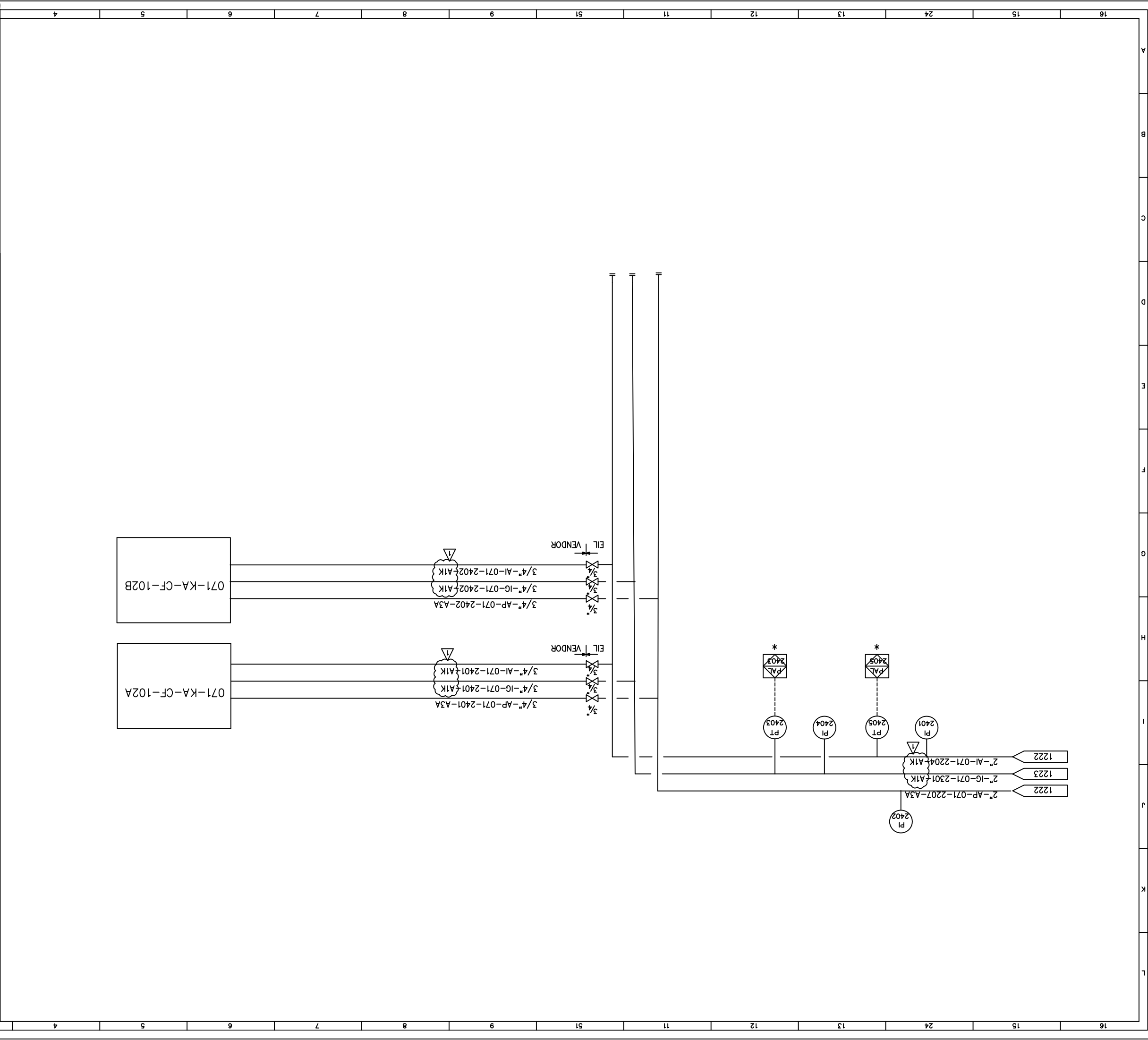
COMPRESSOR STATION WORKS AT KALARAS AND CHAINSA
PIPING AND INSTRUMENTATION DIAGRAM
CHAINSA COMPRESSOR STATION

REVISIONS

No.	Date	Revisions
0	10/11/10	ISSUED FOR COMMENTS/ENGINEERING
1	24/09/10	REVISED AS MARKED
2	16/09/10	REVISED AS MARKED
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4	25/10/10	REVISED AS MARKED
5	10/11/10	REVISED AS PER HAZOP RECOMMENDATIONS & DOW

SCALE: 1:100
DWG. No. 1220
REV. 5

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ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)																COMPRESSOR STATION WORKS AT KALARAS AND CHAINSA GAS AUTHORITY OF INDIA LIMITED																UTILITY DISTRIBUTION AT CHINSA																SCALE																REV.																JOB NO.																DEPT.																SECTN.																UNIT																DWG. 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OPERATING MANUAL FOR DABHOL-BANGALORE PIPELINE (PHASE-I)



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- B. MSDS (MATERIAL SAFETY DATA SHEET)**
- C. DETALIED PRECOMMISSIONING & COMMISSIONING PROCEDURE**
- D. PIPING AND INSTRUMENTATION DIAGRAM**
- E. PIPELINE SCHEMATIC**

PREFACE

This manual contains the supervisory operating guidelines for RLNG pipeline from Dabhol DT to Bidadi RT, including spur lines to Goa and Bangalore. It consists of process description, supervisory instructions for normal operation, pipeline start-up and of various equipments envisaged under this project. This manual also provides general guidelines for preparing the facilities for start-up and on safety aspects.

The instructions have been prepared for the purpose of facilitating the start-up and subsequent operations. The operating procedures and conditions given herein are not mandatory and may have to be modified based on site constraints or as a result of experience gained in operating the facilities.

Detailed operating and maintenance instructions for equipment are not included in this manual, for which manufacturers/vendor's manual may be referred to. In event of any discrepancy between this manual and manufacturer's recommendation, the latter shall be deemed final.

SECTION-1

GENERAL

1.0 INTRODUCTION

M/s GAIL (India) Limited, has awarded EIL the Project Management Consultancy Services for the Dabhol – Bidadi (Bangalore) Pipeline of size 36” dia. up to 248.456 km from Dabhol & balance line of 30” up to Bidadi with design capacity of 16 MMSCMD gas. The system also includes spur lines for supply of gas at various locations viz. in Sangli, Ratnagiri, Kolhapur, Bijapur/Gulberga, Goa, Dharwad/Hubli, Devangere, Tumkur, Harihar and Bangalore. The pipeline originates from Dabhol terminal with length of the main trunk line portion of size 36” of approximately 248.456 km and length of remaining portion of size 30” as approximately 497.29 km. The project is being executed in two phases. In Phase-I the 36”/30” trunk line and 18”/24” spur lines for Bangalore and Goa and corresponding receipt terminals, intermediate pigging stations and consumer terminals for Zuari fertilizers at Goa, Power plant of KPCL at Bidadi and City Gate Station at Bangalore are to be installed and commissioned.

This operating manual deals with the facilities envisaged under phase-I only.

1.1 BASIC PARAMETERS

1.1.1 DABHOL DESPATCH STATION

1.	Products to be transported	Gas
2.	Product properties/specifications	As per section 1.12
3.	Design codes	ASME B31.8 and OISD-226 Guidelines will be followed as applicable. However, in case of contradictory stipulations, the more stringent conditions will prevail.
4.	Source of product(RLNG)	RLNG from Dabhol LNG terminal will be the gas supply source for this pipeline.
5.	Pipeline design throughput (RLNG)	Pipeline hydraulics has been carried out for following cases: (i) Design Throughput of 16.0 MMSCMD, considering RLNG from

		Dabhol terminal at a pressure of 92 kg/cm ² g. (ii) Maximum established throughput of 22.04 MMSCMD considering RLNG from Dabhol terminal at a pressure of 92 kg/cm ² g.

1.1.2 BIDADI RECEIPT STATION

1.	Products to be transported	Gas
2.	Product properties/specifications	As per section 1.12
3.	Design codes	ASME B31.8 and OISD-226 Guidelines will be followed as applicable. However, in case of contradictory stipulations, the more stringent conditions will prevail.
4.	Source of product (RLNG)	RLNG from 36"/30" Dabhol-Bidadi pipeline is the gas supply source for this receipt station.
5.	Pipeline design throughput (RLNG)	Pipeline hydraulics has been carried out for following cases: (i) Design Throughput of 16 MMSCMD, considering RLNG from Dabhol terminal at a pressure of 92 kg/cm ² g. (ii) Maximum established throughput of 22.04 MMSCMD considering RLNG from Dabhol terminal at a pressure of 92 kg/cm ² g.

1.2 PROJECT BATTERY LIMITS

1.2.1 At Dabhol

Hook-up with existing 20" tap-off provided at Dabhol terminal under the project
 "Connectivity Between RGPPL RLNG Terminal with GAIL's Dabhol Terminal."

1.2.2 Battery limit conditions

Inlet flow rate, MMSCMD	:	16MMSCMD
Operating pressure, Kg/cm ² g	:	92.0 Kg/cm ² g
Operating temperature, ° C	:	-4 to +4

1.3 PIPELINE PARAMETERS

1.3.1 DABHOL-BIDADI PIPELINE & ASSOCIATED SPURLINES TO GOA & BANGALORE

1.	Pipeline operating life	25 Years
2.	Pipeline Length	From Dabhol terminal total length of the main trunk line of size 36"/30" will be approx. 743.75 km, and spur line of sizes 18" & 24" will be of approx. 71.9 and 175.3km respectively.
3.	Pipeline roughness	10 micron for line size 18" and above (Internally coated). 45 micron for line size below 18" (Uncoated).
4.	Material of construction for pipeline	Carbon Steel
5.	Pipeline Corrosion Allowance	0.5 mm (on calculated thickness) for internally uncoated pipe. NIL (As per GAIL'S Recent jobs considering gas composition & internal coating) for internally coated pipe.
6.	Subsoil temperature	20 - 30 °C throughout the entire length of the pipeline.
7.	Design Pressure	92.0 Kg/cm ² (G) for Dabhol - Bidadi pipeline and associated spur-lines to Goa and Bangalore
8.	Design temperature	-29 °C to 60 °C for all buried sections -29 °C to 65 °C for above ground portion
9.	Pipeline laying	Buried
10.	Burial Depth, m	Min. 1.0 m, as per OISD norms.
11.	Ground profile	As per Annexure-A
12.	Pipeline corrosion protection system	Pipeline shall be protected from external corrosion by suitable external 3 layers PE coating and impressed current cathodic protection.

13.	Corrosion Monitoring System	Corrosion monitoring system has been provided as required at various stations.
14.	Design margin (for pipeline)	On flow : NIL On length : 3%
15.	Sectionalizing Valves	Sectionalizing valves has been provided along the pipeline as per ASME B31.8. Tap-off provision with valve has been kept at all SV stations for future consumers.

1.4 DISPATCH / RECEIPT STATION PARAMETERS

1.4.1 DABHOL DISPATCH TERMINAL DESIGN PARAMETERS.

1.	Source of Gas	Regasified LNG from Dabhol LNG Terminal.
2.	Location	DABHOL Dispatch Terminal
3.	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	-4 to +4 / 65 -4 to +4 / 65
4.	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	92.0 / 92.0 92.0 / 92.0
5.	Flow rate, MMSCMD	16.0 MMSCMD

1.4.2 BIDADI RECEIPT TERMINAL

i. BIDADI RECEIPT TERMINAL DESIGN PARAMETERS

1.	Source of Gas	Dabhol to Bidadi RLNG pipeline.
2.	Location	Bidadi Receipt terminal
3.	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65

4.	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 92.0
5.	Flow rate, MMSCMD	*5.725 MMSCMD at present (based on maximum achievable capacity of trunk line of 22.04 MMSCMD)

*Figure arrived at by gas balance. However the Bidadi terminal has been designed to flow capacity of 7.347 MMSCMD.

ii. BIDADI CONSUMER TERMINAL FOR KPCL DESIGN PARAMETERS.

1.	Source of Gas	Dabhol to Bidadi RLNG pipeline.
2.	Location	Bidadi receipt terminal
3.	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65
4.	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 49.0
5.	Flow rate, MMSCMD	6.26 MMSCMD

1.4.3 BANGALORE RECEIPT TERMINAL DESIGN PARAMETERS

1.	Source of Gas	Regasified LNG from Bidadi to Bangalore RLNG pipeline.
2.	Location	Bangalore Receipt terminal
3.	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65
4.	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 49.0

5.	Flow rate, MMSCMD	2.199 MMSCMD

1.4.4 GOA RECEIPT TERMINAL DESIGN PARAMETERS (FOR ZUARI FERTILIZERS)

1.	Source of Gas	Regasified LNG from Gokak to Goa RLNG pipeline.
2.	Location	Goa Receipt terminal
3.	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
4.	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.	Flow rate, MMSCMD	1.1 MMSCMD

Note: Spur line to Goa has been terminated at Zuari Fertilizer and TOP provision for CGS, industrial consumers, CNG station and KPCL PP has been provided separately.

1.4.5 RATNAGIRI RECEIPT TERMINAL DESIGN PARAMETERS (PHASE-II)

1.	Source of Gas	Regasified LNG from Sangameshwar TOP to Ratnagiri RLNG Pipeline.
2.	Location	Ratnagiri Receipt terminal
3.	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
4.	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.	Flow rate, MMSCMD	0.343 MMSCMD

1.4.6 SANGALI RECEIPT TERMINAL DESIGN PARAMETERS (PHASE-II)

1.	Source of Gas	Regasified LNG from Herli TOP to Sangali RLNG Pipeline.
2.	Location	Sangali Receipt terminal
3.	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
4.	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.	Flow rate, MMSCMD	0.1 MMSCMD

1.4.7 KOLHAPUR RECEIPT TERMINAL DESIGN PARAMETERS (PHASE-II)

1.	Source of Gas	Regasified LNG from Herli TOP to Kolhapur RLNG Pipeline.
2.	Location	Kolhapur Receipt terminal
3.	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
4.	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.	Flow rate, MMSCMD	0.218 MMSCMD

1.4.8 BIJAPUR/GULBERGA RECEIPT TERMINAL DESIGN PARAMETERS (PHASE-II)

1.	Source of Gas	Regasified LNG from Gokak TOP to Bijapur RLNG pipeline.
2.	Location	Bijapur Receipt terminal

3.	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65
4.	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 92.0
5.	Flow rate, MMSCMD	1.0 MMSCMD

1.4.9 MURUDESHWAR CERAMIC RECEIPT TERMINAL DESIGN PARAMETERS (PHASE-II)

1.	Source of Gas	Regasified LNG from IPS4 to Murudeshwar RLNG pipeline.
2.	Location	Dharwad Receipt terminal
3.	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65
4.	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 19.0
5.	Flow rate, MMSCMD	1.0 MMSCMD

1.4.10 DEVANGERE (RECEIPT CUM DISPATCH STATION FOR HARIHAR) (PHASE-II)

i. DEVANGERE RECEIPT TERMINAL DESIGN PARAMETERS

1.	Source of Gas	Regasified LNG from Jagalur TOP to Devangere RLNG pipeline.
2.	Location	Devangere Receipt terminal
3.	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65

4.	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 92.0
5.	Flow rate, MMSCMD	0.353 MMSCMD

ii. DEVANGERE CONSUMER TERMINAL DESIGN PARAMETERS

1.	Source of Gas	Regasified LNG from Jagalur TOP to Devangere RLNG pipeline.
2.	Location	Devangere Receipt terminal
3.	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65
4.	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 92.0
5.	Flow rate, MMSCMD	0.003 MMSCMD

iii. DEVANGERE DISPATCH TERMINAL FOR HARIHAR DESIGN PARAMETERS

1.	Source of Gas	Regasified LNG from Jagalur TOP to Devangere RLNG pipeline.
2.	Location	Devangere dispatch terminal
3.	Battery limit temperature, °C (Normal/Design) at • Inlet • Outlet	• As per hydraulics / 65 • As per hydraulics / 65
4.	Battery limit pressure, kg/cm ² g (Normal/Design) at • Inlet • Outlet	• As per Hydraulics/ 92.0 • As per Hydraulics/ 92.0
5.	Flow rate, MMSCMD	0.350 MMSCMD

1.4.11 HARIHAR RECEIPT TERMINAL DESIGN PARAMETERS (PHASE-II)

1.	Source of Gas	Regasified LNG from Devangere to Harihar RLNG pipeline.
2.	Location	Harihar Receipt terminal
3.	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
4.	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.	Flow rate, MMSCMD	0.350 MMSCMD

1.4.12 TUMKUR RECEIPT TERMINAL DESIGN PARAMETERS (PHASE-II)

1.	Source of Gas	Regasified LNG from Devanyadurga to Tumkur RLNG pipeline.
2.	Location	Tumkur Receipt terminal
3.	Battery limit temperature, °C (Normal/Design) at - Inlet - Outlet	- As per hydraulics / 65 - As per hydraulics / 65
4.	Battery limit pressure, kg/cm ² g (Normal/Design) at - Inlet - Outlet	- As per Hydraulics/ 92.0 - As per Hydraulics/ 92.0
5.	Flow rate, MMSCMD	0.02 MMSCMD

1.5 UTILITY SPECIFICATION

S. No	Parameters	Plant Air	Instrument Air	Service Water
1.	Source	BY GAIL/ Consumers	BY GAIL/ Consumers	BY GAIL/ Consumers
2.	Dew Point	-	-40 °C at atm. Pr.	-
3.	Pressure, Kg/cm ² g (min/nor/design)	5.0/ 8.0 / 10.5	5.0/ 7.5 / 10.5	3.0

4.	Temperature, ° C	50.0	50.0	Ambient
5.	Consumption	170 Nm ³ /hr (intermittent)	5 Nm ³ /hr (Max)	5 m ³ /hr (intermittent)
6.	Quality	Oil Free	Oil Free	-

1.6 INSTRUMENTATION

1.	General	Adequate instruments and control system have been provided for safe and efficient operations. The pipe line shall be monitored and controlled through supervisory control and data acquisition (SCADA) system designed for remote monitoring and control for safe, efficient and economic operation of the pipeline. RTUs have been provided at required locations for signal transmission to SCADA.
2.	Control Philosophy	Conventional control panel with receiver instrument and flow computers for local level control & monitoring have been provided at Dabhol, Bidadi and manned consumer terminals. At unmanned stations monitoring will be done from field and SCADA. Signals for SCADA have been repeated to RTU's of the SCADA system.
3.	Interlock & Shut down	Relay based interlocks
4.	Safety valve isolation	Safety valve isolation have been provided wherever required. These isolation valves should be locked open.
5.	Block & by-pass valve for control valves	As per design.
6.	Type of control	Electronic and/ or pneumatic
7.	Final control element	Gas/Instrument air actuated

1.7 METERING SYSTEM

1.	Flow meters	Ultrasonic flow meters have been provided at Bidadi RT, Bangalore RT and Goa RT for custody transfer purpose. Reconciliation meters have been provided at Dabhol DT, Gokak TOP for Goa line and at Bechenehalli TOP for Bangalore spur line. 1 working + 1standby meter for custody transfer metering and 1working + 0 standby for check metering or reconciliation metering have been considered.

1.8 SCADA & TELECOMMUNICATION SYSTEM

The SCADA system has been provided for the pipeline facility to ensure effective and reliable control, management and supervision from SMCS at Bidadi and backup SMCS at Dabhol using Remote Telemetry Units (RTU) along the pipeline route at suitable location. Interfaces have been provided for APPS & other third party utility.

1.9 METEOROLOGICAL DATA

1.9.1 TEMPERATURE CONDITIONS

The seasonal temperature of various cities along the pipeline route is mentioned in the following table.

CITY	Scenario	Summer Season Temp. (Deg C)		Winter Season Temp. (Deg C)		Monsoon Season Temp. (Deg C)	
		Min.	Max.	Min.	Max.	Min.	Max.
Ratnagiri	Night	25.8	26.5	21.9	25.6	25.8	26.5
	Day	26.8	28.9	27.6	28.9	26.8	28.9
Kolhapur	Night	23.1	25.4	17.5	21.2	22.6	23.4
	Day	26.7	33.3	27.5	31.1	24.2	28.3
Belgaum	Night	22.6	24.8	17.4	20.8	21.5	22.2
	Day	25.1	31.5	26.7	30.1	23.1	26.2
Bellary	Night	26	28.8	20.4	23.4	25.1	26
	Day	31.9	37.6	27.9	32.2	29.4	29.7
Chitradurga	Night	23.4	25.8	20.1	22.5	22	22.9
	Day	27.4	34.3	25.8	30.6	25.2	27.3
Tumkur	Night	23.1	25.6	19.7	21.8	21.9	22.9
	Day	27.2	33.2	25.4	29.7	25.6	26.8
Mysore	Night	22.8	24.4	19.4	21.4	21.7	22.2
	Day	26.2	32.7	26	29.9	25.1	26.5
Bangalore	Night	22	24.7	17.6	20.3	20.8	21.6
	Day	26.8	31.5	23.4	27.8	25	25.7
Kolhapur	Night	23.1	25.4	17.5	21.2	22.6	23.4
	Day	26.7	33.3	27.5	31.1	24.2	28.3
Panjim	Night	25.4	29	21.5	24.7	25.6	25.9
	Day	27.9	30.6	28.2	28.9	26.8	28.5

1.9.2 RELATIVE HUMIDITY (%)

The seasonal relative humidity of various cities along the pipeline route is mentioned in the following table.

CITY	Scenario	Summer Season		Winter Season		Monsoon Season	
		Min.	Max.	Min.	Max.	Min.	Max.
Ratnagiri	Night	71	87	59	65	77	90
	Day	64	82	57	62	72	86

CITY	Scenario	Summer Season		Winter Season		Monsoon Season	
		Min.	Max.	Min.	Max.	Min.	Max.
Kolhapur	Night	57	84	59	67	76	91
	Day	29	72	26	44	55	83
Belgaum	Night	61	88	64	73	83	93
	Day	42	78	34	51	68	88
Bellary	Night	53	69	66	74	73	75
	Day	29	51	37	53	56	60
Chitradurga	Night	55	82	56	73	78	87
	Day	25	62	27	49	54	72
Tumkur	Night	57	79	60	71	77	83
	Day	24	58	29	56	58	66
Mysore	Night	69	81	67	78	85	83
	Day	27	64	30	57	63	69
Bangalore	Night	64	83	70	81	83	89
	Day	28	60	32	61	63	67
Kolhapur	Night	57	84	59	67	76	91
	Day	29	72	26	44	55	83
Panjim	Night	73	86	72	79	84	90
	Day	63	82	55	62	74	85

Note: Reference

CLIMATOLOGICAL NORMALS (1961- 1990)

1.10 GENERAL PROJECT SPECIFICATIONS

1.10.1 Numbering system followed for this project are as follows.

1.	Equipments	As per EIL standard	
2.	Instruments	As per EIL standard	
3.	Drawings/Documents	As per EIL standard	
		Facilities	Unit No.
		Dabhol-Bidadi pipeline	010
		Gokak TOP-Goa Pipeline	017
		Dabhol dispatch terminal	011
		Ratnagiri receipt terminal	012
		Intermediate pigging station-1	013
		Sangli receipt terminal	014
		Kolhapur receipt terminal	015
		Intermediate Pigging station-2	016
		Goa receipt terminal	017
		Bijapur/Gulberga receipt terminal	018
		Intermediate pigging station on spur line -1(G) at Dhumrewadi	019
		Dharwad/Hubli receipt terminal	021
		Intermediate pigging station-3	022
		Intermediate pigging station-4	023
		Harihar receipt terminal	024
		Devangere receipt terminal	025
		Intermediate pigging station-5	026
		Tumkur receipt terminal	027
		Intermediate pigging station-6	028
		Bidadi receipt terminal	029
		Bangalore receipt terminal	030
		Intermediate pigging station-7	031

1.11 UNITS OF MEASUREMENT

Metric, unless otherwise specified. Gas flow rate are in MMSCMD.

1.12 COMPOSITIONS OF GAS

S. No.	Component	Composition mol %
1.	C1	92.34
2.	C2	5.47
3.	C3	0.32
4.	C4	0.027
5.	C5	0.003
6.	C6	-
7.	CO ₂	-
8.	N ₂	1.78
9.	Total Sulphur	24PPM

1.13 EQUIPMENT LIST WITH BROAD SPECIFICATIONS

a. PIPELINE

PIPELINES	010-PL-00-101 (Dabhol to IPS3)	010-PL-00-102 (IPS3 to Bidadi)	030-PL-00-101 (Bechenehalli Top to Bangalore)	017-PL-00-101 (Gokak Top to Goa)
Diameter (inch, NB)	36	30	18	24
Length, kms	248.456	495.293	71.9	175.3
Flow(MMSCMD) Normal/Maximum	16/22.04	9.9/10.12	2.199/2.199	4.4/10.26
Operating pressure, kg/cm2 (g)	72.9 - 92	46.8 - 92	46 - 92	71 - 92
Operating temp. °C	4 - 23.8	19 - 23.7	28.2 - 30.5	22.5-25.7
Design pressure, kg/cm2 g	92	92	92	92
Design Temp, °C (Buried/Above ground)	(-) 29 to 60/ (-) 29 to 65	(-) 29 to 60/ (-) 29 to 65	(-) 29 to 60/ (-) 29 to 65	(-) 29 to 60/ (-) 29 to 65
Material for pipeline	Carbon Steel	Carbon Steel	Carbon Steel	Carbon Steel
Corrosion Allowance, mm	NIL	NIL	0.5	0.5
Suitable for pigging	Yes (For Intelligent Pigging)	Yes (For Intelligent Pigging)	Yes (For Intelligent Pigging)	Yes (For Intelligent Pigging)
Cathodic protection	Yes (Buried Portion)	Yes (Buried Portion)	Yes (Buried Portion)	Yes (Buried Portion)

b. SCRAPPER LAUNCHER/RECEIVER

Item Description	Item No.	Service	Design Pressure (kg/cm ² g)	Design Temperature °C	Corrosion Allowance (mm)
Pig Launcher at Dabhol Despatch Terminal	011-ML-00-101	Launching of pigs in 36" NB Gas Pipeline from Dhabol DT to IPS1	92	-29-65	3
Pig Receiver at IPS1	013-MR-00-101	Receiving of pigs from Dhabol DT at IPS1	92	-29-65	3
Pig Launcher at IPS1	013-ML-00-101	Launching of pigs in 36" NB Gas Pipeline from IPS1 to IPS2	92	-29-65	3
Pig Receiver at IPS2	016-MR-00-101	Receiving of pigs from IPS1 at IPS2	92	-29-65	3
Pig Launcher at IPS2	016-ML-00-101	Launching of pigs in 36" NB Gas Pipeline from IPS2 to IPS3	92	-29-65	3

Item Description	Item No.	Service	Design Pressure (kg/cm ² g)	Design Temperature °C	Corrosion Allowance (mm)
Pig Receiver at IPS3	022-MR-00-101	Receiving of pigs from IPS2 at IPS3	92	-29-65	3
Pig Launcher at IPS3	022-ML-00-101	Launching of pigs in 30" NB Gas Pipeline from IPS3 to IPS4	92	-29-65	3
Pig Receiver at IPS4	023-MR-00-101	Receiving of pigs from IPS3 at IPS4	92	-29-65	3
Pig Launcher at IPS4	023-ML-00-101	Launching of pigs in 30" NB Gas Pipeline from IPS4 to IPS5	92	-29-65	3
Pig Receiver at IPS5	026-MR-00-101	Receiving of pigs from IPS4 at IPS5	92	-29-65	3
Pig Launcher at IPS5	026-ML-00-101	Launching of pigs in 30" NB Gas Pipeline from IPS5 to IPS6	92	-29-65	3

Item Description	Item No.	Service	Design Pressure (kg/cm ² g)	Design Temperature °C	Corrosion Allowance (mm)
Pig Receiver at IPS6	028-MR-00-101	Receiving of pigs from IPS5 at IPS6	92	-29-65	3
Pig Launcher at IPS6	028-ML-00-101	Launching of pigs in 30" NB Gas Pipeline from IPS6 to IPS7	92	-29-65	3
Pig Receiver at IPS7	031-MR-00-101	Receiving of pigs from IPS6 at IPS7	92	-29-65	3
Pig Launcher at IPS7	031-ML-00-101	Launching of pigs in 30" NB Gas Pipeline from IPS 7 to Bidadi RT	92	-29-65	3
Pig Receiver at Bidadi Receipt Terminal	029-MR-00-101	Receiving of pigs from IPS7 at Bidadi RT	92	-29-65	3
Pig Launcher at Bechenehalli TOP	030-ML-00-101	Launching of pigs in 18" NB Gas Pipeline from Bechenehalli Top to Bangalore RT	92	-29-65	3

Item Description	Item No.	Service	Design Pressure (kg/cm ² g)	Design Temperature °C	Corrosion Allowance (mm)
Pig Receiver at Bangalore Receipt Terminal	030-MR-00-101	Receiving of pigs from Bechenehalli Top at Bangalore RT	92	-29-65	3
Pig Launcher At Gokak TOP	017-ML-00-101	Launching of pigs in 24" NB Gas Pipeline from Gokak Top to IP1G	92	-29-65	3
Pig Receiver at IP1G on Gokak Goa Spurline	019-MR-00-101	Receiving of pigs from Bechenehalli Top at Bangalore RT	92	-29-65	3
Pig Launcher at IP1G on Gokak Goa Spurline	019-ML-00-101	Launching of pigs in 24" NB Gas Pipeline from IP1G to Goa RT	92	-29-65	3
Pig Receiver at Goa Receipt Terminal	017-MR-00-101	Receiving of pigs from IP1G at Goa RT	92	-29-65	3

c. FILTER

Item Description	Item no.	Flow Rate (MMSCMD)		Operating Parameters		Design Parameters	
		Normal	Maximum	Inlet Temperature (Deg C)	Inlet Pressure (kg/cm ² g)	Temperature (Deg C)	Pressure (kg/cm ² g)
Cartridge Filter	011-GN-CT-101 A/B	16	22.04	4	92	65	92

SECTION -2

DESCRIPTION OF FACILITIES

2.0 INTRODUCTION

In order to meet the required flow for consumers, following new modifications and installations have been provided under this project at various locations enroute of the pipeline and at the terminal stations.

2.1 FACILITIES FOR DABHOL-IPS3 SECTION

a. Hook up connection with existing 20” tap-off downstream of AV-1109 at Dhabol DT

- Hook up through the existing 20” tap-off from RLNG terminal has been provided for onward transfer of natural gas to Bidadi RT, Bangalore RT and Goa RT including customers’ enroute of the 36”, 30”, 24” and 18” pipeline.

b. Hook up connection with existing 18” tap-off from DPPL (Dhabol Panvel Pipeline) at Dhabol DT

- Hook up through the existing 18” tap-off from DPPL has been provided for onward transfer of natural gas to Bidadi RT, Bangalore RT and Goa RT including customers’ enroute of the 36”, 24” and 18” pipeline.

c. Pressure Control Valve at Dhabol DT

- Provision of PCV has been provided at Dabhol DT to send the mix gas i.e. rich gas of DPPL and lean gas from RLNG terminal into the Dhabol Bangalore Pipeline.

d. Gas Filter and Metering Assembly at Dabhol DT

- Provision of cartridge filter (1 Operating and 1 Standby) has been provided at Dhabol DT for filtering the gas. The normal and maximum capacity of each filter is 16 and 22.04 MMSCMD respectively.
One reconciliation metering assembly has been provided also to check the flow of gas into the Dabhol Bangalore pipeline.

e. Pig launcher (011-ML-00-101) – at Dabhol DT

- Pig Launcher has been provided at Dabhol DT to launch the pigs during precom./commissioning of the pipeline section from Dabhol DT to IPS1.

Pig Launcher facilities shall be used for launching of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

f. 36"x 82.74 km pipeline from Dabhol DT to IPS1

- 82.74 km long pipeline of 36" NB has been provided from Dabhol DT to IPS1 in order to facilitate transfer of natural gas for consumption by customers enroute and downstream of this pipeline section.

g. Pig Receiver (013-MR-00-101) – at IPS1

- Pig Receiver has been provided at IPS1 to receive the pigs during precom./commissioning of the pipeline section from Dabhol DT to IPS1. Pig Receiver facilities shall be used for receiving of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

h. Pig launcher (013-ML-00-101) – at IPS1

- Pig Launcher has been provided at IPS1 to launch the pigs during precom./commissioning of the pipeline section from IPS1 to IPS2. Pig Launcher facilities shall be used for launching of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

i. 36"x 88.76 km pipeline from IPS1 to IPS2

- 88.76 km long pipeline of 36" NB has been provided from IPS1 to IPS2 in order to facilitate transfer of natural gas for consumption by customers enroute and downstream of this pipeline section.

j. Pig Receiver (016-MR-00-101) – at IPS2

- Pig Receiver has been provided at IPS2 to receive the pigs during precom./commissioning of the pipeline section from IPS1 to IPS2. Pig Receiver facilities shall be used for receiving of pigs during cleaning of

the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

k. Pig launcher (016-ML-00-101) – at IPS2

- Pig Launcher has been provided at IPS2 to launch the pigs during precom./commissioning of the pipeline section from IPS2 to IPS3. Pig Launcher facilities shall be used for launching of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

l. 36"x 76.956 km pipeline from IPS2 to IPS3

- 76.956 km long pipeline of 36" NB has been provided from IPS2 to IPS3 in order to facilitate transfer of natural gas for consumption by customers enroute and downstream of this pipeline section.

m. Pig Receiver (022-MR-00-101) – at IPS3

- Pig Receiver has been provided at IPS3 to receive the pigs during precom./commissioning of the pipeline section from IPS2 to IPS3. Pig Receiver facilities shall be used for receiving of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

n. Pig launcher (022-ML-00-101) – at IPS3

- Pig Launcher has been provided at IPS3 to launch the pigs during precom./commissioning of the pipeline section from IPS3 to IPS4. Pig Launcher facilities shall be used for launching of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

o. 8 nos. of sectionalizing valve (SV) stations enroute of pipeline between DABHOL to IPS3

- In between the pipeline section of Dabhol DT and IPS3, sectionalizing valves have been provided at the following distance and location from Dabhol DT.

S. No.	Tag No.	Operation	Chainage from Dabhol DT	Location
1.	SV-1201 (SV-1)	Remote	21.37	Pangari
2.	SV-1202 (SV-2)	Remote	44.67	Kajurli
3.	SV-1203 (SV-3)	Remote	63.13	Dingnikuran
4.	SV-1601 (SV-4)	Remote	100.57	Murshi
5.	SV-1602 (SV-5)	Remote	128	Shirgaon
6.	SV-1603 (SV-6)	Remote	154.09	Kodoli
7.	SV-2301 (SV-7)	Remote	200.2	Shirowadi
8.	SV-2302 (SV-8)	Remote	220.6	Itnal

Sectionalizing valves stations have been provided on the pipeline to isolate the pipeline section in case of emergency. Gas between two SVs and between SV-Launcher/Receiver can be vented through QOEC vent line by closing the respective SV's and its bypass valve (based on section to be vented) at the upstream/downstream of the SVs.

p. Future Tap-Off

Various future tap-offs have been provided enroute of pipeline and at some SV stations between Dabhol DT to IPS3.

The details of each tap-off have been provided in the table below.

S. No.	Tap-off Location	Purpose	Size of Tap-off (inch)	Chainage from Dabhol DT
1.	At SV-3 (From main pipeline)	Gas Transfer to Ratnagri	8	63.13
2.	At IPS-2	Gas Transfer to Kolhapur	8	171.5
3.	At IPS-2	Gas Transfer to Sangli	8	171.5
4.	At IPS-3	Gas Transfer to Bijapur/Gulberga	10	248.456
5.	At IPS-3	Gas Transfer to Ghatprabha	18	248.456
6.	At IPS-3	Gas Transfer to Goa	24	248.456

2.2 FACILITIES FOR IPS3- BIDADI SECTION

- **30"x 84.695 km pipeline from Dabhol IPS3 to IPS4**
 - 84.695 km long pipeline of 30" NB has been provided from IPS3 to IPS4 in order to facilitate transfer of natural gas for consumption by customers enroute and downstream of this pipeline section.
- **Pig Receiver (023-MR-00-101) – at IPS4**
 - Pig Receiver has been provided at IPS4 to receive the pigs during precom./commissioning of the pipeline section from IPS3 to IPS4. Pig Receiver facilities shall be used for receiving of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.
- **Pig launcher (023-ML-00-101) – at IPS4**

- Pig Launcher has been provided at IPS4 to launch the pigs during precom./commissioning of the pipeline section from IPS4 to IPS5. Pig Launcher facilities shall be used for launching of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

- **30"x 110.502 km pipeline from IPS4 to IPS5**
 - 110.502 km long pipeline of 30" NB has been provided from IPS4 to IPS5 in order to facilitate transfer of natural gas for consumption by customers enroute and downstream of this pipeline section.

- **Pig Receiver (026-MR-00-101) – at IPS5**
 - Pig Receiver has been provided at IPS5 to receive the pigs during precom./commissioning of the pipeline section from IPS4 to IPS5. Pig Receiver facilities shall be used for receiving of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

- **Pig launcher (026-ML-00-101) – at IPS5**
 - Pig Launcher has been provided at IPS5 to launch the pigs during precom./commissioning of the pipeline section from IPS5 to IPS6. Pig Launcher facilities shall be used for launching of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

- **30"x 98.696 km pipeline from IPS5 to IPS6**
 - A 98.696 km long pipeline of 30" NB has been provided from IPS5 to IPS6 in order to facilitate transfer of natural gas for consumption by customers enroute and downstream of this pipeline section.

- **Pig Receiver (028-MR-00-101) – at IPS6**

- Pig Receiver has been provided at IPS6 to receive the pigs during precom./commissioning of the pipeline section from IPS5 to IPS6. Pig Receiver facilities shall be used for receiving of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

- **Pig launcher (028-ML-00-101) – at IPS6**
 - Pig Launcher has been provided at IPS6 to launch the pigs during precom./commissioning of the pipeline section from IPS6 to IPS7. Pig Launcher facilities shall be used for launching of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

- **30"x 96.756 km pipeline from IPS5 to IPS6**
 - A 96.756 km long pipeline of 30" NB has been provided from IPS6 to IPS7 in order to facilitate transfer of natural gas for consumption by customers enroute and downstream of this pipeline section.

- **Pig Receiver (031-MR-00-101) – at IPS7**
 - Pig Receiver has been provided at IPS7 to receive the pigs during precom./commissioning of the pipeline section from IPS6 to IPS7. Pig Receiver facilities shall be used for receiving of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

- **Pig launcher (031-ML-00-101) – at IPS7**
 - Pig Launcher has been provided at IPS7 to launch the pigs during precom./commissioning of the pipeline section from IPS7 to Bidadi RT. Pig Launcher facilities shall be used for launching of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

➤ **30"x 104.644 km pipeline from IPS7 to Bidadi RT**

- A 104.644 km long pipeline of 30" NB has been provided from IPS7 to Bidadi RT in order to facilitate transfer of natural gas for consumption by customers' enroute of the pipeline section and at Bidadi.

➤ **Pig Receiver (029-MR-00-101) – at Bidadi RT**

- Pig Receiver has been provided at Bidadi RT to receive the pigs during precom./commissioning of the pipeline section from IPS7 to Bidadi RT. Pig Receiver facilities shall be used for receiving of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

➤ **Metering skid (029-M-4801) at Bidadi RT having filtration section, metering section and Pressure reduction section**

Natural Gas is received at Bidadi through metering skid. Metering skid has been provided with the following facilities.

i. Filtration Section

Before entering the PRS of the skid, gas shall be filtered. To facilitate this, two nos. of cartridge filters have been provided, in which one will be in working and other in standby mode. The normal flow rate in one filter is 6.26 MMSCMD.

ii. Pressure Reduction Section

Pressure Reduction System has been provided to meet the pressure requirement of customer.

One active and one standby streams have been provided at Bidadi RT for controlling the downstream pressure.

iii. Metering Section

In order to measure the flow of gas to the customers, two nos. of ultrasonic meters have been provided with one running and one standby assembly.

➤ **8 nos. of sectionalizing valve (SV) stations enroute of pipeline between IPS3 to Bidadi RT**

- In between the pipeline section of IPS3 and Bidadi RT, sectionalizing valves have been provided at the following distance and location from Dabhol DT.

S. No.	Tag No.	Operation	Chainage from Dabhol DT	Location
1.	SV-3601 (SV-9)	Remote	271.5	Ajjankatti
2.	SV-3602 (SV-10)	Remote	301.271	Maldure
3.	SV-3701 (SV-11)	Remote	360.144	Sahuwadi
4.	SV-3702 (SV-12)	Remote	385.417	Hirekoppa
5.	SV-3703 (SV-13)	Remote	409.164	Dambal
6.	SV-4201 (SV-14)	Remote	475.506	Chigateri
7.	SV-4202 (SV-15)	Remote	489.845	Gurisiddhapur
8.	SV-4203 (SV-16)	Remote	517.507	Santemuddapur
9.	SV-4601 (SV-17)	Remote	575.169	Giddubanhally
10.	SV-4602 (SV-18)	Remote	607.493	Kariyala
11.	SV-5201 (SV-19)	Remote	669.245	Doddanarmangal
12.	SV-5202 (SV-20)	Remote	690.584	Ramanhalli
13.	SV-5203 (SV-21)	Remote	705.96	Madagandanhalli

14.	SV-5204 (SV-22)	Remote	731.703	Sulivara

Sectionalizing valves stations have been provided on the pipeline to isolate the pipeline section in case of emergency. Gas between two SVs and between SV-Launcher/Receiver can be vented through QOEC vent line by closing the respective SV's and its bypass valve (based on section to be vented) at the upstream/downstream of the SVs.

➤ Future Tap-Off

Various future tap-offs have been provided enroute of pipeline and at some SV stations between IPS3 to Bidadi.

The details of each tap-off have been provided in the table below.

S. No.	Tap-off Location	Purpose	Size of Tap-off (inch)	Chainage from Dabhol DT (km)
1.	At IPS-4	Gas Transfer to Dharwad/Hubli	8	248.456
2.	At SV-3703 (SV-13)	Top for PCKL	18	409.164
3.	At IPS-5	Top for PCKL	12	443.653
4.	At SV-4203 (SV-16)	Top for Devangree/Harihar	8	517.507
5.	At SV-4203 (SV-16)	Top for Jagalur PP	20	517.507
6.	At IPS-6	Top for CNG station	6	542.349
7.	At IPS-7	Top for Tumkur	16	639.105
8.	At IPS-7	Top for CNG station	6	639.105
9.	At SV-5201 (SV-19)	Top for Tumkur City	8	669.245

10.	At SV-5204 (SV-22)	Top for Bangalore	18	731.7
11.	At RT Bidadi	Future	12	743.749

2.3 FACILITIES FOR GOKAK TOP (IPS3) TO GOA RT SECTION

a. Hook up connection with existing 24" flow tee line at IPS3

- Hook up through the 24" flow tee line has been provided at IPS3 for onward transfer of natural gas to Goa RT through 24" x 175.3 km pipe line.

b. Metering Assembly at Gokak Top

- Provision of one reconciliation metering system has been provided at Gokak Top to measure the amount of gas flow in the Gokak Goa spur line.

c. Pig launcher (017-ML-00-101) – at Gokak Top

- Pig Launcher has been provided at Gokak Top to launch the pigs during precom./commissioning of the pipeline section from Gokak Top to IPS1G. Pig Launcher facilities shall be used for launching of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

d. 24"x 88.1 km pipeline from Gokak Top to IP1G

- A 88.1 km long pipeline of 24" NB has been provided from Gokak Top to IPS1G in order to facilitate transfer of natural gas for consumption by customers enroute and downstream of this pipeline section.

a. Pig Receiver (019-MR-00-101)- at IPS1G (Dhumrewadi)

- Pig Receiver has been provided at IPS1G to receive the pigs during precom./commissioning of the pipeline section from Gokak Top to IPS1G. Pig Receiver facilities shall be used for receiving of pigs during cleaning

of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

b. Pig launcher (019-ML-00-101) – at IPS1G (Dhumrewadi)

- Pig Launcher has been provided at IP1G to launch the pigs during precom./commissioning of the pipeline section from IPS1G to Goa RT. Pig Launcher facilities shall be used for launching of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

e. 24"x 87.2 km pipeline from IPS-1G to Goa RT

- A 87.2 km long pipeline of 24" NB has been provided from IPS1G to Goa RT in order to facilitate transfer of natural gas for consumption by customers enroute and downstream of this pipeline section.

c. Pig Receiver (017-MR-00-101)- at Goa RT

- Pig Receiver has been provided at Goa RT to receive the pigs during precom./commissioning of the pipeline section from IPS1G to Goa RT. Pig Receiver facilities shall be used for receiving of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

d. Metering skid (017-M-2701) at Goa RT having filtration section, metering section and Pressure reduction section

Natural Gas is received at Goa RT through metering skid. Metering skid has been provided with the following facilities.

i. Filtration Section

Before entering the PRS of the skid, gas shall be filtered. To facilitate this, two nos. of cartridge filters have been provided, in which one will be in working and other in standby mode. The normal flow rate in one filter is 1.1 MMSCMD.

ii. Pressure Reduction Section

Pressure Reduction System has been provided to meet the pressure requirement of customer.

One active and one standby streams have been provided at Goa RT for controlling the downstream pressure.

iii. Metering Section

In order to measure the flow of gas to the customers, two nos. of ultrasonic meters have been provided with one running and one standby assembly.

e. 5 nos. of sectionalizing valve (SV) stations enroute of pipeline between Gokak Top to Goa RT

- In between the pipeline section of **Gokak Top to Goa RT**, sectionalizing valves have been provided at the following distance and location from Gokak Top.

S. No.	Tag No.	Operation	Chainage from Gokak Top	Location
1.	SV-2501 (SV-1G)	Remote	28.9	Domranhatti
2.	SV-2501 (SV-2G)	Remote	55.6	Belgaum
3.	SV-3101 (SV-3G)	Remote	116	Hevale
4.	SV-3102 (SV-4G)	Remote	141.7	Kudchire
5.	SV-3103 (SV-5G)	Remote	163.3	-

Sectionalizing valves stations have been provided on the pipeline to isolate the pipeline section in case of emergency. Gas between two SVs and between SV-Launcher/Receiver can be vented through QOEC vent line by closing the respective SV's and its bypass valve (based on section to be vented) at the upstream/downstream of the SVs.

f. Future Tap-Off

Various future tap-offs have been provided enroute of pipeline and at some SV stations between Gokak Top to Goa RT.

The details of each tap-off have been provided in the table below.

S. No.	Tap-off Location	Purpose	Size of Tap-off (inch)	Chainage from Gokak Top (km)
1.	-	Top for Gokak Mills	4	10.93
2.	SV-2501 (SV-2G)	Top for Tata PP	10	55.6
3.	SV-3102 (SV-4G)	Top for CNG station	6 & 8 (upstream and downstream)	141.7
4.	Goa RT	Top for KPCL	18	175.3
5.	Goa RT	Top for Reliance and Umicore	8	175.3

2.4 FACILITIES FOR BECHENEHALLI TOP TO BANGALORE SECTION

a. Tapping connection with 30" pipeline downstream of SV-5204 (SV-22)

- Tapping connection from the 30" pipeline downstream of SV-5204 (SV-22) has been provided for onward transfer of natural gas to Bangalore RT through 18" x 71.9 km pipe line.

b. Metering Assembly at Bechenehalli Top

- Provision of one reconciliation metering system has been provided at Bechenehalli Top to measure the amount of gas flow in the Bangalore spur line spur line.

c. Pig Launcher (030-ML-00-101) – at Bechenehalli Top

- Pig Launcher has been provided at Bechenehalli Top to launch the pigs during precom./commissioning of the pipeline section from Bechenehalli

Top to Bangalore RT. Pig Launcher facilities shall be used for launching of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

d. 18"x 71.9 km pipeline from Bechenehalli Top to Bangalore RT

- A 71.9 km long pipeline of 18" NB has been provided from Bechenehalli Top to Bangalore RT in order to facilitate transfer of natural gas for consumption by customers enroute and downstream of this pipeline section.

e. Pig Receiver (030-MR-00-101)- at Bangalore RT

- Pig Receiver has been provided at Bangalore RT to receive the pigs during precom./commissioning of the pipeline section from Bechenehalli Top to Bangalore RT. Pig Receiver facilities shall be used for receiving of pigs during cleaning of the pipeline in case of regular maintenance activity being carried out and for monitoring health of pipeline through intelligent pigging.

g. Metering skid (030-M-5101) at Bangalore RT having filtration section, metering section and Pressure reduction section

Natural Gas is received at Bangalore RT through metering skid. Metering skid has been provided with the following facilities.

i. Filtration Section

Before entering the PRS of the skid, gas shall be filtered. To facilitate this, two nos. of cartridge filters have been provided, in which one will be in working and other in standby mode. The normal flow rate in one filter is 1.0 MMSCMD.

ii. Pressure Reduction Section

Pressure Reduction System has been provided to meet the pressure requirement of customer.

One active and one standby streams have been provided at Bangalore RT for controlling the downstream pressure.

iii. Metering Section

In order to measure the flow of gas to the customers, two nos. of ultrasonic meters have been provided with one running and one standby assembly.

h. 7 nos. of sectionalizing valve (SV) stations enroute of pipeline between Bechenehalli Top to Bangalore RT

- In between the pipeline section of Bechenehalli Top to Bangalore RT, sectionalizing valves have been provided at the following distance and location from Bechenehalli Top.

S. No.	Tag No.	Operation	Chainage from Bechenehalli Top	Location
1.	SV-4901 (SV-1B)	Remote	10.1	-
2.	SV-4902 (SV-2B)	Remote	23.8	-
3.	SV-4903 (SV-3B)	Manual	31.4	-
4.	SV-4904 (SV-4B)	Manual	39.7	-
5.	SV-4905 (SV-5B)	Manual	46.8	-
6.	SV-4906 (SV-6B)	Manual	55.9	-
7.	SV-4907 (SV-7B)	Manual	63.5	-

Sectionalizing valves stations have been provided on the pipeline to isolate the pipeline section in case of emergency. Gas between two SVs and between SV-Launcher/Receiver

can be vented through QOEC vent line by closing the respective SV's and its bypass valve (based on section to be vented) at the upstream/downstream of the SVs.

i. Future Tap-Off

Various future tap-offs have been provided enroute of pipeline and at some SV stations between Bechenehalli Top to Bangalore RT.

The details of each tap-off have been provided in the table below.

S. No.	Tap-off Location	Purpose	Size of Tap-off (inch)	Chainage from Bechenehalli Top (km)
1.	SV-2B	Top for CGS, future CNG & Peenya Ind. area	10	23.8
2.	SV-3B	Top for Yalhanka PP	16	31.4
3.	-	Top for Graphite	6	49.5
4.	Bangalore RT	Top for future CNG Stn. & CGS	10	71.9

SECTION -3

BRIEF DESCRIPTION OF GAS/FIRE DETECTION AND FIRE FIGHTING FACILITIES

3.0 INTRODUCTION

The pipeline handles hydrocarbon gases which can cause fire and explosion if conditions for the same are favorable. Direct contact of hydrocarbons with any source of ignition or fire such as spark or open flame shall be avoided. Sparks or open fire should not be allowed in the operating area where there is a potential of hydrocarbon leakage. Even during shutdown, when an open flame work is absolutely essential, this should be allowed with the permission of the authorized person after suitable precautions have been taken. Approved safety & work permit systems should be strictly followed.

3.1 GENERAL GUIDELINES

Following general guidelines should be followed in order to avoid leakage of hydrocarbon, possibility of fire and accident;

- (i) Improper earthing of equipment may produce static charges. All equipments including launcher, receiver, pipings and valves etc. must be provided earthing connections as per standards.
- (ii) The drain/vent valves and sample points are likely to get plugged, if the lines are not in constant use. Such valves should be crack opened for a few minutes under personnel supervision and only after the gas flow has started, the opening of the valves should be adjusted as required.
- (iii) Leakage of hydrocarbons from equipment and pipe joints are undesirable and must be reported to the immediate supervisor without delay.
- (iv) The set pressure of pressure safety valves on launcher/ receiver, filters etc. should never be altered without prior permission of the authorized persons in writing. Wherever block valves are provided for isolation of relief valves, these valves should be kept locked opened all the times as per stipulations in P&IDs.
- (v) Poor Housekeeping in the operating area is a potential cause of accidents. High standard of housekeeping in the work area should be maintained.

- (vi) Releasing equipment for maintenance without properly preparing it e.g. blinding/isolating & making it hydrocarbon free, electrical isolation etc. should be avoided as this can also result in major accidents.

3.2 FIRE FIGHTING SYSTEM

The operating personnel should be fully conversant with Fire Fighting system provided at the station. All of them should have adequate fire fighting training and will serve as an auxiliary Fire Squad in the event of a fire breakout. It will be the primary responsibility of operating personnel to fight the fire at the very initial stage and, at the least, localize it.

Major Fire fighting facilities provided at various stations across the pipeline are listed below:

A. DT-Dabhol

- a. There is existing fire water system of RGPPL and same (Hydrant system) is being extended/ hookup to safeguard the P/L facilities of the Terminal (existing + proposed facilities).
- b. Fire Extinguishers of suitably Type and size/capacity

B. RT-Bidadi

- a. Extension of proposed Hydrant system of proposed power plant, to safeguard the P/L facilities at this Terminal
- b. Fixed Clean agent system (fire protection system) for Electrical Equipment room, Inst. Control Room, UPS room and Battery room of the station control building.
- c. Fire Extinguishers of suitably Type and size/capacity.

C. RT-Bangalore

- a. Fixed Clean agent system (fire protection system) Electrical Equipment room, Inst. Control Room, UPS room and Battery room of the station control building.
- b. Fire Extinguishers of suitably Type and size/capacity considered as required.

D. RT-Goa

- a. Fixed Clean agent system (fire protection system) for Electrical Equipment room, Inst. Control Room, UPS room and Battery room of the station control building.
- b. Fire Extinguishers of suitably Type and size/capacity.

E. SV/IPS Station

- a. Fixed CO₂ system (fire protection system) for Electrical Equipment room, Telecom/SCADA room and Battery Room of Repeater Building.
- b. Fire Extinguishers of suitably Type and size/capacity considered as required.

3.3 FIRE FIGHTING SYSTEM DESCRIPTION

Brief descriptions of various fire fighting system are described below

a. Fire Water System

Water is most important fire fighting medium. Water is used for fire extinguishment, control, equipment cooling & exposure protection of equipment/personnel from heat radiation.

b. Foam System

For containing large Hydrocarbon fires, foam systems are useful. They have inherent blanketing ability, heat resistance and security against burn back.

c. Portable Fire Extinguishers

Fire should be killed at the incipient stage. Portable fire extinguishers are very useful in fighting small fires. All extinguishers at the stations must be located in specified places only. The operating crew should be acquainted with exact location of the extinguishers. They also must know most suitable type, which, when and how to use an extinguisher. For example, electrical fires should be put out with CO₂ or dry power extinguishers; water and foam should not be used. The used extinguishers should be checked and restored by fire station personnel as and when required on regular basis.

d. Fire Signal

Break Glasses have been provided at strategic locations at various stations to see fire alarm in fire station. If a fire is sighted, glass of window should be smashed, causing fire alarm switch to actuate. This is an emergency call & should be periodically tested for proper functioning.

3.4 LIST OF HYDROCARBON DETECTORS

S. No.	Tag No.	Location	Low Explosive Limit (% V/V in air)	PRE ALARM (% of LEL)	
1.	011-GE/GA-1101	011-GN-CT-101 A/B	4.58	20	60
2.	011-GE/GA-1201	011-ML-00-101	4.58	20	60
3.	013-GE/GA-1601	013-MR-00-101	4.58	20	60
4.	013-GE/GA-1602	013-ML-00-102	4.58	20	60
5.	016-GE/GA-2301	016-MR-00-101	4.58	20	60
6.	016-GE/GA-2302	016-ML-00-101	4.58	20	60
7.	022-GE/GA-3601	022-MR-00-101	4.58	20	60
8.	022-GE/GA-3602	022-ML-00-101	4.58	20	60
9.	023-GE/GA-3701	023-MR-00-101	4.58	20	60
10.	023-GE/GA-3702	023-ML-00-101	4.58	20	60
11.	026-GE/GA-4201	026-MR-00-101	4.58	20	60
12.	026-GE/GA-4202	026-ML-00-101	4.58	20	60
13.	026-GE/GA-4601	028-MR-00-101	4.58	20	60
14.	026-GE/GA-4602	028-ML-00-101	4.58	20	60
15.	031-GE/GA-5201	031-MR-00-101	4.58	20	60
16.	031-GE/GA-5202	031-ML-00-101	4.58	20	60
17.	029-GE/GA-4701	029-MR-00-101	4.58	20	60
18.	030-GE/GA-4901	030-ML-00-101	4.58	20	60
19.	030-GE/GA-4902	030-ML-00-101	4.58	20	60
20.	030-GE/GA-5001	030-MR-00-101	4.58	20	60
21.	017-GE/GA-2501	017-ML-00-101	4.58	20	60

S. No.	Tag No.	Location	Low Explosive Limit (% V/V in air)	PRE ALARM (% of LEL)	
22.	017-GE/GA-2502	017-ML-00-101	4.58	20	60
23.	019-GE/GA-3101	019-MR-00-101	4.58	20	60
24.	019-GE/GA-3102	019-ML-00-101	4.58	20	60
25.	017-GE/GA-2601	017-MR-00-101	4.58	20	60

SECTION -4

PRECOMMISSIONING PROCEDURES

4.0 INTRODUCTION

When the main pipeline, intermediate pigging stations dispatch and receipt terminals are nearing mechanical completion, it is necessary to take up certain activities to prepare the pipeline for start-up.

During this period the operating crew of the respective installations must associate themselves with the commissioning engineers while carrying out the pre-commissioning checks. It will further help the crew in familiarization with the entire system. The pre-commissioning checks for the dispatch, receiving terminals, intermediate pigging stations, sectionalizing valve stations and the main pipeline may be planned separately depending on the completeness of the construction.

A properly planned and well executed pre-commissioning program goes a long way in smooth and successful startup of the system. This apart from reducing avoidable losses makes the operators fully aware of the various systems, facilities and operations involved. The general pre-commissioning procedure described below apply in particular to the first start up of the systems when these have been handed over after completion of construction works. Some of these steps may however may not be necessary in all subsequent startups, but operating crew must be fully aware with various operations and hazard involved in the start-up.

The general areas of pre-commissioning activities of this pipeline system may be classified as under.

- Inspection/ Check listing
- Cleaning/Flushing of station piping
- Swabbing of the pipeline
- Magnetic and Electronic Geometric Pigging of the pipeline
- Leak test of station pipings
- Inertisation of station pipings

- Idle time preservation of the Pipeline

4.1 INSPECTION AND SYSTEM CHECKING

a. SYSTEM CHECKS

It is essential to inspect equipments, pipeline, connected piping and instruments to make sure that construction is as per specified drawings. The system checks are undertaken at the end of construction activity. The entire facility should be checked against latest approved P&IDs and other design specifications. It should include checking the pipe supports, installation and accessibility of different valves, instruments and other fittings. Correct direction of check valves (if any) should be ensured. Critical piping should be checked for proper slopes, high point vents and low points drains. All the vent and drain points should be plugged. Check that there are proper facilities for draining, depressurizing etc. Particular attention should be given to the operational and safety requirements. Any deviation from the design or any other additional requirement should be brought to the notice of construction team.

b. CHECKING OF INSTRUMENTS

All the pressure and temperature instruments should be checked in place and are to be calibrated and installed.

- All the pressure safety valves should be checked in place and calibration of set pressure as per the data sheets.
- All the safety switches, interlocks and alarms should be checked for intended applications.
- All the flow meters are to be checked for proper installation, calibration of this instrument to be done at site as per vendor's instruction.

c. SURVEY OF THE PIPELINE:

A general survey along the pipeline route before start-up is recommended to confirm the proper fittings along with pipeline. Check the cathodic protection stations for their installations and accessibility of the test terminals. Also check that proper type of identification markers are provided at appropriate locations along with pipeline route.

4.2 CLEANING AND FLUSHING OF STATION PIPINGS

The purpose of this operation is to eliminate construction materials (small pieces of mill scale, welding rods and other foreign materials) from equipments and piping at Dispatch Terminal, intermediate pigging stations and Receiving Terminal which can cause serious trouble during normal operation. For proper flushing, the system should be divided into smaller sections. Flushing of each section should be carried out with maximum possible flow of water. Considering the type of fluid handled, pipe material, and internal wall conditions, cleaning by water is suitable. Sufficient number of hoses, flanges, blinds, spool pieces is to be made available during water flushing. While water flushing the system, following guidelines is to be adopted.

- All low point drains and high point vents should be opened.
- All low point flanges should be opened during initial flushing, wherever possible.
- All instruments including metering assembly should be isolated. Metering assembly is installed only after the total flushing is over.
- At opening of the flanged joints, a thin metallic sheet should be inserted to prevent dirty water from entering the equipment or piping.
- Flushing should be carried out with maximum possible flow of water till clear water starts coming out.
- Vertical lines which are long and rather high (say over 100 mm dia.) should preferably be flushed from top to bottom. This will ensure better flushing. Filling the lines and releasing from bottom is also helpful. Temporary water connection at suitable points can be made to carry out flushing operation. The run down lines should be flushed from the battery limit to the respective tanks.
- It should be ensured in all flushing operations that design pressure of lines and equipment are never exceeded. After flushing of lines and equipment, water should be thoroughly drained from all low points. Lines and equipment containing pockets of water should not be left idle for a long time and these lines shall be dried by blowing air after completion of water flushing.
- If water is not available, cleaning shall be done by card board blasting using compressed air.

4.3 SWABBING OF THE PIPELINE

In order to remove residual water from the pipeline, swabbing activity shall be conducted. During this foam pigs shall be moved through the pipeline which will absorb water from the pipeline.

Depending on site constraints, swabbing may be done section wise, and not necessarily from pig launcher to pig receiver or Pig launcher to IP.

Swabbing shall be deemed complete when the weight of foam pig at the receiving terminal is not more than 1.25 times of its initial weight.

4.4 MAGNETIC CLEANING OF THE PIPELINE

In order to remove metallic debris from the pipeline magnetic pigging shall be done. Magnetic cleaning shall be assumed to be completed when the ferrous debris collected along the last magnetic pig of the pig train does not exceed more than 5kg/100km.

4.5 ELECTRO GEOMETRIC PIGGING OF THE PIPELINE

Upon completion of the successful swabbing and magnetic cleaning operation electro geometric pigging of the pipeline shall be done in order to detect denting and bore reduction of the pipeline.

EGP run shall be considered successful if the recorded data is able to deliver valid, interpretable and physically verifiable data.

Minimum requirement for pipeline conformity:

Bore reduction less than 2% of the pipeline section I.D in case of dents and 5% in case of ovality.

4.6 LEAK TEST OF STATION PIPINGS

Station pipings shall be leak tested with compressed air at a pressure of 7kg/cm² g in order to ensure tightness of flanged and tubing joints.

4.7 INERTISATION OF STATION PIPINGS

Station pipings shall be inertised till residual oxygen conc. comes below 1% (vol. /vol.) in the pipings before hydrocarbon is introduced in them.

4.8 IDLE TIME PRESERVATION OF THE PIPELINE

In case pipeline is not commissioned after all the pre-commissioning activities are over, pipeline shall be preserved with N₂ from Dispatch Terminal to Receipt Terminal including all intermediate stations at a pressure of 2-3kg/cm² g. The N₂ pressure in the pipeline shall be monitored continuously during this period.

NOTE: DETAIL PRE-COMMISSIONING PROCEDURE OF PIPELINE/STATION PIPINGS SHALL BE AS PER ATTACHED ANNEXURE- C

SECTION -5

COMMISSIONING PROCEDURES

5.0 INTRODUCTION

Supervisory instructions for Start-up are described in this section. Start-up and shutdown are the most critical period in operation. It is then that the hazardous possibilities are the greatest. Preparation for the start up begins with a complete review of the startup procedure by operating crew. For smooth start-up of the facilities, it is recommended to proceed in the sequence given in this chapter.

The importance of communication between shift personnel should be emphasized. Each shift must be fully aware of what activities were performed in previous shift and what its task is. A close coordination should be maintained between the Despatch Terminal, Intermediate stations and pipeline receipt stations.

5.1 FINAL CHECK FOR COMMISSIONING

Prior to actual commissioning of the pipeline it should be ensured that all preparatory work has been completed successfully and all equipments and instruments are functional. An elementary checklist is given below:

- Check all terminals/pipeline for completion and correctness against P&IDs.
- All equipments and piping are pressure tested, flushed / cleaned, leak tested and ready for service.
- All instrumentation is complete in field as well as in control room. Instruments are calibrated.
- Automation package is fully commissioned and operational. UPS are commissioned.
- Blinds are installed as per the master blind list. Each removal/reversal of blind is to be recorded by operator in charge.
- Utility services like Fire water system, Service water system and Emergency power system are commissioned and operational.

**NOTE: DETAIL COMMISSIONING AND START-UP PROCEDURE OF
PIPELINE/STATION PIPINGS SHALL BE AS PER ATTACHED ANNEXURE-C**

SECTION -6

NORMAL OPERATION

6.0 INTRODUCTION

This section describes the procedure for normal operation of the facilities and handling of emergency situations at Dispatch Station, the intermediate station and the receipt terminals. To enable the operation of the facilities to their optimum utilization and to reduce unplanned breakdowns, some routine checks to be performed by the operators are also mentioned. These routine checks along with other operations as advised by the supervisors should be carried out for long and efficient use of pipeline systems.

Dispatch terminal is to transfer the natural gas as per schedule and achieve the desired results.

6.1 TRANSFER OF GAS

When natural gas is transferred through the pipeline it is necessary to keep an accurate account of gas being supplied and received. The dispatcher keeps this record in the station log sheet. The flow meter 011-FE-1101 provides the quantity of gas being supplied to this pipeline. The dispatcher gets all this information from the PLC based panel with receiver instrument and flow computer installed at Dabhol DT. He transmits over phone all the data to the receipt terminal. In order to calculate the amount of gas flowing in Goa and Bangalore spur line, reconciliation meter has been provided at Gokak Top (017-FE-2501) for Goa spur line and at Bechenehalli Top (030-FE-4901) for Bangalore spur line.

A close watch is kept on the hourly readings of the meters at dispatch station and receipt terminals. Any significant difference between the dispatch and receipt terminals can be a possible indication of a line leak. The meters in such cases should be rechecked and calibrated. If the corrected meter readings are also showing a difference more than 0.25%, the pipeline should be inspected for any leak.

In order to measure the composition of gas flowing into the pipeline provision of gas chromatograph has been provided at the downstream of flow meter at Dabhol DT.

Provision of manual sampling has also been provided at Dabhol DT, Bechenehalli and Gokak Top.

6.2 INTERMIXING OF DPPL AND HIGH PRESSURE RLNG GAS FROM RLNG TERMINAL

The normal pressure of DPPL gas is around 75kg/cm² g whereas that of gas received from RLNG terminal is 92kg/cm² g. Hence, in order to facilitate the intermixing of low pressure DPPL gas and high pressure RLNG gas provision of pressure control valve has been provided at the Dabhol DT.

However, PCV shall remain in bypass mode when gas only from Dhabol RLNG terminal is being fed into the Dabhol- Bangalore pipeline. In that scenario 20" line shall be the route for entire gas flow.

PCV has been sized for a flow of 5MMSCMD gas from LNG terminal.

2" venting line has also been provided on 20" line to vent out the trapped gas in case of blind reversal.

6.3 SECTION. & MAINLINE STATION INLET/OUTLET VALVES OPERATION

When required, the sectionalizing valves & mainline station valves will be closed from the SMCS/Field after ensuring the shutdown of entire pipeline operation. On issuance of close command from SMCS for all mainline valves including sectionalizing valves a prompt shall be available to operator for verification of shutdown of the pipeline operation prior to the closing of valves. Closing command of any sectionalizing valve or any mainline station inlet/outlet valve of a corresponding pipeline will give prompt for shutdown of entire pipeline operation. It is mandatory that operator has to honor the prompt or else he shall not be able to close any mainline valve or sectionalizing valve.

As soon as valve is in close position it should be put in local mode. Local switches will open all these valves only manually in presence of authorized operating personnel.

6.4 ROUTINE CHECKS

For smooth operation some routine checks are suggested as under:

- Every shift checks the differential pressure across the cartridge filter at Dabhol DT, Bangalore RT, Goa RT and clean the filter elements when pressure drop exceeds 0.4 kg/cm².
- Check periodically different alarm and shutdown switches.
- Alternate the standby streams of PRS and metering system periodically.
- Carry out weekly inspection of all fire and safety equipments.
- Calibrate the instruments/safety devices periodically or as per vendor's recommendations.
- Monitor all the process parameters and take appropriate actions.
- Monitor the dispatch and receipt quantity.

6.5 PIPELINE OPERATING PARAMETERS

S. No.	PIPELINE IDENTIFICATION	FLOW (NORMAL/MAXIMUM) MMSCMD	OP.PRESS. kg/cm ² g	OP. TEMP. °C	DESIGN PRESS. kg/cm ² g	DESIGN TEMP. °C	LENGTH km
1.	010-PL-00-101	16/22.04	72.9 - 92	4 - 23.8	92	-29-65 (above ground) -29-60 (buried sections)	248.456
2.	010-PL-00-102	9.9/10.12	46.8 - 92	19 – 23.7	92	-29-65 (above ground) -29-60 (buried sections)	495.293
3.	030-PL-00-102	2.199/2.199	46 - 92	28.2 – 30.5	92	-29-65 (above ground) -29-60 (buried sections)	71.9
4.	017-PL-00-101	4.4/10.26	71 - 92	22.5 – 25.7	92	-29-65 (above ground) -29-60 (buried sections)	175.3

6.6 PIPELINE INSTRUMENTS PARAMETERS

A. PRESSURE INSTRUMENTS

Tag No.	Location	Operating Parameters	
		Temperature (Deg C)	Pressure (kg/cm ² g)
011-PT/PI-1101	20"-P-011-1101-D1A	4	92
011-PT/PI-1102	20"-P-011-1101-D1A	4	92
011-PT/PI-1103	20"-P-011-1102-D1A	4	92
011-PT/PI-1104	011-FE-1101	4	92

Tag No.	Location	Operating Parameters	
		Temperature (Deg C)	Pressure (kg/cm ² g)
011-DPT/DPI-1101	Across 011-GN-CT-101A	4	92
011-DPT/DPI-1102	Across 011-GN-CT-101B	4	92
011-PT/PI-1201	20"-P-011-1102-D1A	4	92
011-PT/PI-1202	20"-P-011-1102-D1A	4	92
011-PT/PI-1203	011-ML-00-101	4	92
011-PT/PI-1204	011-ML-00-101	4	92
011-PT-1201 A	AT SV-1201	6.4	91.1
011-PT-1201 B	AT SV-1201	6.4	91.1
011-PT-1202 A	AT SV-1202	8.8	90.1
011-PT-1202 B	AT SV-1202	8.8	90.1
011-PT-1203 A	AT SV-1203	10.5	89.3
011-PT-1203 B	AT SV-1203	10.5	89.3
013-PI-1601	24"-P-013-1601-D1A	11.5	87.3
013-PI-1602	24"-P-013-1601-D1A	11.5	87.3
013-PT/PI-1603	013-MR-00-101	11.5	87.3
013-PI-1604	013-MR-00-102	11.5	87.3
013-PT/PI-1605	24"-P-013-1601-D1A	11.5	87.3
013-PI-1606	24"-P-013-1601-D1A	11.5	87.3
013-PI-1607	013-ML-00-101	11.5	87.3
013-PI-1608	013-ML-00-101	11.5	87.3
013-PT-1601 A	AT SV-1601	12.4	85.7
013-PT-1601 B	AT SV-1601	12.4	85.7
013-PT-1602 A	AT SV-1602	13.7	82.9
013-PT-1602 B	AT SV-1602	13.7	82.9
013-PT-1603 A	AT SV-1603	14.6	80.4
013-PT-1603 B	AT SV-1603	14.6	80.4
016-PI-2301	24"-P-016-2301-D1A	15.5	78
016-PT/PI-2302	24"-P-016-2301-D1A	15.5	78
016-PI-2303	016-MR-00-101	15.5	78
016-PI-2304	016-MR-00-101	15.5	78
016-PT/PI-2305	24"-P-016-2301-D1A	15.5	78
016-PI-2306	24"-P-013-1601-D1A	15.5	78
016-PI-2307	016-ML-00-101	15.5	78
016-PI-2308	016-ML-00-101	15.5	78
016-PT-2301 A	AT SV-2301	17	76.2
016-PT-2301 B	AT SV-2301	17	76.2
016-PT-2302 A	AT SV-2302	18	74.7
016-PT-2302 B	AT SV-2302	18	74.7
022-PI-3601	24"-P-022-3601-D1A	19	72.9
022-PT/PI-3602	24"-P-022-3601-D1A	19	72.9

Tag No.	Location	Operating Parameters	
		Temperature (Deg C)	Pressure (kg/cm ² g)
022-PI-3603	022-MR-00-101	19	72.9
022-PI-3604	022-MR-00-101	19	72.9
022-PT/PI-3605	16"-P-022-3604-D1A	19	72.9
022-PI-3606	16"-P-022-3604-D1A	19	72.9
022-PI-3607	022-ML-00-101	19	72.9
022-PI-3608	022-ML-00-102	19	72.9
022-PT-3601 A	AT SV-3601	21.5	71.8
022-PT-3601 B	AT SV-3601	21.5	71.8
022-PT-3602 A	AT SV-3602	23.8	70.4
022-PT-3602 B	AT SV-3602	23.8	70.4
023-PI-3701	18"-P-023-3701-D1A	25.3	68.8
023-PT/PI-3702	18"-P-023-3701-D1A	25.3	68.8
023-PI-3703	023-MR-00-101	25.3	68.8
023-PI-3704	023-MR-00-101	25.3	68.8
023-PT/PI-3705	18"-P-023-3701-D1A	25.3	68.8
023-PI-3706	18"-P-023-3701-D1A	25.3	68.8
023-PI-3707	023-ML-00-101	25.3	68.8
023-PI-3708	023-ML-00-101	25.3	68.8
023-PT-3701 A	AT SV-3701	26.3	67.7
023-PT-3701 B	AT SV-3701	26.3	67.7
023-PT-3702 A	AT SV-3702	27	66.4
023-PT-3702 B	AT SV-3702	27	66.4
023-PT-3703 A	AT SV-3703	27.4	65.3
023-PT-3703 B	AT SV-3703	27.4	65.3
026-PI-4201	18"-P-026-4201-D1A	27.8	63.5
026-PT/PI-4202	18"-P-026-4201-D1A	27.8	63.5
026-PI-4203	026-MR-00-101	27.8	63.5
026-PI-4204	026-MR-00-101	27.8	63.5
026-PT/PI-4205	18"-P-026-4201-D1A	27.8	63.5
026-PI-4206	18"-P-026-4201-D1A	27.8	63.5
026-PI-4207	026-MR-00-101	27.8	63.5
026-PI-4208	026-MR-00-101	27.8	63.5
026-PT-4201 A	AT SV-4201	28	62
026-PT-4201 B	AT SV-4201	28	62
026-PT-4202 A	AT SV-4202	28.2	61.2
026-PT-4202 B	AT SV-4202	28.2	61.2
026-PT-4203 A	AT SV-4203	28.2	59.7
026-PT-4203 B	AT SV-4203	28.2	59.7
028-PI-4601	18"-P-028-4601-D1A	28.2	58.3
028-PT/PI-4602	18"-P-028-4601-D1A	28.2	58.3

Tag No.	Location	Operating Parameters	
		Temperature (Deg C)	Pressure (kg/cm ² g)
028-PI-4603	028-MR-00-101	28.2	58.3
028-PI-4604	028-MR-00-101	28.2	58.3
028-PT/PI-4605	18"-P-028-4601-D1A	28.2	58.3
028-PI-4606	18"-P-028-4601-D1A	28.2	58.3
028-PI-4607	028-ML-00-101	28.2	58.3
028-PI-4608	028-ML-00-101	28.2	58.3
028-PT-4601 A	AT SV-4601	28.3	56.5
028-PT-4601 B	AT SV-4601	28.3	56.5
028-PT-4602 A	AT SV-4602	28.2	54.6
028-PT-4602 B	AT SV-4602	28.2	54.6
031-PI-5201	20"-P-031-5201-D1A	28.2	52.8
031-PI-5202	20"-P-031-5201-D1A	28.2	52.8
031-PI-5203	031-MR-00-101	28.2	52.8
031-PI-5204	031-MR-00-101	28.2	52.8
031-PI-5205	20"-P-031-5201-D1A	28.2	52.8
031-PI-5206	20"-P-031-5201-D1A	28.2	52.8
031-PI-5201	031-ML-00-101	28.2	52.8
031-PI-5202	031-ML-00-101	28.2	52.8
031-PT-5201 A	AT SV-5201	28.2	50.9
031-PT-5201 B	AT SV-5201	28.2	50.9
031-PT-5202 A	AT SV-5202	28.3	49.5
031-PT-5202 B	AT SV-5202	28.3	49.5
031-PT-5203 A	AT SV-5203	28.3	47.7
031-PT-5203 B	AT SV-5203	28.3	47.7
031-PT-5204 A	AT SV-5204	28.3	47.03
031-PT-5204 B	AT SV-5204	28.3	47.03
029-PI-4701	029-MR-00-101	28.7	46.8
029-PT/PI-4702	029-MR-00-101	28.7	46.8
029-PI-4703	16"-P-029-4701-D1A	28.7	46.8
029-PI-4704	16"-P-029-4701-D1A	28.7	46.8
030-PI-4901	030-ML-00-101	28.2	47
030-PT/PI-4902	10"-P-030-4902-D1A	28.2	47
030-PI-4903	030-ML-00-101	28.2	47
030-PI-4904	8"-P-030-4902-D1A	28.2	47
030-PI-4905	10"-P-030-4902-D1A	28.2	47
030-PT/PI-4906	10"-P-030-4902-D1A	28.2	47
030-PI-4907	049-FE-4901	28.2	47
030-PT-4901 A	AT SV-4901	29.2	46.9
030-PT-4901 B	AT SV-4901	29.2	46.9
030-PT-4902 A	AT SV-4902	30	46.7

Tag No.	Location	Operating Parameters	
		Temperature (Deg C)	Pressure (kg/cm ² g)
030-PT-4902 B	AT SV-4902	30	46.7
030-PT-4903 A	AT SV-4903	30.2	46.6
030-PT-4903 B	AT SV-4903	30.2	46.6
030-PT-4904 A	AT SV-4904	30.3	46.5
030-PT-4904 B	AT SV-4904	30.3	46.5
030-PT-4905 A	AT SV-4905	30.5	46.4
030-PT-4905 B	AT SV-4905	30.5	46.4
030-PT-4906 A	AT SV-4906	30.5	46.3
030-PT-4906 B	AT SV-4906	30.5	46.3
030-PT-4907 A	AT SV-4907	30.6	46.1
030-PT-4907 B	AT SV-4907	30.6	46.1
030-PI-5001	030-MR-00-101	30.5	46
030-PI-5002	10"-P-030-5001-D1A	30.5	46
030-PI-5003	10"-P-030-5001-D1A	30.5	46
030-PI-5004	030-MR-00-101	30.5	46
017-PT/PI-2501	16"-P-030-5001-D1A	19	72.9
017-PI-2502	16"-P-030-5001-D1A	19	72.9
017-PI-2503	017-ML-00-101	19	72.9
017-PI-2504	017-PI-00-101	19	72.9
017-PI-2505	12"-P-017-2502-D1A	19	72.9
017-PI-2506	025-FE-2501	19	72.9
017-PT/PI-2507	16"-P-017-2502-D1A	19	72.9
017-PT-2501 A	AT SV-2501	22.5	71
017-PT-2501 B	AT SV-2501	22.5	71
017-PT-2502 A	AT SV-2502	24.4	68.6
017-PT-2502 B	AT SV-2502	24.4	68.6
019-PI-3101	16"-P-019-3101-D1A	25	64.9
019-PI-3102	16"-P-019-3101-D1A	25	64.9
019-PI-3103	019-MR-00-101	25	64.9
019-PI-3104	019-MR-00-101	25	64.9
019-PI-3105	16"-P-019-3101-D1A	25	64.9
019-PI-3106	16"-P-019-3101-D1A	25	64.9
019-PI-3107	019-ML-00-101	25	64.9
019-PI-3108	019-ML-00-101	25	64.9
019-PT-3101 A	AT SV-3101	25.5	61.8
019-PT-3101 B	AT SV-3101	25.5	61.8
019-PT-3102 A	AT SV-3102	25.8	57.9
019-PT-3102 B	AT SV-3102	25.8	57.9
019-PT-3103 A	AT SV-3103	25.8	54.8
019-PT-3103 B	AT SV-3103	25.8	54.8

Tag No.	Location	Operating Parameters	
		Temperature (Deg C)	Pressure (kg/cm ² g)
017-PI-2601	017-MR-00-101	25.7	53.1
017-PI-2602	18"-P-017-2601-D1A	25.7	53.1
017-PI-2603	017-MR-00-101	25.7	53.1
017-PI-2604	18"-P-017-2601-D1A	25.7	53.1

B. TEMPERATURE INSTRUMENTS

Tag No.	Location	Operating Parameters	
		Temperature (Deg C)	Pressure (kg/cm ² g)
011-TE/TT/TI-1101	20"-P-011-1101-D1A	4	92
011-TI-1102	20"-P-011-1101-D1A	4	92
011-TI-1103	20"-P-011-1102-D1A	4	92
011-TE/TI-1104	16"-P-011-1102-D1A	4	92
011-TE/TT/TI-1201	AT SV-1201	6.4	91.1
011-TE/TT/TI-1202	AT SV-1202	8.8	90.1
011-TE/TT/TI-1203	AT SV-1203	10.5	89.3
011-TE/TT/TI-1204	12"-BD-011-1203-D1A	4	92
013-TE/TT/TI-1607	12"-BD-011-1601-D1A	11.5	87.3
013-TE/TT/TI-1608	24"-P-013-1601-D1A	11.5	87.3
013-TE/TT/TI-1601	AT SV-1601	12.4	85.7
013-TE/TT/TI-1602	AT SV-1602	13.7	82.9
013-TE/TT/TI-1603	AT SV-1603	16.6	80.4
016-TE/TT/TI-2306	12"-BD-016-2301-D1A	15.5	78
016-TE/TT/TI-2308	24"-P-016-2301-D1A	15.5	78
016-TE/TT/TI-2301	AT SV-2301	17	76.2
016-TE/TT/TI-2302	AT SV-2302	18	74.7
022-TE/TT/TI-3606	12"-BD-022-3601-D1A	19	72.9
022-TE/TT/TI-3608	24"-P-022-3601-D1A	19	72.9
022-TE/TT/TI-3601	AT SV-3601	21.5	71.8
022-TE/TT/TI-3602	AT SV-3602	23.8	70.4
023-TE/TT/TI-3707	10"-BD-023-3701-D1A	25.3	68.8
023-TE/TT/TI-3708	18"-P-023-3701-D1A	25.3	68.8
023-TE/TT/TI-3701	AT SV-3701	26.3	67.7
023-TE/TT/TI-3702	AT SV-3702	27	66.4
023-TE/TT/TI-3703	AT SV-3703	27.4	65.3
026-TE/TT/TI-4207	10"-BD-026-4201-D1A	27.8	63.5
026-TE/TT/TI-4208	18"-P-026-4201-D1A	27.8	63.5
026-TE/TT/TI-4201	AT SV-4201	28	62

Tag No.	Location	Operating Parameters	
		Temperature (Deg C)	Pressure (kg/cm ² g)
026-TE/TT/TI-4202	AT SV-4202	28.2	61.2
026-TE/TT/TI-4203	AT SV-4203	28.2	59.7
028-TE/TT/TI-4606	10"-BD-028-4601-D1A	28.2	58.3
028-TE/TT/TI-4608	18"-P-028-4601-D1A	28.2	58.3
028-TE/TT/TI-4601	AT SV-4601	28.3	56.5
028-TE/TT/TI-4602	AT SV-4602	28.2	54.6
029-TE/TT/TI-4701	16"-P-029-4701-D1A	28.7	46.8
029-TE/TT/TI-4702	10"-BD-029-4701-D1A	28.7	46.8
030-TI-4910	08"-P-030-4902-D1A	28.2	47
030-TE/TI-4908	08"-P-030-4902-D1A	28.2	47
030-TE/TI-4909	6"-BD-030-4903-D1A	28.2	47
030-TE/TI/TT-4901	AT SV-4901	29.2	46.9
030-TE/TI/TT-4902	AT SV-4902	30	46.7
030-TE/TI/TT-4903	AT SV-4903	30.2	46.6
030-TE/TI/TT-4905	AT SV-4905	30.5	46.4
030-TE/TI/TT-4907	AT SV-4907	30.6	46.1
030-TE/TI/TT-5001	10"-P-030-5001-D1A	30.5	46
030-TE/TI/TT-5003	6"-BD-030-5001-D1A	30.5	46
031-TE/TI/TT-5206	10"-BD-031-5201-D1A	28.2	52.8
031-TE/TI/TT-5208	20"-P-031-5201-D1A	28.2	52.8
031-TE/TI/TT-5201	AT SV-5201	28.2	50.9
031-TE/TI/TT-5202	AT SV-5202	28.3	49.5
031-TE/TI/TT-5203	AT SV-5203	28.3	48.7
031-TE/TI/TT-5204	AT SV-5204	28.3	47.03
017-TI-2505	12"-P-017-2502-D1A	19	72.9
017-TE/TI-2503	12"-P-017-2502-D1A	19	72.9
017-TE/TT/TI-2504	8"-BD-017-2503-D1A	19	72.9
017-TE/TT/TI-2501	AT SV-2501	22.5	71
017-TE/TT/TI-2502	AT SV-2502	24.4	68.6
019-TE/TT/TI-3107	8"-BD-019-3101-D1A	25	64.9
019-TE/TT/TI-3108	16"-P-019-3101-D1A	25	64.9
019-TE/TT/TI-3101	AT SV-3101	25.5	61.8
019-TE/TT/TI-3102	AT SV-3102	25.8	57.9
019-TE/TT/TI-3103	AT SV-3103	25.8	54.8
017-TE/TT/TI-2601	18"-P-017-2601-D1A	25.7	53.1
017-TE/TT/TI-2602	8"-BD-017-2601-D1A	25.7	53.1

B. FLOW INSTRUMENTS

Tag No.	Location	Operating Parameters		Flow Rate (MMSCMD)	
		Temperature (Deg C)	Pressure (kg/cm ² g)	Normal	Maximum
011-FE/FT/FQY-1101	20"-P-011-1102-D1A	4	92	22.04	24.24
017-FE/FT/FQY-2501	16"-P-017-2502-D1A	19	72	10.26	11.28
030-FE/FT/FQY-4901	10"-P-030-4902-D1A	28.2	46	2.2	2.42

C. PRESSURE SAFETY VALVES

Tag No.	Location	Operating Parameters		Set Pressure (kg/cm ² g)	Basis of selection
		Temperature (Deg C)	Pressure (kg/cm ² g)		
011-PSV-1101	FILTER 011-GN-CT-101 A	4	91.5	92	Ext. Fire case
011-PSV-1102	FILTER 011-GN-CT-101 B	4	91.5	92	Ext. Fire case
011-PSV-1201	011-ML-00-101	4	0-1	92	Ext. Fire case
013-PSV-1601	013-MR-00-101	11.5	0-1	92	Ext. Fire case
013-PSV-1602	013-MR-00-101	11.5	0-1	92	Ext. Fire case
016-PSV-2301	016-MR-00-101	15.5	0-1	92	Ext. Fire case
016-PSV-2302	016-ML-00-101	15.5	0-1	92	Ext. Fire case
022-PSV-3601	022-MR-00-101	19	0-1	92	Ext. Fire case
022-PSV-3602	022-MR-00-101	19	0-1	92	Ext. Fire case
023-PSV-3701	023-MR-00-101	25.3	0-1	92	Ext. Fire case
023-PSV-3702	023-MR-00-101	25.3	0-1	92	Ext. Fire case
026-PSV-4201	026-MR-00-101	27.8	0-1	92	Ext. Fire case
026-PSV-4202	026-ML-00-101	27.8	0-1	92	Ext. Fire case
028-PSV-4601	028-MR-00-101	28.2	0-1	92	Ext. Fire case
028-PSV-4602	028-ML-00-101	28.2	0-1	92	Ext. Fire case
031-PSV-5201	031-MR-00-101	28.2	0-1	92	Ext. Fire case
031-PSV-5202	031-ML-00-101	28.2	0-1	92	Ext. Fire case
029-PSV-4701	029-MR-00-101	28.7	0-1	92	Ext. Fire case
030-PSV-4901	030-MR-00-101	28.2	0-1	92	Ext. Fire case
030-PSV-5001	030-MR-00-102	28.2	0-1	92	Ext. Fire case
017-PSV-2501	017-ML-00-103	19	0-1	92	Ext. Fire case

Tag No.	Location	Operating Parameters		Set Pressure (kg/cm ² g)	Basis of selection
		Temperature (Deg C)	Pressure (kg/cm ² g)		
019-PSV-3101	019-MR-00-101	25	0-1	92	Ext. Fire case
019-PSV-3102	019-MR-00-102	25	0-1	92	Ext. Fire case
017-PSV-2601	017-MR-00-103	25.7	0-1	92	Ext. Fire case

D. SECTIONALISING VALVES

Tag No.	Location	Operating Parameters		Flow Rate (MMSCMD)	
		Temperature (Deg C)	Pressure (kg/cm ² g)	Normal	Maximum
011-SV-1201	010-PL-00-101	6.4	91.1	22.04	24.24
011-SV-1202	010-PL-00-102	8.8	90.1	22.04	24.24
011-SV-1203	010-PL-00-103	10.5	89.3	22.04	24.24
013-SV-1601	010-PL-00-101	12.4	85.7	21.7	23.9
013-SV-1602	010-PL-00-101	13.7	82.9	21.7	23.9
013-SV-1603	010-PL-00-101	14.6	80.4	21.7	23.9
016-SV-2301	010-PL-00-101	17	76.2	21.4	23.54
016-SV-2302	010-PL-00-101	18	74.7	21.4	23.54
022-SV-3601	010-PL-00-102	21.5	71.8	10.12	11.13
022-SV-3602	010-PL-00-102	23.8	70.4	10.12	11.13
023-SV-3701	010-PL-00-102	26.3	67.7	9.92	10.91
023-SV-3702	010-PL-00-102	27	66.4	9.92	10.91
023-SV-3703	010-PL-00-102	27.4	65.3	9.92	10.91
026-SV-4201	010-PL-00-102	28	62	9.92	10.91
026-SV-4202	010-PL-00-102	28.2	61.2	9.92	10.91
026-SV-4203	010-PL-00-102	28.2	59.7	9.57	10.52
028-SV-4601	010-PL-00-102	28.2	56.5	9.57	10.52
028-SV-4602	010-PL-00-102	28.2	54.6	9.57	10.52
031-SV-5201	010-PL-00-102	28.2	50.9	9.57	10.52
031-SV-5202	010-PL-00-102	28.3	49.5	9.55	10.5
031-SV-5203	010-PL-00-102	28.3	48.7	9.55	10.5
031-SV-5204	010-PL-00-102	28.3	47.03	9.55	10.5
017-SV-2501	017-PL-00-101	22.5	71	10.04	10.34
017-SV-2502	017-PL-00-101	24.4	68.6	8.58	9.43
019-SV-3101	017-PL-00-101	25.5	61.8	8.58	9.43
019-SV-3102	017-PL-00-101	25.8	57.9	8.58	9.43
019-SV-3103	017-PL-00-101	25.8	54.8	8.58	9.43
030-SV-4901	030-PL-00-101	29.2	46.9	2.199	2.42
030-SV-4902	030-PL-00-101	30	46.7	2.199	2.42
030-SV-4903	030-PL-00-101	30.2	46.6	2.199	2.42
030-SV-4904	030-PL-00-101	30.3	46.5	2.199	2.42

Tag No.	Location	Operating Parameters		Flow Rate (MMSCMD)	
		Temperature (Deg C)	Pressure (kg/cm ² g)	Normal	Maximum
030-SV-4905	030-PL-00-101	30.5	46.4	2.199	2.42
030-SV-4906	030-PL-00-101	30.5	46.3	2.199	2.42
030-SV-4907	030-PL-00-101	30.6	46.1	2.199	2.42

E. ACTUATED VALVES

Tag No.	Location	Operating Parameters		Flow Rate (MMSCMD)	
		Temperature (Deg C)	Pressure (kg/cm ² g)	Normal	Maximum
011-AV-1101	20"-P-011-1101-D1A	4	92	22.04	24.24
011-AV-1102	20"-P-011-1102-D1A	4	92	22.04	24.24
011-AV-1103	20"-P-011-1103-D1A	4	92	22.04	24.24
011-AV-1104	20"-P-011-1106-D1A	4	92	22.04	24.24
011-AV-1105	20"-P-011-1101-D1A	4	92	22.04	24.24
011-AV-1106	20"-P-011-1102-D1A	4	92	22.04	24.24
011-AV-1107	20"-P-011-1102-D1A	4	92	22.04	24.24
011-AV-1108	20"-P-011-1107-D1A	4	92	22.04	24.24
011-AV-1109	20"-P-011-1107-D1A	4	92	22.04	24.24
011-AV-1204	010-PL-00-101	4	92	22.04	24.24
011-AV-1205	20"-P-011-1102-D1A	4	92	22.04	24.24
013-AV-1604	010-PL-00-101	11.5	87.3	21.7	23.87
013-AV-1605	24"-P-013-1601-D1A	11.5	87.3	21.7	23.87
013-AV-1606	010-PL-00-101	11.5	87.3	21.7	23.87
016-AV-2303	010-PL-00-101	15.5	78	21.7	23.87
016-AV-2304	24"-P-016-2301-D1A	15.5	78	21.38	23.51
016-AV-2305	010-PL-00-101	15.5	78	21.38	23.51
017-AV-2503	16"-P-017-2502-D1A	19	72.9	10.26	11.28
017-AV-2504	16"-P-017-2502-D1A	19	72.9	10.26	11.28
017-AV-2505	16"-P-017-2501-D1A	19	72.9	10.26	11.28
017-AV-2506	16"-P-017-2501-D1A	19	72.9	10.26	11.28
017-AV-2507	16"-P-017-2502-D1A	19	72.9	10.26	11.28
017-AV-2508	017-PL-00-101	19	72.9	10.26	11.28
017-AV-2601	017-PL-00-101	25.7	53.1	8.8	9.68
017-AV-2602	18"-P-017-2601-D1A	25.7	53.1	8.8	9.68
019-AV-3104	017-PL-00-101	25	64.9	8.8	9.68
019-AV-3105	16"-P-019-3101-D1A	25	64.9	8.8	9.68
019-AV-3106	017-PL-00-101	25	64.9	8.8	9.68
022-AV-3603	010-PL-00-101	19	72.9	21.38	23.51

Tag No.	Location	Operating Parameters		Flow Rate (MMSCMD)	
		Temperature (Deg C)	Pressure (kg/cm ² g)	Normal	Maximum
022-AV-3604	16"-P-022-3605-D1A	19	72.9	10.2	11.22
022-AV-3605	010-PL-00-102	19	72.9	10.2	11.22
023-AV-3704	010-PL-00-102	25.3	68.8	10.2	11.22
023-AV-3705	18"-P-023-3701-D1A	25.3	68.8	9.92	10.91
023-AV-3706	010-PL-00-102	25.3	68.8	9.92	10.91
026-AV-4204	010-PL-00-102	27.8	63.5	9.92	10.91
026-AV-4205	18"-P-026-4201-D1A	27.8	63.5	9.92	10.91
026-AV-4206	010-PL-00-102	27.8	63.5	9.92	10.91
028-AV-4603	010-PL-00-102	28.2	58.3	9.56	10.51
028-AV-4604	18"-P-028-4601-D1A	28.2	58.3	9.56	10.51
028-AV-4605	010-PL-00-102	28.2	58.3	9.56	10.51
029-AV-4701	010-PL-00-102	28.7	46.8	7.35	8.08
029-AV-4702	16"-P-029-4701-D1A	28.7	46.8	7.35	8.08
030-AV-4908	10"-P-030-4902-D1A	28.2	47	2.2	2.42
030-AV-4909	10"-P-030-4901-D1A	28.2	47	2.2	2.42
030-AV-4910	10"-P-030-4901-D1A	28.2	47	2.2	2.42
030-AV-4911	10"-P-030-4901-D1A	28.2	47	2.2	2.42
030-AV-4912	030-PL-00-101	28.2	47	2.2	2.42
030-AV-4913	10"-P-030-4902-D1A	28.2	47	2.2	2.42
030-AV-5001	030-PL-00-101	30.5	46	2.2	2.42
030-AV-5002	10"-P-030-5001-D1A	30.5	46	2.2	2.42
031-AV-5205	010-PL-00-102	28.2	52.8	9.56	10.51
031-AV-5206	20"-P-031-5201-D1A	28.2	52.8	9.56	10.51
031-AV-5207	010-PL-00-102	28.2	52.8	9.56	10.51

F. GAS ANALYSER

Tag No.	Location	Operating Parameters	
		Temperature (Deg C)	Pressure (kg/cm ² G)
011-AE/AT-1101	20"-P-011-1102-D1A	4	91.3

G. METERING SKIDS

Tag No.	Flow Rate (MMSCMD)	Inlet Conditions		Outlet Conditions
		Temperature (Deg C)	Pressure (kg/cm ² g)	Pressure (kg/cm ² g)
029-M-4801	6.26	28.7	46.8	40-45
030-M-5101	1	30.5	46	18-25

Tag No.	Flow Rate (MMSCMD)	Inlet Conditions		Outlet Conditions
		Temperature (Deg C)	Pressure (kg/cm ² g)	Pressure (kg/cm ² g)
017-M-2701	1.1	25.7	53.1	40-45

6.7 NORMAL SHUTDOWN

Shutdown of any station along the pipeline necessitates shutting down of the entire pipeline operation downstream of that station. Depending on the section to be isolated following sequence of action needs to be taken for the shutdown.

1. Close inlet station valve of the respective pipeline section
2. Close outlet station valve of the respective pipeline section
3. Close sectionalizing valve based on requirement.

a. SHUTDOWN OF DABHOL BIDADI SECTION PIPELINE THROUGH SMCS

Following steps shall be required to shutdown the Dabhol Bidadi section of pipeline through SMCS;

Dabhol DT to IPS1 Section

- Close 011-AV-1205 at Dabhol Dispatch Terminal
- Close 013-AV-1605 at IPS1
- Close respective SVs through SMCS in between Dabhol DT and IPS1 Section

IPS1 to IPS2 Section

- Close 013-AV-1605 at IPS1
- Close 016-AV-2304 at IPS2
- Close respective SVs through SMCS in between IPS1 and IPS2 Section

IPS2 to IPS3 Section

- Close 016-AV-2304 at IPS2
- Close 022-AV-3604 at IPS3
- Close respective SVs through SMCS in between IPS2 and IPS3 Section

IPS3 to IPS4 Section

- Close 022-AV-3604 at IPS3
- Close 023-AV-3705 at IPS4
- Close respective SVs through SMCS in between IPS3 and IPS4 Section

IPS4 to IPS5 Section

- Close 023-AV-3705 at IPS4
- Close 026-AV-4205 at IPS5
- Close respective SVs through SMCS in between IPS4 and IPS5 Section

IPS5 to IPS6 Section

- Close 026-AV-4205 at IPS5
- Close 028-AV-4604 at IPS6
- Close respective SVs through SMCS in between IPS5 and IPS6 Section

IPS6 to IPS7 Section

- Close 028-AV-4604 at IPS6
- Close 026-AV-5206 at IPS7
- Close respective SVs through SMCS in between IPS5 and IPS6 Section

IPS7 to Bidadi RT Section

- Close 026-AV-5206 at IPS7
- Close 029-AV-4702 at Bidadi RT
- Close respective SVs through SMCS in between IPS5 and IPS6 Section

b. SHUTDOWN OF BECHENEHALLI TOP TO BANGALORE SPURLINE THROUGH SMCS

Following steps shall be required to shutdown the Bechenehalli Top to Bangalore section of pipeline through SMCS;

Bechenehalli Top to Bangalore Section

- Close 030-AV-4913 at **Bechenehalli Top**
- Close 030-AV-5002 at Bangalore

- Close respective SVs through SMCS in between Bechenehalli Top to Bangalore Section
- Operator to close manual SVs in between Bechenehalli Top to Bangalore Section

c. SHUTDOWN OF GOKAK TOP TO GOA RT SPURLINE THROUGH SMCS

Following steps shall be required to shutdown the Bechenehalli Top to Bangalore section of pipeline through SMCS;

Gokak Top to IP1G (Dhumrewadi) Section

- Close 017-AV-2507 at Gokak Top
- Close 019-AV-3105 at IP1G
- Close respective SVs through SMCS in between Gokak Top to IP1G (Dhumrewadi) Section

IP1G (Dhumrewadi) to Goa RT Section

- Close 019-AV-3105 at IP1G
- Close 017-AV-2602 at Goa RT
- Close respective SVs through SMCS in between IP1G (Dhumrewadi) to Goa RT Section

Note: - During Normal shutdown it is not mandatory to close the SV stations in between the pig launcher and receiver.

6.8 SHUTDOWN OF METERING SKID

Metering skids at Bidadi RT, Bangalore RT and Goa RT have been provided with venting arrangement. During shutdown operation the inlet and outlet valves of the skid shall be closed and the vent lines opened to vent out the gas from the entire skid section. All the intermediate valves inside the skid shall be in open position so that the entire pipings inside the skid are depressurized to the full extent.

6.9 BLOWDOWN SYSTEM

b. Tap-off and Receipt Stations

The discharge from the station blow down valves, safety valves and the vent lines of filters meters is discharged into atmosphere at a minimum distance of 3m above the highest working platform.

ii. Intermediate Pigging Station

The discharge from the safety valve and the vent lines of pig receiver/launcher is discharged into atmosphere at a minimum distance of 3m from the highest working platform.

SECTION -7

EMERGENCY SHUTDOWN

7.0 INTRODUCTION

Several emergency conditions may arise during pipeline operations at any time. Emergency shutdown of the entire pipeline shall be done by the actuation of close command to pipeline inlet, outlet and sectionalizing valve through SMCS. It is the responsibility of the respective stations to inform SMCS for the shutdown of the pipeline. The following sections lists are a general guideline only and may be changed as a result of local conditions or circumstances.

7.1 FEED FAILURE

Feed supply may get cut off from dispatch stations due to a number of reasons e.g. Power failure, emergency conditions.

In case of feed failure or emergency conditions, the pipeline section shall be isolated.

7.2 PIPELINE FAILURE

Any leakage in the pipeline can be detected by comparison of mass flow rate of dispatch and the receipt stations.

- In the event of any leakage, isolate the sections by closing respective sectionalizing valves between the leak points through SCADA/ leak detection system.
- Monitor the pressure and temperature for each section of the pipeline
- Send immediately patrol party for physical survey of the section isolated to identify the leaking point.
- Once the leakage point is located, the particular section has to be vented out.
- The venting area shall be cordoned off.
- Line shall be prepared for repair job after taking necessary safety precautions and clearances.
- Restart the pipeline operation, once the repair job is over, after lining up the system.

7.3 EMERGENCY SHUTDOWN PROCEDURE

In case of emergency, pipeline shall be taken in shutdown mode. Gas shall be vented from IP station or from SV stations as per requirement. The upstream and downstream isolation valve/SVs of the affected portion of the pipeline shall be made in closed position.

Deployment of personnel at each station is mandatory during venting of gas from the pipeline. Venting shall be done through QOEC vent line provided at each station. It is to be noted that 2" depressurization valve provided on QOEC line shall be opened first to vent out trapped gas from the vent line before opening of the QOEC vent.

During depressurization, pipeline temperature shall be continuously monitored by skin effect temperature indicator provided at all remote controlled stations and through thermo well provisions at manual SV stations.

Depending on the section to be isolated following sequence of action needs to be taken for the shutdown.

1. Close inlet station valve of the respective pipeline
2. Close outlet station valve of the respective pipeline
3. Close sectionalizing valve based on requirement.
4. Vent the gas through QOEC vent line provided at DT, RT, IP and SV stations.

Emergency shutdown procedures for various pipeline sections are as explained below

A. DABHOL TO BIDADI PIPELINE

Dabhol DT to IPS1 Section

- Close 011-AV-1205 at Dabhol Dispatch Terminal
- Inform downstream receipt stations about emergency shutdown
- Close 013-AV-1605 at IPS1

- Close respective SVs through SMCS
- Vent the gas from respective DT stations/SV stations/IP stations by opening the QOEC vent valve based on section to be depressurized in between Dabhol DT to IPS1 Section. (Operator to follow the established procedure of gas venting through QOEC vent line as mentioned above)

IPS1- IPS2 Section

- Inform Dabhol Dispatch station about emergency shutdown
- Inform downstream receipt stations about emergency shutdown
- Close 013-AV-1605 at IPS1
- Close 016-AV-2304 at IPS2
- Close respective SVs in between IPS1 &IPS2 Section
- Vent the gas from respective SV stations/ IP stations by opening the vent valve based on section to be depressurized. (Operator to follow the established procedure of gas venting through QOEC vent line as mentioned above)

IPS2- IPS3 Section

- Inform Dabhol Dispatch station about emergency shutdown
- Inform downstream receipt stations about emergency shutdown
- Close 016-AV-2304 at IPS2
- Close 022-AV-3604 at IPS3
- Close respective SVs in between IPS2 &IPS3 Section
- Vent the gas from respective SV stations/ IP stations by opening the vent valve based on section to be depressurized. (Operator to follow the established procedure of gas venting through QOEC vent line as mentioned above)

IPS3- IPS4 Section

- Inform Dabhol Dispatch station about emergency shutdown
- Inform downstream receipt stations about emergency shutdown
- Close 022-AV-3604 at IPS3
- Close 023-AV-3705 at IPS4
- Close respective SVs in between IPS3 &IPS4 Section

- Vent the gas from respective SV stations/ IP stations by opening the vent valve based on section to be depressurized. (Operator to follow the established procedure of gas venting through QOEC vent line as mentioned above)

IPS4- IPS5 Section

- Inform Dabhol Dispatch station about emergency shutdown
- Inform downstream receipt stations about emergency shutdown
- Close 023-AV-3705 at IPS4
- Close 026-AV-4205 at IPS5
- Close respective SVs in between IPS4 &IPS5 Section
- Vent the gas from respective SV stations/ IP stations by opening the vent valve based on section to be depressurized. (Operator to follow the established procedure of gas venting through QOEC vent line as mentioned above)

IPS5- IPS6 Section

- Inform Dabhol Dispatch station about emergency shutdown
- Inform downstream receipt stations about emergency shutdown
- Close 026-AV-4205 at IPS5
- Close 028-AV-4604 at IPS6
- Close respective SVs in between IPS5 &IPS6 Section
- Vent the gas from respective SV stations/ IP stations by opening the vent valve based on section to be depressurized. (Operator to follow the established procedure of gas venting through QOEC vent line as mentioned above)

IPS6- IPS7 Section

- Inform Dabhol Dispatch station about emergency shutdown
- Inform downstream receipt stations about emergency shutdown
- Close 028-AV-4604 at IPS6
- Close 031-AV-5206 at IPS7
- Close respective SVs in between IPS6 &IPS7 Section

- Vent the gas from respective SV stations/ IP stations by opening the vent valve based on section to be depressurized. (Operator to follow the established procedure of gas venting through QOEC vent line as mentioned above)

IPS7- Bidadi Receipt Terminal Section

- Inform Dabhol Dispatch station about emergency shutdown
- Close 031-AV-5206 at IPS7
- Close 029-AV-4702 at Bidadi RT
- Close respective SVs in between IPS7 & Bidadi RT Section
- Vent the gas from respective SV stations/ IP station/ RT station by opening the vent valve based on section to be depressurized. (Operator to follow the established procedure of gas venting through QOEC vent line as mentioned above)

B. BECHENEHALLI TOP TO BANGALORE SPURLINE

Bechenehalli Top to Bangalore Receipt Terminal Section

- Inform Dabhol Dispatch station about emergency shutdown
- Close 030-AV-4913 at Bechenehalli Top
- Close 030-AV-5002 at Bangalore RT
- Close respective remote SVs in between Bechenehalli Top to Bangalore RT Section through SMCS
- Operator to close manual SVs in between Bechenehalli Top to Bangalore RT Section
- Vent the gas from respective SV stations/DT station/RT station by opening the vent valve based on section to be depressurized. (Operator to follow the established procedure of gas venting through QOEC vent line as mentioned above)

C. GOKAK TOP TO GOA RT SPURLINE

Gokak Top to IP1G Section

- Inform Dabhol Dispatch station about emergency shutdown
- Close 017-AV-2507 at Gokak Top
- Close 019-AV-3105 at IP1G
- Close respective SVs in between Gokak Top to IP1G Section
- Vent the gas from respective DT station/SV stations/IP station by opening the vent valve based on section to be depressurized. (Operator to follow the established procedure of gas venting through QOEC vent line as mentioned above)

IP1G to Goa RT Section

- Inform Dabhol Dispatch station about emergency shutdown
- Close 019-AV-3105 at IP1G
- Close 017-AV-2602 at Goa RT
- Close respective SVs in between IP1G to Goa RT Section
- Vent the gas from respective SV stations/IP station/RT station by opening the vent valve based on section to be depressurized. (Operator to follow the established procedure of gas venting through QOEC vent line as mentioned above)

SECTION -8

INSPECTION AND MAINTENANCE

8.0 GENERAL

This section describes the routine inspection and maintenance procedure to be followed for safety, security and long life of pipeline. These procedures are written as general guidelines and may be revised and updated depending upon the local conditions or as more experience is gained in operating the system.

8.1 LINE PATROLLING

Line patrolling is a visual inspection of the pipeline ROU along its entire route. Some of the important aspects to be checked during patrolling are:

- Any breaches and soil erosion along the route of the pipeline especially earth washouts at road and channel crossings.
- Unauthorized occupation and use of right of way, growth of vegetation etc.
- Condition of route markers, route and channel crossing markers, milestone markers, test stations and vent pipes.
- Conditions of line isolation valves. These are normally locked open valves with lock keys under the custody of pumping station in-charge.
- Any leakage etc.

Line patrolling is usually done by line Patrolmen who are assigned certain sections of the line. Each gang of patrolmen is responsible for his section of the line and reports to the Station In charge.

8.2 INSPECTION OF CATHODIC PROTECTION

Maintenance of cathodic protection is the most important single item in preventive maintenance of pipelines. Maintenance of cathodic protection at effective levels require regular watchfulness to ensure that equipments such as rectifiers are continuously operating and other sources continue to produce adequate amounts of current. Service interruptions for a few days may not be serious, but it is easy to overlook cases of inadequate protection unless regular periodic checks are made. It is, therefore, essential to make a schedule for inspection of cathodic protection system of the pipeline. The recommended schedule is given below;

A. Inspection once in five years

- The pipeline should be inspected for corrosion/dents/pits etc. by means of electronic/intelligent pigging.
- Continuous Potential Logging (CPL) survey should be carried out.
- Soil samples within ROW/ROU shall be tested to determine the variation in soil resistivity for determining the adequacy of the Cathodic Protection System.

B. Two years Inspections

- Ultrasonic thickness measurements shall be taken of exposed sections of the pipeline. This thickness measurement shall be taken at 4 location (i.e. 12, 3, 6 and 9 O' clock positions) at the exists bends and at every ten meters interval of exposed piping.

C. Annual Inspection

- The clear visibility of ROW/ROU shall be inspected once in a year.
- Capacity test of the pipeline shall be performed once in a year using the gas transported through the pipeline.
- Insulating joints and couplings shall be inspected.
- Above ground piping and accessories shall be inspected.

D. Monthly inspections

- Measurement of PSP of vulnerable points like road and channel crossings.
- Efficiency of cathodic protection stations e.g. current, rectifier operation and general condition of the station.

E. Other inspections:

- PSP readings at feeding points shall be monitored fortnightly
- PSP readings at the test lead points for entire pipeline shall be taken once in a quarter.

- Rail Bridge, Road Bridge, Suspended crossings shall be inspected once in a quarter to check wear and tear of supports/structures.
- PSP at the nearest point of protection of the pipeline. It is essential that this inspection work be done by a team of trained personnel who can record the observations correctly and do the necessary corrections and changes. Adequate instruments for recording the inspection data should be made available to these people.

8.3 LINE PIGGING

Purpose

Dirt, water (if any) and other fluids gradually settle out of products being transferred due to insufficient flow velocity, intermittent flow and pressure/temperature related changes etc. These fluids contain oxygen and other corrosive agents, which promote internal corrosion of the pipeline and thereby reduce the life of the pipeline. Further, the loose sediments, including corrosion products, scales, sand and dirt etc. if allowed to accumulate reduce the internal diameter of the pipe and thus obstruct the flow requiring higher starting pressures to maintain the line efficiency.

Cleaning pig (s) are therefore run through the pipeline to scrape or wipe the line and maintain the line efficiency and enhance the life of the pipeline. The frequency of pigging the line will vary from installation to installation and a schedule can be made after gaining some experience. However, during initial periods, a pigging frequency of approximately three months can be followed or as per GAIL existing O&M philosophy for gas pipeline.

Procedure

Cleaning pig(s) are used to remove foreign matter and deposits or scales. Normally two types of cleaning elements, namely; brushes and urethane blades are employed in cleaning pigs. Brushes can be used if the line contains mill scale or hard deposit adhering to the pipe wall. Urethane blades can be used to remove gummy or loose deposits. The

exact type of pig to be used should be checked from the pig vendors who usually give advice based on the particular pipeline system.

Following is a brief procedure for pigging the pipeline:

- Plan the pigging operation in consultation with the receiving terminal.
- Inform the receiving terminal to line up their pig receiver barrel.
- Ensure that the pig launcher is isolated completely.
- Open the drain and vent valve on the pig launcher and confirm that it is empty and at atmospheric pressure.
- Open the end closure of the pig launcher and insert the suitable pig. Do not attempt to open the hinged cover until launcher is completely blown down to atmospheric pressure. Push the pig inside the launcher with the help of a rod.
- Close the hinged cover and the drain valves and the launcher.
- Open the kicker valve.
- Close the vent valve on the launcher after air is purged out.
- Close the kicker valve after the launcher pressure is equal to the line pressure.
- Reset the pig indicator.
- Open the pig trap valve.
- Open the kicker valve after closing the pig launcher bypass valve (mainline valve)
- Pig indicator will give indication of the movement of the pig from the launcher.
- Inform the receiving terminal about the time the pig left the launcher and the expected time of its arrival at the pig receiver. Open the pig launcher bypass valve after the pig has passed the barred Tee.
- Now isolate the Scraper Launcher by closing the kicker valve and the pig trap valve.
- Open the vent on the launcher and depressurize it.
- Close the vent valve on the launcher. The launcher is now ready for next pigging operation.
- Two hours before the expected arrival of pig at scraper receiver close the valve on main line around 60-70% and divert part of the flow of gas through the receiver.
- Receiving terminal operator should keep close watch on the arrival of pig. Pig indicators will give indication of the arrival of pig into the receiver.

- When the pig is received in the scrapper receiver divert the product at the receiving terminal by opening main line valve. Isolate the scrapper receiver by closing the kicker valve and the pig trap valve.
- Open the vent valve on the scrapper receiver and depressurize it completely.
- Open the hinged cover and take out the pig. Inspect the pig and keep it at safe place after cleaning and washing the same. Also collect sample of dirt, muck etc. from the receiver and send it for testing.
- Close the drain and vent valve on the scrapper receiver. The receiver is now ready for the next pigging operation.
- The pigging operation is now complete.

If a leak develops in the line, quick action has to be taken to minimize the loss, hazard and interruption in the pipeline operation. It is possible to stop a small leak by suitable temporary leak clamps. The temporary repair permits resumption of operations and allows time to plan the permanent repair, when conditions are more favorable.

Some pipe leaks cannot be closed by temporary clamps and plans for emergency pipe replacement must be put into effect. Following actions should be taken quickly:

- Stop the supply up to the desired station.
- Close the appropriate sectionalizing valves through SCADA to limit the amount of line fill that can flow towards the leak.
- Evacuate people and movable property when they might be endangered by leaking gas.
- Evacuate the pipeline section in which leak has appeared
- The repair work is then planned and carried out after taking the necessary safety precautions and clearances.

SECTION -9

HAZARDS AND SAFETY GUIDELINES

9.0 GENERAL

Safety of personnel and equipment is a very important consideration in the operation of the pipeline system. Though the design of the facilities takes care of a number of emergency conditions and makes the facilities operationally safe, proper operating procedures and use of safety equipments are a must for safe running of pipeline facilities and a safe environment to work in. This chapter contains some safety guidelines, which should be strictly followed in the facilities. However, these procedures should be updated from time to time in the light of the experience gained in operating the pipeline facilities.

9.1 GENERAL HAZARDS IN THE PIPELINE FACILITIES

It is essential to recognize the various possible hazards in the operation of the facilities so that the remedial measures can be planned. Following are some of the common safety hazards encountered.

9.2 HAZARDS OF PERTROLEUM PRODUCTS

All gaseous hydrocarbons in amount depending upon the type, in a confined space, will tend to make the atmosphere leaner in oxygen content thus making it difficult to sustain normal breathing (asphyxiation).

The gaseous hydrocarbon also produces some adverse physiological effects. Fire and explosion hazards are associated with these gases under favorable conditions.

a. PHYSIOLOGICAL EFFECTS

The hydrocarbon vapors heavier than air collect at low points near ground level. The vapors have anesthetic effects. If air with hydrocarbon concentration of 0.1 % is inhaled for about 5 minutes, the person feels giddy.

If concentration increases to 0.5% and a person inhales such air for about four minutes, he exhibit symptoms similar to alcoholism.

A concentration of 1.0% will cause rapid onset of "drunkenness" which may lead to unconsciousness and death if exposure continues. At 2.0% concentration paralysis may occur rapidly followed by death.

b. FIRE

When the proportion of hydrocarbons in the hydrocarbon-air mixtures falls within the flammable limits, a fire could occur in presence of a source of ignition, such as spark or an open flame. A hydrocarbon air mixture can spread on the ground over a considerable distance and catch fire when in contact with a spark or an open flame.

An explosion occurs when the air hydrocarbon mixture is enclosed in a vessel and a fire takes place when the above conditions exist in the open. Explosion produces a considerable volume of gas, which creates high pressures causing damage. One explosion could initiate another explosion or fire at a distance of ten to hundred meters because of its physical nature. Explosion is generally followed by a fire.

9.3 SOURCES OF IGNITION

Common sources of ignition are:

- i. Auto ignition
- ii. Electrical Apparatus
- iii. Stray Electric Currents
- iv. Static Electricity
- v. Lightning
- vi. Non Electrical sources (mechanical Sparks)

i. AUTO-IGNITION

For combustion, three conditions are necessary. These are: Combustible material, sufficient quantity of oxygen and a source of heat.

In free air, there is no risk of ignition if the hydrocarbon vapor temperature is less than the ignition temperature. However, if the temperature of hydrocarbon vapors is equal to its ignition temperature, the vapor can catch fire mixing with oxygen from the atmosphere, even without the help of flame or a spark. This is known as auto-ignition.

The risk of auto-ignition is generally more as the molecular weight of the hydrocarbons increases.

ii. ELECTRICAL APPARATUS

These include all machines, equipment, and fittings, in which conductors are used or of which they form a part e.g. electric switches, push buttons, sockets plugs, circuit breakers, starters, instruments, motors and so on. These may act as a source of ignition by electrical arcs and sparks or raising the surface temperature of the apparatus above the spontaneous ignition temperature.

iii. STRAY ELECTRIC CURRENTS

Stray currents may emanate from electric welding machines.

iv. STATIC ELECTRICITY

Examples of electrostatic generation are:

- Passage of gas through pipes and filters
- Impingement of solids on solids e.g. during sand blasting by impingement of solid particles on tank plates.

v. LIGHTNING

Lightning can fall on metallic objects such as towers and tall buildings. These can damage the structures or lead to ignition of hydrocarbon-air mixtures, if present. The vent/safety relief valve discharges at high points to the atmosphere are especially vulnerable to lightning.

vi. NON ELECTRICAL SOURCES OF IGNITION

- Smoking
- I.C Engines, spark ignition system, Dynamo, battery, hot carbonaceous particles ejected from the exhaust, or flame from the exhaust system.

- Pyrophoric Iron: Iron sulphide formed, is very active chemically and when exposed to air, it rapidly oxidizes and becomes so hot that it glows visually and reaches a temperature, sufficient to ignite a hydrocarbon air mixture.
- Frictional ignition due to impact or rubbing action.
- Falling of iron tools.
- Rubbing of iron tools on concrete or during operation of grinding wheel.

9.4 GENERAL SAFETY GUIDELINES

The following general safety rules are applicable to plant operations. These must be known and strictly observed by all personnel.

SAFETY RULES

- i) Smoking should be permitted only at approved smoking locations.
- ii) If an employee's clothing becomes contaminated with hydrocarbons etc., he must remove clothes immediately and take a shower.
- iii) Defective tools should not be used.
- iv) Use proper tools for the work involved, i.e. do not use a file for a bar, hand wrench for a hammer etc
- v) Over-stressing tools or equipment causes serious injuries.
- vi) Safety belts or lifelines should be used when working 3 meters or more above ground, where it is not practical to make other provisions to prevent falling, as per factory rules
- vii) Falls are the second largest cause of accidental deaths. Following irresponsible acts should be avoided by an individual for personal safety.
 - a. Failure to look around while going round the point.
 - b. Running or jumping in work places.
 - c. Standing on boxes, chairs and makeshifts instead of ladders or platforms.
 - d. Neglecting to use handrails and running on stairs.
 - e. Not facing the ladder when carrying objects on the same.
 - f. Tools and materials should not be dropped from heights. They must be carried down.
 - g. Standing or walking under materials suspended by ropes, chains or cables
- viii) Don't tamper with electrical apparatus. This is the work of qualified electrician.

- ix) Don't remove light bulbs to plug in power equipment
- x) Use only approved electrical fittings. The covers of electrical fittings in hazardous areas should be secured properly to avoid entry of explosive gases.
- xi) All electrical equipment must be properly grounded.
- xii) An electrical extension wire must not be used if it is in bad condition, laid through water or in such a manner as to allow motorized equipment to travel over it.
- xiii) Employees should regard all electrical wires as live and dangerous.
- xiv) Never close a switch or breaker that has been opened unless authorized to do so by your supervisor.
- xv) All electrical breakers must be de-energized and locked before process equipment can be worked upon.
- xvi) All live fuse, lighting and power cabinets must be kept closed.
- xvii) If an electrical power unit motivates moving machinery and it is necessary to make repairs to same then refer to and follow the electrical lock out procedure laid down by the plant management.

9.5 SAFETY RULES FOR PARTICULAR OPERATIONS

The following safety instructions are for the operations carried out frequently in the facilities. These must, in addition to the General safety Rules, be understood and observed strictly by all personnel.

D) PRECAUTIONS BEFORE HANDING OVER EQUIPMENT

Following items should be checked by a responsible operating supervisor before equipment is handed over for maintenance.

- a) Ascertain that equipment is isolated by proper valves and blinds.
- b) Ascertain that there is no pressure of hydrocarbons in the lines, vessels and equipment.
- c) Check for O₂ content at vent and drain to ensure that the vessel is full of air.
- d) Provide tags on the various blinds to avoid mistakes. Maintain a register for blinds.
- e) Keep the surrounding area cleaned up.
- f) Get explosive meter test done in vessels, lines, equipment and surrounding areas.

If welding or hot work is to be done, also:

- a) Keep fire-fighting devices ready for use nearby.
- b) Close the neighboring surface drains with wet gunny bags.
- c) Keep water flowing in the neighboring area to cool down any spark bits etc.

After the above operations have been made, a safety permit should be issued for carrying out the work. A responsible operating supervisor should be personally present at the place of hot work. Hot work should be immediately suspended if instructed by the supervisor or on detecting any unsafe condition. When people have to enter a vessel for inspection or other work, one person should stand outside near the manhole of the vessel for any help needed by the persons working inside. The person entering the vessel should have tied on his waist a rope to enable pulling him out in case of emergency.

9.6 USE OF LIFE SAVING DEVICE

Safety of the personnel should be the prime concern. Life saving device is to be used for personnel protection. Important life saving devices which are required to be used are given below:

- a. Head protection:** - Safety helmets shall be worn by all personnel at all times in the plant for protection of the head. They may be removed when inside rooms or buildings which do not have overhead or other hazards.
- b. Eye and face protection:** - Safety glasses, goggles or face shields shall be worn while performing work, which could result in eye or face injury.
- c. Hand Protection:** - Proper hand protective gloves should be worn.
- d. Foot protection:** - Safety shoes are to be worn for foot protection.
- e. Ear protection:** - Whenever personnel are required to be work in noisy areas proper ear protection device such as ear plug etc, is to be used.
- f. Breathing apparatus:** - Whenever persons are required to work or enter an area of high hydrocarbon vapor concentration, wear appropriate respiratory protection, such as self-contained breathing apparatus or an air mask with an external air supply.

9.7 GOOD HOUSEKEEPING

Good housekeeping on site is essential to personnel safety and efficient operation. The highest standard of cleanliness and order is to be observed at all times. All passages, steps, ladders, platforms and workplaces are to be kept clear and free from obstructions. Floors shall be kept clean and free from slippery substances.

9.8 PERMITS TO WORK

A work permit must be issued by the operations group before commencing any maintenance work affecting the operation of the pipeline or the stations. It is issued for hot or cold work. Station areas are generally identified as hazardous areas as far as the threat of fire is concerned. Therefore in order to carryout works within these areas a written work permit is required.

9.9 SPECIAL TOOLS AND EQUIPMENT

Any special tools and equipment should be identified and labeled indicating their description and to what purpose the special tools and equipment are applicable. A special storage area should be allocated for special tools and equipment. Use of non-specialized tools and equipment can result in injury to personnel and damage to plant and machinery. Tools being used in Hazardous environment shall be non-sparking type.

9.10 TESTING OF SAFETY SYSTEMS

Periodic exercises should be carried out to test the safety organization and procedures ensuring that all personnel are familiar with their responsibilities and required actions.

9.11 EMERGENCY

An emergency plan should be drawn. Notices should be prominently displayed at all telephone locations within the work area giving instructions for calling the company representative, fire fighting crew, medical assistance and civil authorities. Emergency response drill should be conducted on a regular basis to ensure that all elements of the plan are adequate.

9.12 RESTRICTION OF VEHICLES USE NEAR OPERATION AREA

The operation of vehicle engines or other internal combustion engines can provide sources of ignition. Ignition of vapors may occur through the arching of distributor points, hot engines exhaust piping, burning or glowing carbon particles in exhaust piping and backfiring.

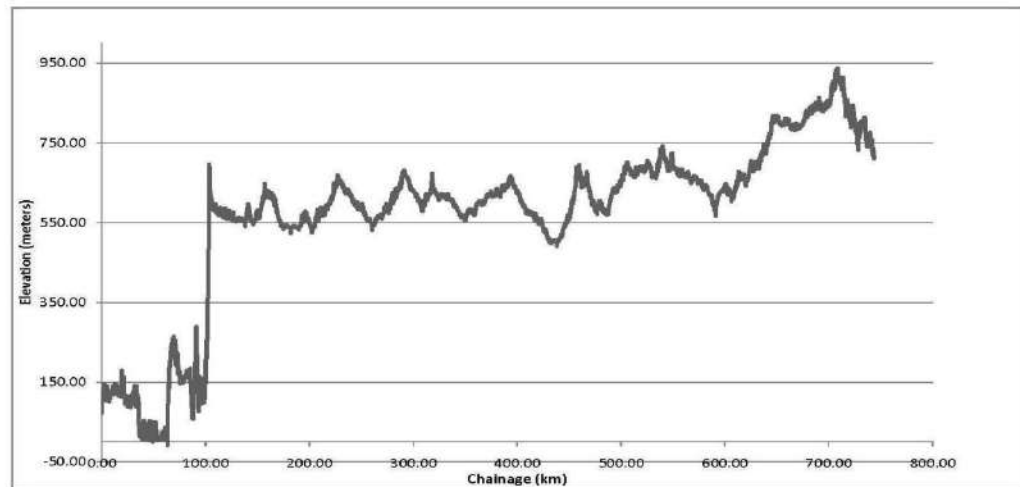
9.13 TRAINING

Accidents are generally caused by people-those who consciously or unconsciously involve themselves in unsafe acts or allow unsafe conditions to exist. Safety indoctrination and training is one of the better means of resolving the human deficiency problem.

ANNEXURE-A

GROUND PROFILE

(DABHOL- BANGALORE PIPELINE)



ANNEXURE-B

MATERIAL SAFETY DATA SHEET OF NATURAL GAS

ANNEXURE-C

DETALIED PRECOMMISSIONING & COMMISSIONING PROCEDURE

ANNEXURE-D

PIPING & INSTRUMENTATION DIAGRAM

ANNEXURE-E

PIPELINE SCHEMATIC

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ENGINEERS INDIA LIMITED NEW DELHI

CENTRIFUGAL COMPRESSOR DATA SHEET (API 617-6TH) SI UNITS

6988

ITEM NO.

R-R proposal no. OG1331

REVISION NO.

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DATE

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BY

J. Bygrave

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V1 APPLICABLE TO: ☒ PROPOSAL ☐ PURCHASE ☐ AS BUILT

2 FOR EIL - GAIL PIPELINE EXPANSION PROJECT

UNIT

3 SITE Chainsa Station

SERIAL NO.

4 SERVICE Gas Transmission

NO. REQUIRED

2

5 ☒ CONTINUOUS ☐ INTERMITTENT ☐ STAND BY

DRIVER TYPE (3.1.1)

Gas Turbine

6 MANUFACTURER Rolls-Royce

MODEL

RFBB36

DRIVER ITEM NO.

7 NOTE: INFORMATION TO BE COMPLETED:

☐ BY PURCHASER☐ BY MANUFACTURER

OPERATING CONDITIONS

(ALL DATA ON PER UNIT BASIS)

OTHER CONDITIONS (3.1.2)

13 ☐ GAS HANDLED (ALSO SEE PAGE 2)14 ☒ nm³/h (1.013 BAR & 0 °C)15 ☒ WEIGHT FLOW, kg/min

INLET CONDITIONS

17 ☒ PRESSURE (kg/cm²g)18 ☒ TEMPERATURE (°C)19 ☐ RELATIVE HUMIDITY %20 ☒ MOLECULAR WEIGHT (Mw)21 ☒ Cp/Cv (K_{AVG})22 ☒ COMPRESSIBILITY23 ☒ INLET VOLUME, (m³/s)

DISCHARGE CONDITIONS

25 ☒ PRESSURE (kg/cm²g)26 ☒ TEMPERATURE (°C)27 ☒ Cp/Cv (K_{AVG})28 ☒ COMPRESSIBILITY29 ☒ FRICTION POWER (KW)30 ☒ kW REQUIRED (ALL LOSSES INCLUDED)31 ☒ SPEED (RPM)32 ☒ ESTIMATED SURGE RANGE, % (AT SPEED ABOVE)33 ☒ POLYTROPIC HEAD (kJ/kg)34 ☒ POLYTROPIC EFFICIENCY (%)35 ☒ CERTIFIED POINT36 ☐ PERFORMANCE CURVE NUMBER

PROCESS CONTROL

38 METHOD ☐ SUCTION THROTTLING☐ VARIABLE INLET☒ SPEED VARIATION☐ DISCHARGE☒ COOLED BYPASS

39 FROM (BAR)(kPa abs)

GUIDE VANES

FROM 70 %

BLOWOFF

FROM Discharge

40 TO (BAR)(kPa abs)

(3.4.2.4)

TO 105 %

TO

TO Suction

42 SIGNAL ☒ SOURCE (3.4.2.1) Suction / Discharge Pressure, Flow43 TYPE ☒ ELECTRONIC ☐ PNEUMATIC ☐ OTHER

44 RANGE 4 - 20 MA

(BAR)(kPa abs)

46 ANTI-SURGE BYPASS ☐ MANUAL☒ AUTOMATIC☐ NONE

48 REMARKS:

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OPERATING CONDITIONS (Continued) (3.1.2) (3.1.3)

2	GAS ANALYSIS:		NORMAL	OTHER CONDITIONS					(2.11.1.3)
3	☐ MOL % ☐			A	B	C	D	E	REMARKS: (2.11.1.8)
4		MW		Rich	Lean				
5	AIR	28.966							
6	OXYGEN	32.000							
7	NITROGEN	28.016		0.09	0.09				
8	WATER VAPOR	18.016		NIL	NIL				
9	CARBON MONOXIDE	28.010							
10	CARBON DIOXIDE	44.010							
11	HYDROGEN SULFIDE	34.076		6 PPMW	6 PPMW			(2.11.1.7)	
12	HYDROGEN	2.016							
13	METHANE	16.042		92.49	94.07				
14	ETHYLENE	28.052							
15	ETHANE	30.068		5.64	4.59				
16	PROPYLENE	42.078							
17	PROPANE	44.094		1.41	1.07				
18	I-BUTANE	58.120		0.20	0.18				
19	n-BUTANE	58.120		0.15					
20	I-PENTANE	72.146							
21	n-PENTANE	72.146		0.01					
22	HEXANE PLUS								
23	TOTAL SULPHUR			24 PPMW	24 PPMW				
24									
25	TOTAL			99.99	100.00				
26	AVG. MOL. WT.			17.4	17.07				
27	LOCATION: (2.1.9)				NOISE SPECIFICATIONS: (2.1.10)				
28	☐ INDOOR ☒ OUTDOOR ☐ GRADE				☐ APPLICABLE TO MACHINE:				
29	☐ HEATED ☒ UNDER ROOF ☐ MEZZANINE				SEE SPECIFICATION				
30	☒ UNHEATED ☐ PARTIAL SIDES ☐				☐ APPLICABLE TO NEIGHBORHOOD:				
31	☒ ELEC. AREA CLASSIFICATION (2.1.15)				SEE SPECIFICATION				
32	☐ WINTERIZATION REQ'D. (2.1.9) ☒ TROPICALIZATION REQ'D. (3.4.6.6)				ACOUSTIC HOUSING: ☐ YES ☒ NO				
33	SITE DATA:				SOUND LEVEL See Note dB (A) @ M				
34	☒ ELEVATION 197.8 m BAROMETER BAR				APPLICABLE SPECIFICATIONS:				
35	☐ RANGE OF / 0.3				API 617, CENTRIFUGAL COMPR. FOR GEN. REFINERY SERV.				
36	DRY BULB WET BULB				☒ VENDOR HAVING UNIT RESPONSIBILITY (2.9.1.7)				
37	NORMAL °C	45 / 85%RH		Rolls-Royce					
38	MAXIMUM °C	45 / 84%RH		☐ GOVERNING SPECIFICATION (IF DIFFERENT)					
39	MINIMUM °C	0 / 37%RH							
40	°C								
41	UNUSUAL CONDITIONS: ☒ DUST ☐ FUMES				PAINTING:				
42	☒ OTHER (2.1.9)				☒ MANUFACTURER'S STD.				
43					☐ OTHER				
44					SHIPMENT: (4.4.1)				
45	REMARKS: Noise level, for the compressor package in				☐ DOMESTIC ☐ EXPORT ☒ EXPORT BOXING REQ'D.				
46	isolation, shall not exceed 88 dba at 1 meter.				☒ OUTDOOR STORAGE MORE THAN 6 MONTHS (4.4.1)				
47					SPARE ROTOR ASSEMBLY PACKAGED FOR (4.4.3.10)				
48					☐ HORIZONTAL STORAGE ☐ VERTICAL STORAGE				
49									
50									



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CONSTRUCTION FEATURES

SPEEDS:

MAX. CONT. 5093 RPM TRIP 5350 RPM

MAX. TIP SPEEDS: 194.7 m/s @ 100% SPEED
204.4 m/s @ MAX. CONT. SPEED

LATERAL CRITICAL SPEEDS (DAMPED)

FIRST CRITICAL 2800 RPM 1st Brg MODE
SECOND CRITICAL ~7100 RPM 2nd Brg MODE
THIRD CRITICAL ~10600 RPM 1st Bendg MODE
FOURTH CRITICAL RPM MODE

LATERAL ANALYSIS REQUIRED (2.9.2.3)

TRAIN TORSIONAL ANALYSIS REQUIRED

(TURBINE DRIVEN TRAIN) (2.9.4.5)

TORSIONAL CRITICAL SPEEDS:

FIRST CRITICAL Per API 617 RPM
SECOND CRITICAL Per API 617 RPM
THIRD CRITICAL Per API 617 RPM
FOURTH CRITICAL Per API 617 RPM

VIBRATION: Std test limit 39.0 μ m, RR to attempt
ALLOWABLE TEST LEVEL 25 μ m with reasonable effort to
(PEAK TO PEAK) obtain

ROTATION, VIEWED FROM DRIVEN END ☐ CW ☒ CCW

MATERIALS INSPECTION REQUIREMENTS (4.2.2)

SPECIAL CHARPY TESTING (2.11.3)
RADIOGRAPHY REQUIRED FOR per specification
ULTRASONIC REQUIRED FOR plus R-R clarifications
MAGNETIC PARTICLE REQUIRED FOR Shaft, Impellers
LIQUID PENETRANT REQUIRED FOR Guide vanes

CASING:

MODEL RFBB36
CASING SPLIT Vertical
MATERIAL CASE & COVER A-34 or A-55 CAST STEEL
THICKNESS (mm) 76 CORR. ALLOW. (mm) 3.2
MAX. WORKING PRESS 150 (BARG)
MAX DESIGN PRESS 155 (BARG)
TEST PRESS (BARG): HELIUM HYDRO 1.5x MWP
MAX OPER. TEMP. 177 °C MIN. OPER. TEMP. -35 °C
MAX NO. OF IMPELLERS FOR CASING 4-5 depends on Appl
MAX CASING CAPACITY (m³/h) 90000
CASING SPLIT SEALING (2.2.10) O-ring
☐ SYSTEM RELIEF VALVE SET PT. (2.2.4) (MPaG)(assumed)

DIAPHRAGMS:

MATERIAL Stl ASTM A36; Gray Iron ASTM A48 CI 40C

IMPELLERS:

NO. 2 DIAMETERS 766.65
NO. VANES EA. IMPELLER 17 (prel)

REMARKS Materials are all RR standard, with years of experience.

Operating Temperature limits are for normal service-Maximum

operating temperature may be modified during detail design

Barrier seal plus separation air system is also included.

TYPE (OPEN, ENCLOSED, ETC.) Enclosed

TYPE FABRICATION Welded

MATERIAL Stl Forging, USS T-1, Type C

MAX. YIELD STRENGTH (N) 620

BRINNEL HARDNESS: MAX 293 MIN 248

SMALLEST TIP INTERNAL WIDTH (mm) After design

MAX. MACH. NO. @ IMPELLER EYE After Design

MAX. IMPELLER HEAD @ 100% SPD (N-m/kg)

SHAFT:

MATERIAL Stl Forging, ASTM A-668 Cl.L

DIA @ IMPELLERS (mm) 215.9 DIA @ COUPLING (mm) 165.1

SHAFT END: ☒ TAPERED ☐ CYLINDRICAL

MAX. YIELD STRENGTH (N) 930

SHAFT HARDNESS (BNH)(Rc) 331 BNH Max

SHAFT HARDNESS (BNH)(Rc) 269 BNH Min

BALANCE PISTON:

MATERIAL Stl Plate ASTM A-514.Gr.F /Q AREA Later (mm²)

FIXATION METHOD Shrink Fit + 2 keys

SHAFT SLEEVES:

N / A

AT INTERSTG. CLOSE

CLEARANCE POINTS

AT SHAFT SEALS

ACCESSIBLE (2.8.2)

LABYRINTHS:

INTERSTAGE

TYPE Renewable MATERIAL Alum AA Alloy 771 T-5

BALANCE PISTON

TYPE Honeycomb MATERIAL SST ASTM A240

SHAFT SEALS: Type 321

SEAL TYPE (2.8.3) Tandem Dry Gas Face Seals

SETTLING OUT PRESSURE (BARG) TBD

SPECIAL OPERATION (2.8.1)

SUPPLEMENTAL DEVICE REQUIRED FOR CONTACT

SEALS (2.8.3.2) TYPE

BUFFER GAS SYSTEM REQUIRED (2.8.7) ☐ MANIFOLD (3.5.1.6)

TYPE BUFFER GAS Pri:Filt Process Gas; Sec: N2; Barrier: Air

BUFFER GAS CONTROL SYSTEM SCHEMATIC BY VENDOR

PRESSURIZING GAS FOR SUBATMOSPHERIC SEALS (2.8.8)

TYPE SEAL Burgmann PDGS intermed laby, intchgle NDE-DE

INNER OIL LEAKAGE GUAR. (λ /DAY/SEAL) N / A

BUFFER GAS REQUIRED FOR:

☐ AIR RUN-IN ☒ OTHER N2 for run-in

BUFFER GAS FLOW (PER SEAL):

NORM: 7.1 am³/h @ Design (kPa) Δ P 50

MAX. 10.7 am³/h @ Design (kPa) Δ P 100

BEARING HOUSING CONSTRUCTION:

TYPE (SEPARATE, INTEGRAL) Separate SPLIT Vertical

MATERIAL Stl ASTM A668 Cl B; Iron ASTM A48 CI 40C



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CONSTRUCTION FEATURES (CONTINUED)

BEARINGS AND BEARING HOUSINGS

RADIAL	INLET	EXHAUST	THRUST	ACTIVE	INACTIVE
TYPE	Tilt-Pad	Tilt-Pad	TYPE	Self Leveling/Tilting Pad	
MANUFACTURER	Waukesha		MANUFACTURER	Waukesha	
LENGTH (mm)	82.6	82.6	UNIT LOADING (MAX BAR)	After Design	After Design
SHAFT DIA. (mm)	165.1	165.1	UNIT LOAD (ULT.) (BAR)	44.83	44.83
UNIT LOAD (ACT/ALLOW) (Bar)	<5 / 15	<5 / 15	AREA (mm ²)	33226	33226
BASE MATERIAL	Steel	Steel	NO. PADS	9	9
BABBIT THICKNESS (mm)	Tin Based > 1.5		PIVOT: CENTER / OFFSET, %	Offset 70 %	Offset 70%
NO. PADS	4	4	PAD BASE MATL	Std / Tin based Babbitt	
LOAD: B'TWN/ON PAD	Between	Between	LUBRICATION: ☒ FLOODED ☐ DIRECTED		
PIVOT: CTR/OFFSET, %	Center	Center	THRUST COLLAR: ☐ INTEGRAL ☒ REPLACEABLE		
			MATERIAL	Steel Plate AISI 4340	

BEARING SPAN	2263	mm
BEARING TEMPERATURE DEVICES	☐ SEE ATTACHED API-670 DATA SHT	
☐ THERMISTORS		
☐ TYPE	POS TEMP COEFF	NEG TEMP COEFF
☐ TEMP SWITCH & INDICATOR BY:	PURCH	MFR
☐ THERMOCOUPLES		
☐ SELECTOR SWITCH & INDIC. BY:	PURCH	MFR
☒ RESISTANCE TEMP DETECTORS		
☒ RESISTANCE MAT'L	Platinum	100 OHMS
☐ SELECTOR SWITCH & INDICATOR BY:	PURCH	X MFR
☒ LOCATION-JOURNAL BRG		
NO. EA PAD	EVERY OTH PAD	2 PER BRG
OTHER		
☒ LOCATION-THRUST BRG		
NO. EA PAD	EVERY OTH PAD	2 PER BRG
OTHER		
NO. (INACT) EA PAD	EVERY OTH PAD	2 PER BRG
OTHER		
☒ MONITOR SUPPLIED BY (3.4.7.4)	Rolls-Royce	
☒ LOCATION	UCP	ENCLOSURE
☒ MFR.	Rolls-Royce	MODEL 3500
☐ SCALE RGE	ALARM	SET @ 120 °C
☒ SHTDWN	SET @ 130 °C	TIME DELAY 1 SEC

VIBRATION DETECTORS:

☒ TYPE	Non-Contacting	MODEL	3300 XL
☒ MFR	Bently-Nevada		
☒ NO. AT EA SHAFT BEARING	2	TOTAL NO.	4
☒ OSCILLATOR-DETECTORS SUPPLIED BY	Rolls-Royce		
☒ MFR	Bently-Nevada	MODEL	3300 XL
MONITOR SUPPLIED BY (3.4.7.2)			
☒ LOCATION	UCP	ENCLOSURE	
☒ MFR.	Bently-Nevada	MODEL	3500
☐ SCALE RGE	ALARM	SET @	60 um
☒ SHTDWN:	SET @ 90 um	☐ TIME DELAY	1 SEC

AXIAL POSITION DETECTOR:

☒ TYPE	Non-Contacting	MODEL	3300 XL
☒ MFR	Bently-Nevada	NO. REQUIRED	2
☒ OSCILLATOR-DEMODULATOR SUPPLIED BY	Rolls-Royce		
☒ MFR	Bently-Nevada	MODEL	3300 XL
MONITOR SUPPLIED BY (3.4.7.2)			
☒ LOCATION	UCP	ENCLOSURE	
☒ MFR.	Bently-Nevada	MODEL	3500
☐ SCALE RGE	☐ ALARM	SET @	+/- .5 um
☒ SHTDWN:	SET @ +/- .65 um	☒ TIME DELAY	1 SEC

CASING CONNECTIONS

CONNECTION	DESIGN APPROVAL REQ'D (2.11.2.10)	ASME API605 OTHERS SIZE	FACING	POSITION (2.4.2.1)	FLANGED OR STUDD (2.4.2.1)	MATING FLG & GASKET BY VENDOR (2.4.2.3)	GAS VELOCITY m/SEC
INLET	No	914.4mm 900#	RF	Horiz/Side	Flanged	Yes	14.50
DISCHARGE	No	914.4mm 900#	RF	Horiz/Side	Flanged	Yes	11.99

REMARKS

Dimensions indicated (diameters and lengths) are typical for normal service - actual dimensions are subject to design review
Vibration and position detector settings are typical
Axial position alarm and shutdown setting is equal to the measured thrust bearing axial clearance plus the indicated value.



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1 OTHER CONNECTIONS

SERVICE:	NO.	SIZE	TYPE
LUBE-OIL INLET	2	1"/1"	NPTF/3000#SAE
LUBE OIL OUTLET	4	1"-2"	3000#SAE
SEAL-OIL INLET			
SEAL-OIL OUTLET			
SEAL GAS INLET	2	.75"	3000# SAE
SEAL GAS OUTLET	2	.75"	3000# SAE
CASING DRAINS	2	.75"	3000# SAE
STAGE DRAINS			
VENTS	2	.75"-2"	3000# SAE
VENTS			
PRESSURE	4	1"	NPTF, 2 each nozz
TEMPERATURE	8	1"	NPTF, 4 each nozz
SOLVENT INJECTION			
PURGE FOR:			
BRG. HOUSING			
BTWN BRG & SEAL	2	.75"	3000# SAE
BTWN SEAL & GAS	2	.75"	3000# SAE

- 20 ☐ INDIVIDUAL STAGE DRAINS REQUIRED (2.4.3.2)
21 ☐ VALVED & BLINDED
22 ☐ VALVED & BLINDED & MANIFOLD 2 Casing drains
23 KEY PHASOR REQUIRED
24 ☒ COMPRESSOR ☐ GEAR ☐ DRIVER

ALLOWABLE PIPING FORCES AND MOMENTS:

	INLET		DISCHARGE			
	FORCE	MOMT	FORCE	MOMT	FORCE	MOMT
	N	N-m	N	N-m	N	N-m
AXIAL	Per Rolls-Royce Standard GER 0123 para 3.2, ref Fig 4 & Table 7b					
VERTICAL						
HORIZ. 90						
	FORCE	MOMT	FORCE	MOMT	FORCE	MOMT
	N	N-m	N	N-m	N	N-m
AXIAL	Per Rolls-Royce Standard GER 0123 para 3.2, ref Fig 4 & Table 7b					
VERTICAL						
HORIZ. 90						

- ☐ ACCELEROMETER(3.4.7.5) N /A
☐ SEE ATTACHED API-670 DATA SHEET
☐ TYPE MODEL
☐ MFR NO. REQUIRED
☐ LOCATION
☐ OSCILATOR-DEMODULATORS SUPPLIED BY
☐ MFR ☐ MODEL
☐ MONITOR SUPPLIED BY (3.4.7.6)
☐ LOCATION ENCLOSURE
☐ MFR ☐ MODEL
☐ SCALE RANGE ☐ ALARM ☐ SET @ mm/SEC²
☐ SHTDWN ☐ SET @ mm/SEC² ☐ TIME DELAY SEC

ACCESSORIES

26 COUPLING AND GUARDS (3.2)

27 NOTE: SEE ROTATING ELEMENTS - SHAFT ENDS

- 28 ☐ SEE ATTACHED API-671 DATA SHEET ☒ KEYLESS HYDRAULIC ☐ KEYED

29 COUPLING FURNISHED BY Rolls-Royce

30 MANUFACTURER Bibby or equal TYPE Dry MODEL service factor ≥ 1.75

31 COUPLING GUARD FURNISHED BY: Rolls-Royce

32 TYPE: ☒ FULLY ENCLOSED ☐ SEMI-OPEN ☐ OTHER non-sparking

33 COUPLING DETAILS (PREL)

34 MAX O.D.	427	mm
35 HUB WEIGHT	46	kg
36 SPACER LENGTH	1524 (1524 DBSE)	mm
37 SPACER WEIGHT	163	kg

34 VENDOR MOUNT HALF COUPLING

LUBRICATION REQUIREMENTS:

- ☒ NON-LUBE ☐ GREASE ☐ CONT. OIL LUBE ☐ OTHER
QUANTITY PER HUB kgs or L/MIN

38 MOUNTING PLATES

- 39 ☐ BASEPLATES: FURNISHED BY (3.3.1.1)
40 ☐ COMPRESSOR ONLY (3.3.2.1) ☐ DRIVER ☐ GEAR
41 ☐ OTHER
42 ☐ DRIP TRIM ☐ LEVELING PADS (3.3.2.2)
43 ☐ COLUMN MOUNTING (3.3.2.3)
44 ☐ SUB-SOLE PLATES REQ'D (3.3.3.2)
45 ☐ STAINLESS STEEL SHIM THICKNESS mm
46 PRIMER FOR EPOXY GROUT REQ'D (3.3.1.2.9)
47 TYPE

39 SOLEPLATES: FURNISHED BY: Rolls-Royce

- ☐ THICKNESS mm
☒ SUBSOLE PLATES REQ'D (3.3.3.2)
☒ STAINLESS STEEL SHIM THICKNESS - mm
☐ DRIVER ☐ GEAR ☒ COMPRESSOR 3.2 mm
☒ PRIMER FOR EPOXY GROUT REQ'D (3.3.1.2.9)
TYPE

REMARKS

Number and size of connections is preliminary
Final quantity and location will be advised after final design
is complete.
Foundation bolts by Rolls-Royce



ENGINEERS INDIA LIMITED NEW DELHI

CENTRIFUGAL COMPRESSOR DATA SHEET (API 617-6TH) SI UNITS

JOB NO. 6988 ITEM NO.
REVISION NO. 0 DATE 6-Apr-08
PAGE 6 OF 6 BY J. Bygrave

R
E
V

UTILITIES

● UTILITY CONDITIONS: (see R-R proposal)			
STEAM:	N / A	DRIVERS	HEATING
INLET MIN	BARG(kPaG)	°C	BARG(kPaG) °C
NORM	BARG(kPaG)	°C	BARG(kPaG) °C
MAX	BARG(kPaG)	°C	BARG(kPaG) °C
EXHAUST. MIN	BARG(kPaG)	°C	BARG(kPaG) °C
NORM	BARG(kPaG)	°C	BARG(kPaG) °C
MAX	BARG(kPaG)	°C	BARG(kPaG) °C

ELECTRICITY: (3.4.6.1)

	DRIVERS	HEATING	CONTROL	SHUTDOWN
VOLTAGE				
HERTZ				
PHASE				

COOLING WATER:

	N / A		
TEMP. INLET	°C	MAX RETURN	°C
PRESS NORM	BARG(kPaG)		
DESIGN	BARG(kPaG)		
MIN RETURN	BARG(kPaG)		
MAX ALLOW Δ P	BAR(kPa)		

WATER SOURCE

INSTRUMENT AIR:

MAX PRESS BARG(kPaG) MIN PRESS BARG(kPaG)

SHOP INSPECTION AND TESTS: (4.1.4)

	REQ'D.	WITN
25 CLEANLINES (4.2.1.5)	●	
26 HYDROSTATIC	●	
27 IMPELLER OVERSPEED	●	●
28 MECHANICAL RUN	●	●
29 ● CONTRACT COUPLING ○ IDLING ADAPTORS		
30 ● CONTRACT PROBES ○ SHOP PROBES		
31 VARY LUBE & SEAL OIL PRESSURES	●	●
32 AND TEMPERATURES (4.3.4.2.5) within allowable limits		
33 POLAR FORM VIB DATA (4.3.4.3.3) Bode plot in polar form	●	
34 VIBRATION DATA RECORDED (4.3.4.3.6) Adre digital data	●	
35 DATA TO PURCHASER (4.3.4.3.7) Adre data via CD	●	
36 SHAFT END SEAL INSP (4.3.4.4.1)	●	●
37 GAS LEAK TEST DISCH PRESS (4.3.5.2)	●	●
38 ○ BEFORE ● AFTER POST TEST INSPECTION (4.3.6.8)		
39 PERFORMANCE TEST(GAS)(PTC10 TYPE II)(4.3.6.1)	●	●
40 NO LOAD STRING TEST (4.3.6.2) (ONE PER STATION)	●	●
41 DIS-ASSEMBLE/RE-ASSEMBLE AFTER TEST (REM-7)	●	●
42 DYNAMIC BALANCING OF ROTOR W/O HALF COUPLING	●	Obs
43 GEAR TEST (4.3.6.4)	○	
44 HELIUM LEAK TEST	○	
45 SOUND LEVEL SURVEY DURING STRING TEST	●	●
46 SHOP VERIFICATION OF UNBALANCED RESPONSE	●	●
47 ANALYSIS (@ COUPLING HUB ONLY) (ONE PER STATION)		
48 COPIES OF CERTIFIED TEST DATA & MATERIALS	●	
49 RESIDUAL ELECT. & MECH RUN OUT	●	●
50 CHECK BEARINGS & SEALS AFTER TEST (REM-7)	●	●
51	●	●

TOTAL UTILITY CONSUMPTION:

COOLING WATER	N / A	m³/h
STEAM, NORMAL	N / A	kg/h
STEAM, MAX	N / A	kg/h
INSTRUMENT AIR	Separation seal air - 20	m³/h
HP (DRIVER)	See compressor performance	kW
HP (AUXILIARIES)	See P&ID's	kW
HEATERS	See P&ID's	KW
PURGE (AIR OR N₂)	Only required for initial start-up	m³/h

MISCELLANEOUS: per RR standards

RECOMMENDED STRAIGHT RUN OF PIPE DIAMETERS

BEFORE SUCTION Minimum of 3

○ NOMOGRAPHS REQUIRED FOR EACH SECTION (5.3.3.1.5)

● VENDOR'S REVIEW & COMMENTS ON PURCHASER'S

PIPING & FOUNDATION (3.5.3.2) Scope/Responsibility to be agreed pre-order

○ COMPRESSOR TO BE SUITABLE FOR FIELD RUN IN

ON AIR (2.1.17)

○ PROVISION FOR LIQUID INJECTION (2.1.11)

● VENDOR'S REVIEW & COMMENTS ON PURCHASER'S

CONTROL SYSTEMS (3.4.1.1)

○ EXTENT OF PROCESS PIPING BY VENDOR (3.5.3.1)

○ SHOP FITUP OF VENDOR PROCESS PIPING (4.4.3.11)

● WELDING HARDNESS TESTING (4.2.1.6)

○

VENDOR'S REPRESENTATIVE SHALL (2.1.14)

○ OBSERVE FLANGE PARTING

○ CHECK ALIGNMENT AT TEMPERATURE

○ BE PRESENT AT INITIAL ALIGNMENT

WEIGHTS (kg):

COMPR.	46500	GEAR	DRIVER	BASE
ROTORS:	COMPR.	1125	DRIVER	GEAR
COMPRESSOR COVER				5500
SOUR SEAL OIL TRAPS				N/A
L.O. CONSOLE			S.O. CONSOLE	
OVERHEAD SEAL OIL TANKS				N/A
MAX. FOR MAINTENANCE (IDENTIFY)				Aero and Rotor 10100
TOTAL SHIPPING WEIGHT				Compressor + Pipe and Elect 49500

SPACE REQUIREMENTS (mm): (See R-R Proposal)

COMPLETE UNIT:	L	W	H
L.O. CONSOLE:	L	W	H
S.O. CONSOLE:	L	W	H

SOUR SEAL OIL TRAPS

OVERHEAD SEAL OIL TANKS

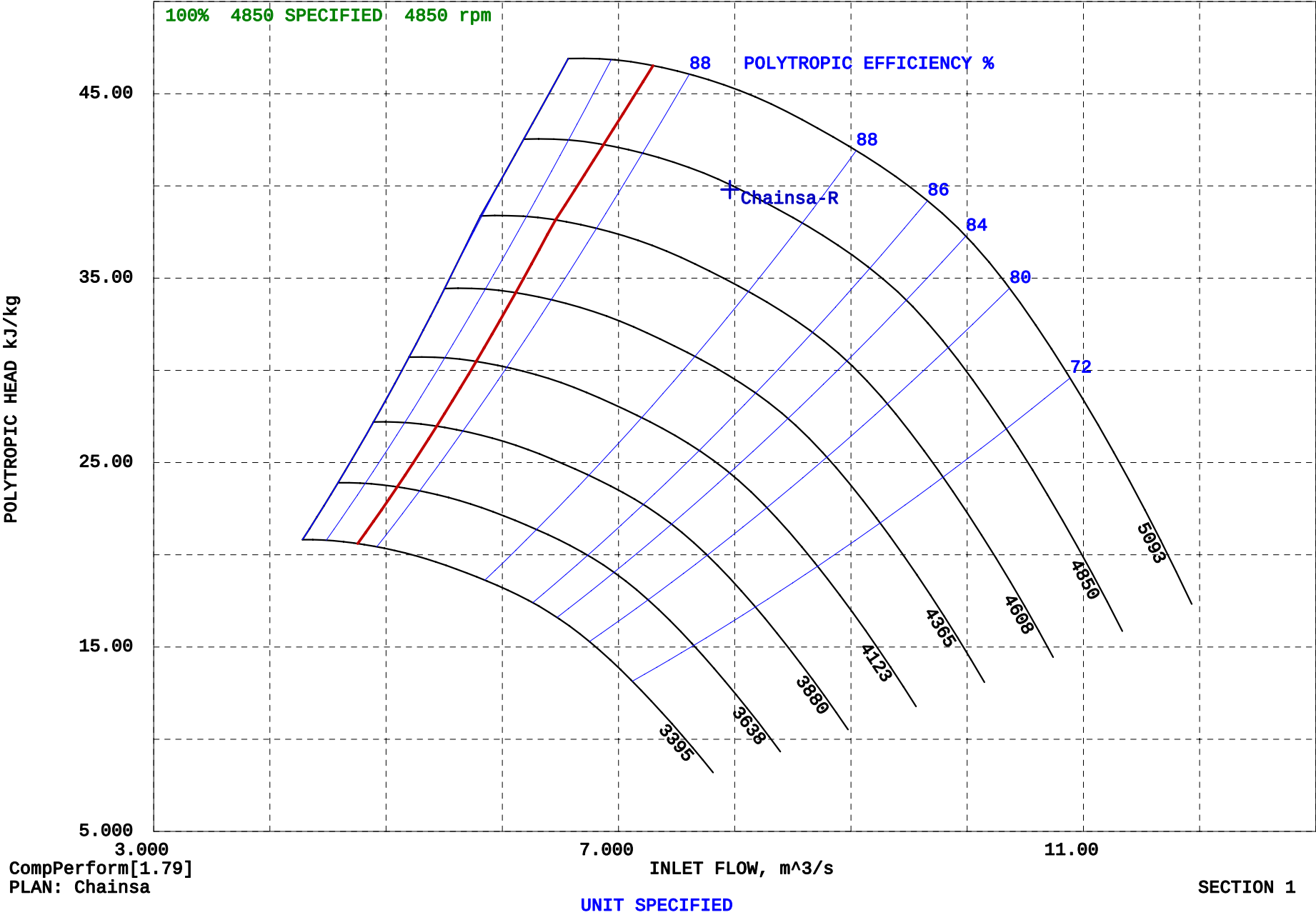
SEE INSTALLATION SECTION OF PROPOSAL

REMARKS: 5) Spare rotor will receive mech run test

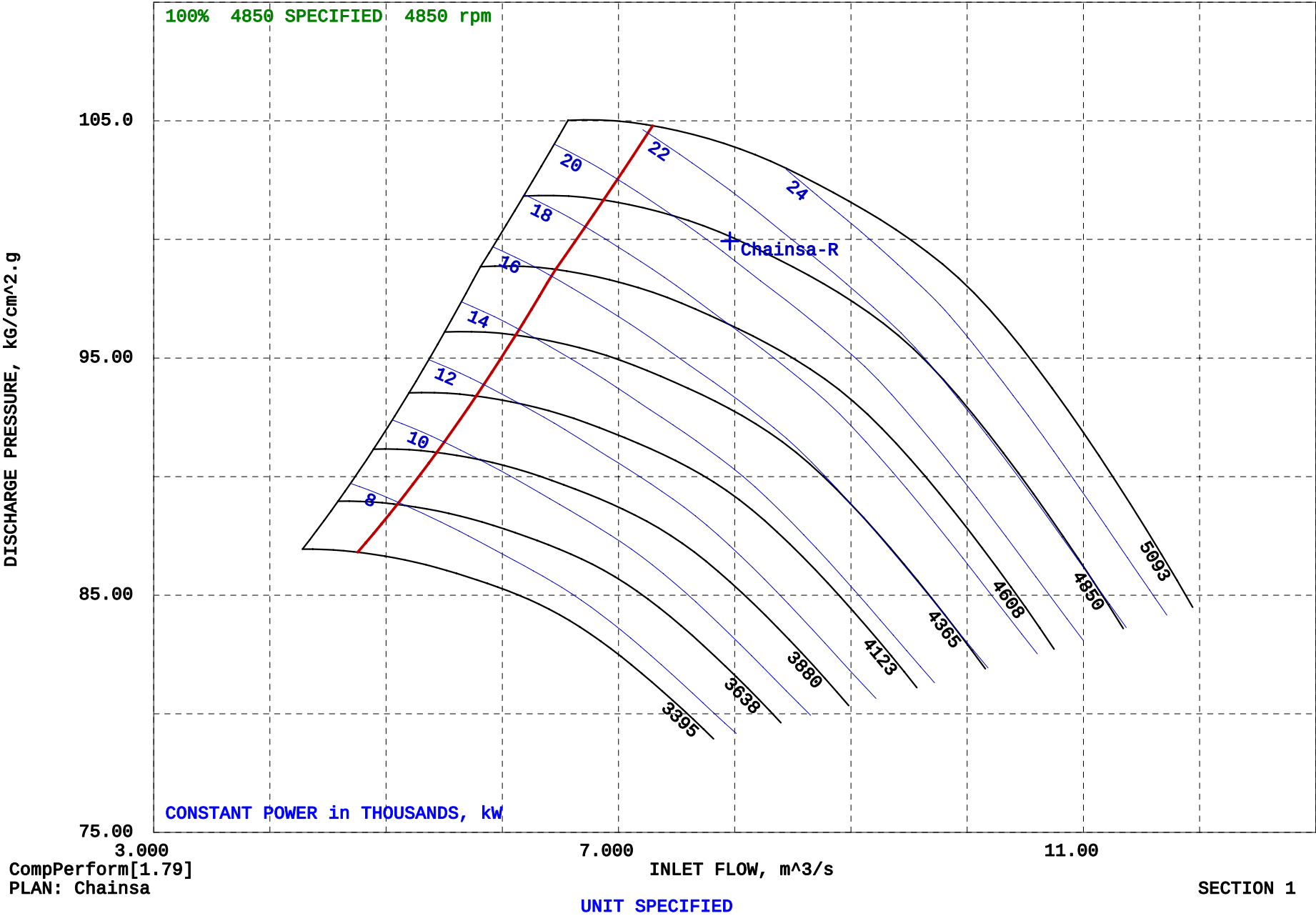
6) No load string test shall be carried out for one GTC package per station

7) Post test inspection of the dry gas seal and bearing shall be carried during the spare rotor changeout only. DGS inspection as per Burgmann instructions

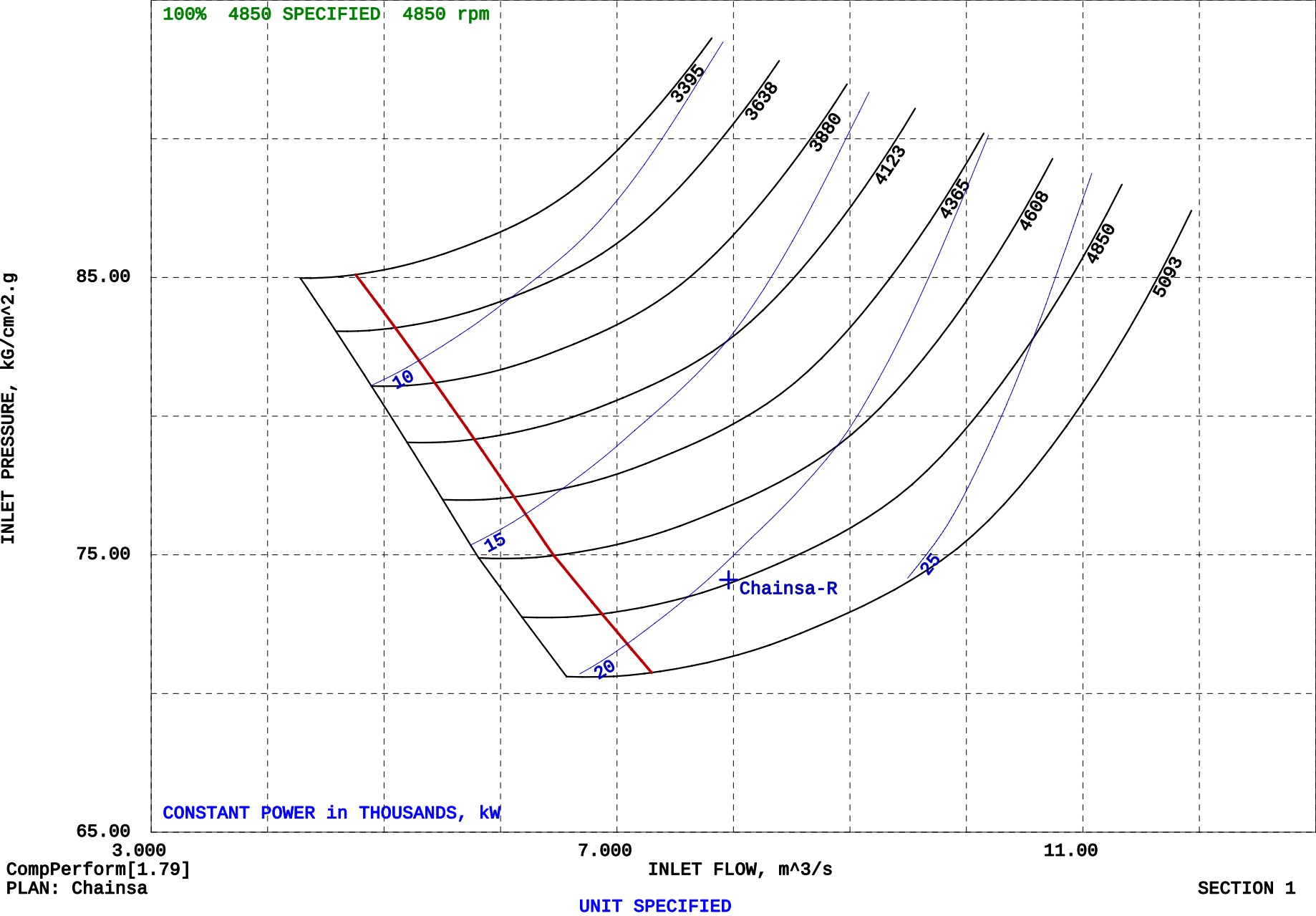
GAIL Pipeline Expansion Project Feb 24'09
RF36-2 MW 17.393 Pd 99.930 kG/cm².g Ti 34.50 °C



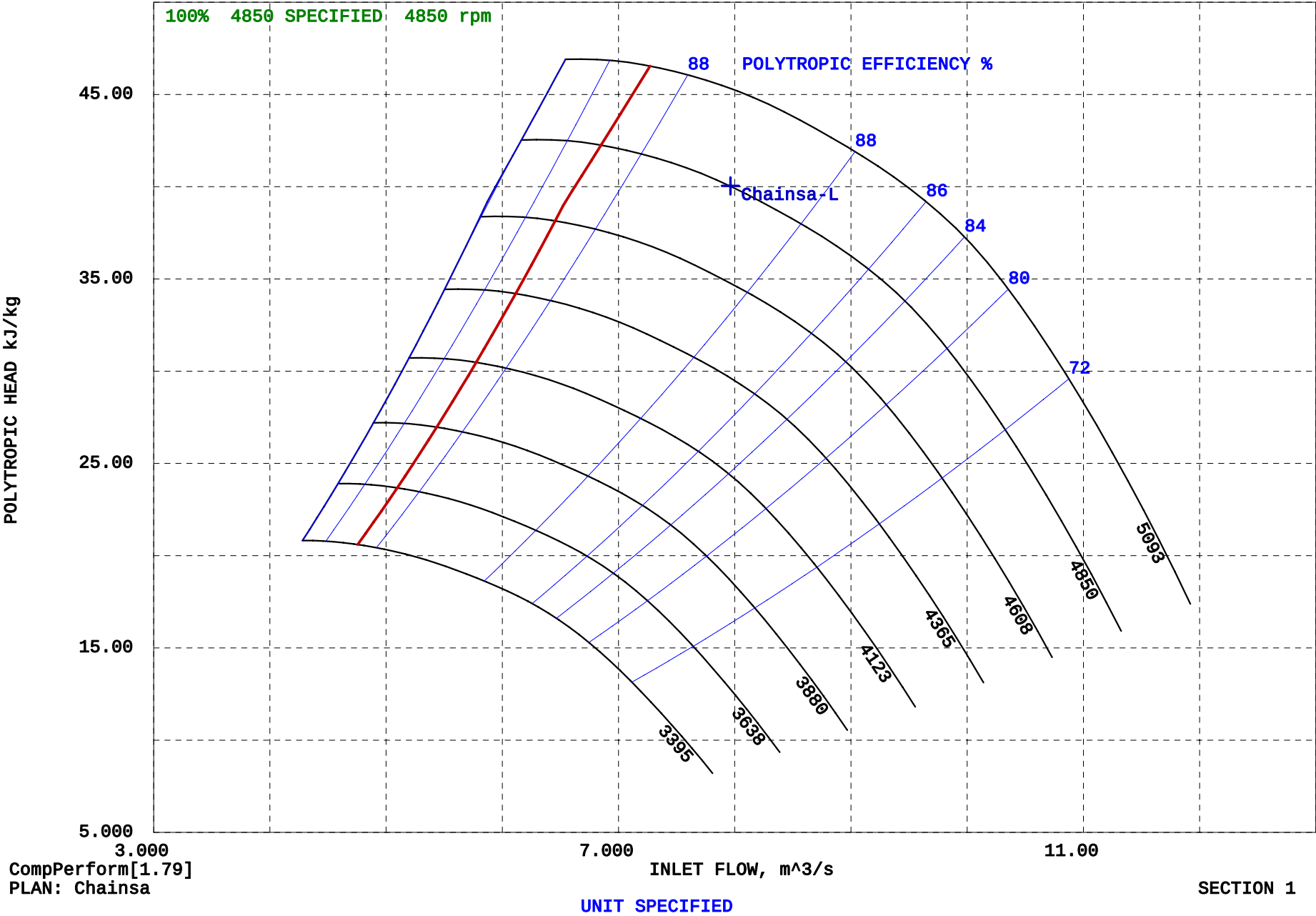
GAIL Pipeline Expansion Project Feb 24'09
RF36-2 MW 17.393 Pi 74.100 kg/cm².g Ti 34.50 °C



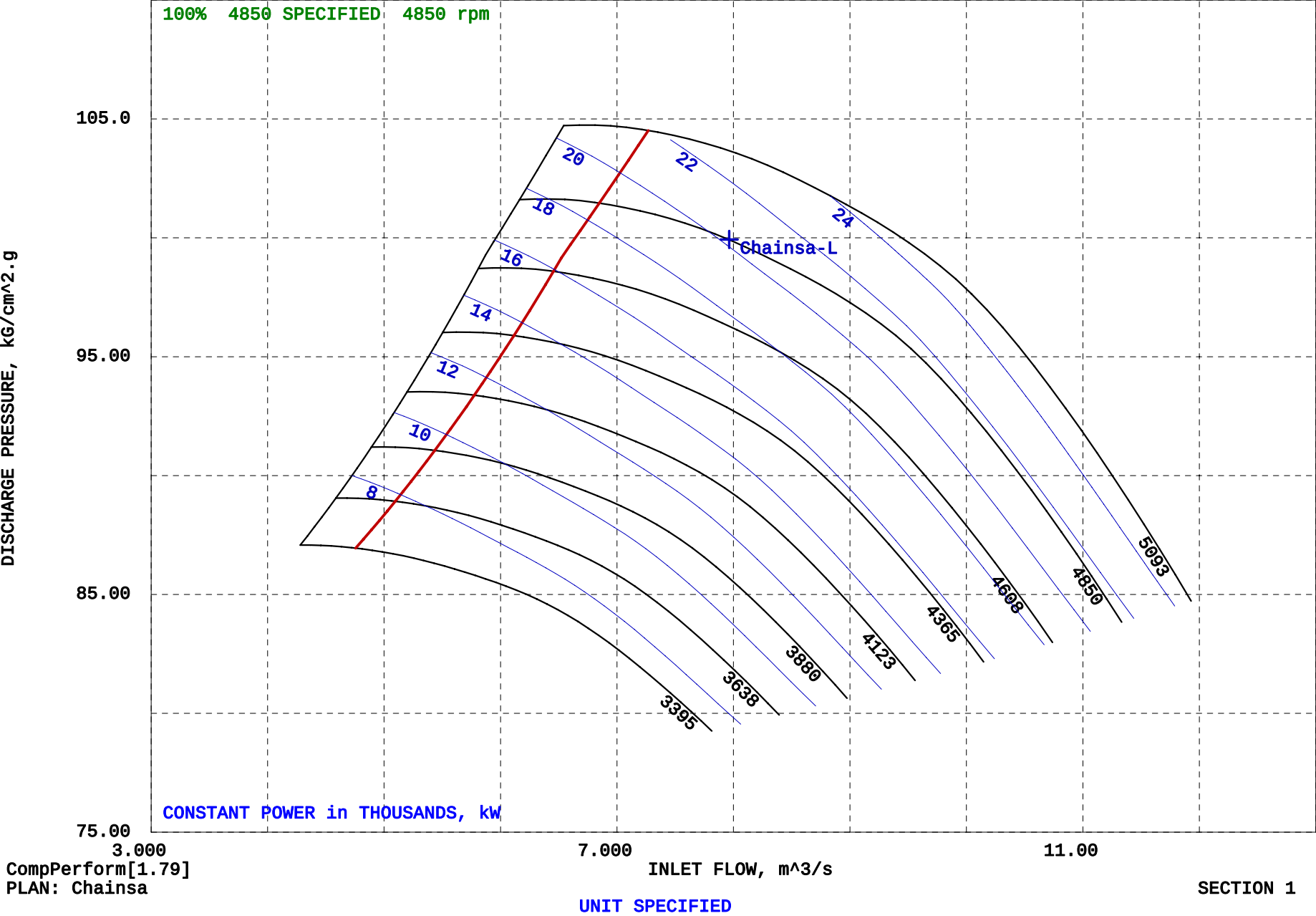
GAIL Pipeline Expansion Project Feb 24'09
RF36-2 MW 17.393 Pd 99.930 kg/cm².g Ti 34.50 °C



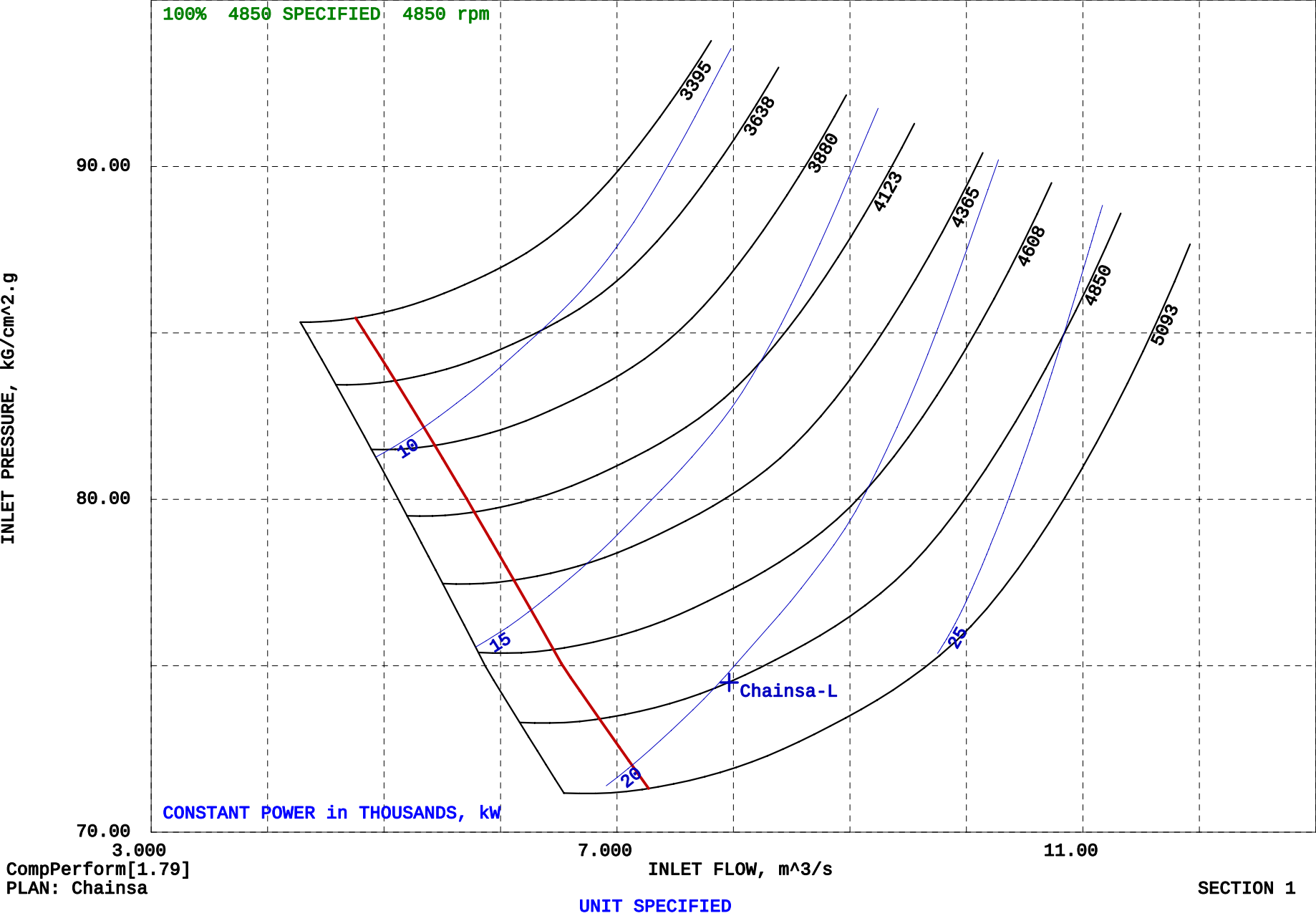
GAIL Pipeline Expansion Project Feb 24'09
RF36-2 MW 17.074 Pd 99.930 kG/cm².g Ti 34.40 °C



GAIL Pipeline Expansion Project Feb 24'09
RF36-2 MW 17.074 Pi 74.500 kG/cm².g Ti 34.40 °C



GAIL Pipeline Expansion Project Feb 24'09
RF36-2 MW 17.074 Pd 99.930 kG/cm².g Ti 34.40 °C



	ENGINEERS INDIA LIMITED NEW DELHI	JOB NO. <u>6988</u> ITEM NO. _____ PURCHASE ORDER NO. _____ SPECIFICATION NO <u>6988-000-KA-MR-5010</u> REVISION NO. <u>0</u> DATE <u>5-Apr-09</u> PAGE <u>1</u> OF <u>10</u> BY <u>Leong, HT</u>	R E V																																																																																					
COMBUSTION GAS TURBINE (API 616-4TH) DATA SHEET SI UNITS																																																																																								
1 APPLICABLE TO: ☒ PROPOSAL ☐ PURCHASE ☐ AS BUILT 2 FOR <u>GAIL (INDIA) LIMITED</u> UNIT <u>PIPELINE EXPANSION PROJECT</u> 3 SITE <u>CHAINSA STATION</u> SERIAL NO. _____ 4 SERVICE <u>GAS COMPRESSOR</u> NO. REQUIRED <u>TWO (2)</u> 5 ☒ CONTINUOUS ☐ INTERMITTENT ☐ STANDBY DRIVEN EQUIP. <u>CENTRIFUGAL COMPRESSOR</u> 6 MANUFACTURER <u>Rolls-Royce</u> ☒ MODEL <u>RB211-GT61 DLE</u> ISO RATING <u>32,987</u> KW @ <u>4850</u> RPM 7 NOTE: INFORMATION TO BE COMPLETED: ☐ BY PURCHASER ☐ BY MANUFACTURER ☒ BY MFR IF NOT BY PURCHASER																																																																																								
GENERAL																																																																																								
9 CYCLE: ☐ REGEN ☒ SIMPLE ☐ EXHAUST HEAT RECOVERY TYPE: ☐ SINGLE SHAFT ☒ MULTI SHAFT 10 DRIVEN EQUIPMENT: NORMAL SHAFT, kW _____ @ _____ RPM RATED SHAFT (KW) _____ @ _____ RPM 11 OUTPUT SHAFT SPEED RANGE (4.1.5) ☒ MIN <u>3152</u> ☒ MAX <u>5090</u> RPM 12 DESIRED MINIMUM SITE POWER _____ kW @ _____ RPM ☒ ENCLOSURE REQUIRED 13 OPERATION ☒ ATTENDED ☐ UNATTENDED ☐ POTENTIAL MAXIMUM POWER (3.33) _____ Kw																																																																																								
PERFORMANCE		LOCATION (4.1.19)																																																																																						
15 GAS TURBINE INCLUDING ALL LOSSES <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">SITE RATED (3.45)</th> <th style="text-align: center;">NORMAL DUTY (3.26)</th> <th style="text-align: center;">SITE MAX TEMP</th> <th style="text-align: center;">SITE MIN TEMP</th> </tr> </thead> <tbody> <tr> <td>19 ☒ DRY BULB TEMP, °C</td> <td style="text-align: center;">45</td> <td></td> <td style="text-align: center;">45</td> <td style="text-align: center;">0</td> </tr> <tr> <td>20 ☒ RELATIVE HUMIDITY %</td> <td style="text-align: center;">84</td> <td></td> <td style="text-align: center;">84</td> <td style="text-align: center;">37</td> </tr> <tr> <td>21 ☒ ALTITUDE (m)</td> <td style="text-align: center;">197.8</td> <td></td> <td style="text-align: center;">197.8</td> <td style="text-align: center;">197.8</td> </tr> <tr> <td>22 ☐ OUTPUT, (KW) (1)</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>23 ☐ HEAT RATE, LHV, MJ/ KW-HR</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>24 ☐ OUTPUT SHAFT SPEED, RPM</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>25 ☐ AIR FLOW kg/SEC</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>26 ☐ EXHAUST FLOW kg/SEC (1)</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>27 ☐ FIRING TEMPERATURE °C</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>28 ☐ GAS GEN. EXHAUST TEMP °C</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>29 ☐ PT EXHAUST TEMP. °C</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>30 ☒ CERTIFIED POINT (3.26)</td> <td style="text-align: center;">YES</td> <td></td> <td></td> <td></td> </tr> <tr> <td>31 (1) INCLUDING ☐ STEAM ☐ WATER EFFECTS FOR</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>32 ☒ EMISSION CONTROL ☐ AUGMENTATION (4.1.9)</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>33 ☐ STEAM FLOW, kg/HR</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>34 ☐ WATER FLOW, m³/HR</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>			SITE RATED (3.45)	NORMAL DUTY (3.26)	SITE MAX TEMP	SITE MIN TEMP	19 ☒ DRY BULB TEMP, °C	45		45	0	20 ☒ RELATIVE HUMIDITY %	84		84	37	21 ☒ ALTITUDE (m)	197.8		197.8	197.8	22 ☐ OUTPUT, (KW) (1)					23 ☐ HEAT RATE, LHV, MJ/ KW-HR					24 ☐ OUTPUT SHAFT SPEED, RPM					25 ☐ AIR FLOW kg/SEC					26 ☐ EXHAUST FLOW kg/SEC (1)					27 ☐ FIRING TEMPERATURE °C					28 ☐ GAS GEN. EXHAUST TEMP °C					29 ☐ PT EXHAUST TEMP. °C					30 ☒ CERTIFIED POINT (3.26)	YES				31 (1) INCLUDING ☐ STEAM ☐ WATER EFFECTS FOR					32 ☒ EMISSION CONTROL ☐ AUGMENTATION (4.1.9)					33 ☐ STEAM FLOW, kg/HR					34 ☐ WATER FLOW, m³/HR					16 ☐ INDOOR ☒ OUTDOOR ☐ GRADE 17 ☐ HEATED ☒ UNDER ROOF ☐ MEZZANINE 18 ☒ UNHEATED ☐ PARTIAL SIDES ☒ ONSHORE 19 ELEC. AREA CLASSIFICATION (4.1.14) ☐ NON-HAZARDOUS ☒ HAZARDOUS 20 APPLICABLE CODE: ☐ NEC500 ☐ NEC505 ☒ IEC 21 GROUP <u>IIA</u> CLASS: _____ TEMPERATURE CODE: <u>T3</u> 22 AREA CLASSIFICATION ☐ DIVISION ☒ ZONE <u>2</u> ☐ THIRD PARTY CERTIFICATION REQUIRED ☐ WINTERIZATION REQD ☐ ☒ TROPICALIZATION REQD (5.4.6.6) 23 UNUSUAL CONDITIONS: ☒ DUST ☐ FUMES ☒ CORROSIVE AGENTS (4.10.1.1) _____ ☒ SO2 ANNUAL MEAN - 6.01mg/m3, 24hr max - 10.66mg/m3 ☒ OTHER (5.5.3.4) <u>ONSHORE OIL&GAS</u> 24 NOISE SPECIFICATIONS: (4.1.10) ☒ APPLICABLE TO MACHINE: (5.7.4.1) SEE SPECIFICATION <u>88 dBA at 1 meter</u> ☐ APPLICABLE TO NEIGHBORHOOD: (5.7.4.2) SEE SPECIFICATION _____	
	SITE RATED (3.45)	NORMAL DUTY (3.26)	SITE MAX TEMP	SITE MIN TEMP																																																																																				
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37 APPLICABLE SPECIFICATIONS: 38 ☒ API 616 GAS TURBINES FOR THE PETROLEUM, CHEMICAL, 39 & GAS INDUSTRY SERVICES 40 ☐ GOVERNING SPECIFICATION (IF DIFFERENT) _____ 41 _____ 42 ☒ VENDOR HAVING UNIT RESPONSIBILITY (4.1.2) 43 <u>Rolls-Royce</u>		PAINTING: ☒ MANUFACTURER'S OFFSHORE STD. ☐ OTHER _____ NOTE: All Data Sheets References to GG=Gas Generator SS = Single Shaft and PT = Power Turbine REMARKS: Also see Rolls-Royce Deviations to API 616																																																																																						
44 SHIPMENT: (6.4) 45 ☐ DOMESTIC ☒ EXPORT ☐ EXPORT BOXING REQD. 46 ☐ OUTDOOR STORAGE MORE THAN 6 MONTHS (6.4.1) 47 SPARE ROTOR ASSEMBLY PACKAGED FOR (6.4.3.10) 48 ☐ DOMESTIC ☐ EXPORT SHIPMENT 49 COMMENTS: _____																																																																																								

	ENGINEERS INDIA LIMITED NEW DELHI	SPEC NO. <u>6988-000-KA-MR-501</u> (ITEM NO. _____) REVISION NO. <u>0</u> DATE <u>5-Apr-09</u> PAGE <u>2</u> OF <u>10</u> BY <u>Leong, HT</u>	R E V
COMBUSTION GAS TURBINE (API 616-4TH) DATA SHEET SI UNITS			
FUEL SYSTEM (5.8)			
2 TYPE ☒ GAS (5.8.2) ☐ LIQUID (5.8.3) ☐ DUAL (5.8.1.5.1) 3 DUAL SYSTEM REQMTS (5.8.1.5.1) ☐ GAS/GAS ☐ GAS/LIQUID ☐ LIQUID/LIQUID 4 ☐ COMPLETE FUEL RECEIVING SYSTEM (5.8.1.1) ☐ MAX. TIME ALLOWED TO COMPLETE TRANSFER _____ SECONDS			
GAS FUELS (5.8.2)		LIQUID FUELS (5.8.3)	
FUEL ANALYSIS - MOL % (3.7.2.1) (3.7.1.8)		FUEL GRADE (5.8.3.3)	
10 COMPOSITION: M.W. NORMAL STARTING ALT 11 AIR 29 THE FUEL GAS COMPOSITION 12 OXYGEN 32 IS AS INDICATED IN THE COMPRESSOR 13 NITROGEN 38 PROCESS DATA SHEET 14 WATER VAPOR 18 INCLUDED IN THIS SECTION. 15 HYDROGEN SULPHIDE 34 _____ 16 CARBON DIOXIDE 44 _____ 17 HYDROGEN 2 _____ 18 METHANE 16 _____ 19 ETHYLENE 26 _____ 20 ETHANE 30 _____ 21 PROPYLENE 42 _____ 22 PROPANE 44 _____ 23 I-BUTANE 58 _____ 24 N-BUTANE 58 _____ 25 I-PENTANE 72 _____ 26 N-PENTANE 72 _____ 27 HEXANE 86 _____ 28 HEPTANE 100 _____ 29 TOTAL _____ 30 AVG. MOL. WT. _____ 31 CORS AGENTS (5.8.2.3) PPM _____ 32 CONTMNTS(5.8.2.2.1) PPM _____ 33 LHV MJ/m³/HR (5.8.2.4) _____ 34 FUEL PRESS.MAX/MIN,kPag _____ 35 FUEL TEMP MAX/MIN °C _____/_____/_____ 36 ☐ FUEL PRESS/TEMP REQD. 37 MIN BarA/DegC _____ 38 COMPRESSION SYS REQD (5.8.1.2.2) ☐ YES ☐ NO 39 HEATER REQD (5.8.2.1) ☐ YES ☐ NO 40 ☐ RATE OF CHANGE OF LHV (5.8.2.4) _____		ASTM D1655 ASTM ☐ 0GT ☐ 1GT JET ☐ A ☐ A-1 ☐ B D2880 ☐ 2GT ☐ 3GT ☐ 4GT ☐ OTHER, INDICATE ANALYSIS BELOW (5.8.3.3 c) LIQUID FUEL TREATMENT REQUIRED ☒ YES ☐ NO TREATMENT SYSTEM BY (3.7.1.5) ☐ VENDOR ☐ OTHER _____ FUEL TRANSFER EQUIP REQUIRED (5.8.1.4.5) ☐ YES ☐ NO HEATER REQUIRED (5.8.1.4.4) ☐ YES ☐ NO ☐ LIQ FUEL PRESS REQD, MAX/MIN,(kPag) _____ / _____ FUEL ANALYSIS DATA (5.8.3.3) ASTM METHOD MEASURED VALUE VISCOSITY SSU, 38°C D-445 _____ DISTILLATION DATA D-86 _____ 50% RECOVERY °C MAX _____ END POINT °C MAX _____ SULFUR CONTENT %WT. MAX. (SELECT APPL METHOD) BOMB METHOD D-129 _____ LAMP METHOD D-1266 _____ HIGH-TEMP METHOD D-1552 _____ CARBON RESIDUE (ON 10% _____ BOTTOMS) % WT. MAX. _____ CONRADSON D-189 _____ RAMSBOTTOM D-524 _____ COPPER STRIP CORROSION PLATE D-130 _____ 3 HRS AT 100°C MAX _____ AROMATIC CONTENT D-1319 _____ ASH CONTENT D-482 _____ SPECIFIC GRAVITY, 15°C D-1298 _____ FLASH POINT °C D-56 _____ POUR POINT °C D-97 _____ WATER D-95 _____ FILTERABLE DIRT. MG/100ML D-2276 _____ TRACE METALS (ATOMIC _____ ABSORPTION/PREFERRED) D-3605 _____ SODIUM _____ POTASSIUM _____ VANADIUM _____ CALCIUM _____ LEAD _____ OTHER METALS _____ LOWER HEATING VALUE MJ/kg D-2382 _____	
REMARKS:			
FUEL SYSTEM PIPING			
49 ☐ BY PASS AND VENT VALVE (3.7.1.3) ☒ ISOLATION BLOCK VALVES ☒ ANSI FLANGE RATING 50 ☐ TWIN Y-TYPE STRAINER WITH CONTINUOUS FLOW ☒ NACE 2002 MATERIAL STANDARDS (4.10.1.8) 51 ☐ TRANSFER VALVE (5.8.1.2.4)			

	ENGINEERS INDIA LIMITED NEW DELHI	SPEC NO. <u>6988-000-KA-MR-501</u> (ITEM NO. _____) REVISION NO. <u>0</u> DATE <u>5-Apr-09</u> PAGE <u>3</u> OF <u>10</u> BY <u>Leong, HT</u>	R E V																																
COMBUSTION GAS TURBINE (API 616-4TH) DATA SHEET SI UNITS																																			
CONSTRUCTION FEATURES (NOTE 1)																																			
SPEEDS: (POWER TURBINE) MAX. CONT. <u>5090</u> RPM TRIP <u>5335</u> RPM ☐ LATERAL CRITICAL SPEEDS (DAMPED) FIRST CRITICAL _____ RPM _____ MODE SECOND CRITICAL _____ RPM _____ MODE THIRD CRITICAL _____ RPM _____ MODE FOURTH CRITICAL _____ RPM _____ MODE ☐ PROTOTYPE OR MODIFIED ROTOR SUPPORT (4.7.3.5) ☒ LATERAL ANALYSIS REQUIRED (INDIVIDUAL COMPONENTS) (D.1.3) ☒ TRAIN TORSIONAL ANALYSIS REQUIRED (2.7.4.5) TORSIONAL CRITICAL SPEEDS: FIRST CRITICAL <u>Per API 616</u> _____ RPM SECOND CRITICAL <u>Per API 616</u> _____ RPM THIRD CRITICAL _____ RPM FOURTH CRITICAL _____ RPM VIBRATION: (4.7.4.5) (7.2.3 o): ☒ ALLOWABLE TEST LEVEL : SHAFT PT: <u>50</u> MICRONS P/P CASE GG: <u>16</u> mm/sec ☒ ROTATION, VIEWED FROM DRIVE END ☒ CW ☐ CCW	MATERIALS OF CONSTRUCTION (4.10) COMPRESSOR ROTOR BLADES <u>Titanium Alloy, FV.535, Inco 738 & 718, Nimonic 105</u> COMPRESSOR STATOR VANES <u>Jethete 152 & EAX, Inco 718, Nimonic 105</u> SHAFT <u>Steel</u> BLADE/VANE COATING <u>Sermetal 5375 & Waspalloy</u> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>TURBINE STAGE</th> <th>NOZZLES</th> <th>BLADES</th> <th>WHEELS OR DISCS</th> </tr> </thead> <tbody> <tr> <td>1 (GG)</td> <td>Mar-M-002</td> <td>CMSX-4</td> <td>Waspalloy</td> </tr> <tr> <td>2 (GG)</td> <td>C.1023</td> <td>CMSX-4</td> <td>Incoloy 901</td> </tr> <tr> <td>3</td> <td></td> <td></td> <td></td> </tr> <tr> <td>1 (PT)</td> <td>Rene'80</td> <td>Rene'80</td> <td>901</td> </tr> <tr> <td>2 (PT)</td> <td>U-500</td> <td>U-500</td> <td>901</td> </tr> <tr> <td>3 (PT)</td> <td>N-155</td> <td>U-500</td> <td>901</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> COMBUSTORS <u>C.263 and Nimonic 75</u> COMPRESSOR CASING <u>Aluminum Alloy, Jethete EAX, Inco 907/904</u> COMBUSTOR CASING <u>Jethete 152</u> TURBINE CASING <u>GG: Nimonic P.E. 16, PT: Waspalloy, Inconel 718</u>			TURBINE STAGE	NOZZLES	BLADES	WHEELS OR DISCS	1 (GG)	Mar-M-002	CMSX-4	Waspalloy	2 (GG)	C.1023	CMSX-4	Incoloy 901	3				1 (PT)	Rene'80	Rene'80	901	2 (PT)	U-500	U-500	901	3 (PT)	N-155	U-500	901				
TURBINE STAGE	NOZZLES	BLADES	WHEELS OR DISCS																																
1 (GG)	Mar-M-002	CMSX-4	Waspalloy																																
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3 (PT)	N-155	U-500	901																																
GAUGE BOARDS AND CONTROL PANELS																																			
AIR COMPRESSOR: STAGES <u>7IP, 6HP</u> MAX. TIP SPEED <u>5.85</u> m/SEC TYPE <u>Axial</u> PRESSURE RATIO <u>21:1</u> CASING SPLIT (2.2.3) ☒ AXIAL ☐ RADIAL ROTOR ☐ SOLID ☒ BUILT UP TURBINE: STAGES <u>1HP, 1LP, 3PT</u> MAX. TIP SPEED <u>8.65 (GG), 7.3 (PT)</u> m/SEC CASING SPLIT (4.2.3) ☒ AXIAL (GG) ☒ RADIAL (PT) ROTOR ☐ SOLID ☒ BUILT UP COMBUSTORS: (4.3.2) ☐ SINGLE ☒ MULTIPLE, NUMBER <u>9</u> ☒ GAS ☐ LIQUID ☐ DUAL FUEL MAX. ALLOW TEMP. VARIATION <u>+/-150</u> °C APPLICABLE PLANE _____ FUEL NOZZLES PER COMBUSTOR <u>3</u> ☐ WOBBE INDEX NO REQD (4.3.7) ☐ MAX _____ MIN _____ MAINTENANCE INTERVALS, HOURS ☒ HOT GAS PATH INSPECTIONS <u>See Note 2</u> ☒ MAJOR OVERHAULS <u>See Note 3</u> ☒ OTHER <u>See Note 4</u>	GAUGE BOARDS ☐ LOCATION _____ CONTROL PANELS (5.4.5.1.1) ☐ ON-SKID ☐ OFF SKID LOCAL ☒ OFF SKID REMOTE WEATHER PROTECTION REQUIRED ☐ YES ☐ NO ☐ SPECIFICATION _____ ☐ ANNUNCIATOR REQUIRED (5.4.4.8.5) _____ ☒ VISUAL DISPLAY UNIT (VDU) ☒ KEYBOARD																																		
CONTROL SYSTEMS																																			
GOVERNOR (5.4.3) ☒ MFR'S STD. ☐ OTHER ☐ MAKE _____ MODEL _____ ☐ CONSTANT SPEED ☒ VARIABLE SPEED ☐ ISOCHRONOUS ☐ DROOP REMOTE SHUTDOWN SIGNAL ☒ ELECTRIC ☐ PNEUMATIC ☐ HYDRAULIC ☐ NONE MANUAL SPEED CHANGER RPM <u>5090</u> MAX. <u>4610</u> MIN. ☐ MAINTAIN TURBINE SPEED UPON FAILURE OF CONTROL SIGNAL OR ACTUATOR	TYPE (5.4.1.5) ☐ MECH ☐ PNEU ☐ HYDRA ☐ ELECTRIC ☒ ELECTRONIC ☒ MICROPROCESSOR BASED ☐ COMBINED _____ ☒ SIGNAL SOURCE <u>4-20 mA, 24 V dc</u> ☐ SENSITIVITY _____ ☐ RANGE _____ TO _____ ☐ TIME OF AC OUTAGE RIDEOUT _____ MIN (5.4.1.6) ☐ SHUT OFF VALVES FOR SHUT DOWN SENSORS (5.4.4.9) STARTING SYSTEM (5.4.2.1) ☐ MANUAL ☐ SEMI AUTOMATIC ☒ AUTOMATIC ☐ PURGE (5.4.2.2) _____ MINUTES ☐ SEPARATE SHUTDOWN VALVE TEST DURING OPERATION NOTE (1) FOR MULTIPLE SHAFT TURBINES, COMPLETE ALL APPLICABLE PORTIONS FOR EACH SHAFT REMARKS: (2) Half Life refurbishment required generally after 25,000 hours of operation; (3) Major overhaul of GG on condition (generally 50,000 hrs. operation); (4) Borescope Inspection recommended generally after 4,000 hrs operation																																		

ENGINEERS INDIA LIMITED NEW DELHI		SPEC NO. <u>6988-000-KA-MR-501</u> (ITEM NO. _____) REVISION NO. <u>0</u> DATE <u>5-Apr-09</u> PAGE <u>4a</u> OF <u>10</u> BY <u>Leong, HT</u>		R E V
COMBUSTION GAS TURBINE (API 616-4TH) DATA SHEET SI UNITS				
CONSTRUCTION FEATURES CONTINUED (NOTE 1)				
RB211 GAS GENERATOR		BEARINGS AND BEARING HOUSINGS (4.8)		
RADIAL (ROLLER, SQUEEZE-FILM TYPE)	HP & IP Turbine	IP Compressor	THRUST (LOCATION TYPE)	IP Compressor
☒ TYPE	Anti-Friction	Anti-Friction	☒ TYPE	Anti-Friction
☒ MANUFACTURER	RHP/FAG (TYP)	RHP (TYP)	☒ MANUFACTURER	RHP/FAG (TYP)
☒ BEARING WIDTH, mm	39.6	24.3	☒ BEARING WIDTH, mm	63.4
☒ OUTER/INNER DIAMETER, mm	254.4 / 221.6	285.5 / 252.1	☒ OUTER/INNER DIAMETER, mm	215.9 / 139.7
☐ UNIT LOAD (ACT/ALLOW) kPa			☐ UNIT LOAD (MAX POTEN.), kPa	
☒ OUTER RACE MATERIAL	AMS6491	AMS6491	☒ OUTER RACE MATERIAL	MSRR6113
☒ ROLLER MATERIAL	AMS6491	AMS6491	☒ ROLLER MATERIAL	MSRR6113
☒ CAGE MATERIAL	AMS6415	AMS6415	☒ CAGE MATERIAL	MSRR6083
☐ LOAD: BETWEEN/ON PAD			☒ L10 LIFE (On Condition), h	>50,000
☐ PIVOT: CENTER/OFFSET, %			LUBRICATION: ☐ FLOODED	☒ SCAVENGE SYSTEM
☐ DAMPER BEARING			THRUST COLLAR: ☐ INTEGRAL	☐ REPLACEABLE
☒ L10 LIFE (On Condition), h	>50,000	>50,000	BEARING MATERIAL	
BEARING TEMPERATURE DEVICES (4.8.5.5)		☐ SEE ATTACHED API-670 DATA SHEET		
☐ THERMOCOUPLES		☐ NO. AT EACH SHAFT BEARING _____ TOTAL NO. _____		
☐ SELECTOR SWITCH & IND. BY: _____ PURCH _____ MFR		☐ OSCILLATOR-DEMODULATOR SUPPLIED BY		
☐ RESISTANCE TEMP DETECTORS		☐ MFR _____ ☐ MODEL _____		
☐ RESISTANCE MAT'L _____ ☐ OHMS		☐ MONITOR SUPPLIED BY (5.4.7.8.2)		
☐ SELECTOR SWITCH & IND. BY: _____ PURCH _____ MFR		☐ LOCATION _____ ☐ ENCLOSURE _____		
☐ LOCATION-JOURNAL BEARING		☐ MFR _____ ☐ MODEL _____		
NUMBER _____ EA PD _____ EVERY OTH PAD _____ PER BRG		☐ SCALE RGE _____ ☐ ALARM SET @ _____ uM		
OTHER _____		☐ SHTDOWN ☐ SET @ _____ uM ☐ TIME DELAY _____ SEC		
☐ LOCATION-THRUST BEARING		AXIAL POSITION DETECTOR (4.8.5.3):		
NO. (ACT) _____ EA PD _____ EVERY OTH PAD _____ PER BRG		☐ SEE ATTACHED API-670 DATA SHEETS		
OTHER _____		☐ TYPE _____ ☐ MODEL _____		
NO. (INACT) _____ EA PD _____ EVERY OTH PAD _____ PER BRG		☒ MFR _____ ☐ NO. REQUIRED _____		
OTHER _____		☐ OSCILLATOR-DEMODULATOR SUPPLIED BY		
☐ MONITOR SUPPLIED BY (5.4.7.5)		☐ MFR _____ ☐ MODEL _____		
☐ LOCATION _____ ☐ ENCLOSURE _____		☐ MONITOR SUPPLIED BY (3.4.7.8.2)		
☐ MFR _____ ☐ MODEL _____		☐ LOCATION _____ ☐ ENCLOSURE _____		
☐ SCALE RGE _____ ☐ ALARM SET @ _____ °C		☐ MFR _____ ☐ MODEL _____		
☐ SHTDOWN ☐ SET @ _____ °C ☐ TIME DLY _____ SEC		☐ SCALE RGE _____ ☐ ALARM SET @ _____ uM		
REMARKS:		☐ SHTDOWN ☐ SET @ _____ uM ☐ TIME DELAY _____ SEC		
		ACCELERATION TRANSDUCERS		
		☐ SEE ATTACHED API-670 DATA SHEETS		
		☒ MFR <u>Vibrometer Inc.</u> ☒ MODEL <u>CE135</u>		
		☒ LOCATION <u>GG Casing</u> ☒ NUMBER <u>3</u>		
		☒ MONITOR SUPPLIED BY (3.4.7.8.4) <u>Rolls-Royce</u>		
		☒ LOCATION <u>UCP</u> ☐ ENCLOSURE _____		
		☒ MFR <u>Bently-Nevada</u> ☒ MODEL <u>3500</u>		
		☐ SCALE RGE _____ ☒ ALARM SET @ <u>< 25 mm/s</u>		
		☒ SHTDOWN ☒ SET @ <u>40 mm/s</u> ☒ TIME DELAY <u>0</u> SEC		
NOTES (1) FOR MULTIPLE SHAFT TURBINES, COMPLETE ALL APPLICABLE PORTIONS FOR EACH SHAFT (2) FOR THREE BEARING SHAFTS, USE A SEPARATE SHEET FOR THE EXTRA BEARING (3) FOR ROLLING ELEMENT BEARINGS, MODIFY ENTRIES AS REQUIRED. SHOW L-10 BEARING LIFE				

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COMBUSTION GAS TURBINE (API 616-4TH) DATA SHEET SI UNITS										
INSTRUMENTS										
DESCRIPTION		INSTRUMENT TYPE		INSTRUMENT LOCATION			TRANS-MITTERS FURNISHED BY		CONTROL ROOM RECEIVERS FURN BY	
		INDICATING	RECORDING	LOCAL	LOCAL PANEL	CONTROL ROOM	VENDOR	OTHERS	VENDOR	OTHERS
GAS GENERATOR OR SINGLE SHAFT GAS TURBINE										
TACHOMETER(S) (NO. <u>2</u>)		●	●	○	○	●	●	○	●	○
Δ P AIR INLET SYSTEM		●	○	●	○	●	●	○	●	○
COMPRESSOR DISCHARGE PRESSURE		●	○	○	●	●	●	○	●	○
FUEL FILTER Δ P		○	○	○	○	○	○	○	○	○
FUEL SUPPLY PRESSURE		●	○	○	○	●	●	○	●	○
STARTING GAS SUPPLY PRESSURE		●	○	○	●	○	○	○	○	○
STARTING GAS EXHAUST PRESSURE		○	○	○	○	○	○	○	○	○
TEMP COMBUSTOR MEASUREMENT (6 PTS MIN) 4.3.2)		●	●	○	○	●	●	○	●	○
TEMP GAS TURB CONTROL PLANE (6 PTS MIN)		○	○	○	○	○	○	○	○	○
INLET AIR TEMPERATURE		●	●	●	○	●	●	○	●	○
TEMPERATURE GG COMPRESSOR DISCHARGE		●	●	○	○	●	●	○	●	○
TEMPERATURE THRUST BEARING OIL DRAIN		○	○	○	○	○	○	○	○	○
TEMPERATURE EACH BEARING SUMP (ROLLING ELEMENT TYPE)		○	○	○	○	○	○	○	○	○
TEMPERATURE FUEL MANIFOLD GAS SUPPLY		●	○	○	○	●	●	○	●	○
TEMPERATURE LUBE OIL RESERVOIR		●	○	○	○	●	●	○	●	○
FIRED HOUR METER		●	●	○	○	●	●	○	●	○
A) NUMBER STARTS COUNTER		●	○	○	○	●	●	○	●	○
B) START SEQUENCE TIMER		●	○	○	○	●	●	○	●	○
LUBE OIL RESERVOIR LEVEL		●	○	●	○	●	●	○	●	○
LUBE OIL PUMP PRESSURE INDICATORS (NO <u>2</u>)		●	○	○	●	○	○	○	○	○
LUBE OIL COOLER OIL INLET TEMPERATURE		○	○	○	○	○	○	○	○	○
LUBE OIL COOLER OIL OUTLET TEMPERATURE		●	○	○	○	●	●	○	●	○
LUBE OIL COOLER COOLANT INLET TEMPERATURE		○	○	○	○	○	○	○	○	○
LUBE OIL COOLER COOLANT OUTLET TEMPERATURE		○	○	○	○	○	○	○	○	○
LUBE OIL FILTER Δ P		●	○	○	●	○	●	○	●	○
LUBE OIL PRESSURE EACH LEVEL (NO. <u>1</u>)		●	○	○	●	●	●	○	●	○
CONTROL OIL PRESSURE		●	○	○	●	●	●	○	●	○
SITE FLOW INDICATOR EACH DRAIN (NO. <u>N/A</u>)		○	○	○	○	○	○	○	○	○
INLET GUIDE VANE POSITION INDICATOR		●	○	○	○	●	●	○	●	○
EXHAUST DUCT Δ P INDICATOR		○	○	○	○	○	○	○	○	○
ENCLOSURE COOLING AIR EXHAUST TEMPERATURE		●	○	○	○	●	●	○	●	○
POWER TURBINE										
TACHOMETER(S) (NO. <u>1</u>)		●	○	○	○	●	●	○	●	○
EXHAUST TEMPERATURE (2 PTS MIN)		○	○	○	○	○	○	○	○	○
JOURNAL BEARING TEMPERATURE		●	○	○	○	●	●	○	●	○
THRUST BEARING TEMPERATURE		●	○	○	○	●	●	○	●	○
BEARING DRAIN TEMPERATURE		○	○	○	○	○	○	○	○	○
SITE FLOW INDICATOR EACH DRAIN (NO. <u>1 COMMON</u>)		●	○	●	○	○	○	○	○	○
LUBE OIL INLET PRESSURE		●	○	○	●	●	○	○	●	○
LUBE OIL INLET TEMPERATURE		○	○	○	○	○	○	○	○	○

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COMBUSTION GAS TURBINE (API 616-4TH) DATA SHEET SI UNITS								
ALARMS AND SHUTDOWNS (5.4.4)								
DESCRIPTION		APPLIES TO:		(5.4.4.8.5) ANNUNCIATOR POINT IN VENDOR FURNISHED CONTROL PANEL		SENSING DEVICES TO BE FURNISHED BY		INDICATING LIGHT ONLY
		SINGLE SHAFT OR G.G.	SEP PWR TURB.	(1) ALARM SHUT- DOWN		VENDOR	OTHERS	
								(2)
9	RADIAL SHAFT VIBRATION (NO. 4)	○	●	●	●	●	○	□
10	AXIAL THRUST POSITION (NO. 2)	○	●	●	●	●	○	□
11	OVERSPEED (1) (NO. 3)	○	●	○	●	●	○	□
12	CASING VIBRATION (NO. 3)	●	○	●	●	●	○	□
13	HIGH THRUST BEARING TEMP	○	●	●	●	●	○	□
14	HIGH RADIAL BEARING TEMP	○	●	●	●	●	○	□
15	LOW FUEL SUPPLY PRESSURE	●	○	●	○	●	○	□
16	HIGH FUEL FILTER Δ P	○	○	○	○	○	○	□
17	GAS TURBINE TEMPERATURE SPREAD HIGH	●	○	●	●	●	○	□
18	EXHAUST OVER TEMP	●	○	●	●	●	○	□
19	FAILURE OF OVER-TEMP SHUTDOWN DEVICE	○	○	○	○	○	○	□
20	HIGH INLET AIR Δ P EACH FILTER	●	○	●	●	●	○	□
21	COMBUSTOR FLAME-OUT (GG UNDERSPEED)	●	○	○	●	●	○	□
22	CHIP DETECTOR, ANTI FRICTION BEARING	○	○	○	○	○	○	□
23	FAILURE STARTING CLUTCH TO ENGAGE OR DISENGAGE	●	○	○	●	●	○	□
24	LOW OIL PRESSURE (NO. 2)	●	●	●	●	●	○	□
25	HIGH LUBE OIL TEMP	●	●	●	●	●	○	□
26	LOW LUBE OIL RESERVOIR LEVEL	●	●	●	○	●	○	□
27	HIGH LUBE OIL RESERVOIR LEVEL	●	○	●	○	●	○	□
28	HIGH OIL FILTER Δ P (NO. 2)	●	●	●	○	●	○	□
29	LUBE OIL SPARE PUMP OPERATING	●	●	●	○	○	●	□
30	LOW CONTROL OIL PRESSURE	●	○	●	●	●	○	□
31	LOW STARTING GAS PRESSURE	○	○	○	○	○	○	□
32	ANTI-ICING SYSTEM - NOT OPERATING			○	○	○	○	□
33	LOW D.C. VOLTAGE	○	○	○	○	○	○	□
34	EMERGENCY D.C. PUMP OPERATING	○	○	○	○	○	○	□
35	RESERVOIR HEATER "ON"			○	○	○	○	□
36	IMPLOSION DOOR OPEN			○	○	○	○	□
37	EXTERNAL PERMISSIVE START SIGNAL	●		●	○	○	●	□
38	EXTERNAL SHUTDOWN SIGNAL	●		○	●	○	●	□
39	LOSS OF AUX COOLING AIR	○		○	○	○	○	□
40	LAMP TEST PUSH BUTTON	○		○	○	○	○	□
41	ENCLOSURE HIGH TEMPERATURE	●	●	●	●	●	○	□
42	CONTROL SIGNAL FAILURE	●	●	○	●	●	○	□
43	CONTROL SYSTEM ACTUATOR FAILURE	●	○	○	●	●	○	□
44	GOVERNOR FAILURE	●	●	○	●	●	○	□
45	ENCLOSURE VENT FAN FAILURE	●	●	○	●	●	○	□
46		○	○	○	○	○	○	□
47								
48								
NOTES: (1) VENDOR TO ADVISE METHOD OF ANNUNCIATION (2) VDU MAY USE MESSAGE INDICATOR								

ENGINEERS INDIA LIMITED NEW DELHI COMBUSTION GAS TURBINE (API 616-4TH) DATA SHEET SI UNITS	SPEC NO. <u>6988-000-KA-MR-501</u> (ITEM NO. _____) REVISION NO. <u>0</u> DATE <u>5-Apr-09</u> PAGE <u>10</u> OF <u>10</u> BY <u>Leong, HT</u> R E V																																																																																												
INSPECTION AND TESTING; LUBRICATION, WEIGHTS SHOP INSPECTION AND TESTS: (6.1.1) WIT- OBSER- REQ NESSED VED 4 SHOP INSPECTION (6.1.2) ● 5 CLEANLINESS (6.2.3.3) ● 6 HYDROSTATIC (6.3.2) ● ○ ○ 7 MECHANICAL RUN (6.3.3) ● ● ○ 8 ☐ CONTRACT ☐ IDLING COUPLING ADAPTOR(S) 9 ☒ CONTRACT ☐ SHOP PROBES PROBES 10 11 12 VIBRATION PLOTS (6.3.3.3.4) ● 13 TAPE RECORD VIB DATA (6.3.3.6) ○ 14 PERFORMANCE TEST (6.3.4.1) (PTC-22) ● ● ○ 15 NO LOAD STRING TEST (ONE PER STATION) ● ● ○ 16 PACKAGE TEST (6.3.4.2.1) ○ ○ ○ 17 LOAD GEAR TEST (6.3.4.3) ○ ○ ○ 18 NOISE SURVEY (6.3.4.4) (DURING STRING TEST) ● ● ○ 19 AUXILIARY EQUIPMENT (6.3.4.5) ● ○ ○ 20 POST TEST INSPECTION (6.3.4.6) ○ ○ ○ 21 UCP FAT ● ○ ○ 22 GOVERNOR RESPONSE TEST (6.3.4.8) ○ ○ ○ 23 SPARE PARTS (6.3.4.9) ○ ○ ○ 24 FIRE PROTECTION SIMULATION (6.3.4.10) ○ ○ ○ 25 OTHER (6.3.4.11) ○ ○ ○ 26 LUBRICATION SYSTEMS (4.9) ● SEE API 614 DATA SHEETS MINERAL OIL SYSTEM ☐ LUBE OIL VISCOSITY (4.9.8) ISO GRADE <u>ISO VG 32 / 46</u> COMMON TO ☐ GAS GENERATOR/SINGLE SHAFT TURBINE ☒ FREE POWER TURBINE ☒ LOAD GEAR (IF APPLICABLE) ☒ DRIVEN EQUIPMENT ☐ AUXILIARIES ○ (COMBINED) (SEPARATE) LUBE/SEAL SYSTEM (4.9.5) ● SYSTEM DESIGNED FOR SYNTHETIC LUBRICANT (4.9.2) LUBE SPECIFICATION <u>Rolls-Royce Approved Synthetic Oil</u> COMMON TO ☒ GAS GENERATOR ☐ POWER TURBINE ☐ LOAD GEAR ☐ DRIVEN EQUIPMENT ☐ AUXILIARIES <table style="width: 100%; border-collapse: collapse; font-size: 0.8em;"> <tr> <th style="width: 60%;"></th> <th style="width: 10%; text-align: center;">FLOW m³/HR</th> <th style="width: 10%; text-align: center;">PRESSURE kPag</th> <th style="width: 20%; text-align: center;">HEAT LOAD MJ/HR</th> </tr> <tr> <td style="background-color: #f0f0f0;">OIL REQUIREMENTS</td> <td></td> <td></td> <td></td> </tr> <tr> <td>GG</td> <td></td> <td></td> <td></td> </tr> <tr> <td>DRIVEN EQUIP.</td> <td></td> <td></td> <td></td> </tr> <tr> <td>GEAR</td> <td></td> <td></td> <td></td> </tr> <tr> <td>COUPLINGS</td> <td></td> <td></td> <td></td> </tr> <tr> <td>POWER TURBINE</td> <td></td> <td></td> <td></td> </tr> <tr> <td style="text-align: right;">TOTAL</td> <td></td> <td></td> <td></td> </tr> </table> MOUNTING ARRANGEMENT ☐ CONSOLE ☐ COLONY ☐ BASEPLATE		FLOW m ³ /HR	PRESSURE kPag	HEAT LOAD MJ/HR	OIL REQUIREMENTS				GG				DRIVEN EQUIP.				GEAR				COUPLINGS				POWER TURBINE				TOTAL				MATERIALS INSPECTION REQUIREMENTS (6.2.1.3) ○ SPECIAL CHARPY TESTING (4.10.5.3) ○ RADIOGRAPHY REQUIRED FOR _____ ○ MAGNETIC PARTICLE REQUIRED FOR _____ ○ LIQUID PENETRANT REQUIRED FOR _____ ○ ULTRASONIC REQUIRED FOR _____ ○ WELD INSPECTION (4.10.4.6.1) _____ ○ WELDING HARDNESS TESTING (6.2.3.4) _____ 35 WEIGHTS DRY INSTALLED SHIPPING DIMEN <u>WT. (kg)</u> <u>WT. (kg)</u> <u>LxWxH (m)</u> FOR DETAILS OF THE PACKAGE WEIGHTS PLEASE REFER TO THE GA DRAWING WITHIN TECHNICAL PROPOSAL. <table style="width: 100%; border-collapse: collapse; font-size: 0.8em;"> <tr> <td style="width: 60%;"></td> <td style="width: 10%;"></td> <td style="width: 10%;"></td> <td style="width: 20%;"></td> </tr> <tr> <td>GG OR SS TURBINE</td> <td></td> <td></td> <td></td> </tr> <tr> <td>SS TURB. ROTOR</td> <td></td> <td></td> <td></td> </tr> <tr> <td>POWER TURBINE</td> <td></td> <td></td> <td></td> </tr> <tr> <td>P.T. ROTOR</td> <td></td> <td></td> <td></td> </tr> <tr> <td>LUBE SYSTEM</td> <td></td> <td></td> <td></td> </tr> <tr> <td>DRIVEN EQUIP.</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FILTER</td> <td></td> <td></td> <td></td> </tr> <tr> <td>INLET SILENCER</td> <td></td> <td></td> <td></td> </tr> <tr> <td>EXHAUST SILENCER</td> <td></td> <td></td> <td></td> </tr> <tr> <td>DUCTING</td> <td></td> <td></td> <td></td> </tr> <tr> <td>MAX ERECTION</td> <td></td> <td></td> <td></td> </tr> <tr> <td>WEIGHT (kg)</td> <td></td> <td>ITEM</td> <td></td> </tr> <tr> <td>MAX MAINT.</td> <td></td> <td></td> <td></td> </tr> <tr> <td>WEIGHT (kg)</td> <td></td> <td>ITEM</td> <td></td> </tr> </table>					GG OR SS TURBINE				SS TURB. ROTOR				POWER TURBINE				P.T. ROTOR				LUBE SYSTEM				DRIVEN EQUIP.				FILTER				INLET SILENCER				EXHAUST SILENCER				DUCTING				MAX ERECTION				WEIGHT (kg)		ITEM		MAX MAINT.				WEIGHT (kg)		ITEM	
	FLOW m ³ /HR	PRESSURE kPag	HEAT LOAD MJ/HR																																																																																										
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MISCELLANEOUS: ● VENDOR'S REVIEW & COMMENTS ON PURCHASER'S PIPING & FOUNDATION (4.1.18) ● FINAL ASSEMBLY CLEARANCES (6.2.1.1.e) ● COORDINATION MEETING SITE (7.1.3) <u>Supplier's Facility</u> ○ SPEED-TORQUE CURVE (7.2.4-a) ○ INCREASE POWER FOR STEAM/WATER (7.2.4-b) ○ EFFECTS OF AMB. COND. ON EXHAUST FLOW (7.2.4-c) ○ RUN DOWN CURVES (7.2.4 d) ○ PURCHASER REVIEW OF CAMP./GOODMAN DIAG. (4.5.3.3) ○ VENDOR WITNESS ALIGNMENT (4.1.18) ● TECHNICAL DATA MANUAL (7.3.6.4) ○ NO OF PROPOSAL COPIES (7.2.1) _____ 49 50	REMARKS:																																																																																												



Rolls-Royce

eRB211 v6.1.4

31 March 2009

Customer: GAIL

Project: Pipeline Expansion Project
RB211-GT61

DLE Combustion

Site Conditions - Chainsa

Ambient Temp : 45degC

Altitude :197.8m

Relative Humidity : 84%

Fuel

Fuel Type: Lean gas

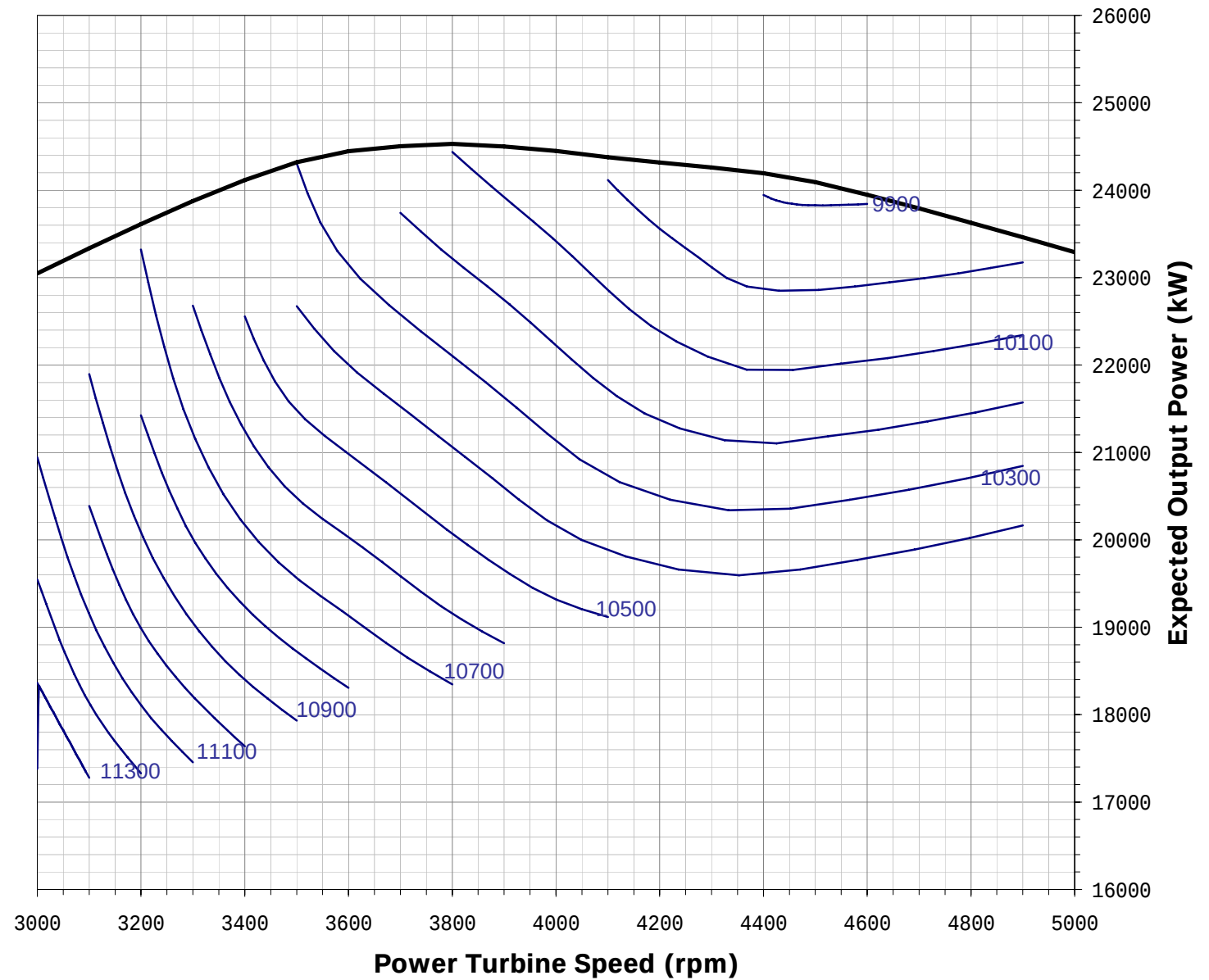
Fuel LHV: 49602 kJ/kg

Installation Pressure Losses

Inlet: 100 mmH2O

Exhaust: 250 mmH2O

Expected Heat Rate kJ/kW.hr



COMPRESSOR STATION WORKS AT KAILARAS & CHAINSA -COMPRESSOR PACKAGE

1. OPERATING CASE: CHAINSA (Lean Gas, MW=17.07)
Compressor
- 1.1 BkW required at compressor input shaft including all losses (with 0% positive tolerance) kW : 20680 (GUARANTEED)
2. **Gas Turbine Site Rating** Ú
- 2.1 GT Site Rating @ 45EC (at compressor operating point speed) kW : 23546 (GUARANTEED)
3. **Heat Rate at Site Conditions**
 (while generating rated BkW as at 1 above)
- GT Heat rate @ 45EC (at compressor operating point speed) kJ/kWh | kcal/kWh : 10704 / 2557 (GUARANTEED)
- 3.1 Ú These figures correspond to the following site/operating conditions:
- | | | | | |
|-------|---|----------------------|---|-------------|
| i) | Expected TBO (Hot Section) | hrs | : | 25000 |
| ii) | Expected TBO (Power Turbine) | hrs | : | 50000 |
| iii) | GG Rated Speed | rpm | : | 6395 / 9326 |
| iv) | PT Rated Speed | rpm | : | 4850 |
| v) | Gas Turbine ISO Rating (with losses below) | kW | : | 31213 |
| vi) | Site Altitude | m | : | 197.8 |
| vii) | Max. Inlet Loss (At Site) | mm H ₂ O | : | 100 |
| viii) | Max. Exhaust Loss (At site) with Heat recovery in future | mm H ₂ O | : | 250 |
| ix) | Site Rated/Temperature | EC | : | 45 |
| x) | Relative Humidity | % | : | 84 |
| xi) | GGT Inlet Temperature (GG Exit Temp)
[While generating site rated power] | EC | : | 801.8 |
| Xii) | NHV of fuel gas (LHV) | kcal/Sm ³ | : | 8565 |
4. Overall compressor package noise level @ 1 meter from the equipment train (Including compressor, turbine and other aux. equipment & piping). dBA :

(NOTE: - This is a typical data sheet. Bidder shall furnish data sheets filled for each operating case of each compressor station with Proposal).

Page of

	ENGINEERS INDIA LIMITED NEW DELHI	COMBUSTION GAS TURBINE	DATA SHEET NO.	Rev.
			6988-000-KT-DS-0020	0

COMPRESSOR STATION WORKS AT KAILARAS & CHAINSA -COMPRESSOR PACKAGE

OPERATING CASE: <u>CHAINSA (Rich Gas, MW=17.4)</u>			
1.	<u>Compressor</u>		
1.1	BKW required at compressor input shaft including all losses (with 0% positive tolerance)	kW	: 20943
2.	<u>Gas Turbine Site Rating</u> <u>Ú</u>		
2.1	GT Site Rating @ 45EC (at compressor operating speed)	kW	: 23547
3.	<u>Heat Rate at Site Conditions</u> (while generating rated BKW as at 1 above)		
	GT Heat rate @ 45EC (at compressor operating point speed)	kJ/kWh kcal/kWh	: 10176 / 2430
3.1	<u>Ú</u> These figures correspond to the following site/operating conditions:		
	i) Expected TBO (Hot Section)	hrs	: 25000
	ii) Expected TBO (Power Turbine)	hrs	: 50000
	iii) GG Rated Speed	rpm	: 6396 / 9326
	iv) PT Rated Speed	rpm	: 4837
	v) Gas Turbine ISO Rating (with losses below)	kW	: 31199
	vi) Site Altitude	m	: 197.8
	vii) Max. Inlet Loss (At Site)	mm H ₂ O	: 100
	viii) Max. Exhaust Loss (At site) with Heat recovery in future	mm H ₂ O	: 250
	ix) Site Rated/Temperature	EC	: 45
	x) Relative Humidity	%	: 84
	xi) GGT Inlet Temperature (GG Exit Temp) [While generating site rated power]	EC	: 801.8
	Xii) NHV of fuel gas (LHV)	kcal/Sm3	: 8716
4.	Overall compressor package noise level @ 1 meter from the equipment train (Including compressor, turbine and other aux. equipment & piping).	dBA	:

(NOTE: - This is a typical data sheet. Bidder shall furnish data sheets filled for each operating case of each compressor station with Proposal).

Page of

	ENGINEERS INDIA LIMITED NEW DELHI	COMBUSTION GAS TURBINE	DATA SHEET NO.	Rev.
			6988-000-KT-DS-0020	0

COMPRESSOR STATION WORKS AT KAILARAS & CHAINSA (GT –COMPRESSOR PACKAGE)

PERFORMANCE TABLE							
Sr No	DESCRIPTION	UNITS	OPERATING CASE : CHAINSA (Lean Gas, MW=17.07)				Remarks
			ISO	Rated	Max	Min	
1	Ambient temperature	°C	15	45	45	0	
2	Relative humidity	%	60	84	84	37	
3	NHV of Fuel gas	kcal/kg	11847	11847	11847	11847	
4	Compressor Power at High speed Coupling (incl. Of mech. Seal losses)	kW	20680	20680	20680	20680	
5	Rated Speed of the Compressor	rpm	4850	4850	4850	4850	
6	Mech. Losses of Gas Turbine (Power to all auxiliaries)	kW	0	0	0	0	
7	Power Turbine Shaft speed	rpm	4850	4850	4850	4850	
8	Power required on Power Turbine Shaft [= (4) + (6)]	kW	20680	20680	20680	20680	
9	Site efficiency	%	35.31	33.63	33.63	35.75	
10	H _R : Heat Rate corresponding to (8)	kJ/kWh kcal/kWh	10195 2435	10704 2557	10704 2557	10069 2405	
11	W _{max} : Max. Power on PT Shaft at corresponding shaft speed Site Elevation = 197.8 m (As per site & Utility Data) Max. Inlet pressure Losses = 100 mm H ₂ O Max. Exhaust Pressure Losses = 250 mm H ₂ O & Including all other losses	kW	31213	23546	23546	34837	
12	η _S corresponding to W _{max} .	%	38.76	35.38	35.38	39.68	
13	H _R corresponding to W _{max} .	kJ/kWh kcal/kWh	9289 2219	10176 2430	10176 2430	9072 2167	
14	T _S : PT Exhaust Temperature	°C	451.9	520.0	520.0	416.9	
15	GG Exhaust Temp	°C	698.5	774.0	774.0	656.9	
16	Firing Temp	°C	Proprietary	Proprietary	Proprietary	Proprietary	
17	Exhaust Flow	kg/sec	78.1	71.5	71.5	81.3	
18	Actual Margin available with offered GT [= {(11) – (8)}/{(8)} * 100]	%	50.93	13.86	13.86	68.46	
	(NOTE: - This is a typical data sheet. Bidder shall furnish data sheets filled for each operating case of each compressor station with Proposal).						

 ENGINEERS INDIA LIMITED NEW DELHI	COMBUSTION GAS TURBINE	DATA SHEET NO.	Rev.
		6988-000-KT-DS-0020 Page __ of __	A

COMPRESSOR STATION WORKS AT KAILARAS & CHAINSA (GT –COMPRESSOR PACKAGE)

PERFORMANCE TABLE							
Sr No	DESCRIPTION	UNITS	OPERATING CASE : CHAINSA (Rich Gas, MW=17.4)				Remarks
			ISO	Rated	Max	Min	
1	Ambient temperature	°C	15	45	45	0	
2	Relative humidity	%	60	84	84	37	
3	NHV of Fuel gas	kcal/kg	11824	11824	11824	11824	
4	Compressor Power at High speed Coupling (incl. Of mech. Seal losses)	kW	20943	20943	20943	20943	
5	Rated Speed of the Compressor	rpm	4837	4837	4837	4837	
6	Mech. Losses of Gas Turbine (Power to all auxiliaries)	kW	0	0	0	0	
7	Power Turbine Shaft speed	rpm	4837	4837	4837	4837	
8	Power required on Power Turbine Shaft [= (4) + (6)]	kW	20943	20943	20943	20943	
9	Site efficiency	%	35.45	34.26	34.26	35.90	
10	H _R : Heat Rate corresponding to (8)	kJ/kWh kcal/kWh	10155 2425	10507 2510	10507 2510	10028 2395	
11	W _{max} : Max. Power on PT Shaft at corresponding shaft speed Site Elevation = 197.8 m (As per site & Utility Data) Max. Inlet pressure Losses = 100 mm H ₂ O Max. Exhaust Pressure Losses = 250 mm H ₂ O & Including all other losses	kW	31199	23547	23547	34823	
12	η _S corresponding to W _{max} .	%	38.74	35.38	35.38	39.67	
13	H _R corresponding to W _{max} .	kJ/kWh kcal/kWh	9292 2219	10176 2430	10176 2430	9075 2168	
14	T _S : PT Exhaust Temperature	°C	452.6	520.9	520.9	417.5	
15	GG Exhaust Temp	°C	700.9	776.6	776.6	659.2	
16	Firing Temp	°C	Proprietary	Proprietary	Proprietary	Proprietary	
17	Exhaust Flow	kg/sec	78.5	71.9	71.9	81.7	
18	Actual Margin available with offered GT [= {[(11) – (8)]/(8)} * 100]	%	48.97	12.43	12.43	66.28	
	(NOTE: - This is a typical data sheet. Bidder shall furnish data sheets filled for each operating case of each compressor station with Proposal).						

 ENGINEERS INDIA LIMITED NEW DELHI	COMBUSTION GAS TURBINE	DATA SHEET NO.	Rev.
		6988-000-KT-DS-0020 Page __ of __	A



ENGINEERS INDIA LIMITED
NEW DELHI

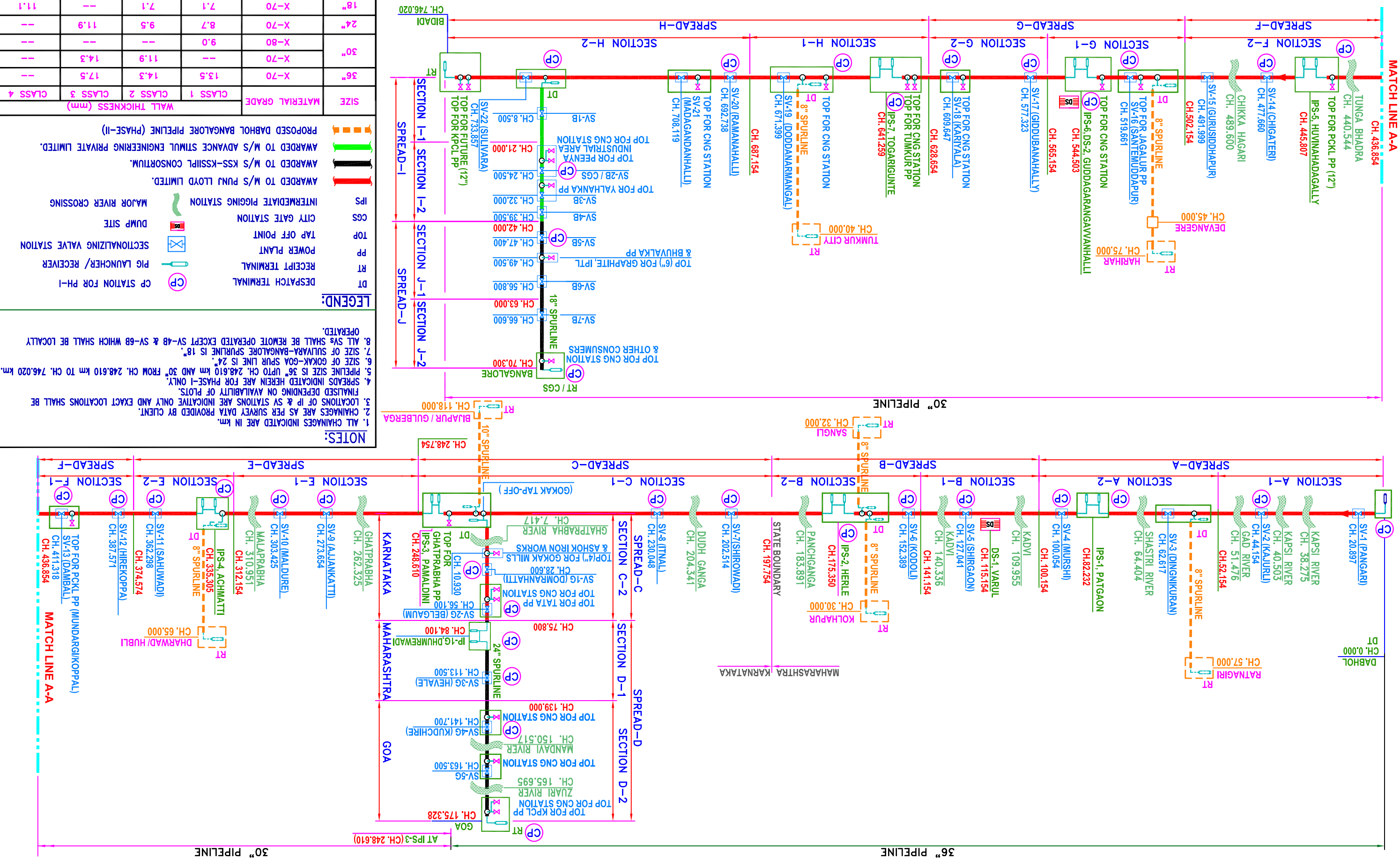


PROJECT : DABHOL-BANGALORE
PIPELINE
CLIENT : M/s GAIL (INDIA) LTD.
JOB NO : A027

REV.	DATE	REVISION	BY	CHK	APPROVED
4	18.10.10	REVISED & RE-ISSUED FOR ENGINEERING	ISH	AKS/RK	RK
3	30.04.10	REVISED & RE-ISSUED FOR ENGINEERING	SS	AKS/RK	RK
2	12.04.10	REVISED & RE-ISSUED FOR ENGINEERING	SS	AKS/RK	RK
1	12.03.10	REVISED & RE-ISSUED FOR ENGINEERING	SS	AKS/RK	RK
0	09.03.10	ISSUED FOR ENGINEERING	SS	AKS/RK	RK

SCHEMATIC ARRANGEMENT OF
PIPELINE FACILITIES (PHASE-I ONLY)

REV.	DRAWING NO.	SHEET 1 OF 1
4	A027-010-16-71-3001	



DABHOL-BANGALORE PIPELINE
(PHASE-I : OD 36\"/>

Tabulated below are the comparative capacity assessment figures (rounded-off figures) at an interval of one year as carried out by entity & EIL:

Assessment years	Pipeline Capacity as determined by Entity (in MMSCMD)	Pipeline Capacity as assessed by EIL (in MMSCMD)
	Entity	EIL
	Software used - Pipeline Studio (TGNET)	Software used - Pipeline Studio (TGNET)
2022-23	140	145
2023-24	156	163.8

** As the pipeline capacity was arrived as per PNGRB regulation [based on MAOP considerations], hence variation in determined capacity for various assessment years is due to change in sources and /or deliveries and / or network length and / or network configuration.

2023-2024

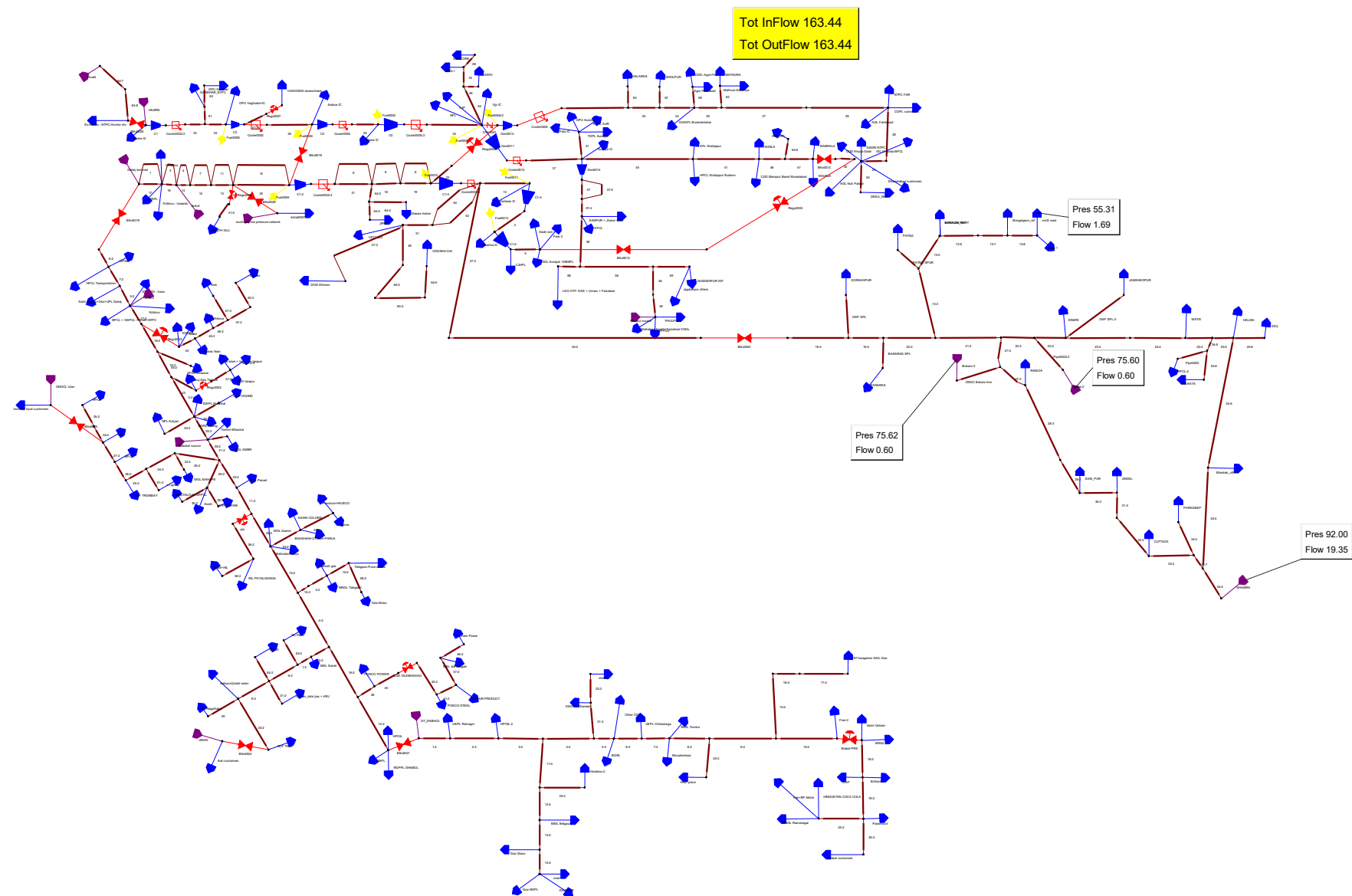
Pipe	
	MSM3/D
33	43.445184
34	41.401273
36	38.429926
35	38.41161
32	38.359415
61	2.0439119
63	2.043912
17	24.637934
14	23.669971
13	23.663748
20	23.077767
21	23.059141
19	22.757513
18	22.759059
23	17.184565
25	16.792094
24	16.769747
30	14.561727
27	12.209642
26	12.209642
28	9.6441087
29	9.6441087
42	12.096153
47	9.3328943
41	2.2370433
45	0.45229502
22	4.5000003
54	2.1093929
65	0.3822
52	3.4663703
37	12.558822
57	2.3055314
58	5.1572886
56	4.6744101
59	2.684058
48	1.9903521
49	1.9903521
51	6.9327405
15	23.662825
16	22.87131
53	1.727193
55	0.78078377
69	0
31	3.7075684
68	0.4828785
64	0.39247189

67	0.022347106
66	2.1462584
62	2.3520845
60	0.18069999
1	34.607828
3	32.157148
4	33.253584
7	33.260683
11	33.259595
10	32.448562
9	32.37706
8	31.968072
6	31.969621
12	35.649571
2	35.49626
5	33.89196
50	3.4663703
46	6.84294
57-2	4.8841213
45-2	7.5271761
02-Jun	7.5406434
17-2	6.4284537
20-2	5.2486376
21-2	4.911519
22-2	1.869151
02-Nov	1.869151
23-2	2.2342681
14-2	2.565497
02-Apr	4.1500937
16-2	10.197323
15-2	1.5846114
13-2	6.0472272
02-Aug	4.1017643
19-2	6.1118041
52-2	0.075932779
26-2	5.8794851
25-2	5.0137446
61-2	0.074041953
29-2	0.90115593
30-2	0.57199659
24-2	5.0877866
36-2	0.36511707
53-2	0.30470281
54-2	0.074605312
31-2	1.7355011
32-2	0.79169838
55-2	0.19109961
50-2	0
60-2	0.046800164
58-2	0.06770179

28-2	3.4446479
27-2	1.5206649
34-2	1.455665
35-2	1.455665
49-2	1.251757
33-2	2.809302
02-Mar	5.5042962
18-2	6.1118041
44	0.26487921
45-3	0.24791422
48-2	0.20344957
57-3	0.20344957
62-2	0
56-2	0.14765842
02-Sep	5.9118719
42-2	0.24146854
41-2	0.037373379
40	0.24146811
37-2	0.034969369
38	0.24146819
46-2	0
02-Dec	10.43879
59-2	0
02-Oct	0.2366004
43	0.60750791
51-2	0.42337174
02-Jul	6.6500559
39	0.59684254
02-May	6.3094525
63-2	0.010557903
47-2	0
02-Feb	1.5846116
02-Jan	5.9224261
04-Jan	2.6312812
04-Nov	1.6966562
25-3	0.11271
04-Apr	0.85012502
04-Dec	1.5839462
04-Sep	0.64182199
24-3	0.01733745
04-Oct	0.095691993
15-4	0.54613
16-4	0.54613
18-3	0.045186993
19-3	0.035241993
20-3	0.013
04-May	0.83267154
23-3	0.016440743
13-4	1.5322832
04-Aug	0.65915944

21-3	0.017453475
22-3	0.003149256
17-4	0.54613
04-Feb	2.5987812
04-Jun	0.79701049
14-4	1.5150411
04-Jul	0.78934049
04-Mar	2.5467812
37-3	7.5271764
18-4	7.5271757
19-4	4.6671764
20-4	4.5371763
21-4	1.9628188
22-4	6.0756223
23-4	3.81562
24-4	3.8156205
25-4	1.8656229
13-3	6.5000134
13-5	6.3700137
27-3	7.4384425
28-3	7.6984415
29-3	7.6984379
30-3	7.9584482
32-3	8.0884023
33-3	8.3483515
34-3	19.352811
31-3	8.0884506
GKP SPL	2.8599987
BANARAS SPL	0.12999976
25-5	1.605624
13-6	3.2500065
13-7	3.2500071
PATNA SPUR	0.1300002
GKP SPL-2	0
13-8	1.6900037
34-4	7.1499394
34-5	3.8543338
34-6	3.5943644
34-7	15.498282
34-8	0.25999961
34-9	0.25999958
Pipe0002	0
25-6	4.940001
64-2	0.70901971
64-3	0.54911992
64-4	0.15989998
60-3	0.1807
60-4	0.18069998
64-5	0.18069997
47-3	0.69335223

51-5	1.3970032
57-4	7.1896527
64-6	2.4899546
51-3	2.6767
64-7	1.06691
64-8	1.06691
27-4	8.0384399
ONGC Bokaro line	0.6
22-5	6.675616
Pipe0002-2	0.6



Email

Technical Division PNGRB

Re: Capacity Assessment of the GAIL's CJHPL, KG BASIN & INTEGRATED NGPL networks

From : MRAGANG SHEAKHAR <m.sheakhar@eil.co.in> Thu, Mar 21, 2024 07:10 PM
Subject : Re: Capacity Assessment of the GAIL's CJHPL, KG BASIN & INTEGRATED NGPL networks 3 attachments
To : Technical Division PNGRB <e-technical.pngrb@nic.in>
Cc : JAYATI GHOSH <jayati.ghosh@eil.co.in>, HASMUKH K PARMAR <hk.parmar@eil.co.in>, ANSHU KUMAR <anshu.kumar@eil.co.in>, Anil Garg <garg.anil@pngrb.gov.in>, Muktikam Phukan <muktikamphukan@pngrb.gov.in>, Gagan Aggarwal <gaggarwal@pngrb.gov.in>, Yuvraj Singh Rathore <yuvraj.rathore@pngrb.gov.in>, Voona Venkata Narendra <narendra.vv@pngrb.gov.in>, VAIBHAV VAIBHAV <vaibhav.srivastava@eil.co.in>

Dear Sir,

With regard to Entity observations received vide trailing mail, no change is envisaged for capacity of subject networks and hence final study reports are attached for following :

- CHHAINSA-JHAJJAR-HISSAR NATURAL GAS PIPELINE (CJHPL)
- INTEGRATED/INTERCONNECTED PIPELINE NETWORK
- KG BASIN NGPL NETWORK

Annexures : <https://email.gov.in/home...riefcase/PNGRB%2001032024>

Regards,

Mragang Sheakhar | Process-1| Engineers India Limited, P&I Building, Gurgaon
Ground Floor, Icom 3025, Mobile 9555438664



From: "Technical Division PNGRB" <e-technical@pngrb.gov.in>
To: "JAYATI GHOSH" <jayati.ghosh@eil.co.in>
Cc: "HASMUKH K PARMAR" <hk.parmar@eil.co.in>, "MRAGANG SHEAKHAR" <m.sheakhar@eil.co.in>, "ANSHU KUMAR" <anshu.kumar@eil.co.in>, "Anil Garg" <garg.anil@pngrb.gov.in>, "Muktikam Phukan" <muktikamphukan@pngrb.gov.in>, "Gagan Aggarwal" <gaggarwal@pngrb.gov.in>, "Yuvraj Singh Rathore" <yuvraj.rathore@pngrb.gov.in>, "Voona Venkata Narendra" <narendra.vv@pngrb.gov.in>
Sent: Tuesday, March 19, 2024 2:29:26 PM
Subject: Capacity Assessment of the GAIL's five NGPL networks

Dear Madam,

This has reference to updated reports on capacity assessment of the subject pipeline

network and the meeting held on 26.02.2024 w.r.t review of the Capacity Assessment of the 06 Natural Gas Pipeline Networks.

As decided in the meeting the updated reports were shared with GAIL along with input/output files provided by EIL and GAIL was advised to submit its inputs on the updated report of the Capacity Assessment latest by 07.03.2024. Accordingly, GAIL has provided its inputs vide emails dated 07.03.2024, 18.03.2024 & 19.03.2024 which are enclosed as trailing mail(s).

In view of the above, EIL is hereby advised to review the inputs provided by GAIL and submit its reply to inputs of GAIL. Also, same may be annexed in the final report.

The Final report of the capacity assessment of five GAIL NGPL networks along with all Annexures shall be submitted to PNGRB by **22.03.2024** positively.

धन्यवाद और सादर | Thanks and Regards,

तकनीकी विभाग | Technical Division

पेट्रोलियम एवं प्राकृतिक गैस विनियामक बोर्ड
Petroleum and Natural Gas Regulatory Board

प्रथम-तल, वर्ल्ड ट्रेड सेंटर, बाबर रोड, नई दिल्ली - ११० ००१
1st Floor, World Trade Center, Babar Road, New Delhi - 110 001

W: www.pngrb.gov.in

E: e-Technical@pngrb.gov.in

D: 011-23457741

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भारत 2023 INDIA

वसुधैव कुटुम्बकम्

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From: "Corporate Regulatory Affairs group (निगमित विनियामक मामला गुप)"
<cragroup@gail.co.in>

To: "Technical Division PNGRB" <e-technical.pngrb@nic.in>

Cc: "Secretary" <secretary@pngrb.gov.in>, "Anil Garg" <garg.anil@pngrb.gov.in>, "Gagan

Aggarwal" <gaggarwal@pngrb.gov.in>, "Yuvraj Singh Rathore" <yuvraj.rathore@pngrb.gov.in>, "Voona Venkata Narendra" <narendra.vv@pngrb.gov.in>, skishore@gail.co.in, jpathak@gail.co.in, "r kannan" <r_kannan@gail.co.in>

Sent: Tuesday, March 19, 2024 10:30:58 AM

Subject: RE: Capacity Assessment of the GAIL's five NGPL networks

Dear Sir,

In continuation to the inputs/comments of GAIL as provided vide the trailing email, it is requested to kindly consider the following input also:

"In previous capacity assessment exercises by Capacity Assessment Group, an allowance of 5% was also considered for declared capacity as theoretical capacity are determined considering extreme conditions. Same may also be included in the present capacity assessment to maintain uniformity."

Regards,

R Kannan,

DGM (Mktg-RA),

Regulatory Affairs Group,

GAIL (India) Limited, New Delhi

From: Corporate Regulatory Affairs group (निगमित विनियामक मामला ग्रुप)

Sent: 18 March 2024 17:47

To: 'Technical Division PNGRB' <e-technical.pngrb@nic.in>

Cc: R Kannan (आर. कन्नन) <r_kannan@gail.co.in>; Secretary <secretary@pngrb.gov.in>; Anil Garg <garg.anil@pngrb.gov.in>; Gagan Aggarwal <gaggarwal@pngrb.gov.in>; Yuvraj Singh Rathore <yuvraj.rathore@pngrb.gov.in>; Voona Venkata Narendra <narendra.vv@pngrb.gov.in>; Sumit Kishore (सुमित किशोर) <skishore@gail.co.in>; Jitendra Pathak (जितेन्द्र पाठक) <jpathak@gail.co.in>; R Kannan (आर. कन्नन) <r_kannan@gail.co.in>

Subject: RE: Capacity Assessment of the GAIL's five NGPL networks

Dear Sir,

With reference to the trailing email communications, and the meeting held at PNGRB on 14.03.2024, please find enclosed GAIL inputs/comments on the Draft Capacity Assessment Reports prepared by EIL for the following NG Pipelines of GAIL:

1. GAIL Integrated NGPL
2. Cauvery Basin Network – NKM subnetwork

3. Chhainsa Jhajjar Hissar NGPL
4. KG Basin Network
5. Gujarat NGPL subnetworks

Regards,

R Kannan,
DGM (Mktg-RA),
Regulatory Affairs Group,
GAIL (India) Limited, New Delhi

From: Technical Division PNGRB <e-technical@pngrb.gov.in>
Sent: 11 March 2024 14:34
To: Jitendra Pathak (जितेन्द्र पाठक) <jpathak@gail.co.in>; Corporate Regulatory Affairs group (निगमित विनियामक मामला ग्रुप) <cragroup@gail.co.in>
Cc: R Kannan (आर. कन्नन) <r_kannan@gail.co.in>; Secretary <secretary@pngrb.gov.in>; Anil Garg <garg.anil@pngrb.gov.in>; Gagan Aggarwal <gaggarwal@pngrb.gov.in>; Yuvraj Singh Rathore <yuvraj.rathore@pngrb.gov.in>; Voona Venkata Narendra <narendra.vv@pngrb.gov.in>
Subject: Re: Capacity Assessment of the GAIL's five NGPL networks

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This has reference to trailing mails(s).

We acknowledge the comments provided by GAIL.

As GAIL has not submitted any specific inputs to the EIL's Capacity Assessment draft reports for the five NGPL networks, we are going ahead with the reports for their finalization.

धन्यवाद और सादर | Thanks and Regards,

तकनीकी विभाग | Technical Division

पेट्रोलियम एवं प्राकृतिक गैस विनियामक बोर्ड

Petroleum and Natural Gas Regulatory Board

प्रथम-तल, वर्ल्ड ट्रेड सेंटर, बाबर रोड, नई दिल्ली - ११० ००१

1st Floor, World Trade Center, Babar Road, New Delhi - 110 001

W: www.pngrb.gov.in
E: e-Technical@pngrb.gov.in
D: 011-23457741

From: "Corporate Regulatory Affairs group (निगमित विनियामक मामला ग्रुप)" <cragroup@gail.co.in>
To: "Technical Division PNGRB" <e-technical.pngrb@nic.in>
Cc: "Secretary" <secretary@pngrb.gov.in>, "Anil Garg" <garg.anil@pngrb.gov.in>, "Gagan Aggarwal" <gaggarwal@pngrb.gov.in>, "Yuvraj Singh Rathore" <yuvraj.rathore@pngrb.gov.in>, "Voona Venkata Narendra" <narendra.vv@pngrb.gov.in>, jpathak@gail.co.in, "r kannan" <r_kannan@gail.co.in>
Sent: Thursday, March 7, 2024 6:45:49 PM
Subject: RE: Capacity Assessment of the GAIL's five NGPL networks

Dear Sir,

With reference to the trailing emails on the subject, it is submitted that the draft Reports are being studied by concerned Departments in GAIL for providing inputs. Collating the inputs and subsequent approval needs sufficient time.

Further, it is observed that respective TNet files, based on which the draft reports have been prepared by EIL, are not available in the data folders shared by PNGRB. The TNet files are required to understand multiple assumptions of source/delivery/pipelines etc. to have better clarity on assessment methodology.

Hence, it is requested to kindly share the TNet files and allow us 2 more weeks for submitting the comments of GAIL on these draft reports.

Regards,

R Kannan,
DGM (Mktg-RA),
Regulatory Affairs Group,
GAIL (India) Limited, New Delhi

From: Technical Division PNGRB <e-technical@pngrb.gov.in>
Sent: 04 March 2024 15:20
To: Jitendra Pathak (जितेन्द्र पाठक) <jpathak@gail.co.in>; Corporate Regulatory Affairs group (निगमित विनियामक मामला ग्रुप) <cragroup@gail.co.in>
Cc: R Kannan (आर. कन्नन) <r_kannan@gail.co.in>; Secretary <secretary@pngrb.gov.in>; Anil Garg <garg.anil@pngrb.gov.in>; Gagan Aggarwal <gaggarwal@pngrb.gov.in>; Yuvraj Singh Rathore <yuvraj.rathore@pngrb.gov.in>; Voona Venkata Narendra

<narendra.vv@pngrb.gov.in>

Subject: Re: Capacity Assessment of the GAIL's five NGPL networks

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Sir,

This is in furtherance to trailing mail(s). The input/output datasheet for capacity assessed for GAIL Gujarat Sub-Network by EIL is being forwarded for your perusal.

In line with the previous mail, you are advised to provide your inputs (as per Email dated 26.02.2024) latest by 07.03.2024 *for all the five NGPL networks*. In absence of any inputs by 07.03.2024, it will be presumed that you have no inputs w.r.t Capacity Assessment Report(s) of EIL and same may be considered as final report(s) towards capacity assessment.

धन्यवाद और सादर | Thanks and Regards,

तकनीकी विभाग | Technical Division

From: "Technical Division PNGRB" <e-technical@pngrb.gov.in>

To: "Jitendra Pathak (जितेन्द्र पाठक)" <jpathak@gail.co.in>, "Corporate Regulatory Affairs group (निगमित विनियामक मामला ग्रुप)" <cragroup@gail.co.in>

Cc: "R Kannan (आर. कन्नन)" <r_kannan@gail.co.in>, "Secretary" <secretary@pngrb.gov.in>, "Anil Garg" <garg.anil@pngrb.gov.in>, "Gagan Aggarwal" <gaggarwal@pngrb.gov.in>, "Yuvraj Singh Rathore" <yuvraj.rathore@pngrb.gov.in>, "Voona Venkata Narendra" <narendra.vv@pngrb.gov.in>

Sent: Saturday, March 2, 2024 3:46:20 PM

Subject: Re: Capacity Assessment of the GAIL's five NGPL networks

Sir,

This is in furtherance to trailing mail(s). The input/output datasheet for capacity assessed of EIL is being forwarded for your perusal.

You are advised to provide your inputs (as per Email dated 26.02.2024) latest by 07.03.2024 for following NGPL networks. In absence of any inputs by 07.03.2024, it will be presumed that you have no inputs w.r.t Capacity Assessment Report(s) of EIL and same may be considered as final report(s) towards capacity assessment. Please find enclosed datasheet for:

1. GAIL Integrated NGPL
2. Cauvery Basin Network
3. Chhainsa Jhajjar Hisar NGPL

4. KG Basin Network

5. Gujarat Sub-Network NGPL(will be share by Monday)

धन्यवाद और सादर | Thanks and Regards,

तकनीकी विभाग | Technical Division

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Petroleum and Natural Gas Regulatory Board

प्रथम-तल, वर्ल्ड ट्रेड सेंटर, बाबर रोड, नई दिल्ली -११० ००१

1st Floor, World Trade Center, Babar Road, New Delhi - 110 001

From: "Corporate Regulatory Affairs group (निगमित विनियामक मामला ग्रुप)" <cragroup@gail.co.in>

To: "Technical Division PNGRB" <e-technical.pngrb@nic.in>

Cc: "Secretary" <secretary@pngrb.gov.in>, "Anil Garg" <garg.anil@pngrb.gov.in>, "Gagan Aggarwal" <gaggarwal@pngrb.gov.in>, "Yuvraj Singh Rathore" <yuvraj.rathore@pngrb.gov.in>, "Voona Venkata Narendra" <narendra.vv@pngrb.gov.in>, jpathak@gail.co.in, "r kannan" <r_kannan@gail.co.in>

Sent: Thursday, February 29, 2024 4:07:43 PM

Subject: RE: Capacity Assessment of the GAIL's five NGPL networks

Dear Sir,

Vide the trailing email and through One Drive, PNGRB has shared the DRAFT REPORTS of Capacity Assessment of the following five Natural Gas Pipeline networks of GAIL:

1. GAIL Integrated NGPL
2. Cauvery Basin Network
3. Chainsa – Jhajjar – Hissar NGPL
4. Gujarat NGPL sub networks
5. KG Basin Network

Studying these Draft Reports and the documents needs sufficient time. Hence, it is requested to kindly allow us one month time for providing the comments of GAIL on these draft reports.

Further, it is requested to kindly share the assumptions, if any, which might have been considered by EIL in the capacity determination in place of any unavailable data.

Regards,

R Kannan,

DGM (Mktg-RA),

Regulatory Affairs Group,
GAIL (India) Limited, New Delhi

From: Technical Division PNGRB <e-technical@pngrb.gov.in>
Sent: 26 February 2024 17:42
To: Jitendra Pathak (जितेन्द्र पाठक) <jpathak@gail.co.in>; Corporate Regulatory Affairs group (निगमित विनियामक मामला ग्रुप) <cragroup@gail.co.in>
Cc: R Kannan (आर. कन्नन) <r_kannan@gail.co.in>; Secretary <secretary@pngrb.gov.in>; Anil Garg <garg.anil@pngrb.gov.in>; Gagan Aggarwal <gaggarwal@pngrb.gov.in>; Yuvraj Singh Rathore <yuvraj.rathore@pngrb.gov.in>; Voona Venkata Narendra <narendra.vv@pngrb.gov.in>
Subject: Fwd: Capacity Assessment of the GAIL's five NGPL networks
Importance: High

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Sir,

Based on inputs from GAIL, EIL has submitted the reports of Capacity Assessment of five Natural Gas Pipeline networks (Copies enclosed and annexures of the reports have been shared through One Drive link).

You may like to see the same and offer your inputs on the following:

1. Verification of data/details considered by EIL in its assessments.
2. Difference between methodology adopted by EIL and GAIL, in line with the existing provisions of PNGRB (Determining Capacity of Petroleum, Petroleum Products and Natural Gas Pipeline) Regulations, 2010 for assessment of the capacity of the respective NGPL networks.

You are advised to submit the same by 29.02.2024 positively.

धन्यवाद और सादर | Thanks and Regards,

तकनीकी विभाग | Technical Division

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Petroleum and Natural Gas Regulatory Board

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E: e-Technical@pngrb.gov.in

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 **Report _GKGBNGL.pdf**
643 KB

 **Report _GIIPN.pdf**
485 KB

 **Report _CJHPL.pdf**
646 KB

Email

Technical Division PNGRB

From : MRAGANG SHEAKHAR <m.sheakhar@eil.co.in> Fri, Mar 01, 2024 08:12 PM
Subject : Re: BASIS FOR CAPACITY ASSESSMENT
To : Technical Division PNGRB <e-technical.pngrb@nic.in>
Cc : Gagan Aggarwal <gaggarwal@pngrb.gov.in>, Anil Garg <garg.anil@pngrb.gov.in>, Technical Division PNGRB <e-technical.pngrb@nic.in>, HASMUKH K PARMAR <hk.parmar@eil.co.in>, VAIBHAV VAIBHAV <vaibhav.srivastava@eil.co.in>, ANSHU KUMAR <anshu.kumar@eil.co.in>

Dear Sir,

As discussed, native files are not part of deliverable and hence input / output considerations (basis) of capacity assessment are being provided.

Regards, Mragang Sheakhar | Process-1 | Engineers India Limited, P&I Building, Gurgaon Ground Floor, Icom 3025, Mobile 9555438664

----- Original Message -----

From: ANSHU KUMAR <anshu.kumar@eil.co.in>
To: Gagan Aggarwal <gaggarwal@pngrb.gov.in>
Cc: Anil Garg <garg.anil@pngrb.gov.in>, Technical Division PNGRB <e-technical.pngrb@nic.in>, HASMUKH K PARMAR <hk.parmar@eil.co.in>, MRAGANG SHEAKHAR <m.sheakhar@eil.co.in>, VAIBHAV VAIBHAV <vaibhav.srivastava@eil.co.in>
Sent: Fri, 01 Mar 2024 19:32:51 +0530 (IST)
Subject: BASIS FOR CAPACITY ASSESSMENT

Dear Sir,

As discussed, please find attached Basis of Capacity Assessment for networks of PNGRB :

- * KG Basin
- * Cauvery Basin
- * GSPL HP Grid
- * GAIL Integrated
- * CJHPL

Regards,
Anshu Kumar
EIL

GAIL's views/inputs/comments on Draft Report on Capacity Assessment of 05 Natural Gas Pipelines of GAIL shared by PNGRB

PNGRB, vide email dated 26.02.2024, has shared Draft Report for capacity assessment of following Natural Gas Pipelines of GAIL, soliciting GAIL's inputs on the same:

1. Narimanam-Kuthalam (NKM) sub-network of Cauvery Basin Natural Gas Pipeline Network
2. Chhainsa-Jhajjar-Hissar Natural Gas Pipeline (CJHPL)
3. Gujarat Natural Gas Pipeline Network
4. KG Basin Natural Gas Pipeline Network
5. GAIL Integrated Natural Gas Pipeline (GAIL INGPL)

In this regard, following are the comments / queries based on GAIL's understanding of the document:

A. Comments in general to all the networks assessments shared

- I. For the purpose of reviewing the aforesaid draft reports, the respective TNet files are required so that the multiple assumptions of source/delivery/pipelines etc. can be viewed for clarity on assessment methodology. The request for sharing the TNet files has been submitted to PNGRB vide email dated 07.03.2024.
- II. During the Capacity assessment exercise of 2011-12, the capacity determination was carried out by a Capacity Assessment Group (CAG) comprising of Prof. A Moharir of IIT Bombay, PNGRB representative and representatives of other entities owning and operating gas pipelines in the country (representatives of 02 transporters other than the entity of which the pipeline capacity is to be certified). The group ensured transparent approach to capacity assessment exercise through inclusion of practical and industrial aspects of determining capacity after discussion with the entities. It is understood that such constitution of Capacity Assessment Group, has not been done in the instant capacity assessment exercise.
- III. It is pertinent to note that the capacity assessment group consisting of representatives from IIT Bombay, GSPL, GAIL, RGTIL as well as PNGRB, laid down various parameters to be considered for capacity assessment for natural gas pipeline networks. During capacity assessment of natural gas pipelines under the provision of regulations the duly constituted committee deliberated on various practical limitations and suggested following aspects for determination/finalization of natural gas pipeline networks capacity:
 1. All deliveries within 50 km of any source shall be limited to contractual flow quantities.
 2. Pressure drop across the metering and regulating stations taken as 4 barg or higher on the basis of documentary evidence.
 3. Pressure drop across check meter / station will be 2 barg.
 4. Following source capacity limitations to be considered:
 - a. Depleting Source/Field: Source will be considered as a limiting source based on actual/current pressure and volume.

- b. LNG terminal capacity: Terminal will be considered as a limiting source based on regasification capacity.
 - c. Contractual off-take: All source and customer contractual pressure volume requirement are to be considered
 - d. Entry point pressure limitations of source: All contractual obligations of pressure and offtake to be considered.
5. It was also considered that the farthest / most critical customer shall be considered for free flow (volume maximization). It was agreed that such method would give true capacity of the pipeline and all other customers on the network in this case would also be fulfilled in terms of their contractual requirements.

The committee further deliberated that these aspects shall be uniformly applicable in all the future capacity assessment of natural gas pipelines.

The points at point nos. III (1-4) above are referenced from the PNGRB order of 2016 on capacity of EWPL of M/s RGTIL. The document titled Order pertaining to capacity of Natural Gas East West Pipeline (EWPL) of M/s Reliance Gas Transportation Infrastructure Limited (RGTIL) for the period between 1.4.2010 to 31.03.2011 and 01.04.2011 to 31.03.2012 has been referenced. It is not clear whether the aforementioned parameters have been included in the capacity determination of subject networks or not.

- IV. Further, CAG report of 2011 for RIL's EWPL, clause 1 (c)(b)(5) inter alia states that "At limiting condition of installed equipment (maximum available turbine power, compressor speed or maximum pressure, etc.) or delivery pressures, the maximum volumetric flow possible is considered as the capacity of the pipeline system that can be used for declaring system capacity. There was no data to suggest that other units such as filter, cooler, etc. were capacity limiting. In principle, any unit at such stations as represented in the station P&ID could be limiting and should be duly considered in capacity estimation". This implies that all limiting conditions of installed equipment viz. metering skids etc. must be considered in the capacity determination.

Since GAIL has not been provided the TNET files of the simulation, it is understood that the assessment of capacity of these networks has been carried out considering the equipment limitations at each of the tap-off locations as considered in previous assessments quoted herein. For instance, the installed pressure reduction skids at each of the branch lines along Sultanpur Neemrana section of CJHPL will pose limitations on account of their installed capacity.

- V. Additionally, the CAG report of 2011 for RIL's EWPL, clause 1 (c)(b)(3) points out that pipeline efficiency can deteriorate with time with increase in surface roughness and may also vary across different sections. GAIL's experience with pipeline operations indicate that pipeline efficiencies range mostly between 85%-90% and the same vary across sections based on different diameters, pipeline roughness, coating and age difference factors, gas type etc. It is understood that same has been considered for the instant cases as the report does not mention the efficiency considered against each of the networks in the assessment.

The aforementioned assumptions of the previous CAG have been evolved based on detailed deliberations carried out between stakeholders, PNGRB and

their appointed representative from IIT Bombay. These deliberations acknowledged the various practical aspects of determination of pipeline capacity. Therefore, it is GAIL's request that these deliberations and recommendations of the last CAG may please be considered in the instant case as well.

- VI. In the draft reports of capacity assessment clause 6.2 "Step wise methodology given for Capacity determination in Clause No. 5.(5) of PNGRB capacity regulation" at sub clause (ii) and (iii), it is mentioned that as per capacity regulation, at the originating point and at intermediate points in the direction of flow, the pressure should be set as a fixed parameter. It is requested to please provide the MAOP considered and the underlying philosophy in its selection thereof, in each of the cases and the individual sections. Further, it is understood that MAOP will be 4 kg/cm² below the design pressure or the de-rated value as the case may be.

B. Comments specific to the individual networks:

Chhainsa-Jhajjar-Hissar NGPL (CJHPL):

- VII. As per regulation 5 (5) (a) (iii) of the Capacity Determination Regulations, "*.... software will be run till any customer connected to the system reaches limiting condition of pressure required at the respective exit point or maximum flow capacity is reached at entry or intermediate compressor stations (if installed in the system) or the velocity of natural gas reaches limiting value....*". In this regard, GAIL would like to emphasize that Chhainsa Compressor station is the feed compressor for CJHPL as well as for Dadri-Bawana-Nangal NG Pipeline (DBNPL) and Dadri-Panipat NG Pipeline (DPPL). Hence, total capacity of these networks will not exceed the capacity of Chhainsa compressor station. It may be noted that the rated capacity of Chhainsa compressor station is 53.5 MMSCMD.
- VIII. It is requested to please provide the MAOP considered and the underlying philosophy in its selection thereof, in each of the cases and the individual sections. Further it is understood that MAOP will be 4 kg/cm² below the design pressure or the de-rated value as the case may be.

Gujarat Regional, Cauvery Basin (NKM) and KG Basin Networks:

- IX. Sub points (iii) and (iv) of clause 6.2 of the draft reports shared, may be read in conjunction with RIL order dated 30.12.2016 wherein it is emphasised that capacity assessment exercise for declared capacity goes by contractual obligations with regards to supply gas pressure. The networks of Gujarat, KG Basin and Cauvery Basin consist of depleting sources and there are contractual obligations on their offtake at pressures which are lower than the design pressure of the network they are connected to. It is requested to kindly confirm whether such contractual offtake requirements have been considered while assessment of capacity of these pipeline networks.

- X. The RIL order dated 30.12.2016, add emphasis on the above. The order cites a case wherein, to maximise capacity of GSPL network, CAG had taken higher pressure at Atakpardi source of 93 barg instead of 85 barg HLPL pressure. By running the simulation with other nearby sources at higher pressure, simulated node pressure at HLPL came out to be 86 barg which was higher as against the maximum contractual available pressure at HLPL, thus automatically forcing flow from HLPL source as zero. Such case would mean that the contractual offtake of gas from sources will not be honoured.
- XI. Further, the methodology adopted and elaborated at clause 6.2 of the draft reports mentions that gas at the entry point has been assumed as unlimited with MAOP conditions and then the selected software was run till any customer connected to the system reaches limiting condition as defined in regulation. In this regard, this, when read in conjunction with the aspects mentioned above at serial no. A(III), require that MAOP will be 4 kg/cm² below the design pressure or the de-rated value as the case may be. It is requested to kindly confirm the MAOP considered for each section.
- XII. In view of the above, it is requested to kindly confirm that the above-mentioned observations have been considered during the present capacity assessment. Further, it is again requested that TNet files may be provided for understanding the methodology of capacity assessment.

C. Comments related to data:

XIII. MAOP data:

- a) **NKM Subnetwork of Cauvery Basin Network:** As per the data shared, the MAOP considered by EIL in the capacity assessment of NKM subnetwork of Cauvery Basin Network is 49 kg/cm². In this regard, it is submitted that the NKM subnetwork is a closely interconnected network connected with multiple local gas fields. Though certain pipeline sections in this subnetwork have design pressure more than 19 kg/cm², the entire subnetwork has MAOP of 19 kg/cm².
- b) **Gujarat NGPL Subnetworks:** A table showing the MAOP considered by EIL in the draft reports and the inputs of GAIL is provided below for kind consideration:

SN	Subnetwork	In EIL Report – MAOP (kg/cm ²)	GAIL Inputs – MAOP (kg/cm ²)	Remarks
1	Motwan,	19	5.5	
2	Kadi Kalol	19	49	
3	Mehsana	19	5.5	MRTS pipeline is non-existing and Sabar Dairy connectivity is customer pipeline.
4	Paliyad	19	5.5	
5	Kalol Ramol	49	4.5	

- XIV. **Ex-Hazira Subnetwork data:** The requisite data in respect of determination of capacity of the Ex-Hazira subnetwork of Gujarat NGPL have been submitted to PNGRB vide email dated 05.03.2024.
- XV. **Pipeline section details:** The length of KG Basin has been given as 796.97 km and that for NKM subnetwork of Cauvery Basin has been given as 245.33 km in the draft report. It is requested to kindly provide the sections considered for capacity determination.
- XVI. **KG Basin pipeline replacement:** In the draft report it has been mentioned that Tatipaka -Oduru – KJ point section was changed in Assessment year 2017-18. Original & replacement sizes are both 18” respectively. Further, the length of replaced 24” pipeline section of Tatipaka – Chinchinad has been mentioned as 18.5 km. Both these data may please be reviewed in light of point no. 6.2.1.11 (d) (ii) under PNGRB’s Ruling on actual capex at page 18 of the KG Basin Tariff Order dated 28.06.2019, a snapshot of the relevant table is provided below:

						(Rs. Crore)
S. No.	Pipeline Sections	Original Size	Replaced size	Replaced Length (Km)	Capex Claimed	Capex considered
1	Tatipaka-Chinchinada	18”	24”	19.67	83.47	55.23
2	Tatipaka-Oduru-KJ Point	18”	24”	75.65	269.00	212.43
	Total			95.32	352.47	267.66

D. Other comments related to Tariff submissions:

XVII. GAIL Integrated NG Pipeline:

- As mentioned in the Draft Capacity Assessment Report, "Tie-In Connectivity" from Natural Gas source of Jaya Fields (Jambusar, Gujarat) of M/s Vedanta Ltd. to South Gujarat Main sub-network of Gujarat Natural Gas Pipeline Network (GNGPN) of GAIL was not a part of Integrated pipeline network and South Gujarat Main sub-network as provided by entity. However, it is informed that while submission of Integrated NGPL Tariff to PNGRB, the Jambusar Tie-in connectivity with South Gujarat Sub-network with its expected commissioning date has been conveyed as Sep-2023 and the same was also considered by PNGRB in their Tariff Order.
- GAIL Integrated NGPL Capacity before and after commissioning of new source/Tie-in connectivities (additional capacity) may please be mentioned separately with respective dates in order to determine the Normative Volumes as per PNGRB Tariff Regulations.
- As per Draft Capacity Assessment Report, Impact for Bokaro Tie-in connectivity and Jharia Tie-in connectivity has been considered in FY 2023-24. However, expected commissioning date of these Tie-in connectivity was August 2024 and same has been considered by PNGRB in the Tariff Order. Accordingly, the same may please be reviewed.

- iv) At page no. 13 of the draft report, it is mentioned that Baroda, Kadi-Kalol, Kalol-Ramol, Mehsana, Motwan, Paliyad and Ex-Hazira sub-network are part of South Gujarat low pressure network and are shown as part of the sources of GAIL Integrated NGPL. The same may please be reviewed since the Baroda sub-network alone is part of the GAIL Integrated NGPL and other sub-networks are not a part of the same.

XVIII. NKM Subnetwork of Cauvery Basin:

The capacity of Cauvery Basin-NKM subnetwork before and after commissioning of the Madanam Tie-in connectivity may please be mentioned separately in the report for the purpose of calculation of Normative Volume as on respective commissioning dates as per PNGRB Tariff Regulations.

XIX. CJHPL:

Capacity of CJHPL before and after commissioning of the following may please be mentioned separately with respective dates in the report for the purpose of calculation of Normative Volume as per PNGRB Tariff Regulations:

- i) Chhainsa Compressor Station
- ii) Sultanpur-Jhajjar-Hissar section

XX. Gujarat NGPL:

- i) Capex and Opex of certain customers (i.e. Schott Glass, HSGL, Haldyn Glass and Punjab Steel) of South Gujarat-Main were not considered by PNGRB while tariff processing of GAIL Integrated NGPL. Accordingly, the same needs to be specified separately in Capacity Assessment Report so that necessary treatment of Capex and Opex may be done in next tariff review by PNGRB.
- ii) Capex and Opex of one another customer (i.e. Shyam Industries) under Kalol-Ramol sub-network also was not allowed in last tariff order. Accordingly, this section also needs to be specified separately in Capacity determination report for necessary treatment.

XXI. KG Basin Network:

- i) Odalarevu Bodasakuru pipeline Tie-in connectivity was completed in Nov 2018, whereas, it has been mentioned in the draft Capacity Assessment Report that the Odalarevu source has been added in the year 2016-17.
- ii) Bantumili Tie-in connectivity was completed in March-2023, and hence the impact of the same on the capacity of KG Basin Network may have to be determined.
