Annexure-V

इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

COMPRESSOR
PROCESS DATA SHEET

Document No. 6988-071-02-DS-1501
Rev. No. 2

PROJECT	COMPRESSOR STATION WORKS AT KAILARAS & CHAINSA	CLIENT	GAIL		
UNIT	CHAINSA COMPRESSOR STATION	JOB NO.	6988	UNIT NO.	071
ITEM NO.	071-KA-CF-101A/B/C	SERVICE	NATURAL GAS COMPRESSOR		
TYPE	CENTRIFUGAL	LOCATION	CHAINSA (UNDER ROOF)		
NUMBER OF COMPRESSORS REQUIRED		IN REGULAR USE	NOTE-1	AS SPARE	NOTE-1
LUBRICATING OR NON-LUBRICATING TYPE					
TYPE OF DRIVER	REGULAR COMPRESSOR	GAS TURBINE DRIVEN			
	SPARE COMPRESSOR	GAS TURBINE DRIVEN			
NUMBER OF STAGES		ONE			

PROPERTIES OF GAS (COMPOSITION AT SUCTION)

COMPOSITION MOLE %		RICH GAS	LEAN GAS(NOTE-28)
WATER VAPOUR		-	-
HYDROGEN		-	-
NITROGEN		0.09	0.09
OXYGEN		-	-
CARBON MONOXIDE		-	-
CARBON DIOXIDE		-	-
HYDROGEN SULPHIDE		6 PPMW	6 PPMW
METHANE		92.49	94.07
ETHYLENE		-	-
ETHANE		5.64	4.59
PROPYLENE		-	-
PROPANE		1.41	1.07
I-BUTANE		0.20	0.18
N-BUTANE		0.15	-
I-PENTANE		-	-
N-PENTANE		0.01	-
HAXANE PLUS	(AVERAGE M. WT.)	-	-
AMMONIA		-	-
HYDROGEN CHLORIDE		-	-
CHLORINE		-	-
INERTS	(AVERAGE M. WT.)		
AIR	(DRY BASIS)		
H2O		NIL	NIL
TOTAL SULFUR		24 PPMW	24 PPMW

FLOW RATE	(NORMAL)	NM3/HR	2109030 (NOTE-2)	2109030 (NOTE-2)
		KG/HR		
AVERAGE M. WT.			17.4	17.07
DENSITY		KG/M3	57.5 (2)	56.3 (2)
COMPRESSIBILITY FACTOR			0.872	0.877
RATIO OF SPECIFIC HEATS	(Cp/Cv)		1.28 (NOTE -18)	1.28 (NOTE -18)
CORROSIVE / EROSIVE ELEMENTS			NONE	NONE
PARTICLE SIZE OF EROSIVES (IF ANY)				
IS DESIGN FOR NACE CODE IS REQUIRED			NO	NO
RATING				
SUCTION			600#(NOTE-26)	600#(NOTE-26)
DISCHARGE			900# (2)	900# (2)
OPERATING CONDITIONS				
SUCTION PRESSURE		KG/CM2 G	74.1 (NOTE-3)	74.5 (NOTE-3)
SUCTION TEMPERATURE		DEG C	34.5	34.4
DISCHARGE PRESSURE		KG/CM2 G	99.93(NOTE-23)	99.93 (NOTE-23)
DISCHARGE TEMPERATURE		DEG C	61.3 (NOTE-7)	61.2 (NOTE-7)
COMPRESSION RATIO			1.344 (2)	1.337 (1)
AFTER COOLER BY VENDOR			YES (NOTE-21)	YES (NOTE-21)
MAX DISCH. TEMP AT AFTERCOOLER EXIT		DEG C	55	
CONDENSATE FROM INTERSTAGES			NIL	
REFERENCE P&ID NUMBER (IF ANY)			NOTE-8	

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2	24.02.2009	REVSED AS MARKED	MKA	AS	AS
1	19.02.2009	REVISED AS PER CLIENT'S/ENGG. INPUTS	MKA	HKP	HKP
0	02.01.2009	ISSUED FOR COMMENTS/ENGINEERING	MKA	AS	AS

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UNIT NO.	071		
ITEM NO.	071-KA-CF-101A/B/C	SERVICE	NATURAL GAS COMPRESSOR

CAPACITY CONTROL					
MODE		AUTOMATIC			
RANGE FOR RECIPROCATING MACHINE (STEPS/STEPLESS)					
TYPE OF CONTROL		NOTE-8			
AUTO START / AUTO STOP REQUIREMENT					
MECHANICAL DATA		UPSTREAM		DOWNSTREAM	
DESIGN PRESSURE	KG/CM2 G	99.93		104.17 (NOTE - 15)	
DESIGN TEMPERATURE	DEG C	65.0		65.0 (NOTE - 16) / (NOTE -7,27)	
UTILITIES AVAILABLE					
COOLING MEDIUM					
TYPE		AIR COOLED			
		IN		OUT	MECH. DESIGN
TEMPERATURE	DEG C	2.0/46.0			
PRESSURE	KG/CM2 G				
STEAM					
		MINIMUM	NORMAL	MAXIMUM	MECH. DESIGN
TEMPERATURE	DEG C				
PRESSURE	KG/CM2 G				
EXHAUST PRESSURE	KG/CM2 G				
DEGREE OF SUPER HEAT	DEG C				
INSTRUMENT AIR					
PRESSURE	KG/CM2 G	5.0	7.5		10.5
FUEL GAS		NOTE-17			
TEMPERATURE	DEG C				
PRESSURE	KG/CM2 G				
EXHAUST PRESSURE	KG/CM2 G				
DEW POINT HC	DEG C				
WATER	DEG C				
NET HEATING VALUE	KCAL/KG				
NITROGEN					
PRESSURE	KG/CM2 G		4.5 (NOTE-25)		10.5
REFERENCE P&ID NUMBER (IF ANY)		NOTE-8			

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PROJECT	COMPRESSOR STATION WORKS AT KAILARAS & CHAINSA		CLIENT	GAIL	
UNIT	CHAINSA COMPRESSOR STATION		JOB NO.	6988	UNIT NO. 071
ITEM NO.	071-KA-CF-101A/B/C	SERVICE	NATURAL GAS COMPRESSOR		

NOTES:

1 NO. OF COMPRESSORS

IN REGULAR USE	SPARE
2	1

ABOVE CONFIGURATION IS TENTATIVE ONLY, COMPRESSOR VENDOR TO CONFIRM THE FINAL CONFIGURATION.
SPARING PHILOSOPHY SHALL BE ADOPTED KEEPING MINIMUM ONE THIRD OF THE GROSS CAPACITY AS SPARE MACHINE HAVING CAPACITY IDENTICAL TO REGULAR UNIT, SUBJECT TO MINIMUM OF ONE SPARE UNIT.

2 TOTAL FLOW RATE TO COMPRESSORS. INDIVIDUAL COMPRESSOR CAPACITY SHALL DEPEND ON CONFIGURATION.

3 SUCTION PRESSURE INDICATED IS AT THE SUCTION FLANGE OF THE COMPRESSOR.TEMPORARY STRIANER SHALL BE IN SUCTION LINE DURING START UP AND THE SAME SHALL BE REPLACED BY PERMANENT STRAINER SUBSEQUENTLY.
STRAINER PRESSURE DROP OF 0.1 KG/CM2 HAS BEEN CONSIDERED TO ARRIVE AT THE COMPRESSOR SUCTION PRESSURE.

4 VENDOR TO PROVIDE THE MESH SIZE AND THE PRESSURE DROP ACROSS THE PERMANENT STRAINER.

5 VENDOR SHALL SUPPLY PERFORMANCE CURVES FOR ALL CASES OF OPERATION.

6 VENDOR TO ALSO INCLUDE IN THE SCOPE OF SUPPLY ALL NORMAL INSTRUMENTATION AND CONTROL FOR EFFICIENT OPERATION, SHUTDOWN AND SAFETY REQUIREMENTS AND ESSENTIAL ACCESSORIES.

7 VENDOR TO CONFIRM THE COMPRESSOR DISCHARGE TEMPERATURE.

8 APART FROM THE VENDOR'S SCOPE OF SUPPLY AS PER P&ID NO. 6988-02-41-071-1220 & 1221,VENDOR SHALL SUPPLY ADDITIONAL INSTRUMENTATION, CONTROL & SHUTDOWN LOGIC DEVICES FOR SAFE AND EFFICIENT OPERATION OF MACHINE.

9 AUTOMATIC SPILL BACKS IS CONSIDERED FOR EACH COMPRESSOR.

10 COMPRESSOR WILL START FROM CONTROL PANEL LOCATED IN MAIN CONTROL ROOM, HOWEVER, START CLEARANCE FROM FIELD WILL BE PROVIDED.MONITORING & CONTROL OF THE COMPRESSOR STATION SHALL BE PERFORMED AT TWO LEVELS, VIZ. MASTER CONTROL CENTRE (SCADA) AND UNIT CONTROL PANEL (UCP)/ COMMON FACILITY PANEL (FCP).

11 VENDOR TO INDICATE UTILITY REQUIREMENT.

12 NORMAL SEAL GAS SUPPLY SHALL BE FROM COMPRESSOR DISCHARGE,HOWEVER, PROVISION FOR START-UP/EMERGENCY SEAL GAS FROM LINE PACK OF EXISTING HBJ PIPELINE SHALL BE MADE. PROVISION FOR CHANGE OVER FROM NORMAL TO EMERGENCY SEAL GAS SUPPLY & VIS-À-VIS IS UNDER GTC VENDOR'S SCOPE. VENDOR TO PROVIDE FLOW INDICATION AND ALARM IN SEAL GAS SUPPLY LINE.

13 VENDOR TO PROVIDE NECESSARY FILTER, ELECTRIC HEATER, PRESSURE REGULATOR, CONTROL VALVES ETC. FOR SEAL GAS SYSTEM.

14 ACCERSSORIES LIKE AFTERCOOLERS, INSTRUMENTATION AND CONTROL PANEL ARE IN VENDORS SCOPE OF SUPPLY.

15 PSV ON COMPRESSOR DISCHARGE SHALL BE SET AT 104.17 KG/CM2G.

16 DESIGN TEMPERATURE SPECIFIED IS FOR DOWNSTREAM OF AFTER COOLER.

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UNIT NO.	071		
ITEM NO.	071-KA-CF-101A/B/C	SERVICE	NATURAL GAS COMPRESSOR

NOTES:

17 FUEL GAS SHALL BE TAKEN FROM COMPRESSOR INLET COMMON HEADER .

GAS COMPOSTION :-	COMPONENT	MOLE% (RICH GAS)	MOLE% (LEAN GAS, NOTE-28)
	METHANE	92.49	94.07
	ETHANE	5.64	4.59
	PROPANE	1.41	1.07
	I-BUTANE	0.2	0.18
	N-BUTANE	0.15	0.00
	N-PENTANE	0.01	0.00
	NITROGEN	0.09	0.09
	H2S	6 PPMW	6 PPMW
	TOTAL SULFUR	24 PPMW	24 PPMW
	TOTAL	**100.0**	**100.00**
	SUPPLY PRESSURE KG/CM2(G)	73.6	74.0
	SUPPLY TEMP. DEG. C	34.5	34.4
	LHV (KCAL/KG)=	11840	11860
	HC DEW POINT(DEG C)= AT SUCTION PRESSURE	< -46.0	< -46.0

1

18 C_p/C_V VALUE IS ESTIMATED FOR CALCUALTION PURPOSE.

19 NOTE - DELETED.

20 COMPRESSOR VENDOR TO FURNISH SETTLE OUT PR5ESSURE CALCULATION AND BLOW DOWN CALCULATIONS FOR REVIEW BY EIL.

21 FOR AFTER COOLER DATA SHEET, REFER DOC. NO. 6988-071-02-DS-1401

22 VENDOR TO PROVIDE MAX. RATE OF DEPRESSURISATION DURING COMPRESSOR TRIP/ESD.

23 DISCHARGE PRESSURE INDICATED IS AT THE COMPRESSOR DISCHARGE FLANGE.

24 NECESSARY PROVISION SHALL BE KEPT FOR WASTE HEAT RECOVERY FROM GT EXHAUST IN FUTURE.

25 VENDOR TO INDICATE NITROGEN REQUIREMENT FOR EACH COMPRESSOR.

26 INDICATED IS MINIMUM RATING. VENDOR TO CHECK AND CONFIRM THE SAME.

27 VENDOR TO COMPUTE DESIGN TEMPERATURE AT COMPRESSOR DISCHARGE FLANGE BASED ON THE GOVERNING CASE OF HIGHEST DISCHARGE TEMPERATURE.

28 COMPOSITION CONSIDERED AFTER C2 / C3 RECOVERY FROM EXISTING RLNG SUPPLY OF 12 MMSCMD FROM PLL.

29 START UP/ EMERGENCY SEAL GAS SUPPLY FROM EXISTING LINE PACK OF GREP PIPELINE IS CHARACTERIZED AS BELOW.

COMPONENTS	H20	N2	CO2	H2S	C1	C2	C3	I-C4	N-C4	I-C5	N-C5	C6	C7	MOL. WT.
RLNG+HP LEAN GAS EX LPG MOL %	NIL	0.13	1.4	NIL	91.80	2.34	4.07	0.14	0.1	0	0	0.00	0	18

PRESSURE HOLD KG/CM2 G. DEW POINT HOLD

TEMPERATURE HOLD KG/CM2 G.

30 DEW POINT OF NORMAL SEAL GAS SUPPLY SHALL BE AS INDICATED IN NOTE-17

31 NOTE -DELETED

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ENGINEERS INDIA LIMITED
NEW DELHI

6988 ITEM NO.

R-R proposal no. OG1331

REV

CENTRIFUGAL COMPRESSOR DATA SHEET (API 617-6TH) SI UNITS

REVISION NO. 0 DATE 6-Apr-08

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APPLICABLE TO: ● PROPOSAL ○ PURCHASE ○ AS BUILT

FOR EIL - GAIL PIPELINE EXPANSION PROJECT UNIT

SITE Chainsa Station SERIAL NO.

SERVICE Gas Transmission NO. REQUIRED 2

● CONTINUOUS ○ INTERMITTENT ○ STAND BY DRIVER TYPE (3.1.1) Gas Turbine

MANUFACTURER Rolls-Royce MODEL RFBB36 DRIVER ITEM NO.

NOTE: INFORMATION TO BE COMPLETED: ○ BY PURCHASER ☐ BY MANUFACTURER

OPERATING CONDITIONS

(ALL DATA ON PER UNIT BASIS)

	OTHER CONDITIONS (3.1.2)				
	Rich	Lean	C	D	E
○ GAS HANDLED (ALSO SEE PAGE 2)	Rich Gas	Lean Gas			
● nm³/h (1.013 BAR & 0 °C)	2109030	2109030			
● WEIGHT FLOW, kg/min	27340	26834			
INLET CONDITIONS					
● PRESSURE (kg/cm2g)	74.1	74.5			
● TEMPERATURE (°C)	34.5	34.4			
○ RELATIVE HUMIDITY %					
● MOLECULAR WEIGHT (Mw)	17.393	17.073			
● Cp/Cv (K_{AVG})	1.4496	1.4565			
■ COMPRESSIBILITY	0.8747	0.8803			
■ INLET VOLUME, (m³/s)	7.9589	7.9631			
DISCHARGE CONDITIONS					
■ PRESSURE (kg/cm2g)	99.93	99.93			
■ TEMPERATURE (°C)	59.03	58.68			
■ Cp/Cv (K_{AVG})	1.4496	1.4565			
■ COMPRESSIBILITY	0.888	0.8935			
■ FRICTION POWER (KW)	41.5	41.7			
■ kW REQUIRED (ALL LOSSES INCLUDED)	20943	20680			
■ SPEED (RPM)	4837	4850			
■ ESTIMATED SURGE RANGE, % (AT SPEED ABOVE)	22.5	22.6			
■ POLYTROPIC HEAD (kJ/kg)	39.802	40.044			
■ POLYTROPIC EFFICIENCY (%)	88.77	88.78			
● CERTIFIED POINT	NO	YES			
☐ PERFORMANCE CURVE NUMBER					

PROCESS CONTROL

METHOD ○ SUCTION THROTTLING ○ VARIABLE INLET GUIDE VANES (3.4.2.4) ● SPEED VARIATION ○ DISCHARGE BLOWOFF ● COOLED BYPASS

FROM ____ (BAR)(kPa abs) FROM 70 % FROM Discharge

TO ____ (BAR)(kPa abs) TO 105 % TO ____ TO Suction

SIGNAL ● SOURCE (3.4.2.1) Suction / Discharge Pressure, Flow

TYPE ● ELECTRONIC ○ PNEUMATIC ○ OTHER ____

RANGE 4 - 20 MA ____ (BAR)(kPa abs) ____

ANTI-SURGE BYPASS ○ MANUAL ● AUTOMATIC ○ NONE

REMARKS:

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
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OPERATING CONDITIONS (Continued) (3.1.2) (3.1.3)

GAS ANALYSIS: ○ MOL % ○	MW	NORMAL	OTHER CONDITIONS A	B	C	D	E	REMARKS: (2.11.1.3) (2.11.1.8)
	MW			Rich	Lean			
AIR	28.966							
OXYGEN	32.000							
NITROGEN	28.016			0.09	0.09			
WATER VAPOR	18.016			NIL	NIL			
CARBON MONOXIDE	28.010							
CARBON DIOXIDE	44.010							
HYDROGEN SULFIDE	34.076			6 PPMW	6 PPMW			(2.11.1.7)
HYDROGEN	2.016							
METHANE	16.042			92.49	94.07			
ETHYLENE	28.052							
ETHANE	30.068			5.64	4.59			
PROPYLENE	42.078							
PROPANE	44.094			1.41	1.07			
I-BUTANE	58.120			0.20	0.18			
n-BUTANE	58.120			0.15				
I-PENTANE	72.146							
n-PENTANE	72.146			0.01				
HEXANE PLUS								
TOTAL SULPHUR				24 PPMW	24 PPMW			
TOTAL				99.99	100.00			
AVG. MOL. WT.				17.4	17.07			

LOCATION: (2.1.9)
○ INDOOR ● OUTDOOR ○ GRADE
○ HEATED ● UNDER ROOF ○ MEZZANINE
● UNHEATED ○ PARTIAL SIDES ○
● ELEC. AREA CLASSIFICATION (2.1.15)
○ WINTERIZATION REQ'D. (2.1.9) ● TROPICALIZATION REQ'D. (3.4.6.6)

SITE DATA:
● ELEVATION 197.8 m BAROMETER BAR
○ RANGE OF A 0.3

		DRY BULB	WET BULB
NORMAL	°C	45 / 85%RH	
MAXIMUM	°C	45 / 84%RH	
MINIMUM	°C	0 / 37%RH	
	°C		

UNUSUAL CONDITIONS: ● DUST ○ FUMES
● OTHER (2.1.9)

REMARKS: Noise level, for the compressor package in isolation, shall not exceed 88 dba at 1 meter.

NOISE SPECIFICATIONS: (2.1.10)
○ APPLICABLE TO MACHINE:
SEE SPECIFICATION
○ APPLICABLE TO NEIGHBORHOOD:
SEE SPECIFICATION
ACOUSTIC HOUSING: ○ YES ● NO
SOUND LEVEL See Note dB (A) @ M

APPLICABLE SPECIFICATIONS:
API 617, CENTRIFUGAL COMPR. FOR GEN. REFINERY SERV.
● VENDOR HAVING UNIT RESPONSIBILITY (2.9.1.7)
Rolls-Royce
○ GOVERING SPECIFICATION (IF DIFFERENT)

PAINTING:
● MANUFACTURER'S STD.
○ OTHER

SHIPMENT: (4.4.1)
○ DOMESTIC ○ EXPORT ● EXPORT BOXING REQ'D.
● OUTDOOR STORAGE MORE THAN 6 MONTHS (4.4.1)
SPARE ROTOR ASSEMBLY PACKAGED FOR (4.4.3.10)
○ HORIZONTAL STORAGE ○ VERTICAL STORAGE

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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 µm, RR to attempt 25 µm with reasonable effort to obtain
ALLOWABLE TEST LEVEL (PEAK TO PEAK)

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 Cl 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 CLEARENCE POINTS MATL
AT SHAFT SEALS MATL

○ ACCESSILBLE (2.8.2)

LABYRINTHS:
INTERSTAGE
TYPE Renewable MATERIAL Alum AA Alloy 771 T-5
BALANCE PISTON
TYPE Honeycomb MATERIAL SST ASTM A240 Type 321

SHAFT SEALS:
● 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, intchgble 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 Cl 40C

CONSTRUCTION FEATURES (CONTINUED)

BEARINGS AND BEARING HOUSINGS

RADIAL	INLET	EXHAUST
TYPE	Tilt-Pad	Tilt-Pad
MANUFACTURER	Waukesha	
LENGTH (mm)	82.6	82.6
SHAFT DIA. (mm)	165.1	165.1
UNIT LOAD (ACT/ALLOW) (Bar)	<5 / 15	<5 / 15
BASE MATERIAL	Steel	Steel
BABBIT THICKNESS (mm)	Tin Based > 1.5	
NO. PADS	4	4
LOAD: B'TWN/ON PAD	Between	Between
PIVOT: CTR/OFFSET, %	Center	Center

THRUST	ACTIVE	INACTIVE
TYPE	Self Leveling/Tilting Pad	
MANUFACTURER	Waukesha	
UNIT LOADING (MAX BAR)	After Design	After Design
UNIT LOAD (ULT.) (BAR)	44.83	44.83
AREA (mm²)	33226	33226
NO. PADS	9	9
PIVOT: CENTER / OFFSET, %	Offset 70 %	Offset 70%
PAD BASE MATL	Stl / Tin based Babbit	

LUBRICATION: ● FLOODED ○ DIRECTED
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: ○ SEE ATTACHED API-670 DATA SHEET

- ● 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 υμ ○ TIME DELAY 1 SEC

AXIAL POSITION DETECTOR: ○ SEE ATTACH. API-670 DATA SHEET

- ● 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) Rolls-Royce
  - ● LOCATION UCP ENCLOSURE
  - ● MFR. Bently-Nevada ■ MODEL 3500
  - ☐ SCALE RGE ____ ○ ALARM ■ SET @ + / - .5 μμ
- ● SHTDWN: ■ SET @ +/- .65 μμ ● 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 STUDDED (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.

ENGINEERS INDIA LIMITED
NEW DELHI

CENTRIFUGAL COMPRESSOR
DATA SHEET (API 617-6TH)
SI UNITS

REV

JOB NO. 6988 ITEM NO.
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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

○ INDIVIDUAL STAGE DRAINS REQUIRED (2.4.3.2)
○ VALVED & BLINDED
○ VALVED & BLINDED & MANIFOLD 2 Casing drains

KEY PHASOR REQUIRED
● COMPRESSOR ○ GEAR ○ DRIVER

ALLOWABLE PIPING FORCES AND MOMENTS:

	INLET		DISCHARGE			
	FORCE N	MOMT N-m	FORCE N	MOMT N-m	FORCE N	MOMT N-m
AXIAL	Per Rolls-Royce Standard GER 0123 para 3.2, ref Fig 4 & Table 7b					
VERTICAL						
HORIZ. 90						
	FORCE N	MOMT N-m	FORCE N	MOMT N-m	FORCE N	MOMT 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

COUPLING AND GUARDS (3.2)

NOTE: SEE ROTATING ELEMENTS - SHAFT ENDS
○ SEE ATTACHED API-671 DATA SHEET ● KEYLESS HYDRAULIC ○ KEYED
COUPLING FURNISHED BY Rolls-Royce
MANUFACTURER Bibby or equal TYPE Dry MODEL service factor ≥ 1.75
COUPLING GUARD FURNISHED BY: Rolls-Royce
TYPE: ● FULLY ENCLOSED ○ SEMI-OPEN ○ OTHER non-sparking

COUPLING DETAILS (PREL)

■ MAX O.D. 427 mm
■ HUB WEIGHT 46 kg
■ SPACER LENGTH 1524 (1524 DBSE) mm
■ SPACER WEIGHT 163 kg

● VENDOR MOUNT HALF COUPLING
LUBRICATION REQUIREMENTS:
● NON-LUBE ○ GREASE ○ CONT. OIL LUBE ○ OTHER
QUANTITY PER HUB kgs or L/MIN

MOUNTING PLATES

○ BASEPLATES: FURNISHED BY (3.3.1.1)
○ COMPRESSOR ONLY (3.3.2.1) ○ DRIVER ○ GEAR
○ OTHER
○ DRIP TRIM ○ LEVELING PADS (3.3.2.2)
○ COLUMN MOUNTING (3.3.2.3)
○ SUB-SOLE PLATES REQ'D (3.3.3.2)
☐ STAINLESS STEEL SHIM THICKNESS mm
PRIMER FOR EPOXY GROUT REQ'D (3.3.1.2.9)
TYPE

○ BASE PLATE WILL BE ON CONCRETE FOUNDATION (3.3.2.5)
○ MACHINED MOUNTING PADS REQ'D. (3.3.2.6)

● 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)
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REV

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)

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 preformance	kW
HP (AUXILIARIES)	See P&ID's	kW
HEATERS	See P&ID's	KW
PURGE (AIR OR N_2)	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

SHOP INSPECTION AND TESTS: (4.1.4)	REQ'D.	WITN
CLEANLINES (4.2.1.5)	●	
HYDROSTATIC	●	
IMPELLER OVERSPEED	●	●
MECHANICAL RUN	●	●
● CONTRACT COUPLING ○ IDLING ADAPTORS		
● CONTRACT PROBES ○ SHOP PROBES		
VARY LUBE & SEAL OIL PRESSURES AND TEMPERATURES (4.3.4.2.5) within allowable limits	●	●
POLAR FORM VIB DATA (4.3.4.3.3) Bode plot in polar form	●	
VIBRATION DATA RECORDED (4.3.4.3.6) Adre digital data	●	
DATA TO PURCHASER (4.3.4.3.7) Adre data via CD	●	
SHAFT END SEAL INSP (4.3.4.4.1)	●	●
GAS LEAK TEST DISCH PRESS (4.3.5.2)	●	●
○ BEFORE ● AFTER POST TEST INSPECTION (4.3.6.8)		
PERFORMANCE TEST(GAS)(PTC10 TYPE II)(4.3.6.1)	●	●
NO LOAD STRING TEST (4.3.6.2) (ONE PER STATION)	●	●
DIS-ASSEMBLE/RE-ASSEMBLE AFTER TEST (REM-7)	●	●
DYNAMIC BALANCING OF ROTOR W/O HALF COUPLING	●	Obs
GEAR TEST (4.3.6.4)	○	
HELIUM LEAK TEST	○	
SOUND LEVEL SURVEY DURING STRING TEST	●	●
SHOP VERIFICATION OF UNBALANCED RESPONSE	●	●
ANALYSIS (@ COUPLING HUB ONLY) (ONE PER STATION)		
COPIES OF CERTIFIED TEST DATA & MATERIALS	●	
RESIDUAL ELECT. & MECH RUN OUT	●	●
CHECK BEARINGS & SEALS AFTER TEST (REM-7)	●	●
	●	●

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

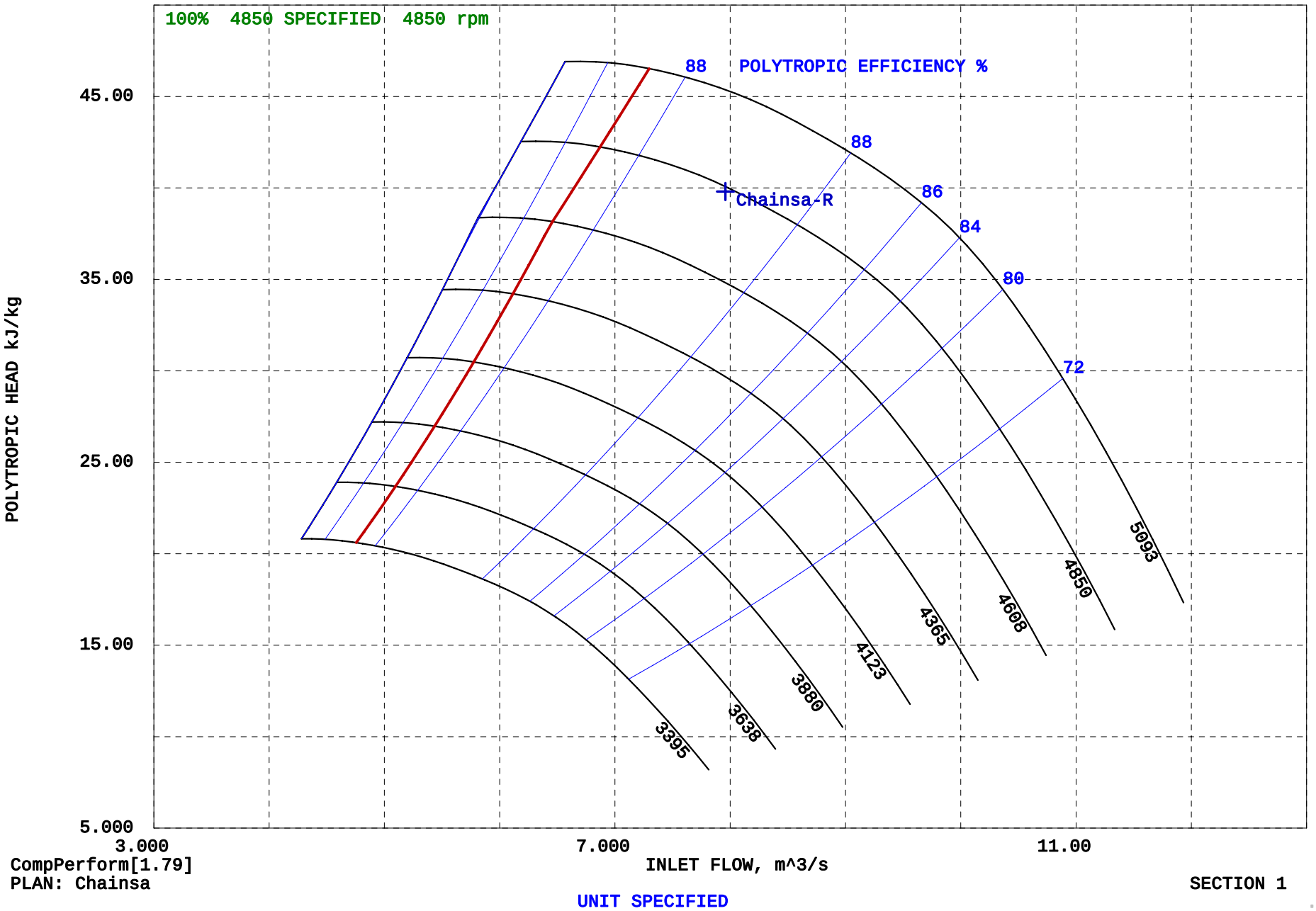
REMARKS:
5) Spare rotor will receive mech run test
6) No load string test shall be carried out for one GTC package per station
7) Post test inspection of the dry gas seal and bearing shall be carried during the spare rotor changeout only. DGS inspection as per Burgmann instructions

Rolls-Royce Energy Systems Inc.

Tue Mar 31 09:57:34 2009

GAIL Pipeline Expansion Project Feb 24'09

RF36-2 MW 17.393 Pd 99.930 kG/cm^2.g Ti 34.50 °C



CompPerform[1.79]

PLAN: Chainsa

SECTION 1

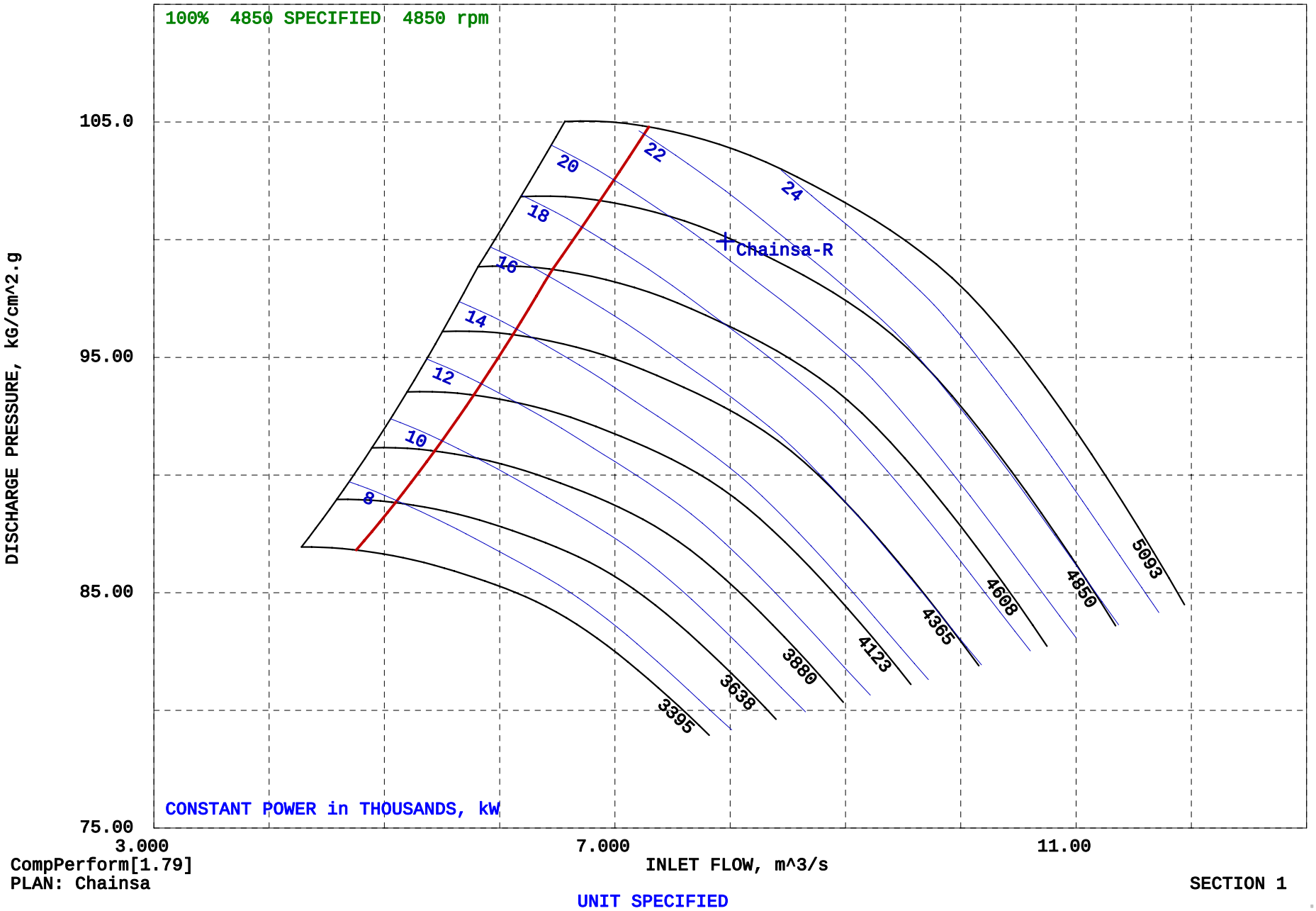
UNIT SPECIFIED

Rolls-Royce Energy Systems Inc.

Tue Mar 31 09:57:34 2009

GAIL Pipeline Expansion Project Feb 24'09

RF36-2 MW 17.393 Pi 74.100 kG/cm^2.g Ti 34.50 °C



CompPerform[1.79]

PLAN: Chainsa

SECTION 1

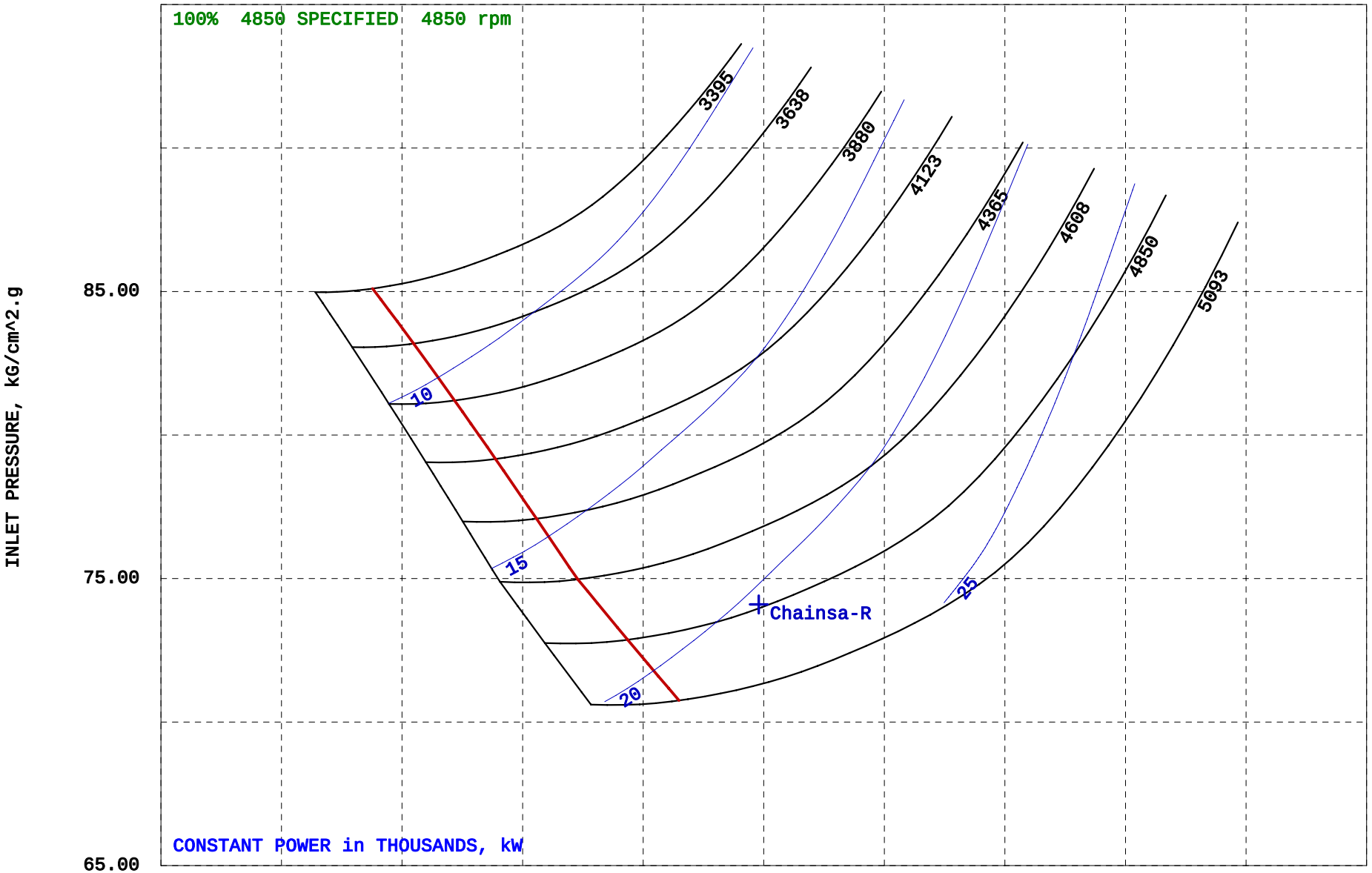
UNIT SPECIFIED

Rolls-Royce Energy Systems Inc.

Tue Mar 31 09:57:34 2009

GAIL Pipeline Expansion Project Feb 24'09

RF36-2 MW 17.393 Pd 99.930 kG/cm^2.g Ti 34.50 °C



CompPerform[1.79]

PLAN: Chainsa

SECTION 1

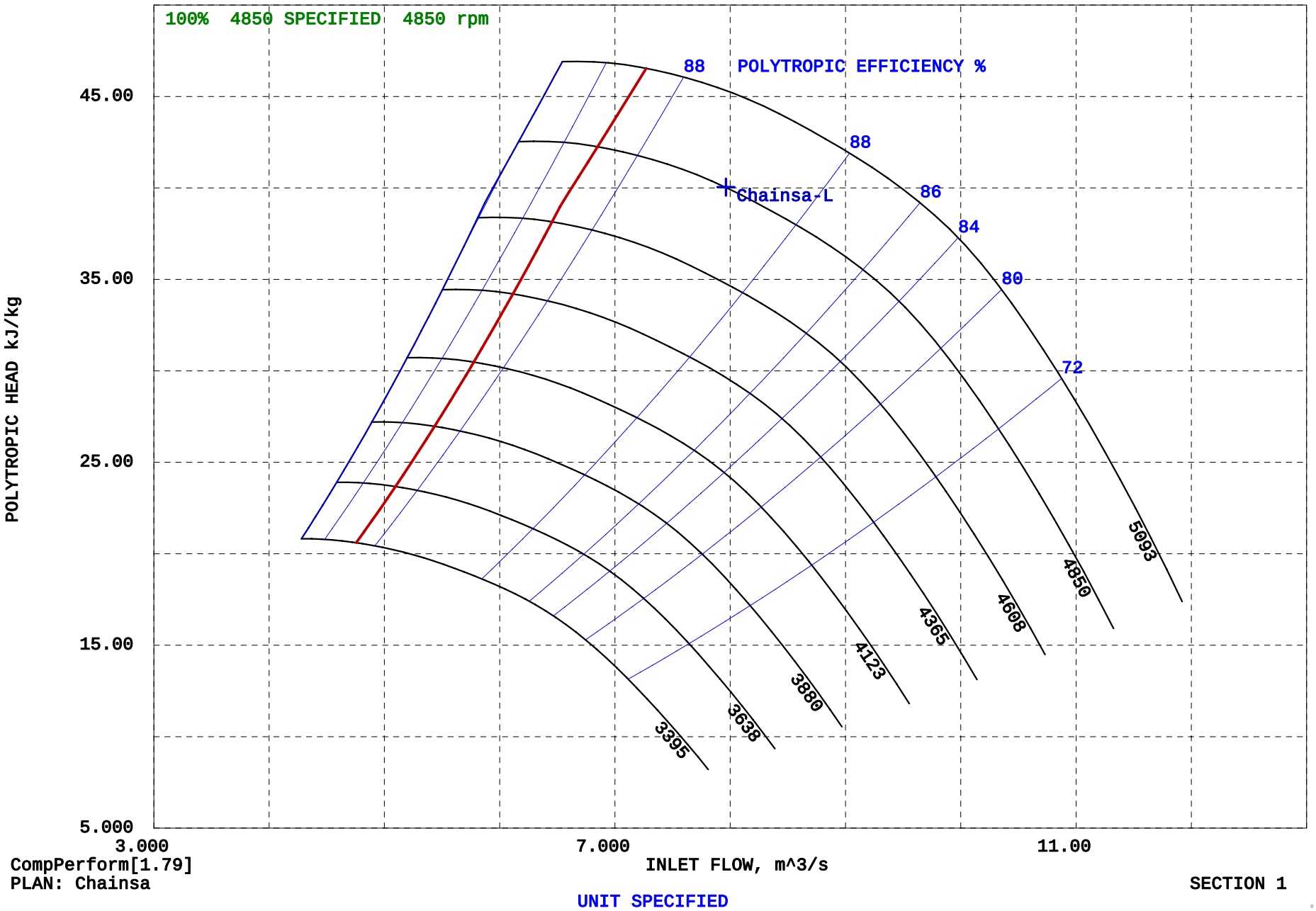
UNIT SPECIFIED

Rolls-Royce Energy Systems Inc.

Tue Mar 31 09:57:34 2009

GAIL Pipeline Expansion Project Feb 24'09

RF36-2 MW 17.074 Pd 99.930 kG/cm^2.g Ti 34.40 °C



CompPerform[1.79]

PLAN: Chainsa

SECTION 1

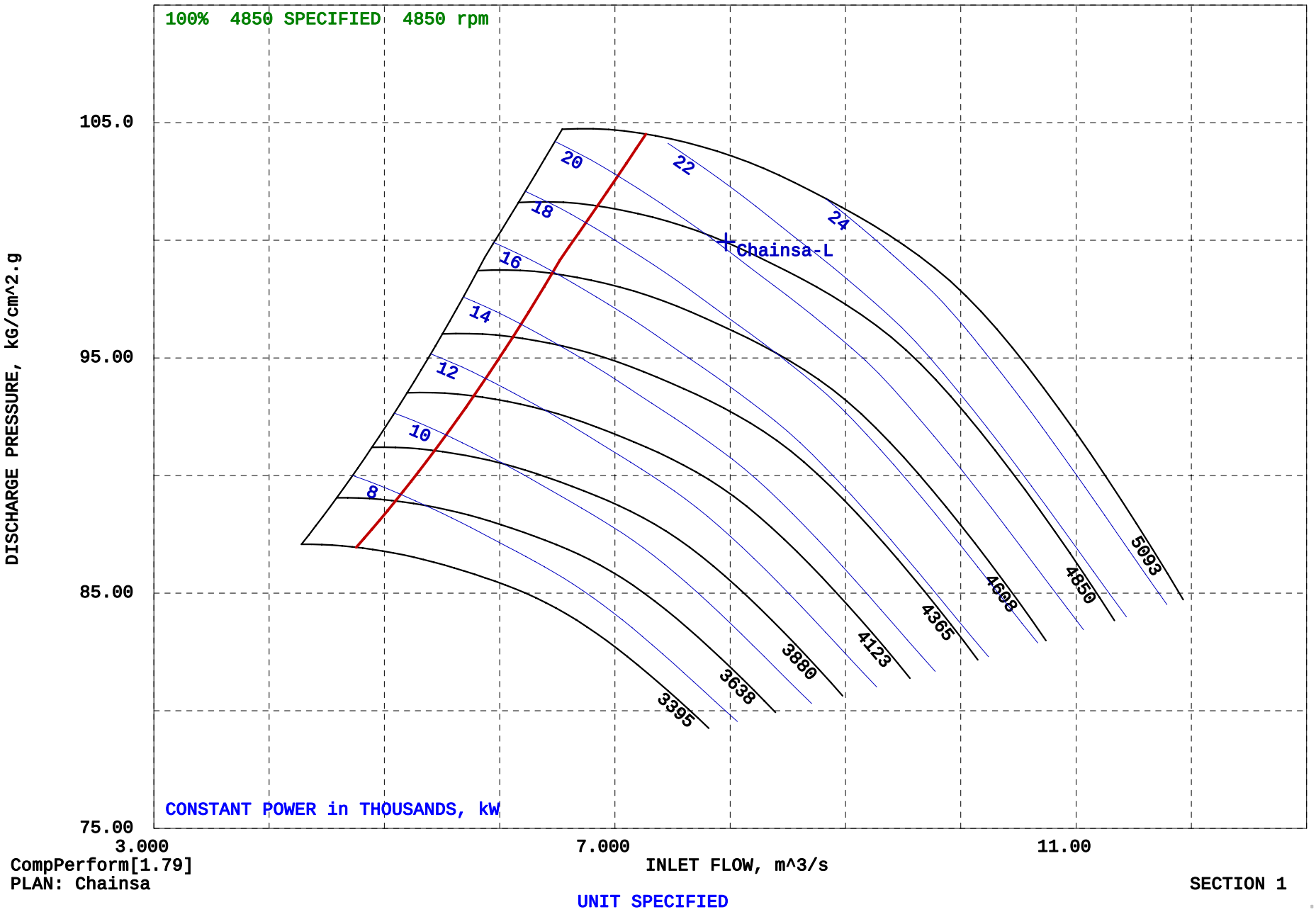
UNIT SPECIFIED

Rolls-Royce Energy Systems Inc.

Tue Mar 31 09:57:34 2009

GAIL Pipeline Expansion Project Feb 24'09

RF36-2 MW 17.074 Pi 74.500 kG/cm^2.g Ti 34.40 °C



CompPerform[1.79]

PLAN: Chainsa

SECTION 1

UNIT SPECIFIED

Rolls-Royce Energy Systems Inc.

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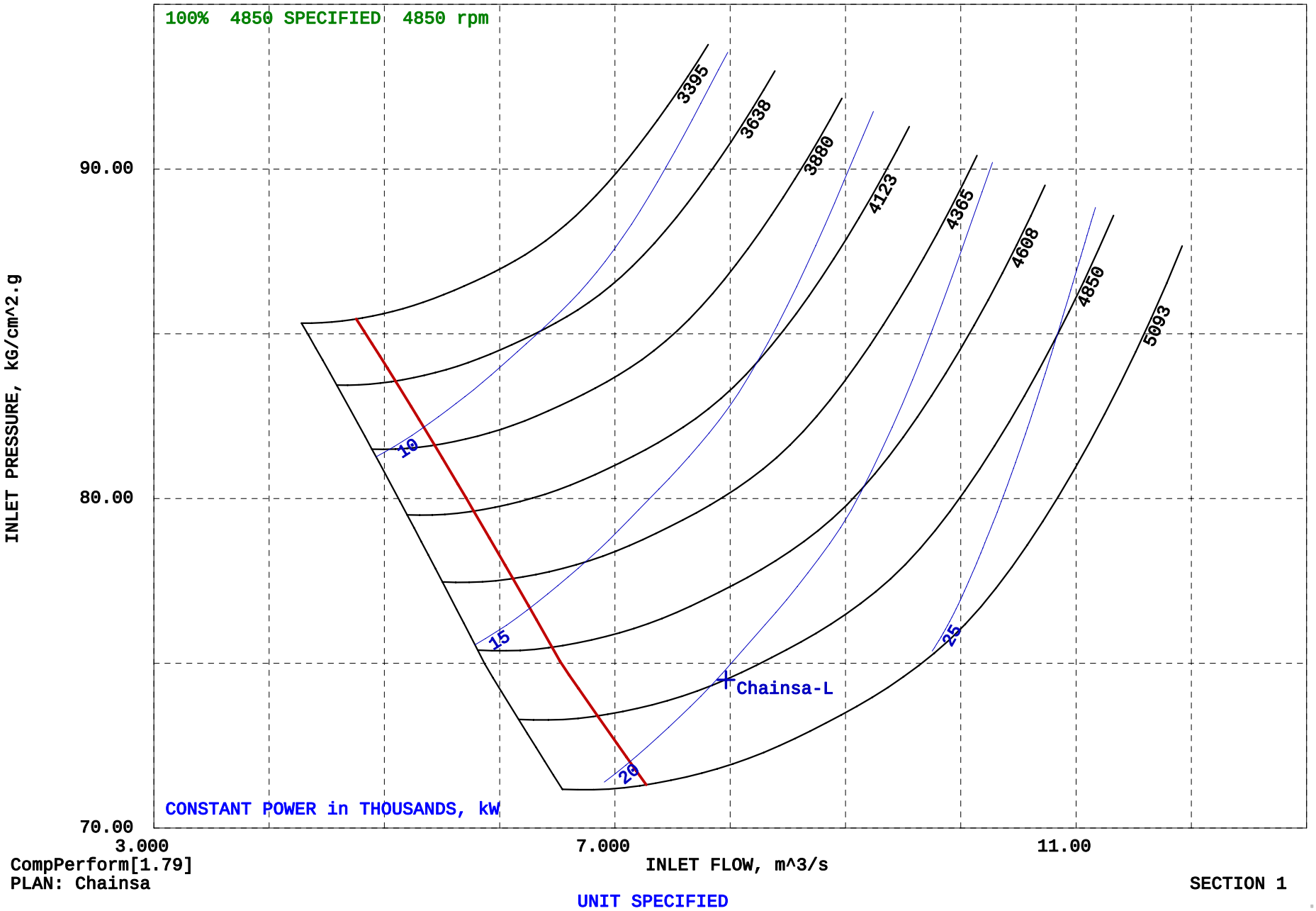
GAIL Pipeline Expansion Project Feb 24'09

RF36-2 MW 17.074 Pd 99.930 kG/cm^2.g Ti 34.40 °C



CompPerform[1.79]

PLAN: Chainsa

SECTION 1

UNIT SPECIFIED

ENGINEERS INDIA LIMITED
NEW DELHI

JOB NO. 6988 ITEM NO.
PURCHASE ORDER NO.
SPECIFICATION NO 6988-000-KA-MR-5010
REVISION NO. 0 DATE 5-Apr-09
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REV

COMBUSTION GAS TURBINE (API 616-4TH) DATA SHEET SI UNITS

APPLICABLE TO: ● PROPOSAL ○ PURCHASE ○ AS BUILT
FOR **GAIL (INDIA) LIMITED** UNIT **PIPELINE EXPANSION PROJECT**
SITE **CHAINSA STATION** SERIAL NO.
SERVICE **GAS COMPRESSOR** NO. REQUIRED **TWO (2)**
● CONTINUOUS ○ INTERMITTENT ○ STANDBY DRIVEN EQUIP. **CENTRIFUGAL COMPRESSOR**
MANUFACTURER **Rolls-Royce** ● MODEL **RB211-GT61 DLE** ISO RATING **32,987** kW @ **4850** RPM
NOTE: INFORMATION TO BE COMPLETED: ○ BY PURCHASER ☐ BY MANUFACTURER ◯ BY MFR IF NOT BY PURCHASER

GENERAL

CYCLE: ○ REGEN ● SIMPLE ○ EXHAUST HEAT RECOVERY TYPE: ◯ SINGLE SHAFT ● MULTI SHAFT
DRIVEN EQUIPMENT: NORMAL SHAFT , kW @ RPM RATED SHAFT (KW) @ RPM
OUTPUT SHAFT SPEED RANGE (4.1.5) ● MIN **3152** ■ MAX **5090** RPM
DESIRED MINIMUM SITE POWER kW @ RPM ● ENCLOSURE REQUIRED
OPERATION ● ATTENDED ○ UNATTENDED ☐ POTENTIAL MAXIMUM POWER (3.33) Kw

PERFORMANCE

GAS TURBINE INCLUDING ALL LOSSES

	SITE RATED (3.45)	NORMAL DUTY (3.26)	SITE MAX TEMP	SITE MIN TEMP
● DRY BULB TEMP, °C	45		45	0
● RELATIVE HUMIDITY %	84		84	37
● ALTITUDE (m)	197.8		197.8	197.8
☐ OUTPUT, (KW) (1)				
☐ HEAT RATE, LHV, MJ/ KW-HR	FOR GAS TURBINE SITE PERFORMANCE PLEASE REFER TO PERFORMANCE DATASHEET UNDER THIS SECTION OF THE PROPOSAL.			
◯ OUTPUT SHAFT SPEED, RPM				
☐ AIR FLOW kg/SEC				
☐ EXHAUST FLOW kg/SEC (1)				
☐ FIRING TEMPERATURE °C				
☐ GAS GEN. EXHAUST TEMP °C				
☐ PT EXHAUST TEMP. °C				
● CERTIFIED POINT (3.26)	YES			

(1) INCLUDING ○ STEAM ○ WATER EFFECTS FOR
◯ EMISSION CONTROL ◯ AUGMENTATION (4.1.9)
☐ STEAM FLOW, kg/HR
☐ WATER FLOW, m³/HR

APPLICABLE SPECIFICATIONS:
● API 616 GAS TURBINES FOR THE PETROLEUM,CHEMICAL, & GAS INDUSTRY SERVICES
○ GOVERNING SPECIFICATION (IF DIFFERENT)
● VENDOR HAVING UNIT RESPONSIBILITY (4.1.2)
Rolls-Royce

SHIPMENT: (6.4)
○ DOMESTIC ● EXPORT ○ EXPORT BOXING REQD.
○ OUTDOOR STORAGE MORE THAN 6 MONTHS (6.4.1)
SPARE ROTOR ASSEMBLY PACKAGED FOR (6.4.3.10)
○ DOMESTIC ○ EXPORT SHIPMENT
COMMENTS:

LOCATION (4.1.19)

○ INDOOR ● OUTDOOR ○ GRADE
○ HEATED ● UNDER ROOF ○ MEZZANINE
● UNHEATED ○ PARTIAL SIDES ● ONSHORE
ELEC. AREA CLASSIFICATION (4.1.14)
○ NON-HAZARDOUS ● HAZARDOUS
APPLICABLE CODE: ○ NEC500 ○ NEC505 ● IEC
GROUP **IIA** CLASS: TEMPERATURE CODE: **T3**
AREA CLASSIFICATION ○ DIVISION ● ZONE **2**
○ THIRD PARTY CERTIFICATION REQUIRED
○ WINTERIZATION REQD ○
● TROPICALIZATION REQD (5.4.6.6)
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) **ONSHORE OIL&GAS**

NOISE SPECIFICATIONS: (4.1.10)
● APPLICABLE TO MACHINE: (5.7.4.1)
SEE SPECIFICATION 88 dBA at 1 meter
○ APPLICABLE TO NEIGHBORHOOD: (5.7.4.2)
SEE SPECIFICATION

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

ENGINEERS INDIA LIMITED
NEW DELHI

COMBUSTION GAS TURBINE (API 616-4TH)
DATA SHEET
SI UNITS

SPEC NO. 6988-000-KA-MR-501(ITEM NO.
REVISION NO. 0 DATE 5-Apr-09
PAGE 2 OF 10 BY Leong, HT

REV

FUEL SYSTEM (5.8)

TYPE ● GAS (5.8.2) ○ LIQUID (5.8.3) ○ DUAL (5.8.1.5.1)
DUAL SYSTEM REQMTS (5.8.1.5.1) ○ GAS/GAS ○ GAS/LIQUID ○ LIQUID/LIQUID
○ COMPLETE FUEL RECEIVING SYSTEM (5.8.1.1) ○ MAX. TIME ALLOWED TO COMPLETE TRANSFER _____ SECONDS

GAS FUELS (5.8.2)

● FUEL ANALYSIS - MOL % (3.7.2.1) (3.7.1.8)

COMPOSITION:	M.W.	NORMAL	STARTING	ALT
AIR	29	THE FUEL GAS COMPOSITION		
OXYGEN	32	IS AS INDICATED IN THE COMPRESSOR		
NITROGEN	38	PROCESS DATA SHEET		
WATER VAPOR	18	INCLUDED IN THIS SECTION.		
HYDROGEN SULPHIDE	34			
CARBON DIOXIDE	44			
HYDROGEN	2			
METHANE	16			
ETHYLENE	26			
ETHANE	30			
PROPYLENE	42			
PROPANE	44			
I-BUTANE	58			
N-BUTANE	58			
I-PENTANE	72			
N-PENTANE	72			
HEXANE	86			
HEPTANE	100			
TOTAL				
AVG. MOL. WT.				
CORS AGENTS (5.8.2.3)	PPM			
CONTMNTS)5.8.2.2.1)	PPM			
LHV MJ/m³/HR (5.8.2.4)				
FUEL PRESS.MAX/MIN,kPag				
FUEL TEMP MAX/MIN °C		/	/	/
☐ FUEL PRESS/TEMP REQD. MIN BarA/DegC				

COMPRESSION SYS REQD (5.8.1.2.2) ○ YES ○ NO
HEATER REQD (5.8.2.1) ☐ YES ☐ NO
○ RATE OF CHANGE OF LHV (5.8.2.4) _____

REMARKS: _____

LIQUID FUELS (5.8.3)

FUEL GRADE (5.8.3.3)

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 EQUP 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) PROPERTY	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	

FUEL SYSTEM PIPING

○ BY PASS AND VENT VALVE (3.7.1.3) ■ ISOLATION BLOCK VALVES ◎ ANSI FLANGE RATING
○ TWIN Y-TYPE STRAINER WITH CONTINUOUS FLOW ■ NACE 2002 MATERIAL STANDARDS (4.10.1.8)
○ TRANSFER VALVE (5.8.1.2.4)

ENGINEERS INDIA LIMITED
NEW DELHI

COMBUSTION GAS TURBINE (API 616-4TH) DATA SHEET SI UNITS

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CONSTRUCTION FEATURES (NOTE 1)

■ SPEEDS: **(POWER TURBINE)**
MAX. CONT. **5090** RPM TRIP **5335** 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 **Per API 616** RPM
SECOND CRITICAL **Per API 616** RPM
THIRD CRITICAL ____ RPM
FOURTH CRITICAL ____ RPM
VIBRATION: (4.7.4.5) (7.2.3 o):
■ ALLOWABLE TEST LEVEL : SHAFT **PT: 50** MICRONS P/P
CASE **GG: 16** mm/sec
■ ROTATION, VIEWED FROM DRIVE END ■ CW ○ CCW

AIR COMPRESSOR:
STAGES **7IP,6HP** MAX. TIP SPEED **5.85** m/SEC
TYPE **Axial** PRESSURE RATIO **21:1**
CASING SPLIT (2.2.3) ● AXIAL ○ RADIAL
ROTOR ☐ SOLID ■ BUILT UP

TURBINE:
STAGES **1HP,1LP,3PT** MAX. TIP SPEED **8.65(GG),7.3(PT)** m/SEC
CASING SPLIT (4.2.3) ■ AXIAL **(GG)** ● RADIAL **(PT)**
ROTOR ☐ SOLID ■ BUILT UP

COMBUSTORS: (4.3.2)
☐ SINGLE ■ MULTIPLE, NUMBER 9
■ GAS ☐ LIQUID ☐ DUAL FUEL
MAX. ALLOW TEMP. VARIATION **+/-150** °C
APPLICABLE PLANE ____
FUEL NOZZLES PER COMBUSTOR **3**
○ WOBBE INDEX NO REQD (4.3.7) ☐ MAX ____ MIN ____

MAINTENANCE INTERVALS, HOURS
■ HOT GAS PATH INSPECTIONS **See Note 2**
■ MAJOR OVERHAULS **See Note 3**
■ OTHER ____ **See Note 4**

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 **5090** MAX. **4610** MIN.
○ MAINTAIN TURBINE SPEED UPON FAILURE OF CONTROL SIGNAL OR ACTUATOR

MATERIALS OF CONSTRUCTION (4.10)

COMPRESSOR ROTOR BLADES **Titanium Alloy,FV.535,Inco 738 & 718, Nimonic 105**
COMPRESSOR STATOR VANES **Jethete 152 & EAX,Inco718,Nimonic 105**
SHAFT **Steel** BLADE/VANE COATING **Sermetal 5375 & Waspaloy**

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

COMBUSTORS **C.263 and Nimonic 75**
COMPRESSOR CASING **Aluminum Alloy,Jethete EAX, Inco 907/904**
COMBUSTOR CASING **Jethete 152**
TURBINE CASING **GG: Nimonic P.E. 16,PT: Waspaloy, Inconel 718**

GAUGE BOARDS AND CONTROL PANELS

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

TYPE (5.4.1.5)
○ MECH ○ PNEU ○ HYDRA ○ ELECTRIC ● ELECTRONIC
● MICROPROCESSOR BASED ○ COMBINED ____
● SIGNAL SOURCE 4-20 mA, 24 V dc
○ 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

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CONSTRUCTION FEATURES CONTINUED (NOTE 1)

RB211 GAS GENERATOR

BEARINGS AND BEARING HOUSINGS (4.8)

RADIAL (ROLLER, SQUEEZE-FILM TYPE)	HP & IP Turbine	IP Compressor
TYPE	Anti-Friction	Anti-Friction
MANUFACTURER	RHP/FAG (TYP)	RHP (TYP)
BEARING WIDTH, mm	39.6	24.3
OUTER/INNER DIAMETER, mm	254.4 / 221.6	285.5 / 252.1
UNIT LOAD (ACT/ALLOW) kPa	/	/
OUTER RACE MATERIAL	AMS6491	AMS6491
ROLLER MATERIAL	AMS6491	AMS6491
CAGE MATERIAL	AMS6415	AMS6415
LOAD: BETWEEN/ON PAD		
PIVOT: CENTER/OFFSET, %		
DAMPER BEARING		
L10 LIFE (On Condition), h	>50,000	>50,000

THRUST (LOCATION TYPE)	IP Compressor	HP Compressor
TYPE	Anti-Friction	Anti-Friction
MANUFACTURER	RHP/FAG (TYP)	RHP (TYP)
BEARING WIDTH, mm	63.4	76.2
OUTER/INNER DIAMETER, mm	215.9 / 139.7	215.8 / 127.0
UNIT LOAD (MAX POTEN.), kPa		
OUTER RACE MATERIAL	MSRR6113	MSRR6083
ROLLER MATERIAL	MSRR6113	MSRR6083
CAGE MATERIAL	MSRR6083	MSRR6013
L10 LIFE (On Condition), h	>50,000	>50,000

LUBRICATION: ◯ FLOODED ■ SCAVENGE SYSTEM
THRUST COLLAR: ◯ INTEGRAL ◯ REPLACEABLE
BEARING MATERIAL

BEARING TEMPERATURE DEVICES (4.8.5.5) ○ SEE ATTACHED API-670 DATA SHEET

○ THERMOCOUPLES
○ SELECTOR SWITCH & IND. BY: ___ PURCH ___ MFR
○ RESISTANCE TEMP DETECTORS
○ RESISTANCE MAT'L ☐ ___ OHMS
○ SELECTOR SWITCH & IND. BY: ___ PURCH ___ MFR
○ LOCATION-JOURNAL BEARING
NUMBER ___ EA PD ___ EVERY OTH PAD ___ PER BRG
OTHER
○ LOCATION-THRUST BEARING
NO. (ACT) ___ EA PD ___ EVERY OTH PAD ___ PER BRG
OTHER
NO.(INACT) ___ EA PD ___ EVERY OTH PAD ___ PER BRG
OTHER
○ MONITOR SUPPLIED BY (5.4.7.5)
○ LOCATION ENCLOSURE
○ MFR ☐ MODEL
☐ SCALE RGE ☐ ALARM SET @ °C
○ SHTDOWN ☐ SET @ °C ○ TIME DLY SEC

REMARKS:

VIBRATION DETECTORS: (4.8.5.3) ○ SEE ATTACHED API-670 DATA SHEET

RADIAL VIBRATION DETECTORS

○ TYPE ◯ MODEL
◯ MFR
○ NO. AT EACH SHAFT BEARING TOTAL NO.
○ OSCILLATOR-DEMODULATOR SUPPLIED BY
○ MFR ☐ MODEL
○ MONITOR SUPPLIED BY (5.4.7.8.2)
○ LOCATION ENCLOSURE
○ MFR ☐ MODEL
☐ SCALE RGE ☐ ALARM SET @ uM
○ SHTDWN ☐ SET @ uM ○ TIME DELAY SEC

AXIAL POSITION DETECTOR (4.8.5.3): **NOT REQUIRED**

○ SEE ATTACHED API-670 DATA SHEETS
○ TYPE ◯ MODEL
◯ MFR ○ NO. REQUIRED
○ OSCILLATOR-DEMODULATOR SUPPLIED BY
○ MFR ☐ MODEL
○ MONITOR SUPPLIED BY (3.4.7.8.2)
○ LOCATION ENCLOSURE
○ MFR ☐ MODEL
☐ SCALE RGE ☐ ALARM SET @ uM
○ SHTDWN ☐ SET @ uM ○ TIME DELAY SEC

ACCELERATION TRANSDUCERS

○ SEE ATTACHED API-670 DATA SHEETS
● MFR Vibrometer Inc. ■ MODEL CE135
● LOCATION GG Casing ● NUMBER 3
● MONITOR SUPPLIED BY (3.4.7.8.4) Rolls-Royce
● LOCATION UCP ENCLOSURE
● MFR Bently-Nevada ■ MODEL 3500
☐ SCALE RGE ■ ALARM SET @ < 25 mm/s
● SHTDWN ■ SET @ 40 mm/s ● TIME DELAY 0 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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CONSTRUCTION FEATURES CONTINUED (NOTE 1)

RT61 POWER TURBINE

BEARINGS AND BEARING HOUSINGS (4.8)

RADIAL (NOTES 2 AND 3)	DISC	CPLG
TYPE	TILT PAD	TILT PAD
MANUFACTURER	KMC	Waukesha
LENGTH, mm	102	89
SHAFT DIAMETER, mm	254	203
~~UNIT~~ LOAD (ACT/ALLOW), kg	21129 / 65834	667 / 42569.0
BASE MATERIAL	Steel	Steel
BABBITT THICKNESS, mm	5.08	1.3
NO. PADS	4	4
LOAD: BETWEEN/ON PAD	Between	Between
PIVOT: CENTER/OFFSET, %	60	60
DAMPER BEARING	YES	NO

THRUST (NOTE 3)	ACTIVE	INACTIVE
TYPE	TILT PAD	Collar
MANUFACTURER	Waukesha (TYP)	Waukesha
~~UNIT~~ LOAD (ULTIMATE), kg		
~~UNIT~~ LOAD (SITE RATED), kg	19,047	N/A
~~UNIT~~ LOAD (MAX POTEN.), kg	50439	N/A
NO. OF PADS / AREA (mm^2)	9 / 86451	0 / N/A
BASE MATERIAL	Steel	Steel
BABBITT THICKNESS, mm		
PIVOT: CENTER/OFFSET, %		

LUBRICATION: ● FLOODED ○ DIRECTED
THRUST COLLAR: ○ INTEGRAL ● REPLACEABLE
BEARING MATERIAL

BEARING TEMPERATURE DEVICES (4.8.5.5) ○ SEE ATTACHED API-670 DATA SHEET

○ THERMOCOUPLES
○ SELECTOR SWITCH & IND. BY: PURCH MFR
● RESISTANCE TEMP DETECTORS
● RESISTANCE MAT'L Platinum ■ 100 OHMS
● SELECTOR SWITCH & IND. BY: PURCH X MFR
● LOCATION-JOURNAL BEARING
NUMBER 1 EA PD X EVERY OTH PAD 2 PER BRG
OTHER
● LOCATION-THRUST BEARING
NO. (ACT) 1 EA PD X EVERY OTH PAD 2 PER BRG
OTHER
NO.(INACT) X EA PD X EVERY OTH PAD 2 PER BRG
OTHER NONE REQUIRED
● MONITOR SUPPLIED BY (5.4.7.5) Rolls-Royce
● LOCATION TCP ENCLOSURE
● MFR RR Controls ■ MODEL
☐ SCALE RGE ■ ALARM SET @ 120 °C
● SHTDOWN ■ SET @ 130 °C ○ TIME DLY SEC
REMARKS:

VIBRATION DETECTORS: (4.8.5.3) ○ SEE ATTACHED API-670 DATA SHEET

RADIAL VIBRATION DETECTORS

● TYPE Non-Contacting ■ MODEL 3300 Series
■ MFR Bently-Nevada
● NO. AT EACH SHAFT BEARING 2 TOTAL NO. 4
● OSCILLATOR-DEMODULATOR SUPPLIED BY Rolls-Royce
● MFR Bently-Nevada ■ MODEL 3300 Series
● MONITOR SUPPLIED BY (5.4.7.8.2) Rolls-Royce
● LOCATION TCP ENCLOSURE
● MFR Bently Nevada ■ MODEL 3500 Series
☐ SCALE RGE ■ ALARM SET @ 60 uM
● SHTDWN ■ SET @ 90 uM ○ TIME DELAY SEC

AXIAL POSITION DETECTOR (4.8.5.3):

○ SEE ATTACHED API-670 DATA SHEETS
● TYPE Non-Contacting ● MODEL 3300 Series
● MFR Bently-Nevada ● NO. REQUIRED 2
● OSCILLATOR-DEMODULATOR SUPPLIED BY Rolls-Royce
● MFR Bently-Nevada ■ MODEL 3300 Series
● MONITOR SUPPLIED BY (3.4.7.8.2) Rolls-Royce
● LOCATION TCP ENCLOSURE
● MFR Bently Nevada ■ MODEL 3500 Series
☐ SCALE RGE ■ ALARM SET @ +/-125 uM
● SHTDWN ■ SET @ +/-200 uM ○ TIME DELAY SEC

ACCELERATION TRANSDUCERS **NOT REQUIRED**

○ SEE ATTACHED API-670 DATA SHEETS
○ MFR ☐ MODEL
○ LOCATION ○ NUMBER
○ MONITOR SUPPLIED BY (3.4.7.8.4)
○ LOCATION ENCLOSURE
○ MFR ☐ MODEL
☐ SCALE RGE ☐ ALARM SET @ G
○ SHTDWN ☐ SET @ G ○ TIME DELAY 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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UTILITIES: CONNECTIONS

UTILITY CONDITIONS: N/A N/A

STEAM:	AUXILIARY DRIVERS		HEATING	
INLET MIN	kPag	°C	kPag	°C
NORM	kPag	°C	kPag	°C
MAX	kPag	°C	kPag	°C
EXHST MIN.	kPag	°C	kPag	°C
NORM	kPag	°C	kPag	°C
MAX	kPag	°C	kPag	°C
	STARTING	N/A	INJECTION	N/A
INLET MIN	kPag	°C	kPag	°C
NORM	kPag	°C	kPag	°C
MAX	kPag	°C	kPag	°C
EXHST MIN.	kPag	°C		
NORM	kPag	°C		
MAX	kPag	°C		

ELECTRICITY: (5.4.6.1) PILOT LIGHT INDICATORS

	MOTORS	HEATING	CONTROL	SHUTDOWN
VOLTAGE	400	230	230	230
HERTZ	50	50	50	50
PHASE	3	1	1	1

COOLING WATER:
INLET TEMP. °C MAX RETURN °C
DESIGN TEMPERATURE °C
NORM PRESS kPag MIN RETURN kPag
DESIGN PRESS kPag MAX ALLOW D P kPaD
WATER SOURCE
INSTRUMENT AIR PRESSURE DESIGN, kPag
MAX 1000 NORMAL 790 MIN 650

REMARKS:

TOTAL UTILITY CONSUMPTION:

COOLING WATER				m³/HR
STEAM LEVEL	N/A kPag	kPag	kPag	kPag
STEAM, NORMAL	N/A			kg/HR
STEAM, MAX	N/A			kg/HR
INSTRUMENT AIR	See Utility List in Proposal			Nm³/HR
MOTORS (AUXILIARIES)	See Utility List in Proposal			kW
BATTERY CHARGERS	See Utility List in Proposal			kW
HEATERS	See Utility List in Proposal			kW
PURGE (AIR OR N_2)	See Utility List in Proposal			Nm³/HR

TURBINE AIR EXTRACTION REQUIRED: (4.1.22)
Nm³/HR @ kPag
MAXIMUM PRESSURE AVAILABLE kPag
MINIMUM SPEED RPM
DISCHARGE TEMPERATURE °C
COMPRESSOR EXTRACTION STAGE NUMBER

REMARKS:
FOR FULL DETAILS OF UTILITY REQUIREMENTS
OF THIS GAS TURBINE PACKAGE PLEASE REFER
TO THE UTILITY SCHEDULE ATTACHED UNDER
TECHNICAL PROPOSAL.

PURCHASER CONNECTIONS

CONNECTION	DESIGN APPROVAL REQ'D (4.10.4.6.4)	SIZE	FACING and RATING	POSITION (4.4.1)	FLANGED OR STUDDED (4.4.1)	MATING FLG & GASKET BY VENDOR (4.4.5.4)	GAS VELOCITY m/SEC
INLET	No			TOP / SIDE			
EXHAUST	No			TOP			
GAS FUEL SUPPLY	No	2"	600# RF		Flanged	Yes	
STEAM	N/A			N/A			
WATER	N/A			N/A			
GAS FUEL VENT	No	1"	150# RF		Flanged		
AUXILIARY AIR SUPPLY	No	0.75"	FNPT				

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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. 2)	●	●	○	○	●	●	○	●	○
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 2)	●	○	○	●	○	○	○	○	○
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. 1)	●	○	○	●	●	●	○	●	○
CONTROL OIL PRESSURE	●	○	○	●	●	●	○	●	○
SITE FLOW INDICATOR EACH DRAIN (NO. N/A)	○	○	○	○	○	○	○	○	○
INLET GUIDE VANE POSITION INDICATOR	●	○	○	○	●	●	○	●	○
EXHAUST DUCT Δ P INDICATOR	○	○	○	○	○	○	○	○	○
ENCLOSURE COOLING AIR EXHAUST TEMPERATURE	●	○	○	○	●	●	○	●	○
POWER TURBINE									
TACHOMETER(S) (NO. 1)	●	○	○	○	●	●	○	●	○
EXHAUST TEMPERATURE (2 PTS MIN)	○	○	○	○	○	○	○	○	○
JOURNAL BEARING TEMPERATURE	●	○	○	○	●	●	○	●	○
THRUST BEARING TEMPERATURE	●	○	○	○	●	●	○	●	○
BEARING DRAIN TEMPERATURE	○	○	○	○	○	○	○	○	○
SITE FLOW INDICATOR EACH DRAIN (NO. 1 COMMON)	●	○	●	○	○	○	○	○	○
LUBE OIL INLET PRESSURE	●	○	○	●	●	○	○	●	○
LUBE OIL INLET TEMPERATURE	○	○	○	○	○	○	○	○	○

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ALARMS AND SHUTDOWNS (5.4.4)

DESCRIPTION	APPLIES TO: ~~SINGLE SHAFT~~ OR G.G.	APPLIES TO: SEP PWR TURB.	(5.4.4.8.5) ANNUNCIATOR POINT IN VENDOR FURNISHED CONTROL PANEL (1): ALARM	(5.4.4.8.5) ANNUNCIATOR POINT IN VENDOR FURNISHED CONTROL PANEL (1): SHUT-DOWN	SENSING DEVICES TO BE FURNISHED BY: VENDOR	SENSING DEVICES TO BE FURNISHED BY: OTHERS	INDICATING LIGHT ONLY (2)
RADIAL SHAFT VIBRATION (NO. 4)	○	●	●	●	●	○	☐
AXIAL THRUST POSITION (NO. 2)	○	●	●	●	●	○	☐
OVERSPEED (1) (NO. 3)	○	●	○	●	●	○	☐
CASING VIBRATION (NO. 3)	●	○	●	●	●	○	☐
HIGH THRUST BEARING TEMP	○	●	●	●	●	○	☐
HIGH RADIAL BEARING TEMP	○	●	●	●	●	○	☐
LOW FUEL SUPPLY PRESSURE	●	○	●	○	●	○	☐
HIGH FUEL FILTER Δ P	○	○	○	○	○	○	☐
GAS TURBINE TEMPERATURE SPREAD HIGH	●	○	●	●	●	○	☐
EXHAUST OVER TEMP	●	○	●	●	●	○	☐
FAILURE OF OVER-TEMP SHUTDOWN DEVICE	○	○	○	○	○	○	☐
HIGH INLET AIR Δ P EACH FILTER	●	○	●	●	●	○	☐
COMBUSTOR FLAME-OUT (GG UNDERSPEED)	●	○	○	●	●	○	☐
CHIP DETECTOR, ANTI FRICTION BEARING	○	○	○	○	○	○	☐
FAILURE STARTING CLUTCH TO ENGAGE OR DISENGAGE	●	○	○	●	●	○	☐
LOW OIL PRESSURE (NO. 2)	●	●	●	●	●	○	☐
HIGH LUBE OIL TEMP	●	●	●	●	●	○	☐
LOW LUBE OIL RESERVOIR LEVEL	●	●	●	○	●	○	☐
HIGH LUBE OIL RESERVOIR LEVEL	●	○	●	○	●	○	☐
HIGH OIL FILTER Δ P (NO. 2)	●	●	●	○	●	○	☐
LUBE OIL SPARE PUMP OPERATING	●	●	●	○	○	●	☐
LOW CONTROL OIL PRESSURE	●	○	●	●	●	○	☐
LOW STARTING GAS PRESSURE	○	○	○	○	○	○	☐
ANTI-ICING SYSTEM - NOT OPERATING			○	○	○	○	☐
LOW D.C. VOLTAGE	○	○	○	○	○	○	☐
EMERGENCY D.C. PUMP OPERATING	○	○	○	○	○	○	☐
RESERVOIR HEATER "ON"			○	○	○	○	☐
IMPLOSION DOOR OPEN			○	○	○	○	☐
EXTERNAL PERMISSIVE START SIGNAL	●		●	○	○	●	☐
EXTERNAL SHUTDOWN SIGNAL	●		○	●	○	●	☐
LOSS OF AUX COOLING AIR	○		○	○	○	○	☐
LAMP TEST PUSH BUTTON	○		○	○	○	○	☐
ENCLOSURE HIGH TEMPERATURE	●	●	●	●	●	○	☐
CONTROL SIGNAL FAILURE	●	●	○	●	●	○	☐
CONTROL SYSTEM ACTUATOR FAILURE	●	○	○	●	●	○	☐
GOVERNOR FAILURE	●	●	○	●	●	○	☐
ENCLOSURE VENT FAN FAILURE	●	●	○	●	●	○	☐
	○	○	○	○	○	○	☐

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. 6988-000-KA-MR-501(ITEM NO.
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REV

ACCESSORIES SUPPLIED BY GAS TURBINE MANUFACTURER

STARTING AND HELPER DRIVERS 5.1)

● STARTER ONLY (5.1.1.2) ○ STARTER/HELPER (5.1.1.3)
TYPE (5.1.1.1) ● MOTOR ○ STEAM TURBINE
○ GAS EXPANDER ○ IC ENGINE ● HYDRAULIC
○ GAS TURBINE ■ STARTER IS CLUTCHED (5.1.1.7)
○ HELPER RATING (5.1.2.2) kW
☐ STARTER RATING (5.1.2.1) kW
◎ SHAFT TURNING DEVICE REQUIRED (5.1.3.1)

■ MOTOR
TYPE RATING 185 kW
MFR MODEL

☐ STEAM TURBINE (REFERENCE API DATA SHEETS)
MFR MODEL
kW MAX. STEAM FLOW kg/HR
TOTAL/START kg

☐ GAS EXPANDER
APPLICABLE SPEC. (5.1.1.6)
MFR MODEL
kW MAX. GAS FLOW kg/HR
TOTAL/START kg
○ GAS FOR EXPANSION TURBINE:

	MIN	MAX	NORMAL
INLET PRESSURE, (kPa)			
EXHAUST PRESS, (kPa)			
GAS TEMP., °C INLET			
GAS TEMP., °C EXHAUST			
MOLECULAR WEIGHT			

SPEED CONTROL ○ GOVERNOR ○ PRESSURE REGULATOR

	YES	NO
INLET CONTROL VALVE FURNISHED		
STAINLESS STEEL PIPING MANIFOLD		
CARBON STEEL FLANGES		
Y-STRAINER W/BREAKOUT FLANGES		
LOW SPEED CAPABILITY (FOR COMPRESSOR CLEANING)		

RELIEF VALVE PRESSURE SET POINT kPag
CASING MATERIAL
SEAL TYPE

☐ INTERNAL COMBUSTION ENGINE
TYPE ○ SPARK IGNITED ○ DIESEL
APPLICABLE SPECIFICATION (5.1.1.6)
MFR MODEL
SPEED RPM POWER kW

☐ COMBUSTION GAS TURBINE
APPLICABLE SPEC (5.1.1.6)
MFR MODEL
SPEED RPM POWER kW

● GEARS: SEE SEPARATE API 613 GEAR DATA SHEETS (5.2.1.1)
● DRIVEN EQUIPMENT., SEE SEPARATE DATA SHEETS
■ FIRE PROTECTION EQUIPMENT (5.7.3.1)
TYPE ◎ HALON 1301 ◎ WATER MIST ◉ CO_2
● TYPE OF SENSOR ◎ NUMBER OF DETECTORS
● HEAT NUMBER 2
● INFRARED NUMBER 3
● INFRARED GAS DETECTORS NUMBER 8

MOUNTING PLATES (5.3)

TYPE (5.3.1.1) ○ SOLEPLATE ● BASEPLATE
☐ SHIM PACK THICKNESS mm (5.3.1.2.9)

BASEPLATE (5.3.2)

● FURNISHED BY Rolls-Royce (5.3.2.1)
● GAS TURBINE ONLY ○ EXTENDED FOR
◎ SUB-SOLEPLATES REQ'D (5.3.2.7) ○ DRIP RIM
○ COLUMN MOUNTING (5.3.2.4)(3-POINT) ○ LEVELING PADS (3.3.2.2)

ENCLOSURES (5.7.5)

● ENCLOSURE REQUIRED
REQUIREMENTS (5.7.5.1)
● ACOUSTICAL
● WEATHERPROOF
○ SAFETY
○ FIREPROTECTION
● POSITIVE VENTILATION (2 X 100%)

COUPLINGS AND GUARDS (5.2.2)

● SEE ATTACHED API-671 DATA SHEETS
☐ MANUFACTURER ■ TYPE Dry Flexible
☐ MODEL ☐ GUARD SUPPLIED BY
☐ MAXIMUM OUTSIDE DIAMETER mm
☐ HUB WEIGHT kg
☐ SPACER LENGTH mm ☐ SPACER WEIGHT kg
○ IDLING ADAPTER REQ'D ○ SOLO PLATE REQ'D
■ GUARD SUPPLIED BY Rolls-Royce
TYPE: ● FULLY ENCLOSED ○ SEMI-OPEN ○ OTHER
LUBRICATING REQUIREMENTS:
● NON-LUBE ○ GREASE ○ CONT. OIL LUBE
QUANTITY PER HUB kg or m³/HR

REMARKS:

ENGINEERS INDIA LIMITED
NEW DELHI

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COMBUSTION GAS TURBINE (API 616-4TH) DATA SHEET SI UNITS

ACCESSORIES SUPPLIED BY GAS TURBINE MANUFACTURER

INLET SYSTEM

- (●) AIR FILTER (5.5.4.1) **UPDRAFT STATIC FILTER W/ PREFILTER WRAPS**
- ( ) INERTIAL TYPE SEPARATOR (●) MEDIA FILTERS
- (●) PREFILTER WRAP ( ) COMBINATION
- ( ) SELF CLEANING (PULSE TYPE)
- ( ) SINGLE STAGE WITH PROVISION FOR FUTURE EXTRA STAGES ( ) YES ( ) NO
- ( ) NORMAL DUST LOADING _____ kg/Nm³/HR
- (●) WIND DESIGN VELOCITY **44** m/sec
- ( ) SNOW LOAD _____ kg/m²
- (●) SEISMIC ZONE **NON-SEISMIC**
- LOCATION: ( ) GROUND LEVEL (●) ELEVATED (5.5.4.6)
- [ ] FILTRATION EFFICIENCY _____ % (5.5.4.3)
- [ ] MAINTENANCE INTERVAL _____ MONTHS
- [ ] CLEANING FREQUENCY _____ DAYS
- ( ) IMPLOSION DOOR (5.5.4.5)
- ( ) EVAPORATIVE COOLER (5.6.1.1) ( ) ANTI-ICING (5.5.3.10)
- ( ) LIQUID TO AIR EXCHANGER (5.6.2.2)
- ( ) WALKWAYS, LADDERS, HANDRAILS REQUIRED (5.6.1.5)
- (●) COMP CLEANING SYSTEM, TYPE **Crank Soak Wash** (5.5.3.9)
- (●) SILENCER PLATE ELEMENT MAT'L (5.5.5.1.4) **304 SST**
- [ ] FILTER MFR. _____ MODEL _____
  @ 110% RATED AIR FLOW Δ P _____ mm H_2O
  CLEAN _____ mm H_2O ALARM _____ mm H_2O
- [ ] COOLER MFR. _____ MODEL _____ Δ P _____ mm H_2O
- [ ] EXCHANGER MFR (5.6.2.3) _____
  MODEL _____ Δ P _____ mm H_2O
- [■] DUCTING GAUGE / MATERIAL _____ / **See remark-1**
- [ ] EXPANSION JOINT MFR _____ TYPE _____
- [ ] SILENCER MFR _____ Δ P _____ mm H_2O
- [ ] MANOMETER MFR _____ MODEL _____
  RANGE _____ mm H_2O
- [■] SYSTEM SITE RATED PRESSURE DROP **100** mm H_2O
  @ 110% RATED AIR FLOW

REMARKS 1. Combustion air intake inside skin -304SST, outside skid is carbon steel

EXHAUST SYSTEM

- ( ) EXTENT OF FURN. INSULATION (SEE SKETCH) (5.7.1.2)
- ( ) (RELIEF) (DIVERSION) VALVE (5.5.6.8)
- ( ) EXHAUST HEAT RECOVERY SYSTEM (5.5.3.1)
- ( ) EMISSION CONTROL SYSTEM (5.5.3.1)
- (●) EXHAUST SILENCER PLATE ELEMENT MATERIAL (5.5.5.2.3)
  CARBON STEEL W/ 409 SST FLOW LINER
- ( ) EMISSIONS SAMPLING SYSTEM (5.5.6.10)
- [ ] EXPANSION JOINT MFR _____ TYPE _____
- [ ] DUCTING GAUGE/MATERIAL _____ / _____
- [ ] SILENCER MFR _____ Δ P _____ mm H_2O
- [ ] HEAT RECOVERY DEVICE
  MFR _____ TYPE _____ Δ P _____ mm H_2O
  STEAM GEN: PRESS _____ kPag TEMP _____ °C
  RATE _____ kg/HR
- [ ] MANOMTR MFR _____ MODEL _____ RANGE _____ mm H_2O
- [ ] ATMOSPHERIC RELIEF DEVICE (5.5.6.8)
  TYPE _____ MFR _____ LOCATION _____
- [■] SYSTEM SITE RATED PRESSURE DROP **250** mm H_2O

ATMOSPHERIC EMISSIONS

- ( ) EMISSION SUPPRESSION SYSTEM REQUIRED (5.8.4.1)
- (●) NO_x REQUIREMENTS (5.5.3.1.1) 100PPMV @15% O2
- [ ] NO_x EMITTED _____

EMISSIONS REDUCTION METHOD (IF REQUIRED) (5.8.4.2)

- [◯] WATER INJECTION (5.8.4.4) [◯] SCR
- [◯] STEAM (5.8.4.4) [◯] DRY COMBUSTOR
- [◯] OTHER _____

- ( ) SO_x REQUIREMENTS _____
- ( ) SULFUR CONTENT OF FUEL _____
- [ ] SO_x EMITTED (BASED ON STATED SULFUR CONTENT) _____
- ( ) CO REQUIREMENTS _____
- [ ] CO EMITTED _____
- ( ) PARTICULATE REQUIREMENTS _____
- [ ] PARTICULATE EMITTED _____
- ( ) UNBURNED HC REQUIREMENTS _____
- [ ] UNBURNED HC EMITTED _____

APPLICABLE EMISSION CODES OR REGULATIONS

- ( ) EPA - TITLE 40 - CFR ( ) OTHERS _____

SPECIALIZED INSTRUMENTS

TACHOMETERS (5.4.7.2.2)
TYPE ( ) ELECTRICAL (●) ELECTRONIC
( ) ANALOG (●) DIGITAL
(●) MANUFACTURER **Rolls-Royce Controls**
( ) OIL FILLED PRESSURE GAUGES (5.4.7.6)

SWITCHES: (5.4.4.8.2)
CIRCUIT SHALL
( ) ENERGIZE (●) DEENERGIZE TO ALARM
( ) ENERGIZE (●) DEENERGIZE TO SHUTDOWN

ENCLOSURES
( ) EXPLOSION PROOF ( ) WEATHER PROOF

ENGINEERS INDIA LIMITED
NEW DELHI

COMBUSTION GAS TURBINE (API 616-4TH) DATA SHEET SI UNITS

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INSPECTION AND TESTING; LUBRICATION, WEIGHTS

SHOP INSPECTION AND TESTS: (6.1.1)

	REQ	WIT-NESSED	OBSER-VED
SHOP INSPECTION (6.1.2)	●		
CLEANLINESS (6.2.3.3)	●		
HYDROSTATIC (6.3.2)	●	○	○
MECHANICAL RUN (6.3.3)	●	●	○
☐ CONTRACT COUPLING ☐ IDLING ADAPTOR(S)			
■ CONTRACT PROBES ☐ SHOP PROBES			
VIBRATION PLOTS (6.3.3.3.4)	●		
TAPE RECORD VIB DATA (6.3.3.3.6)	○		
PERFORMANCE TEST (6.3.4.1) **(PTC-22)**	●	●	○
NO LOAD STRING TEST (ONE PER STATION)	●	●	○
PACKAGE TEST (6.3.4.2.1)	○	○	○
LOAD GEAR TEST (6.3.4.3)	○	○	○
NOISE SURVEY (6.3.4.4) (DURING STRING TEST)	●	●	○
AUXILIARY EQUIPMENT (6.3.4.5)	●	○	○
POST TEST INSPECTION (6.3.4.6)	○	○	○
UCP FAT	●	○	○
GOVERNOR RESPONSE TEST (6.3.4.8)	○	○	○
SPARE PARTS (6.3.4.9)	○	○	○
FIRE PROTECTION SIMULATION (6.3.4.10)	○	○	○
OTHER (6.3.4.11)	○	○	○

LUBRICATION SYSTEMS (4.9)

● SEE API 614 DATA SHEETS **MINERAL OIL SYSTEM**
☐ LUBE OIL VISCOSITY (4.9.8) ISO GRADE **ISO VG 32 / 46**
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 **Rolls-Royce Approved Synthetic Oil**
COMMON TO ■ GAS GENERATOR ☐ POWER TURBINE
☐ LOAD GEAR ☐ DRIVEN EQUIPMENT
☐ AUXILIARIES

■ OIL REQUIREMENTS	FLOW m³/HR	PRESSURE kPag	HEAT LOAD MJ/HR
GG	**FOR DETAILS OF THE PACKAGE**		
DRIVEN EQUIP.	**OIL REQUIREMENTS PLEASE**		
GEAR	**REFER TO THE FLUIDS SCHEDULE**		
COUPLINGS	**WITHIN TECHNICAL PROPOSAL.**		
POWER TURBINE			
TOTAL			

MOUNTING ARRANGEMENT
○ CONSOLE ○ COLONY ○ BASEPLATE

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)

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) Supplier's Facility
○ 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)

■ WEIGHTS

	DRY INSTALLED WT. (kg)	SHIPPING WT. (kg)	DIMEN LxWxH (m)
GG OR SS TURBINE	**FOR DETAILS OF THE PACKAGE**		
SS TURB. ROTOR	**WEIGHTS PLEASE REFER TO THE**		
POWER TURBINE	**GA DRAWING WITHIN TECHNICAL**		
P.T. ROTOR	**PROPOSAL.**		
LUBE SYSTEM			
DRIVEN EQUIP.			
FILTER			
INLET SILENCER			
EXHAUST SILENCER			
DUCTING			

MAX ERECTION WEIGHT (kg) ITEM
MAX MAINT. WEIGHT (kg) ITEM

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

Altiude :197.8m

Relative Humidity : 84%

Fuel

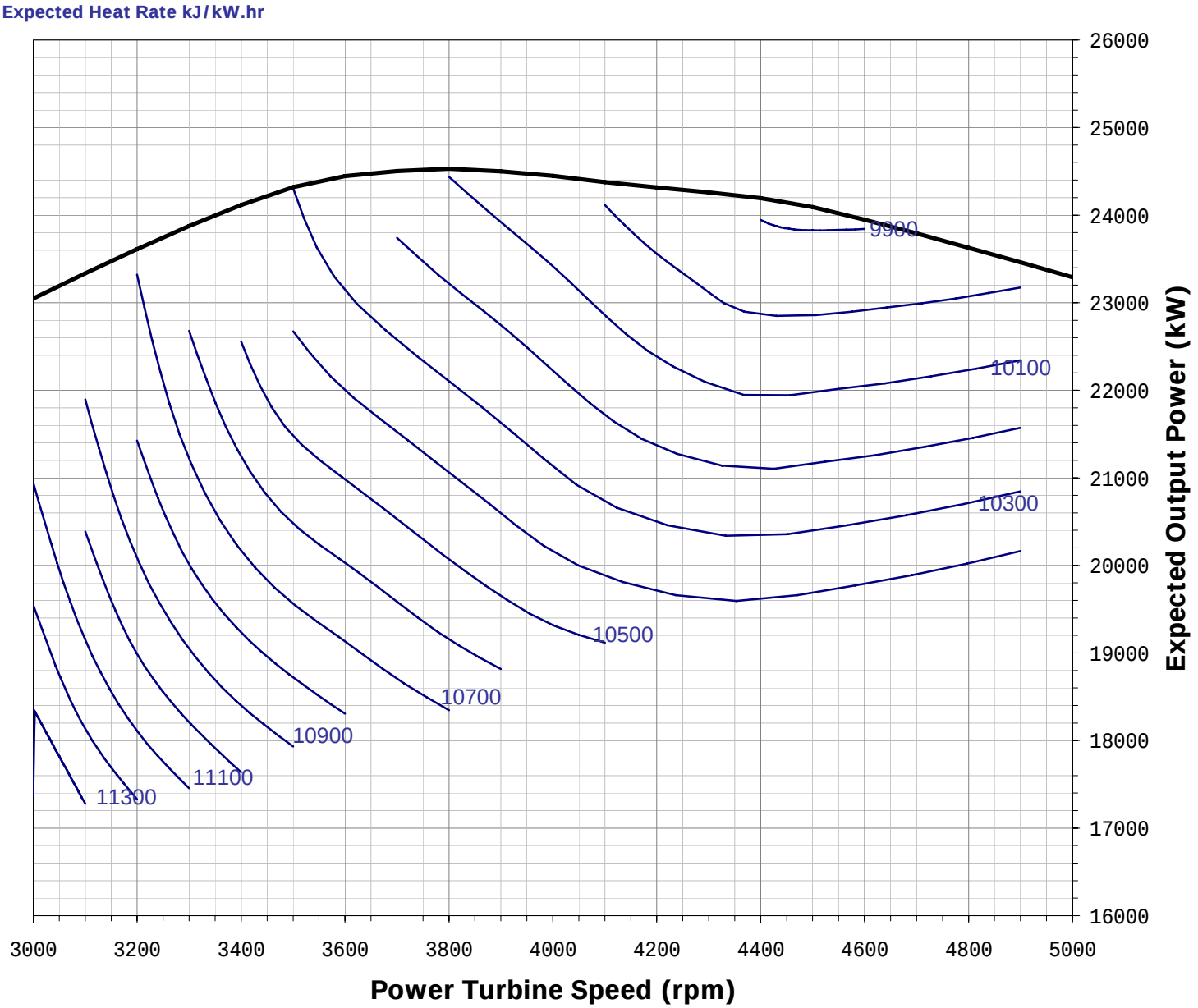
Fuel Type: Lean gas

Fuel LHV: 49602 kJ/kg

Installation Pressure Losses

Inlet: 100 mmH2O

Exhaust: 250 mmH2O



COMPRESSOR STATION WORKS AT KAILARAS & CHAINSA -COMPRESSOR PACKAGE

OPERATING CASE: CHAINSA (Lean Gas, MW=17.07)

1.	**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_2O	:	100
viii)	Max. Exhaust Loss (At site) with Heat recovery in future	mm H_2O	:	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	:	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).

COMPRESSOR STATION WORKS AT KAILARAS & CHAINSA -COMPRESSOR PACKAGE

OPERATING CASE: CHAINSA (Rich Gas, MW=17.4)

1.	**Compressor**			
1.1	BKW required at compressor input shaft including all losses (with 0% positive tolerance)	kW	:	20943
2.	**Gas Turbine Site Rating** Ú			
2.1	GT Site Rating @ 45EC (at compressor operating speed)	kW	:	23547
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	:	10176 / 2430

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	:	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_2O	:	100
viii)	Max. Exhaust Loss (At site) with Heat recovery in future	mm H_2O	:	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).

PERFORMANCE TABLE							
Sr No	**DESCRIPTION**	**UNITS**	**OPERATING CASE : CHAINSA (Lean Gas, MW=17.07)**				**Remarks**
			ISO	**Rated**	**Max**	**Min**	
1	Ambient temperature	ºC	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_2O Max. Exhaust Pressure Losses = 250 mm H_2O & 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	ºC	451.9	520.0	520.0	416.9	
15	GG Exhaust Temp	ºC	698.5	774.0	774.0	656.9	
16	Firing Temp	ºC	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).						

PERFORMANCE TABLE							
Sr No	**DESCRIPTION**	**UNITS**	**OPERATING CASE : CHAINSA (Rich Gas, MW=17.4)**				**Remarks**
			ISO	**Rated**	**Max**	**Min**	
1	Ambient temperature	ºC	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_2O Max. Exhaust Pressure Losses = 250 mm H_2O & 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	ºC	452.6	520.9	520.9	417.5	
15	GG Exhaust Temp	ºC	700.9	776.6	776.6	659.2	
16	Firing Temp	ºC	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).						