



**REPORT  
FOR  
CAPACITY ASSESSMENT OF CHHAINSA-JHAJJAR-HISSAR  
NATURAL GAS PIPELINE (CJHPL)  
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/ Organisations only. The matter contained in the Report is confidential.

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D	16.02.2024	RE -ISSUED AS UPDATED STUDY REPORT	VS /AK	MS	HKP
C	28.11.2023	ISSUED AS UPDATED DRAFT STUDY REPORT	VS /AK	MS	HKP
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A	20.07.2023	ISSUED AS PRELIMINARY DRAFT STUDY REPORT	VS	MS	HKP
<b>Rev. No.</b>	<b>Date</b>	<b>Purpose</b>	<b>Prepared by</b>	<b>Reviewed by</b>	<b>Approved by</b>

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## Abbreviations

PNGRB	:	Petroleum and Natural Gas Regulatory Board
CJHPL	:	Chhainsa-Jhajjar-Hissar Natural Gas Pipeline
GAIL	:	GAIL (India) Limited
EIL	:	Engineers India Limited
LOA	:	Letter of Award



## 1.0 EXECUTIVE SUMMARY

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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 / (2) / 2014 (P-2798) dated 8th Jul, 2022) (Refer **ANNEXURE-VIII**) for carrying out the capacity assessment of existing Chhainsa-Jhajjar-Hissar Natural Gas Pipeline (CJHPL) of M/s GAIL (India) Limited [hereinafter referred as an “Entity” also] for the given period of operation i.e. Year 2010-11 to 2022-23.

Role of Engineers India Limited (EIL) [a Govt. of India Undertaking] shall be to review the capacity assessment submitted by the operator for Chhainsa-Jhajjar-Hissar Natural Gas Pipeline (CJHPL) of GAIL (India) Limited 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 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 of 2010-2023 periods:

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 against defined step wise methodology given in the regulation of capacity determination as clause no. 5.(5).

Entity data/ inputs has been verified 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 CJHPL 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)	
2010-11	5.72	8.25	
2011-12	5.81	8.29	
2012-13	6.02	8.62	
2013-14	9.83	14.58	Addition of Chainsa Compressor at source & additional six consumers [Note-3]
2014-15	9.84	14.68	Change in network by addition of five consumers & two kms length
2015-16	9.71	14.7	Addition of two consumers in the network
2016-17	9.19	14.75	Addition of eleven consumers in the network
2017-18	9.19	14.75	
2018-19	9.93	14.78	
2019-20	10.22	12.63	Change in network by deletion of

			nine consumers & two kms length
2020-21	12.0	12.73	Sultanpur-Jhajjar-Hissar (135 km) was not considered as part of overall network [as not commissioned] [Note-4,5]
2021-22	12.0	12.73	
2022-23	9.87	13.2	23 no's of customers increased

Note –

1. Entity has considered operating conditions for maximum capacity estimation of CJHPL network.
2. 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.
3. Chainsa Compressor was incorporated as part of network from year 2013-14 onwards. Impact of insertion of only Chainsa Compressor on network is 4 MMSCMD.
4. Sultanpur-Jhajjar-Hissar section was not commissioned and was not part of CJHPL network. Entity has listed this section as part of CJHPL network for assessment year 2020-21 & 2021-22.
5. Impact of Sultanpur-Jhajjar-Hissar section to be considered as 2 MMSCMD.



## 2.0 INTRODUCTION

## 2.0 INTRODUCTION

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 to be carried out.

PNGRB has entrusted EIL vide LOA (PNGRB/ Tech / 10-CapNGPL / (2) / 2014 (P-2798)) for carrying out capacity determination Chhainsa-Jhajjar-Hissar Natural Gas Pipeline (CJHPL) of GAIL (India) Limited [hereinafter referred as an "Entity"] for the given period of operation i.e. Year 2010-11 to 2022-23. Scope of work for EIL was to assess the capacity of Chhainsa-Jhajjar-Hissar Natural Gas Pipeline (CJHPL) of GAIL (India) Limited from Chhainsa to Hissar for the given period of operation i.e. year 2010-11 to 2022-23 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 simulated the CJHPL network with operating conditions at source & free flow. However, EIL has 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 wherein assuming gas at the

entry point (single source of gas) as unlimited with MAOP conditions, the selected software was run till any customer connected to the system reaches limiting condition 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 has been presented to PNGRB. PNGRB has reviewed the approach which has been detailed out in following sections of the report.

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## 3.0 EXISTING CHHAINSA-JHAJJAR-HISSAR NATURAL GAS PIPELINE (CJHPL) DESCRIPTION

### 3.0 EXISTING PIPELINE DESCRIPTION [BY ENTITY]

Ministry of Petroleum & Natural Gas (MoP&NG), vide letter no. L-14014/49/06-GP dated 06th July 2007, issued Grant of Authorization to GAIL for the Chhainsa-Jhajjar-Hissar Natural Gas Pipeline (CJHPL). Subsequently, based on GAIL's submissions under Schedule-H format, PNGRB, vide letter no. Infra/PL/New/17/CJHPL/GAIL/01/10 dated 13th December, 2010, issued the Final Acceptance of the Central Government authorization, which shall be further subject to determination in terms of PNGRB's Capacity Determination Regulations, 2010.

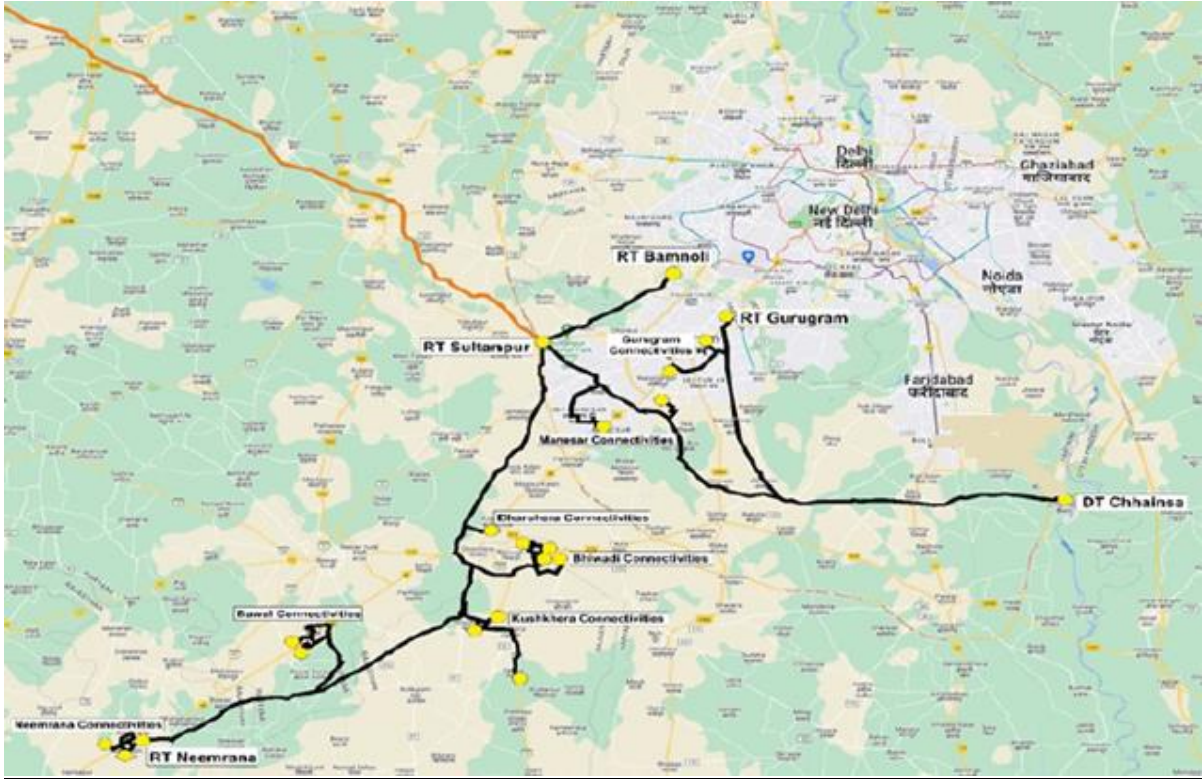
Meanwhile, the 36" diameter Chhainsa to Sultanpur section was already commissioned by GAIL. As regards the subsequent sections of CJHPL, the envisaged original project configuration of Sultanpur - Jhajjar section of 36" diameter size and Jhajjar - Hissar section of 20" diameter size was based on various prospective gas-based projects viz., HPGCL & Tata Power, HPGCL & Jindal Stainless Ltd., RIL SEZ etc. However, later-on these projects were shelved by the consumers for their own reasons, which were beyond the reasonable control of the pipeline developer, and as a result, these sections of the CJHPL project were put on hold.

In 2018, in the context of 9th CGD bidding round by PNGRB, potential demand reassessment was worked out for these balance CJHPL sections, and with the mandatory extra capacity (common carrier), a total potential demand of up to 1.47 MMSCMD was envisaged. Given this demand re-assessment, considering 95 kg/cm<sup>2</sup>g gas pressure at Chhainsa, a hydraulic study simulation was carried out and based on the simulation, at present conditions, 12" size was found to be sufficient for the Sultanpur-Jhajjar-Hissar section.

Presently the major pipeline and spur lines of the Chhainsa-Jhajjar-Hissar Natural Gas Pipeline (CJHPL) are as follows:

- Chainsa - Sultanpur (36" x 71 Km)
- Sultanpur-Jhajjar-Hissar (12" x 135 Km.)
- Sultanpur – Neemrana (18" x 84 Km.)
- 12" Spur line to Bhiwadi.
- 10" Spur line to Manesar.
- 10" Spur line to Gurgaon.
- Associated pipeline networks

CHHAINSA-JHAJJAR-HISSAR NATURAL GAS PIPELINE (CJHPL)



Refer flow diagram given in annexure for pipeline schematic, compressor stations, supply & delivery points flow & process parameters etc. for respective capacity assessment years.

Maximum Allowable Operating Pressure (MAOP) of the Pipeline is 98.0 bar(g).

Inlet point for all capacity assessment years is Chainsa station.

Year wise length & delivery details are as below:

Sr. no.	2010-11	2011-12	2012-13	2013-14
	<b>Total length</b>	<b>Total length</b>	<b>Total length</b>	<b>Total length</b>
	213 km	213 km	244 km	246 km
	<b>Deliveries</b>	<b>Deliveries</b>	<b>Deliveries</b>	<b>Deliveries</b>
1	HERO MOTO	HERO MOTO	HERO MOTO	HERO MOTO
2	KAJARIA	KAJARIA	KAJARIA	KAJARIA
3	MSIL	MSIL	MSIL	MSIL
4	OMAX AUTO	MANESAR- OTHERS	MANESAR-OTHERS	MANESAR- OTHERS
5		OMAX AUTO	OMAX AUTO	OMAX AUTO
6	HNG-2			
7	Uttam Strip	HNG-2	CAPARO POWER	CAPARO POWER
8	Indo Alusys	Sharp Menthol	HONDA CAR	HONDA CAR
9	Dakshin	Uttam Strip	HNG-2	HNG-2
10	FCC Clutch	Dakshin	SANDEN	SANDEN
11	USG Boral	USG Boral	Richfield	Richfield
12	Parle Biscuit	Parle Biscuit	HSIL-2	Toyoda
13	Rathi Bar	Rathi Bar	Sharp Menthol	HSIL-2
14	Rathi Steel	Rathi Steel	Mica II	SAINT GOBAIN
15		RICO	Shan Tableware	Sharp Menthol
16		Rathi Saria	Pelican Ceramics	Mica II
17			Feather touch	Shan Tableware
18			Uttam Strip	Pelican Ceramics
19			AMTEK II	Feather touch
20			MICA-1	Uttam Strip
21			KEI	AMTEK II
22			Indo Alusys	MICA-1
23			Continental Engine	KEI
24			Arvind Press Caps	Surya
25			AV Infra	Indo Alusys
26			Dakshin	Continental Engine
27			Century	Arvind Press Caps
28			HMSIL	AV Infra
29			USG Boral	Dakshin
30			Parle Biscuit	Sunbeam

31			Rathi Bar	Century
32			Rathi Steel	HMSIL
33			Hero Moto-1	USG Boral
34			RICO	Parle Biscuit
35			Rathi Saria	Rathi Bar
36				Rathi Steel
37				IGP
38				Hero Moto-1
39				Havell
40				RICO
41				Rathi Saria
	<b>Source</b>	<b>Source</b>	<b>Source</b>	<b>Source</b>
	Chainsa	Chainsa	Chainsa	Chainsa

	2014-15	2015-16	2016-17	2017-18
	<b>Total length</b>	<b>Total length</b>	<b>Total length</b>	<b>Total length</b>
	248 km	248 km	249 km	249 km
	<b>Deliveries</b>	<b>Deliveries</b>	<b>Deliveries</b>	<b>Deliveries</b>
1	HERO MOTO	HERO MOTO	HERO MOTO	HERO MOTO
2	KAJARIA	KAJARIA	KAJARIA	KAJARIA
3	MSIL	MSIL	MSIL	MSIL
4	CAPARO MARUTI	CAPARO MARUTI	CAPARO MARUTI	CAPARO MARUTI
5	MANESAR-OTHERS	MANESAR-OTHERS	MANESAR-OTHERS	MANESAR-OTHERS
6	OMAX AUTO	OMAX AUTO	OMAX AUTO	OMAX AUTO
7				
8	CAPARO POWER	CAPARO POWER	CAPARO POWER	CAPARO POWER
9	CMR NIKKEI	CMR NIKKEI	CMR NIKKEI	CMR NIKKEI
10	HONDA CAR	HONDA CAR	HONDA CAR	HONDA CAR
11	HNG-2	HNG-2	HNG-2	HNG-2
12	SANDEN	SANDEN	SANDEN	SANDEN
13	Richfield	Richfield	Richfield	Richfield
14	Toyoda	Toyoda	Toyoda	Toyoda
15	HSIL-2	HSIL-2	HSIL-2	HSIL-2

16	SAINT GOBAIN	SAINT GOBAIN	SAINT GOBAIN	SAINT GOBAIN
17	Special Ceramics	Special Ceramics	Special Ceramics	Special Ceramics
18	Sharp Menthol	Sharp Menthol	Sharp Menthol	Sharp Menthol
19	Mica II	Mica II	Mica II	Mica II
20	Shan Tableware	Shan Tableware	Shan Tableware	Shan Tableware
21	Pelican Ceramics	Pelican Ceramics	Pelican Ceramics	Pelican Ceramics
22	Feather touch	Feather touch	Feather touch	Feather touch
23	Uttam Strip	Uttam Strip	Uttam Strip	Uttam Strip
24	AMTEK II	AMTEK II	AMTEK II	AMTEK II
25	MICA-1	MICA-1	MICA-1	MICA-1
26	KEI	KEI	KEI	KEI
27	Surya	Surya	Surya	Surya
28	Indo Alusys	Indo Alusys	Indo Alusys	Indo Alusys
29	Continental Engine	Continental Engine	Continental Engine	Continental Engine
30	Arvind Press Caps	Arvind Press Caps	Arvind Press Caps	Arvind Press Caps
31	AV Infra	AV Infra	AV Infra	AV Infra
32	Dakshin	Dakshin	Dakshin	Dakshin
33	Sunbeam	Sunbeam	Sunbeam	Sunbeam
34	Century	Century	Century	Century
35	Hema	Hema	Hema	Hema
36	HMSIL	HMSIL	HMSIL	HMSIL
37	FCC Clutch	FCC Clutch	FCC Clutch	FCC Clutch
38	USG Boral	USG Boral	USG Boral	USG Boral
39	Parle Biscuit	Parle Biscuit	Parle Biscuit	Parle Biscuit
40	Rathi Bar	Rathi Bar	Rathi Bar	Rathi Bar
41	Rathi Steel	Rathi Steel	Rathi Steel	Rathi Steel
42	IGP	IGP	IGP	IGP
43	Hero Moto-1	Hero Moto-1	Hero Moto-1	Hero Moto-1
44	Havell	Havell	Havell	Havell
45	RICO	RICO	RICO	RICO
46	Rathi Saria	Rathi Saria	Rathi Saria	Rathi Saria
47		Sant AL	Sant AL	Sant AL
48		Jhalani	Jhalani	Jhalani
49		NHK Spring	NHK Spring	NHK Spring
50		Rockman	Rockman	Rockman
51		Ahresty	Ahresty	Ahresty
52		Wanfeng	Wanfeng	Wanfeng
53		Minda	Minda	Minda
54		Agrawal Metal	Agrawal Metal	Agrawal Metal
55		AURONEXT	AURONEXT	AURONEXT

56			JJF Casting	JJF Casting
57			Mehru	Mehru
58			RSGL	RSGL
59			SPOT Customers	SPOT Customers
	<b>Source</b>	<b>Source</b>	<b>Source</b>	<b>Source</b>
	Chainsa	Chainsa	Chainsa	Chainsa

	2018-19	2019-20	2020-21
	<b>Total length</b>	<b>Total length</b>	<b>Total length</b>
	254 km	256 km	395 km
	<b>Deliveries</b>	<b>Deliveries</b>	<b>Deliveries</b>
1	HERO MOTO	HERO MOTO	HERO MOTO
2	KAJARIA	KAJARIA	KAJARIA
3	MSIL	MSIL	MSIL
4	CAPARO MARUTI	SUZUKI MOTORCYCLE	CAPARO MARUTI
5	MANESAR-OTHERS	MANESAR-OTHERS	SUZUKI MOTORCYCLE
6			MANESAR-OTHERS
7	CAPARO POWER	CAPARO POWER	OMAX/RICO
8	HONDA CAR	HONDA CAR	
9	rockman	rockman	CAPARO POWER
10	HNG-2	HNG-2	CMR NIKKEI
11	SANDEN	SANDEN	HONDA CAR/FCC clutch/BORAL
12	Richfield	Richfield	rockman/wanfeng/asian color/minda
13	Nippon steel	Nippon steel	HNG-2
14	Toyoda	Toyoda	SANDEN
15	Mikuni	Mikuni	RICHF/IGP/HERO MOTO/HAVELL-2
16	HSIL-2	HSIL-2	PARLE G/PARLE NEW
17	SAINT GOBAIN	SAINT GOBAIN	Nippon steel
18	Special Ceramics	Special Ceramics	Toyoda
19	Shiva Stainless Steel	Shiva Stainless Steel	Mikuni
20	Sharp Menthol	Mica II	Deliv0005

21	Mica II	Shan Tableware	HSIL-2
22	Shan Tableware	Pelican Ceramics	SAINT GOBAIN
23	Pelican Ceramics	Uttam Strip	Special Ceramics
24	Feather touch	AMTEK II	Shiva Stainless Steel
25	Uttam Strip	MICA-1	Sharp Menthol
26	AMTEK II	KEI	Mica II
27	MICA-1	Surya	Shan Tableware
28	KEI	JJF Casting	Pelican Ceramics
29	Surya	Indo Alusys	Feather touch
30	JJF Casting	Continental Engine	Uttam Strip
31	Indo Alusys	Sant Al	Amtek I
32	Continental Engine	AURONEXT	AMTEK II
33	Arvind Press Caps	Agrawal Metal	MICA-1
34	Sant Al	Orient Ceramics	KEI
35	AURONEXT	Matod	Surya Irrigation
36	Agrawal Metal	RELAXO	JJF Casting
37	Orient Ceramics	Mehru	Indo Alusys
38	Matod	Jaguar	Continental Engine
39	Murti Udyog	RSGL Neemrana	Arvind Press Caps
40	AJANTA chem	Siddhi	Sant Al
41	APM	Dakshin	AURONEXT
42	RELAXO	Sunbeam	Agrawal Metal
43	Mehru	Century	Orient Ceramics
44	Jaguar	Sant AL 2	Matod
45	RSGL Neemrana	Hema	Murti Udyog
46	Siddhi	HMSIL	AJANTA chem
47	AV Infra	Jhalani	APM
48	Dakshin	HCGKPL	RELAXO
49	Sunbeam	Adani IGL	Mehru
50	Century	FCC Clutch	Jaguar
51	Ajanta Soya	USG Boral	RSGL Neemrana
52	Sant AL 2	Parle Biscuit	Siddhi
53	Hema	Rathi Bar	AV Infra
54	HMSIL	Rathi Steel	RathiBar/Specia/Dakshin
55	Jhalani	Wanfeng	Century+Sunbeam
56	Ahresty	Minda K	Century
57	Adani IGL	asian color	Ajanta Soya
58	FCC Clutch	IGP	Sant AL 2
59	USG Boral	Hero Moto-1	Hema
60	Parle Biscuit	Havell	HMSIL
61	Rathi Bar	RICO	Jhalani

62	Rathi Steel	NHK Spring	Ahresty
63	Wanfeng		IGL Sakatpur
64	Minda K		IGL Rewari
65	asian color		IGL Ajmer
66	IGP		IGL Bhiwadi
67	Hero Moto-1		HCGKPL
68	Havell		Adani IGL
69	RICO		Adani Mahendragarh
70	NHK Spring		
71	Mehsana		
	<b>Source</b>	<b>Source</b>	<b>Source</b>
	Chainsa	Chainsa	Chainsa

	2021-22	2022-23
	<b>Total length</b>	<b>Total length</b>
	395 km	258.6 KM
	<b>Deliveries</b>	<b>Deliveries</b>
60	HERO MOTO	HERO MOTO
61	KAJARIA	KAJARIA
62	MSIL	MSIL
63	CAPARO MARUTI	SUZUKI MOTORCYCLE
64	SUZUKI MOTORCYCLE	MANESAR-OTHERS
65	MANESAR-OTHERS	
66	OMAX/RICO	CAPARO POWER
67		HONDA CAR
68	CAPARO POWER	rockman
69	CMR NIKKEI	HNG-2
70	HONDA CAR/FCC clutch/BORAL	SANDEN
71	rockman/wanfeng/asian color/minda	Richfield
72	HNG-2	Nippon steel
73	SANDEN	Toyoda
74	RICHF/IGP/HERO MOTO/HAVELL-2	Mikuni
75	PARLE G/PARLE NEW	HSIL-2
60	Nippon steel	SAINT GOBAIN

61	Toyoda	Special Ceramics
62	Mikuni	Shiva Stainless Steel
63	Deliv0005	Mica II
64	HSIL-2	Shan Tableware
65	SAINT GOBAIN	Pelican Ceramics
66	Special Ceramics	Uttam Strip
67	Shiva Stainless Steel	AMTEK II
68	Sharp Menthol	MICA-1
69	Mica II	KEI
70	Shan Tableware	Surya
71	Pelican Ceramics	JJF Casting
72	Feather touch	Indo Alusys
73	Uttam Strip	Continental Engine
74	Amtek I	Sant Al
75	AMTEK II	AURONEXT
60	MICA-1	Agrawal Metal
61	KEI	Orient Ceramics
62	Surya Irrigation	Matod
63	JJF Casting	RELAXO
64	Indo Alusys	Mehru
65	Continental Engine	Jaguar
66	Arvind Press Caps	RSGL Neemrana
67	Sant Al	Siddhi
68	AURONEXT	Dakshin
69	Agrawal Metal	Sunbeam
70	Orient Ceramics	Century
71	Matod	Sant AL 2
72	Murti Udyog	Hema
73	AJANTA chem	HMSIL
74	APM	Jhalani
75	RELAXO	HCGKPL
60	Mehru	Adani IGL
61	Jaguar	FCC Clutch
62	RSGL Neemrana	USG Boral
63	Siddhi	Parle Biscuit
64	AV Infra	Rathi Bar
65	RathiBar/Specia/Dakshin	Rathi Steel
66	Century+Sunbeam	Wanfeng
67	Century	Minda K
68	Ajanta Soya	asian color
69	Sant AL 2	IGP

70	Hema	Hero Moto-1
71	HMSIL	Havell
72	Jhalani	RICO
73	Ahresty	NHK Spring
74	IGL Sakatpur	Ahresty
75	IGL Rewari	CAPARO MARUTI
60	IGL Ajmer	CMR NIKKEI
61	IGL Bhiwadi	IGL Sakatpur
62	HCGKPL	IGL Rewari
63	Adani IGL	Arvind Press Caps
64	Adani Mahendragarh	AV Infra
65		Feather touch
66		Murti Udyog
67		AJANTA chem
68		APM
69		Ajanta Soya
70		Sharp Menthol
71		HCGDL
72		Adani Nuh Palwal
73		Mehsana
74		IGX
75		Knauf
76		Eugia
77		RHI Mag
78		Honda Motorcycle
79		Jindal AI
80		Torrent Neemrana
	<b>Source</b>	<b>Source</b>
	Chainsa	Chainsa

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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 PNRB 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

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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 of existing Chhainsa-Jhajjar-Hissar Natural Gas Pipeline (CJHPL) of GAIL (India) Limited [hereinafter referred as an “Entity”] for the given period of operation i.e. Year 2010-11 to 2022-23.

For the above purpose, PNGRB appointed EIL to carry out the capacity assessment of CJHPL 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:

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.



## 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. MAOP – 98 Barg [As per design documents], Refer Annexure IX
6. Friction factor equation: Panhandle – A Modified for < 24”, Panhandle – B Modified for > 24”
7. Standard Temperature & Pressure: 1.01325 Barg & 15 Deg C
8. Allowable Max velocity in the pipeline: 20 m/s
9. Average Sub- Soil temperature: 25 - 30 Deg C
10. 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.

### 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 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) (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 CJHPL 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)	
2010-11	5.72	8.25	
2011-12	5.81	8.29	
2012-13	6.02	8.62	
2013-14	9.83	14.58	Addition of Chainsa Compressor at source & additional six consumers [Note-3]
2014-15	9.84	14.68	Change in network by addition of five consumers & two kms length
2015-16	9.71	14.7	Addition of two consumers in the network
2016-17	9.19	14.75	Addition of eleven consumers in the network
2017-18	9.19	14.75	
2018-19	9.93	14.78	
2019-20	10.22	12.63	Change in network by deletion of nine consumers & two kms length
2020-21	12.0	12.73	Sultanpur-Jhajjar-Hissar (135 km) was not considered as part of overall network [as not commissioned] [Note-4,5]
2021-22	12.0	12.73	
2022-23	9.87	13.2	

Note –

1. Entity has considered operating conditions for maximum capacity estimation of CJHPL network.
2. 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.
3. Chainsa Compressor was incorporated as part of network from year 2013-14 onwards. Impact of insertion of only Chainsa Compressor on network is 4 MMSCMD.
4. Sultanpur-Jhajjar-Hissar section was not commissioned and was not part of CJHPL network. Entity has listed this section as part of CJHPL network for assessment year 2020-21 & 2021-22.
5. Impact of Sultanpur-Jhajjar-Hissar section to be considered as 2 MMSCMD.



## 7.0 SUMMARY

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This report presents the observations arrived at by the Capacity Assessment Group (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 CJHPL pipeline (at an interval of one year) carried out by entity & EIL:

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