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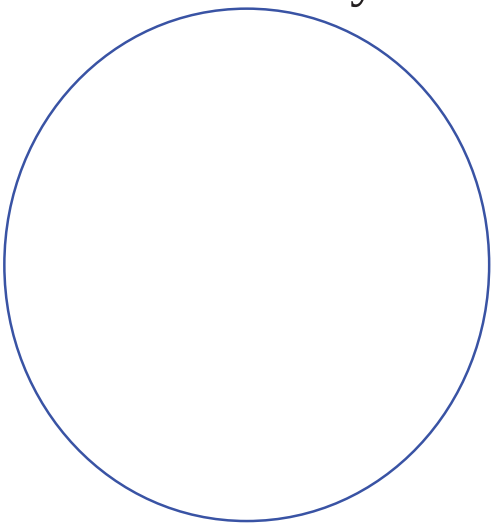
Turbo-compressor

TEK-3200/3300/3400

RCM study



Reported by Santi Songkunlertchai
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Project Ref No : 07-10- .

Date 28 Oct 2007

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8.

1. Summary

The summary below indicates the major findings only.

1.1 It is found that the current job card is not full-fill the maintenance activities. Job card shall drilldown to activities and maintenance item level (sub-skid level) as per the result of this RCM.

1.2 Online washing should be introduced to Gas Producer in order to extend the crank wash interval.

1.3 To eliminate wax-gum cumulative at dry gas seal, the source of “buffer gas” shall be off-taken from the final discharge downstream of the after cooler.

1.4 Dry gas seal replacement interval shall be extended and based on “condition base” instead of “time base”.

1.5 Online washing should be introduced to “compressor”. Rigorous study shall be conducted to prevent “dry gas seal” damage during on-line wash.

1.6 Power augmentation should be introduced to gain the gas export.

1.7 Anti-surge function shall be tested-stimulated as regular basis.

1.8 To increase the system availability, “TT-3320” function should be changed from “shutdown” to “alarm” only.

1.9 Each compression string, it is found that the total maintenance cost with lost time for maintenance will be 76 million Baht per year

1.10 Each compression string, it is found that the minimum total production lost with out maintenance will be 487 million Baht per year, Maximum: 8000 million Baht per year

1.11 It can pointed that the average recovery time from breakdown should be 12 hours at the lost of revenue at 25% of each of gas compression string.

Cost from maintenance activities	76 231 593	Baht per year	with product lost (parts included)
Min production lost w/o maintenance	487 142 857	Baht per year	
Max breakdown cost with production lost	8 035 535 410	Baht per year	
RAM	2	A 0,5	

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2. Introduction

This report was made according the PTTEP Service Order No…….to conduct the RCM study using the combination of FMEA* (Failure Mode Effective Analysis) technique and FMECA* (Failure Mode Effective Critical Analysis*)

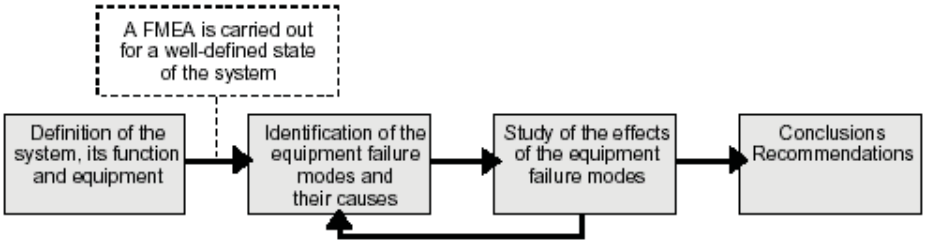
* Developed by Equity Services & Solutions Co., Ltd

Failure modes and effects analysis (FMEA)

FMEA is an analytical method to study the cause and effects likely to affect the equipment in an operating system in order to:

- assess the effects of each failure mode on the equipment in a system and on the various functions of the system
- identify the failure modes significantly affecting the reliability, availability, maintainability or safety of the system.

The main steps in the performance of an FMEA are illustrated



The FMEA methodology provides:

- Assurance that all conceivable failure modes and their effects on the system operation have been taken into account in the design or operation phase
- Identification of single failures, particularly where safety systems are generally designed to meet the single failure criterion
- An inventory of failure modes according to the extent of their effects on the system functions
- Identification of secondary failures and required redundancy
- Design of detection systems (for example, alarms, periodic tests) for the failure mode; the adequacy of these can be appraised
- Development of the appropriate maintenance procedure corresponding to each failure mode.

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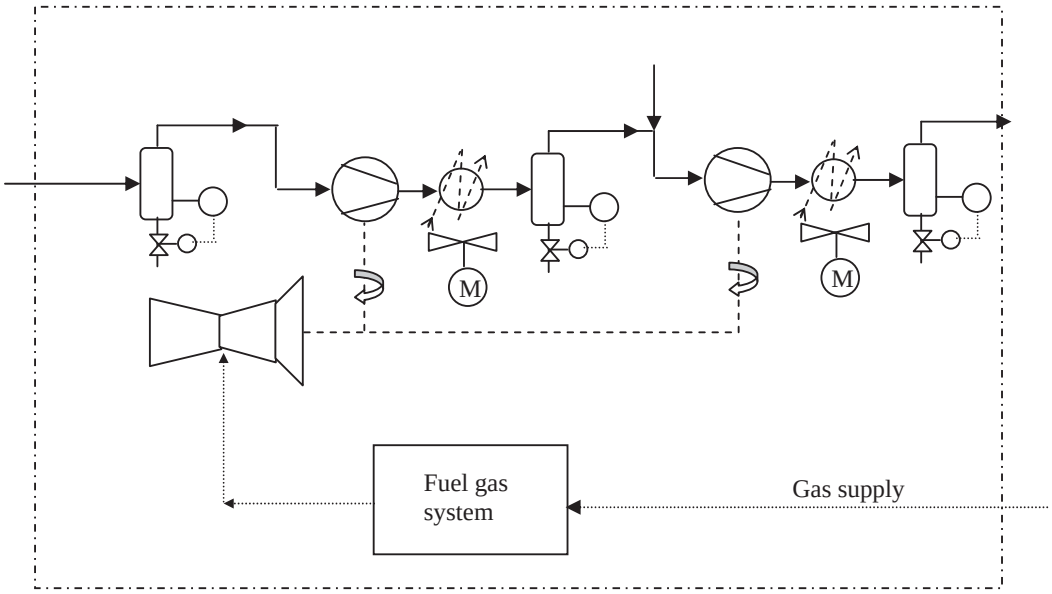
3. Work scope

The study cover the gas turbine driving export gas compressor for one unit only (three units are identical), and partly of fuel gas system (full scale RCM study of fuel gas system is separated) as per sketch.



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4. Details

4.1 This RCM study is based on:

4.1.1 MTTR (Mean Time To Repair) is not including the "lead time" of the work preparation or spare part.

4.1.2 Repair or replace process is based on spare module, assembly available e.g. starter, electric motor, gas producer module, etc.

4.1.3 On condition maintenance covers "on-line" and "off-line" and "occasion"

- On-line maintenance consists of all operating/process parameters, vibration analysis, oil analysis (RBOT), thermo-graphic, emission analysis, strain measurement, UTM, Pulse eddy current, and including visual external inspection.
- Off-line maintenance consists of all internal inspection, pressure test, geometric measurement, NDT, function test / calibration, Etc which requires to shutdown the system.
- Occasion maintenance is maintenance activity that schedule to be aligned with scheduled off-line maintenance.

4.1.4 Unplanned shows in RCM study as breakdown maintenance

4.1.5 Scheduled maintenance (either overhaul or replacement) interval is pre-fixed in master plan.

The firmed schedule maintenance will be based on the condition assessment which should be implemented 3-6 months ahead from the pre-fixed schedule using the projection/prediction technique.

4.1.6 **Operating context:**

Turbo-compressor function (TEK-3200/3300/3400)
All three compressors are installed at PP to deliver gas from separation process to [illegible]s 33,3 % x 3 duty.

Custodian transfer is made at PP via flow-computer.

Operating condition
First stage Inlet parameter
Pressure, Barg : 23,1 (mean) max 24, min 23,0
Inlet temp, C : 24,4 (mean), max 25,6
MW 26,05 kg/kmol
Compressibility: 0,92 (inlet)
See gas compositions attached
Operating speed, rpm: 5900-6100 range

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First stage discharge
Pressure, barg: 56,3
Temp, C: 99,9

Second stage Inlet parameter
Pressure, Barg: 54, 1 (mean) max, min
Inlet temp, C: 50,8 (mean), max
MW: 26,05 kg/kmol
Compressibility: 0,865(inlet)
See gas compositions attached
Operating speed, rpm: 5900-6100 range

Second stage discharge
Pressure, barg: 108,2 (mean), 112 (max)
Temp, C: 119,8

Total Reliability and availability
Reliability: 99 %
Availability: 95 %

Each of gas compression train
Availability: 98,5 %
Reliability: unable to pinpoint due to insufficient information.

Delivery agreement, penalty
Guarantee point at delivery at 630 MMscfd (max)

Each compressor train comprise of:
LM-2500 gas turbine
PG-25 power turbine
NP: 2BCL-608, compressor, internal combine stage (1+2),

Lubrication system
GG uses synthetic oil: Mobil and TOTAL, VG-32
PG & comp used mineral oil: TOTAL VG-32

Seal system
Dry gas seal: John crane T28AT
Tandem arrangement
Buffer stage 1: Process gas
Buffer stage 2: Instrument air

LM-2500
Requires fuel gas: 7780kg/h (max) at 31 barg

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NP-2BCL-608
Each train, inlet gas before reaching gas compressor train has to be knock-out inlet liquid at suction scrubber.

After 1st stage compression: 99,9 deg C will be cooled by 1st air/gas cooler (A3230) to 52,4 deg C.

At 2nd stage, inlet stream will be combined with side stream at 54,1 Barg at 50,8 deg C. prior reaching 2nd comp unit, gas will be scrubbed by 2nd KO (D-3240)

Final outlet from 2nd compressor: 108 barg at 119 deg C will be cooled down via air / gas cooler (A3260) at 107,2 barg at 50 deg C.

4.1.7 Primary and secondary functions

As described, RCM is based on FMEA technique. Primary & secondary functions are determined from the above operating context as:

1	To deliver gas at 210 MMscfd at the operating condition
2	To meet availability 98,5%
3	To meet reliability 99%
4	To maintain lube oil/iquid containment
5	To maintain process gas containment
6	To limit discharge temp < 120 deg C at inlet 26 (1st) , 54 (2 nd st)
7	To maintain structural integrity
8	To maintain emergency response-life saving-asset integrity
9	To maintain the ignition integrity

4.1.8 Cost critical analysis is based on:

Operational capability	
Production capacity, MMscf/hour	8,75
Loss, of full capacity/hour	100%
Deferment, from loss of full capacity/hour	2%
Sale price, Baht/MMscfh	238 095,24

Rate, Baht/hour	
Specialist	3000
Elect	320
Helper	170
Instr	320
Mech	390
Prod	320
Tech-Elec	450
Tech-Instr	450
Tech-Mech	630
Welder	210

In addition, the total production loss of 28,013,400 million Baht is base on the penalty if no total-sale after 24 hours with the loss of sale opportunity of 5% interest

Parts and material cost is specified in each of failure mode individually.

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4.1.9 Risk Assessment

Risk assessment is quantified using the specific Risk Matrix and failure consequences which is developed to

Risk Assessment Matrix

				Production losses 25%	50%	75%	100%
				A	B	C	D
Evident but no effects on HSE, environment of operation	Mild	72 h	1				
Evident degraded operation capacity, No effects on HSE		12 h	2				
Hidden degraded operation/non-operation capability, No effect on HSE		asap	3				
Evident safety and/or environment hazard	Lost of life	HSE	4				
Hidden safety and/or environment hazard							

Sample Coding 1B0.5

1	No effect to HSE
B	Cause production lost 50%
0,5	Probability occure 1 in every 2 years

4A0.25

4	Potential to lost of life or injure
A	Cause production lost 25%
0,25	Probability occure 1 in every 4 years

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4.1.10 Maintenance strategy

Maintenance strategy decision is based on the lowest quantified cost amongst tasks categories which the methodology is made differently as:

- “On Condition Maintenance (OCM)” has to be corporate with "Incipient failure" failure mode only.
  The cost of OCM is based on person(s) who carry out the On Condition Monitoring and assessment only.
  The subsequent "scheduled maintenance” cost is not considered on this maintenance task category.
  It is recommended that NON RECURRING MAINTENANCE & BUDGET should be reserved.

- "Scheduled Overhaul (SO)" will be carried out when it gives the lowest cost without effects to HSE
  The cost of SO is base on the total OCM cost (assuming equivalent to the total man-hour requirement for SO) plus spare parts divided by MTBF plus the cost of Loss & Deferment

- "Schedule Replacement (SR)" will be carried out when it gives the lowest cost without effects to HSE.
  The cost of SR is base on the total OCM cost (assuming equivalent to the total man-hour requirement for SR) plus equipment cost divided by MTBF plus the cost of Loss & Deferment divided by 3

- "Failure Finding (FF)" shall not corporate with "Incipient failure mode"
  The cost of FF is based on person(s) who carry out the FUNCTION TEST only.
  The subsequent "scheduled maintenance" cost is not considered on this maintenance task category
  It is recommended that NON RECURRING MAINTENANCE & BUDGET should be reserved.

- "Corrective Maintenance (CM)" will be carried out when it gives the lowest cost without effects to HSE
  The cost of CM is based on SO cost and further biased with the rejection value of the failure probability.

- "Redesign (RD)" will be commenced when all above are not applicable
  The cost of RD is based on the equipment cost divided by the useful life multiplied by 3

Component corrosion can be applied with this RCM as "Inspection" to be used as "FF"

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4.1.11 Failure Characteristic Analysis

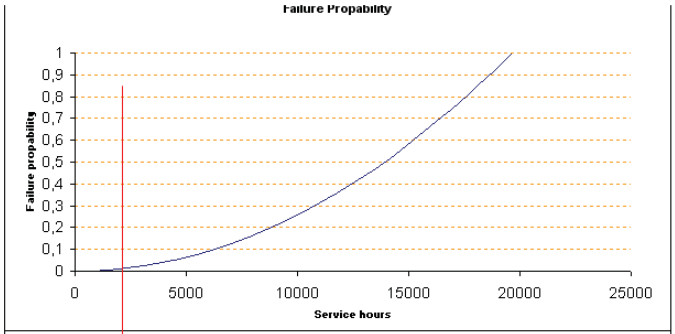
Each of failure modes is classified to the 1 of the six failure pattern shown.

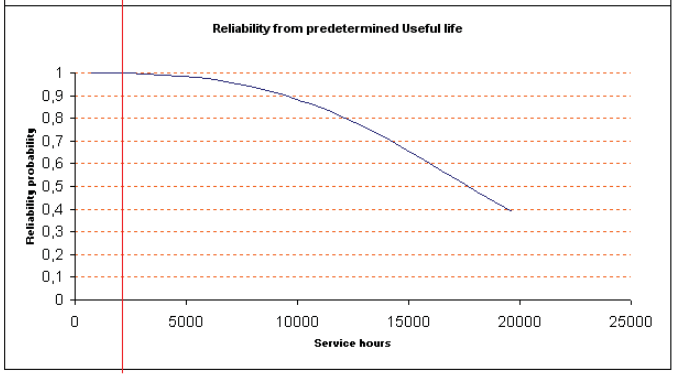
Any failure mode that the history could be traced, the maintenance interval can be allocated naturally.

Any failure mode that history could not be traced, the failure pattern and predicted useful life and trouble free life and the potential to failure are model in Weibull curve as the function of:

Weirbull probability density/distributions			**Probability of failure/rate**
Weirbull characteristic			failure rate = at^(b-1)
			a = scale factor/parameter
f(t) =(b/a^b)t^(b-1). Exp(-(t/a)^b			t = time in service
			b = weibull slope
b = shape parameter	6		
a = scale parameter	100		
t = start hour	50		

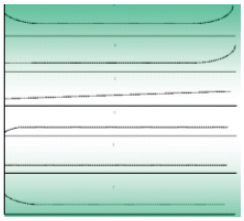
Failure rate R(T)=1/MTBF		or propability of failure
or		
$R(T) = at^{(B-1)}$		
a= scale factor	100	
B = Weibull slop, shape	6	
t =starting time in service	50	





FCA and Propability and Reliability model developed by Manorom C.(ESS Co.,Ltd)

Scale factor = 0,05
Slope parameter = 3
Starting time, hours = 750



pattern	slope
A	
B	>2
C	2
D	1-2
E	1
F	<1

Useful life, hours = 20000
Or MTBF as appropriate
Reject availability 98,00%

Notice. Time scale shall be aligned the "useful life /MTBF" by changing "scale factor" or "starting time"

Interval time should be half life of the reject availability
or
800 hours FFI

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Figure 1

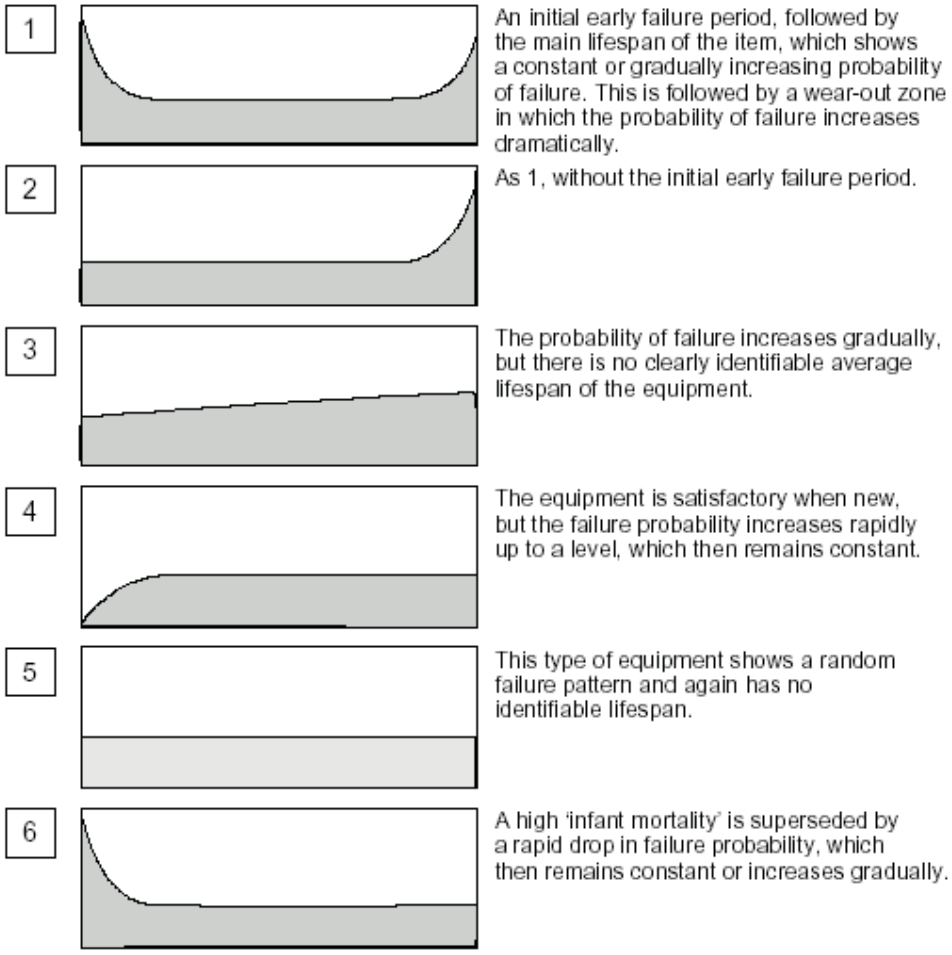

Figure 1: Six Patterns of Failure

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4.1.12 Function and failure mode

Primary/secondary function	
To deliver gas at 210 MMscfd at the operating condition	
Function failure	**Failure mode**
Gas compressor low performance	Fouling develop at compressor rotor
GG bearing failure due to lubrication degradation	Contaminates in synthetic oil degradation or oxidation.
GG blades fails from foreign object	High vibration due foreign objects to GG from corrosion on vane mist separator, air intake and exhaust ducts
GG low performance from	GG compressor blade fouling
GG unable to operated at desire speed/power	Inlet filter blockage
	TE3200 - High ambient temp, leads to low mass rate
	Fuel gas blockage (offskid)
	FV44220 Control VV, fails close due to controller malfunction
	XV42215 S/d/ VV, fails to stuck open or controller malfunction
	XV42225 fails to function, Loss of fuel gas supply from FV42220,
	TE3200 - Strainer (inlet fuel gas to GG) blockage
	XV42211 malfunction due to loss of instrument air
	LSHH42211 not activate or stuck
	SDV42200 malfunction
	PSV42210 passing
	T5 malfunction or spread due to thermocouples deteriorated
	XV42211 malfunction
	TE3200 - VSV control out of tolerances
	TE3200 - Corrosion cracks on compressor blades or blade coating damaged.
	PDSH42171 malfunction
	ARV42162 clogged up
	PSV42160 passing
	PSV42110 passing
	T42130 (oil/air separator) damaged or clogged up
	PDSL42713 & 15 malfunction
GG unable to start on demand due to starting system failed	TS3200 Gas starter failure
	TE3200 - Starting gas turbine regulating valve system malfunction

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Function failure	Failure mode
Insufficient cooling and lubricating GG, PT and compressor bearings.	A42145 & A 42820 - Cooling fan bearing failure.
	A42145 & A42820 - Transmission belt or pulleys failure.
Insufficient hydraulic oil supply to system	P42160 hydraulic pump failure
Insufficient lube oil to cool and lubricate GG, PT and compressor bearings.	A42145 & A42820 - Cooling fan failure.
Insufficient lube oil to cooling and lubricating compressor and power turbine bearings.	P42850 Filter blockage on discharge of cool down pump
	PDI42855 incorrect reading at low side
	TSH42823 malfunction
Insufficient lube oil to lubricate and cool GG, PT and compressor bearings.	M42820, 25 cooler fan motor bearing failure
Insufficient lube oil to lubricate and cool GG bearings.	TE3200 - P42110 synthetic oil pump failure
	TE3200 - P42140-43 Scavenge pumps failure
	PSV42246 passing
	TCV42147 malfunction
	A42145 & A42820 oil cooler fouling
Insufficient lube oil supply to cool and lubricate compressor bearings	M 42820, M 42825 bearing failure
	PCV42840 malfunction
	TV42821 malfunction
	M42850 bearing failure
	P42850 bearing failure
Insufficient lube oil supply to cool and lubricate compressor bearings.	M42805 bearing failure
	PCV42813 malfunction
Poor GG compression performance due to insufficient off-line cleaning on compressor blades	P42610, water wash pump failure
	M42610 bearing failure, water wash pump
	T42605 & T42600 tanks corroded or deposit in tanks.
	Deposits on H42605 heater or heater poor performance
PT or compressor bearing failure due to lubrication degradation	Contaminates in lube oil, mineral oil degradation or oxidation.
Unable to operate compressor on demand	XV3221 malfunction
Unable to operate compressor on demand due to high temp lube oil.	A42820 – Lube oil cooler fouling.
Unable to produce at the optimum point	FV3220 (1st stage anti-surge valve) malfunction
Unable to run compressor continuously due to both lube oil pumps not functioned.	PSL42812 not activated

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Function failure	Failure mode
Unable to run compressor smoothly due to spurious trip	LSLL3242 not activated
	PALL3223 malfunction (1st suction)
	TAHH3220 malfunction (1st suction)
	PAHH3226 & PALL3226 malfunction (1st discharge)
	TAHH3223 malfunction (1st discharge)
	PALL3253 malfunction (2nd suction)
	PALL3254 & PAHH3254 malfunction (2nd discharge)
	TAHH3253 malfunction (2nd discharge)
	PAHH3259 malfunction (2nd discharge)
	PDAHH3229 malfunction (PD discharge both stage)
	PT42842 - PSL malfunction
	PSH42851 not activated
	P42850 - F42855 filter blockage
	P42805 - F42830 & F42835 filter blockage
	PDSH 42831 not activated
	TE3200-M42500(AC) bearing failure
	TE3200-M42502 (DC) bearing failure.
	TE3200-FDP42500 stuck closed
	TSHH42502 malfunction
	TE3200-FSL42500 malfunction
	PDSHH42501 malfunction
	PDSL42508 malfunction
	TE3200-FDP42503 stuck closed
Unable to seal gas in the compressor effectively.	SDV3214 malfunction
Unable to start compressor due to not permissive to start lube oil pump	LSL42801 malfunction
Unable to start GG on demand	Igniter failure
Compressor stop from High thrust / journal bearing temp & vibration	Bearing damaged or worn out from aging
	Rotor dynamics problems: Shaft cracks, shaft bent, rubbing, impeller damaged, etc.
	Couplings failure, Misalignment
	Blockage in compressor drain piping.

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Primary/secondary function	
To limit discharge temp < 120 deg C at inlet 26 barg (1stage) , 54 barg (2nd stage)	
Function failure	**Failure mode**
Insufficient to cooling stage discharge gas.	A3230 - Heat exchanger fouling or paraffin formation inside tube wall.
	A3230 - Cooling fan blade damaged.
	A3230 - Cooling fan bearing failure.
	A3260 - Heat exchanger fouling or paraffin formation inside tube wall.
	A3260 - Cooling fan blade damaged.
	A3260 - Cooling fan bearing failure.
Insufficient to cooling 1st stage discharge gas.	A3230 - M3230A/B/C/D motor bearing failure
	A3230 - Transmission belt failure
Insufficient to cooling 2nd stage discharge gas.	A3260 - M3260A/B/C/D motor bearing failure
	A3260 - Transmission belt failure
	TAHH3220 malfunction (1st suction)
	PAHH3226 & PALL3226 malfunction (1st discharge)
	TAHH3223 malfunction (1st discharge)
	PALL3253 malfunction (2nd suction)
	PALL3254 & PAHH3254 malfunction (2nd discharge)
	TAHH3253 malfunction (2nd discharge)
	PAHH3259 malfunction (2nd discharge)
	PDAHH3229 malfunction (PD discharge both stg)

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Function failure	**Failure mode**
Unable to run compressor smoothly due to spurious trip	TAHH3220 malfunction (1st suction)
	PAHH3226 & PALL3226 malfunction (1st discharge)
	TAHH3223 malfunction (1st discharge)
	PALL3253 malfunction (2nd suction)
	PALL3254 & PAHH3254 malfunction (2nd discharge)
	TAHH3253 malfunction (2nd discharge)
	PAHH3259 malfunction (2nd discharge)
	PDAHH3229 malfunction (PD discharge both stg)
Primary/secondary function	
To maintain emergency response-life saving-asset integrity	
Function failure	**Failure mode**
Unable to stop compressor safely, compressor reverse flow & reverse direction	EI3222, EI3252 (discharge check valve) and station valve stuck opened
Unable to depressurize process gas from the unit	BDV3251 malfunction
Primary/secondary function	
To maintain lube oil/ Liquid containment	
Function failure	**Failure mode**
Unable to maintain synthetic oil in GG package	T42100 Synthetic oil tank corrosion or deposits in tank
Unable to maintain lube oil in compressor package	Lube oil leakage due to T 42800 outside corrosion
	T42800 Lube oil leakage due to internal corrosion or deposit in tank.
Unable to seal lube oil in cool-down pump	P42850 mech-seal leakage

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Primary/secondary function	
To maintain process gas containment	
Function failure	**Failure mode**
GG unable to operated at desire speed/power	D42210 internal / outside corrosion
Unable to contain gas in the compressor effectively.	PSH42725 malfunction
Unable to operate compressor safely	D3210, D3240 - Internal Corrosion.
Unable to run compressor safely.	D3210, D3240 - External Corrosion.
	A3230, A3260 Internal / External Corrosion
Unable to seal gas in the compressor effectively.	Blockage in primary or secondary DGS vent lines
	DGS failure due to deterioration buffer gas
	Buffer fuel gas supply blockage due to strainer or check valve plugged.
	PDCV42710 malfunction
	PCV42725 malfunction
	No instrument air supply to DGS due to orifice plate plugged
	PDT42710 malfunction
	PDSL42710 malfunction
Primary/secondary function	
To maintain structural integrity	
Function failure	**Failure mode**
Oil cooling fan blade damage and fly away or possible tube damage	VSH42820, VSH42825 Vibration switch not activated

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Primary/secondary function	
To maintain the ignition integrity	
Function failure	**Failure mode**
Fire inside the package enclosure	Unable to fire protection in enclosure due to Faults from fire detectors or no fire suppression medium
Insufficient to fire fighting due to damper not fully closed.	Damper stuck opened.
Unable to alert when hot gas leakage in enclosure.	TSHH 42502 malfunction
Unable to control flame explosion.	Flame arrestor malfunction or internal corrosion
Unable to control flame explosion	Gas detector malfunction
Primary/secondary function	
To meet availability 98,5%	
Function failure	**Failure mode**
Short components life from high temperature expose	High temp alarm in enclosure due to ventilation fails
Turbine blade damage from fatigue life	GG blade damage from fatigue or hot path or corrosion
Turbine blade damage from fatigue life	PT blade fatigue damage

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Primary/secondary function	
To meet reliability 99%	
Function failure	**Failure mode**
Unable to indicate correct machine condition	Vibration displacement probes failure due to deterioration
	Vibration accelerometer failure due to deterioration
	Vibration seismic probe failure due to deterioration
Unable to indicate correct speed on GG or PT	Speed probes (eddy current) failure due to deterioration
Unable to indicate correct speed or key phasor for compressor	Vibration displacement probes failure due to deterioration
Unable to monitor or verify actual equipment condition.	PT 42215, 16, 17, 18 malfunction
	PI42230 malfunction
	TSL42211 malfunction
	PSL42173 malfunction
	PI42172 malfunction
	PDI42170 malfunction
	All gages (PI, PDI, TI, LG, FG) malfunction
Unable to protect compressor bearings failure when low lube oil pressure.	PSLL42843 malfunction
Unable to run compressor smoothly due to condition monitoring system faults	Bently Nevada system malfunction
Unable to run compressor smoothly due to spurious trip	LV3214 malfunction
	LAHH3211 malfunction
	SDV3210 malfunction
	PSV3230, PSV3258 passing
	LV3244 malfunction
	LAHH3241 malfunction

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Function failure	Failure mode
Unable to run compressor smoothly due to spurious trip	SDV3242 malfunction
	SDV3241 malfunction
	FV3250 (2nd stg anti-surge valve) malfunction
	FE3250 malfunction-Blockage or corrosion
	PSV3210 passing
	SDV3211 malfunction
	FE3220 malfunction
	FT3200 malfunction-stuck sticky
	TE3200-Fuel gas strainer blockage
Unable to run GG smoothly due to turbine control system faults	TCP system malfunction
Unable to stop lube oil emergency pump when oil pressure reach 1.8 bar	PSH42844 not activated

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4.1.13 Failure mode and local effects and consequences

Failure mode	Local & System effect-1	Local & System effect-2	Local & System effect-3	Consequence and Category	Recovery, class	Severity class
Bearing damaged or worn out from aging	Compressor trip	Possible shaft journal damaged.		C-Evident degraded operation capacity, No effects on HSE	2	D
Rotor dynamics problems: Shaft cracks, shaft bent, rubbing, impeller damaged, etc.	Catastrophic failure on compressor	Compressor trip from high vibration		C-Evident degraded operation capacity, No effects on HSE	2	D
Couplings failure, Misalignment	Compressor trip from high vibration.	Leads to bearing damages	Possible trip from over speed	C-Evident degraded operation capacity, No effects on HSE	2	D
Unable to fire protection in enclosure due to Faults from fire detectors or no fire suppression medium	GG trip.	Properties loss	Possible people endanger	A-Hidden safety and/or environment hazard	4	D
Fouling develop at compressor rotor	High discharge temp	Low throughput		C-Evident degraded operation capacity, No effects on HSE	2	D
Contaminates in synthetic oil degradation or oxidation.	Cause GG bearings damaged.			C-Evident degraded operation capacity, No effects on HSE	2	D
High vibration due foreign objects to GG from corrosion on vane mist separator, air intake and exhaust ducts	Damage compressor blades and high vibration may lead to GG trip.			C-Evident degraded operation capacity, No effects on HSE	2	D
GG compressor blade fouling	High T2	Low P3		C-Evident degraded operation capacity, No effects on HSE	2	D
Inlet filter blockage	Low mass rate, leads to high heat rate	High diff pressure across filter > 250 mmWG	High Temp pdc, low PCD	C-Evident degraded operation capacity, No effects on HSE	2	B
TE3200 - High ambient temp, leads to low mass rate	Low mass rate, leads to high heat rate	Possible T5 topping		C-Evident degraded operation capacity, No effects on HSE	2	A
Fuel gas blockage(offskid)	Fuel gas filter trip by LL trip. Alarm 29 Barg			C-Evident degraded operation capacity, No effects on HSE	2	B
FV44220 Control VV, fails close due to controller malfunction	Fuel gas fluctuated and may leads to GG trip.			C-Evident degraded operation capacity, No effects on HSE	2	B

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Failure mode	Local & System effect-1	Local & System effect-2	Local & System effect-3	Consequence and Category	Recovery, class	Severity class
XV42215 S/d/ VV, fails to stuck open or controller malfunction	Unable to start from isolation test function during ramp start up	Possible explosion due to incomplete purge		A-Hidden safety and/or environment hazard	4	D
XV42225 fails to function, Loss of fuel gas supply from FV42220,	Loss of fuel gas, leads to GG trip			C-Evident degraded operation capacity, No effects on HSE	2	C
TE3200 - Strainer (inlet fuel gas to GG) blockage	Loss of fuel gas, leads to GG trip			C-Evident degraded operation capacity, No effects on HSE	2	B
XV42211 malfunction due to loss of instrument air	Loss fuel gas to GG leads to low power GG	LP flare will receive more flow	Possible low fuel gas pressure	C-Evident degraded operation capacity, No effects on HSE	2	A
LSHH42211 not activate or stuck	Liquid fuel may carry over to GG			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
SDV42200 malfunction	If stuck closed, it is unable to start GG	No fuel gas into system		C-Evident degraded operation capacity, No effects on HSE	2	C
D42210 outside corrosion	Lead to fuel gas leakage or explosion			B-Evident safety and/or environment hazard	4	D
D42210 internal corrosion	Lead to fuel gas leakage			B-Evident safety and/or environment hazard	4	D
PSV42210 passing	Fuel gas leak to flare. But operators can close manual valve on down stream line.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	No
T5 malfunction or spread due to thermocouples deteriorated	Alarm on T5	It requires to replace thermocouples ASAP.		C-Evident degraded operation capacity, No effects on HSE	2	A
XV42211 malfunction	If stuck closed, possible liquid high level trip GG	If leakage during GG running, GG may be uncontrollable or performance drop.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
TE3200 - VSV control out of tolerances	To reduce GG speed cause lower production.	Compressor surge or more stress on 1st stage compressor blades may be presented.		C-Evident degraded operation capacity, No effects on HSE	2	A
TE3200 - Corrosion cracks on compressor blades or blade coating damaged.	Possibly broken compressor blades may cause catastrophic failure on GG.			C-Evident degraded operation capacity, No effects on HSE	2	D
PDSH42171 malfunction	No alert to operation when hydraulic oil filter blockage.	Reading on PI 42172 can be verified.	Filter blockage cause hydraulic oil pressure drop until PSL 42173 alarm.	E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A

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Failure mode	Local & System effect-1	Local & System effect-2	Local & System effect-3	Consequence and Category	Recovery, class	Severity class
ARV42162 clogged up	Air may be blockage in hydraulic oil supply.	It may cause fuel control system malfunction.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
PSV42160 passing	Hydraulic oil pressure dropped and fluctuated.	Fuel control system may be uncontrollable.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
PSV42110 passing	Lube oil pressure drop may lead to GG low lube oil pressure trip.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
T42130 (oil/air separator) damaged or clogged up	Air may plug in lube oil passage.	Insufficient lube oil to cooling and lubricating GG bearings lead to GG trip.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
PDSL42713 & 15 malfunction	It may cause permissive to start fails, lube oil pump.	Can not start compressor.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
TS3200 Gas starter failure	No throughput due to unable to operate			C-Evident degraded operation capacity, No effects on HSE	2	D
TE3200 - Starting gas turbine regulating valve system malfunction	Delay on start-up due to fix the regulator.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
A42145 & A 42820 - Cooling fan bearing failure.	Vibration switches may be activated to trip motor.	High temp in lube oil tank.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
A42145 & A42820 - Transmission belt or pulleys failure.	It may cause belt slip and pulleys worn out.	Vibration switches may be activated to trip motor.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
P42160 hydraulic pump failure	Fuel control valve not function and cause GG trip			C-Evident degraded operation capacity, No effects on HSE	2	D
A42145 & A42820 - Cooling fan failure.	Vibration switches may be activated alarm and trip motor.	High temp in lube oil tank.	Broken blade may hit cooler tubing, and possible it may cause oil leakage.	B-Evident safety and/or environment hazard	4	A
P42850 Filter blockage on discharge of cool down pump	Insufficient cooling PT may cause bearing cooking.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	No
PDI42855 incorrect reading at low side	No indication for filter blockage of cool down pump.	If actual filter blocked, insufficient cooling PT may occur.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	No
TSH42823 malfunction	No alert sent to operation when high lube oil temp. Consequently, more wear and tear on bearings may be presented.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	No

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M42820, 25 cooler fan motor bearing failure	High temp lube oil may cause insufficient cooling and lubricating GG bearings, lead to high deterioration of bearings.	May lead to belt damaged, high wear & tear of pulley.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	B
A3230 - M3230A/B/C/D motor bearing failure	Motor may trip from overload current.	High temp on 1st discharge gas.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
A3230 - Transmission belt failure	Motor may trip from overload current or underload current.	High temp on 1st discharge gas.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
A3260 - M3260A/B/C/D motor bearing failure	Motor may trip from over current.	Noisy to surroundings.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
A3260 - Transmission belt failure	Motor may trip from overload current or underload current.	Noisy to surroundings.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
A3230 - Heat exchanger fouling or paraffin formation inside tube wall.	High temp on 2nd stg suction gas.	Compressor performance drop.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
A3230 - Cooling fan blade damaged.	High temp on 2nd stg suction gas.	High vibration transmit to structure and equipment, it may cause fin tubes damaged.	People endanger	B-Evident safety and/or environment hazard	4	A
A3230 - Cooling fan bearing failure.	High vibration transmits to structure and equipment.	Possible motor tripped due to overload current.	High temp on 2nd stg suction gas.	C-Evident degraded operation capacity, No effects on HSE	2	A
A3260 - Heat exchanger fouling or paraffin formation inside tube wall.	High temp on discharge gas to glycol contactor.	Compressor performance drop.		C-Evident degraded operation capacity, No effects on HSE	2	A
A3260 - Cooling fan blade damaged.	High temp on discharge gas to glycol contactor.	High vibration transmits to structure and equipment, it may cause fin tubes damaged.	People endanger	B-Evident safety and/or environment hazard	4	B
A3260 - Cooling fan bearing failure.	High vibration transmits to structure and equipment.	Possible motor tripped due to overload current.	High temp on 2nd stg suction gas.	C-Evident degraded operation capacity, No effects on HSE	2	A
Damper stuck opened.	Possible loss of properties	Possible people endanger		A-Hidden safety and/or environment hazard	4	D
TE3200 - P42110 synthetic oil pump failure	Low lube oil pressure and lead to GG trip			C-Evident degraded operation capacity, No effects on HSE	2	D
TE3200 - P42140-43 Scavenge pumps failure	Oil sump temp increased, may lead to GG trip.			C-Evident degraded operation capacity, No effects on HSE	2	B

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PSV42246 passing	Too much hot oil bypass to synthetic oil tank	Scavenge pressure drop may lead to alarm.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	B
TCV42147 malfunction	High temp lube oil may cause insufficient cooling and lubricating GG bearings, may lead to GG trip.	High temp in lube oil tank.	Can isolate TCV and use bypass valve to manual control after cooled temp.	E-Hidden degraded operation/non-operation capability, No effect on HSE	3	B
A42145 & A42820 oil cooler fouling	High temp synthetic oil may cause insufficient cooling and lubricating GG bearings, lead to high deterioration of bearings.	High temp in lube oil tank.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
M 42820, M 42825 bearing failure	Motor may trip from over current.	Standby fan motor need to start immediately		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	No
PCV42840 malfunction	Lube oil header pressure may be fluctuated or hunting. It may cause lube oil pressure trip.			C-Evident degraded operation capacity, No effects on HSE	2	A
TV42821 malfunction	High lube oil temp. cause insufficient cooling and lubricating bearings. But it can do manual control when TV fault.	In case operators not action when TV faults, it may cause high temp lube oil trip.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
M42850 bearing failure	Insufficient lube oil to cool-down PT during shutdown.	Insufficient cooling PT may cause rotor bent.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	C
P42850 bearing failure	Insufficient lube oil to cool-down PT during shutdown.	Insufficient cooling PT may cause rotor bent.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	C
M42805 bearing failure	Motor may trip from overload current.	Lube oil pressure drop and standby pump will start up automatically		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	No
PCV42813 malfunction	Lube oil back pressure may be fluctuated or hunting. If high back pressure, it can relief pressure on PSV.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	C
VSH42820, VSH42825 Vibration switch not activated	No signal to stop motor may cause high vibration to structure and consequently damage equipment.	Lube oil temp may be high and lead to GG trip.	Possible oil spill	A-Hidden safety and/or environment hazard	4	A
P42610, water wash pump failure	Delay on offline water wash , to fix wash pump			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	No

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M42610 bearing failure, water wash pump	Delay to offline water wash , to fix wash pump			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
T42605 & T42600 tanks corroded or deposit in tanks.	Water wash leak to the external			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
Deposits on H42605 heater or heater poor performance	Rinsing water heat up insufficiently	insufficient cleaning efficiency		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
Contaminates in lube oil, mineral oil degradation or oxidation.	Cause PT and compressor bearings damaged.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	C
High temp alarm in enclosure due to ventilation fails	System will alarm	High temp enclosure trip		D-Evident but no effects on HSE, environment of operation	1	A
GG blade damage from fatigue or hot path or corrosion	GG possible total damage	Possible leads to fluid containment fails		B-Evident safety and/or environment hazard	4	D
PT blade fatigue damage	PT possible total damage	Possible leads to fluid containment fails		B-Evident safety and/or environment hazard	4	D
PSH42725 malfunction	If on high to alarm, it may be noise to operator.	If on low side, no action may cause loss of a lot of instrument air.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
Flame arrestor malfunction or internal corrosion	In case of fuel gas leakage, flame may explode to atm.			A-Hidden safety and/or environment hazard	4	A
Gas detector malfunction	If sensor faults, it cause erratic trip on the compressor.	No safeguarding when fuel gas leakage from DGS failure.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
BDV3251 malfunction	If stuck closed when unit need to depressurize, it need to open bypass valve to flare immediately	If leakage during operation, it cause loss of process gas to flare. But operators can close manual valve on down stream line.		A-Hidden safety and/or environment hazard	4	A
Vibration displacement probes failure due to deterioration	Sensitivity changes cause incorrect readings and dynamic response.	Probe tip may be broken and cause erratic fault or trip on the compressor.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
Vibration accelerometer failure due to deterioration	Sensitivity changes cause incorrect readings and dynamic response.	Spike vibration from failed probes may cause GG trip.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A

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Vibration seismic probe failure due to deterioration	Sensitivity changes cause incorrect readings and dynamic response.	Spike vibration from failed probes may cause GG trip.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
Speed probes (eddy current) failure due to deterioration	Sensitivity changes cause incorrect readings and dynamic response.	Another spare speed probe can be used.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
Vibration displacement probes failure due to deterioration	Sensitivity changes cause incorrect readings and dynamic response.	Less ability to detect machine condition.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
Lube oil leakage due to T 42800 outside corrosion	Lube oil spill to external may cause fire.			B-Evident safety and/or environment hazard	4	A
T42800 Lube oil leakage due to internal corrosion or deposit in tank.	Lube oil spill to external may cause fire.	Deposits in lube oil system often clog up the filter.		B-Evident safety and/or environment hazard	4	A
T42100 Synthetic oil tank corrosion or deposits in tank	Oil leakage to outside, often clog up in lube oil filters			B-Evident safety and/or environment hazard	4	D
PT 42215, 16, 17, 18 malfunction	2 of 3 voting shall have no effect on GG.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
PI42230 malfunction	No instrument to verify fuel flow and combustion performance			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	No
TSL42211 malfunction	No alert when fuel gas temp over 45 deg C.	Reading on TI 42210 can be verified.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	B
PSL42173 malfunction	No alert to operation when hydraulic oil supply faults.	Reading on PI 42172 can be verified.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
PI42172 malfunction	No reading on hydraulic oil pressure			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
PDI42170 malfunction	No reading on hydraulic filter diff pressure.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
All gages (PI, PDI, TI, LG, FG) malfunction	No corrected readings may cause misinformation for problem			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
XV3221 malfunction	Valve stuck closed during startup cause unable to balance compressor pressure and permissive to start compressor fails.	If valve leakage during operation, it will cause compressor performance drop		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
A42820 - Lube oil cooler fouling.	High lube oil temp. May cause insufficient cooling and lubricating bearings.			C-Evident degraded operation capacity, No effects on HSE	2	A

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D3210, D3240 - Internal Corrosion.	Combustible gas may leak to external and cause fire.			B-Evident safety and/or environment hazard	4	D
FV3220 (1st stg anti-surge valve) malfunction	It cause process surging and may be compressor trip from vibration.	Process down stream fluctuated		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	B
PSLL42843 malfunction	If not activate when low lube oil pressure, it may cause compressor bearings damaged.	No lube oil supply to cooling PT during shutdown. It may PT rotor bent.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
PSL42812 not activated	When lube oil pressure lower than 6.5 bar, automatic start standby pump is not functioned.	Unfortunately, if main pump failure and manual start standby pump not in time; compressor may trip from low lube oil pressure.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
D3210, D3240 - External Corrosion.	Combustible gas may leak to external and cause fire.			B-Evident safety and/or environment hazard	4	D
A3230, A3260 Internal / External Corrosion	Combustible gas may leak to external and cause fire.			B-Evident safety and/or environment hazard	4	D
Bently Nevada system malfunction	Compressor trip or can not start up.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
LSLL3242 not activated	No signal to close SDV3214.	LV3244 can be closed automatically or operators can close a manual valve as well.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
LV3214 malfunction	If stuck closed, operators need to open manual valve to drain header.	If stuck open, it can isolate the valve for maintenance or replace online.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
LAHH3211 malfunction	If not activate when high liquid, compressor trip from high vibration	If stuck on high level, it cause erratic fault or not permissive to start compressor.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
SDV3210 malfunction	If stuck closed, it cause unable to start compressor.	If stuck partially opened, it needs to close upstream ball valve.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A

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PSV3230, PSV3258 passing	Loss process gas and compressor performance drop. But operator can close manual valve on down stream line.	Noisy to surroundings.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	No
PALL3223 malfunction (1st suction)	Erratic signal may cause compressor trip.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
TAHH3220 malfunction (1st suction)	Erratic signal may cause compressor trip.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
PAHH3226 & PALL3226 malfunction (1st discharge)	Erratic signal may cause compressor trip.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
TAHH3223 malfunction (1st discharge)	Erratic signal may cause compressor trip.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
PALL3253 malfunction (2nd suction)	Erratic signal may cause compressor trip.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
PALL3254 & PAHH3254 malfunction (2nd discharge)	Erratic signal may cause compressor trip.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
TAHH3253 malfunction (2nd discharge)	Erratic signal may cause compressor trip.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
PAHH3259 malfunction (2nd discharge)	Erratic signal may cause compressor trip.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
PDAHH3229 malfunction (PD discharge both stg)	Erratic signal may cause compressor trip.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
LV3244 malfunction	If stuck closed, operators need to open manual valve to drain header.	If stuck open, it can isolate the valve for maintenance or replace online.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
LAHH3241 malfunction	If not activate when high liquid, compressor trip from high vibration	If stuck on high level, it may cause erratic alarm or trip on the compressor.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
SDV3242 malfunction	If stuck closed, high liquid level (LAHH3241) may cause compressor trip.	If stuck open, LV3244 (automatic closed drain to 2nd stg separator) and closed drain header lines can be closed by manual valves.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D

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SDV3241 malfunction	If stuck closed, it need fuel gas from well head supplying to GG.	If stuck partially opened when ESD active, gas can pass to blow down valve.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
FV3250 (2nd stg anti-surge valve) malfunction	It cause process surging and may be compressor trip from vibration.	Process down stream fluctuated		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	B
FE3250 malfunction-Blockage or corrosion	If erosion or corrosion caused oversize diameter, incorrect readings may cause anti-surge valve function improperly.	If blockage, it can not to run compressor.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	B
PSV3210 passing	Loss of process gas to flare. But it can close down stream line by manual valve (HV3210)			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
SDV3211 malfunction	Not open, can override signal to open SDV3210			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
FE3220 malfunction	If erosion and corrosion caused oversize diameter, incorrect readings may cause anti-surge valve function improperly.	If blockage, it can not to run compressor.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	B
FT3200 malfunction-stuck sticky	No effect to GG operation, only cannot do performance calculation.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
TE3200-Fuel gas strainer blockage	Insufficient fuel gas supplies to GG and PSL 42211 alarm on low pressure.	Possible GG trip or lower speed.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
PT42842 - PSL malfunction	If unit running, when low lube oil pressure PSL not activated to start standby pump, it may cause compressor trip.	If unit shutdown, when main lube oil pump cannot build pressure enough and standby pump not start, it may cause delay to start compressor.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
PSH42851 not activated	No status on cool down pump running properly is presented. But operators can verify its status with local PI42850 or PI42844.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	No
P42850 - F42855 filter blockage	Insufficient lube oil supply to cool down PT rotor during unit shutdown.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A

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Failure mode	Local & System effect-1	Local & System effect-2	Local & System effect-3	Consequence and Category	Recovery, class	Severity class
P42805 - F42830 & F42835 filter blockage	Insufficient lube oil supply may cause high bearing temp trip.	However, PDSH42831 activated alarm, operator need to switch over standby filter.		C-Evident degraded operation capacity, No effects on HSE	2	A
PDSH 42831 not activated	No status on lube oil filter blockage is presented.	If not switch over to standby filter in a proper time, insufficient lube oil supply may cause high bearing temp trip.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
TE3200-M42500(AC) bearing failure	Low pressure alarm and activated standby ventilation fan running, in worse case possible high temp in enclosure room trip.	In case motor overload trip, standby fan will start automatically.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
TE3200-M42502 (DC) bearing failure.	If loss of AC power, insufficient ventilation for cooling in enclosure room when GG shutdown.	High temp in enclosure room may cause failure on instrumentation.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	No
TE3200-FDP42500 stuck closed	Low pressure alarm and activated standby ventilation fan running.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	No
TSHH42502 malfunction	Erratic signal may cause compressor trip.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
TE3200-FSL42500 malfunction	Improper ventilation fan operation can not be presented.	High temp in enclosure room can be presented alternatively.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
PDSHH42501 malfunction	If over activated fault, it cause GG erratic trip.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
PDSL42508 malfunction	When ventilation fan fault, no signal to start standby vent fan.	High temp in enclosure room may cause GG trip.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
TE3200-FDP42503 stuck closed	High pressure in enclosure room.	High temp in enclosure room may cause GG trip.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
TCP system malfunction	GG trip or can not start up			C-Evident degraded operation capacity, No effects on HSE	2	D
Blockage in primary or secondary DGS vent lines	Insufficient cooling on DGS face, heat up to cause DGS failure.	Compressor trip.		C-Evident degraded operation capacity, No effects on HSE	2	C

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DGS failure due to deterioration buffer gas	Compressor trip.			C-Evident degraded operation capacity, No effects on HSE	2	D
Buffer fuel gas supply blockage due to strainer or check valve plugged.	PDSL 42710 activated alarm.	Dirt from process gas may pass to DGS and cause primary DGS failure.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	C
PDCV42710 malfunction	Operators have to open bypass valve immediately.	Dirt from process gas may pass to DGS and cause primary DGS failure.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
PCV42725 malfunction	Stuck open, PSH44725 activated alarm. Loss instrument air.	Stuck closed, buffer gas may leak to 2nd seal and gas contaminated lube oil.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
No instrument air supply to DGS due to orifice plate plugged	PDSL44713 & 14 activated alarm.	Stuck closed, buffer gas may leak to 2nd seal and gas contaminated lube oil.		C-Evident degraded operation capacity, No effects on HSE	2	A
PDT42710 malfunction	Improper control clean gas to against process gas leak to DGS			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
PDSL42710 malfunction	If not activated when true, it may cause no immediate action to verify the problem.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A
SDV3214 malfunction	If stuck closed, high liquid level (LAHH3211) may cause compressor trip.	If stuck open, LV3214 (automatic closed drain to 2nd stg separator) and closed drain header lines can be closed by manual valves.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
P42850 mech seal leakage	Lube oil spill to atm may cause fire.			B-Evident safety and/or environment hazard	**4**	A
LSL42801 malfunction	If stuck high and actual low level, it may cause lube oil pump run dry until motor trip.	If stuck low, during compressor startup sequences, main lube oil pump can not start due to impermissive from lube oil level fault.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
Igniter failure	No throughput due to unable to operate			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	D
EI3222, EI3252 (discharge check valve) and station valve stuck opened	Back pressure may cause compressor rotor reversal turning.	Possible DGS damaged.		E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A

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PSH42844 not activated	Not signal to stop cool down pump, it may cause hot pump running if not stop by manual.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	No
TSHH 42502 malfunction	Possibly damage or burn instruments and controls.			E-Hidden degraded operation/non-operation capability, No effect on HSE	3	A

5. Maintainable item and interval and maintenance technique

Interval	On line Off line Occasion	Resource	Maintenance strategy	Work description	Tag
daily	On line	*Prod*	On condition maint	1) Since it is A/B/C/D arrangement, to monitor and switchover is normal practice. 2) While switchover, replacement filter is a must. 3) However, there are automatic control valves to open a bypass line across the filters when blockage.	Fuel filter skid
daily	On line	*Prod*	On condition maint	Walk around observe for noise & temp profile from passing	PSV-3210
daily	On line	*Prod*	On condition maint	Daily, verify that no passing leak of anti surge valve at normal operation	FV-3220
daily	On line	*Prod*	On condition maint	Daily check& record lube oil temp and pressure.	PSV 42246
monthly	On line	*Prod*	On condition maint	1) Monthly measure record fuel gas pressure	TE-3200 - Fuel gas strainer
daily	On line	Mech	On condition maint	1) Walk around to observe noise of icing from high gas flow 2) Visual check at valve stem position 3) Recommend to install work instruction at local.	XV-42211
daily	On line	Mech	On condition maint	Monitor & record lube oil pressure (PI42125) and temp (TE42121).	P-42110 PI-42125 TE-42121
daily	On line	Mech	On condition maint	Monitor & record oil sump temp and sump discharge pressure.	P-42140 P-42141 P-42242 P-42103
daily	On line	Mech	On condition maint	Monitor & trending diff. temp between TI 42144 and TI 42145.	A-42145 TI-42144 TI-42145
daily	On line	Mech	On condition maint	Monitor PDI 42170 and PI 42172 in order to verify hydraulic pump problem.	P-42160 PSV-42160 PDI-42170 PI-42172

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daily	On line	Mech	On condition maint	1) Monitor for trending T5 element profile 2) Occasion planned to replacement	T5 element
daily	On line	Mech	On condition maint	Daily measure record seal buffer gas pressure and flow and vent pipe skin temp	DGS : buffer gas filter system
daily	On line	Mech	Scheduled overhaul	Walk around to observe any abnormal noise, vibration or belt tension.	M-42145 M-42845 A-3230 A-3260
daily	On line	Mech	On condition maint	1) Observe PDI42830 in order to monitor the filter blockage. 2) Change over filter and clean filter when PDSH42831 is alarmed	F-42830 F-42835 PDI-42830 PDSH-42831
daily	On line	Mech	On condition maint	Measure skin temp of gas vent pipe for trending	DGS FV-42710 FV-42711 PSE-42720 PSE-42723
daily	On line	Mech	On condition maint	Daily check & record for trending	PDI-42170
daily	On line	Mech	On condition maint	Daily, verify that no passing leak of anti surge valve at normal operation	FV-3250
daily	On line	Mech	On condition maint	Walk around inspection in order to find any corrosion or insulation damaged.	D-42210
monthly	On line	Mech	On condition maint	1) Vibration analysis and trend analysis. 2) Occasion to replace bearing from trend analysis	M-42820 M-42825
monthly	On line	Mech	On condition maint	1) Measure & record vibration analysis comparing to baseline spectrum. 2) Measure & record motor running current	M-42610
monthly	On line	Mech	On condition maint	Measure & record vibration	A-42145 A-42845
monthly	On line	Mech	On condition maint	1) Vibration analysis for motor of ventilation fan in order to check bearing faults. 2) Planned to replace ventilation fan from trend analysis	TE-3200, Enclosure ventilation fan
monthly	On line	Mech	On condition maint	1) Monitor TI3230 &TI3232 for trending. 2) Vibration analysis	A-3230 TI-3230/TI-3232 All bearings A-3260
monthly	On line	Mech	On condition maint	Vibration analysis and trend analysis.	M-42805 M-42810
monthly	On line	Mech	On condition maint	Monitor & trending diff. temp between	A-42820

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Interval	On line Off line Occasion	Resource	Maintenance strategy	Work description	Tag
				TI42812 and TI42820.	TI-42812, TI-42820
monthly	On line	Mech	On condition maint	Vibration analysis and trend analysis.	M-42820 M-42825
monthly	On line	Mech	On condition maint	1) Vibration analysis and trend analysis.	A-42145 A-42845
monthly	On line	Mech	On condition maint	1) Vibration analysis and trend analysis.	M-3230A/B/C/D
monthly	On line	Mech	On condition maint	1) Vibration analysis and trend analysis.	M-3260A/B/C/D
monthly	On line	Mech	On condition maint	1) In case abnormal noise or vibration, further vibration analysis comparing to baseline shall be performed. (If bearing faults founded, switching to use standby fan running and carry out recondition)	M-42500 M-42501
monthly	On line	Mech	On condition maint	Record data for trending	PI-42230
monthly	On line	Mech	On condition maint	Monitor & record lubeoil temp and pressure.	T-42130
monthly	On line	Mech	On condition maint	Walk around to observe any corrosion or insulation material damaged.	D-3210 D-3240
monthly	On line	Mech	On condition maint	Measure vibration and record for trending	M-42502
3 months	***Occasion***	Mech	On condition maint	1) Inspect and clean the strainer, replace as necessary	TE-3200
3 months	Off line	Mech	On condition maint	Carry out off line water wash per compressor performance monitoring.	TE-3200
6 months	***Occasion***	Mech	Scheduled overhaul	Visual inspection and measure/adjust belt tension	M-42145 M-42845 A-3230 A-3260
6 months	***Occasion***	Mech	Scheduled overhaul	Check and adjust belt tension or replace belt if required.	A-42145 A-42845
1 year	***Occasion***	Mech	On condition maint	Occasion, Inspect, clean or replace as necessary	DGS : buffer gas filter system
1 year	***Occasion***	Mech	Scheduled overhaul	Occasion planned to clean the heat exchanger from trend analysis	A-42820 TI-42812, TI-42820
1 year	***Occasion***	Mech	On condition maint	1) Occasion planned inherently with yearly borescope inspection, perform vibration analysis and trend analysis during compressor shutdown and cool-down pump running.	M-42850 P-42850
1 year	***Occasion***	Mech	Scheduled overhaul	Occasion planned inherently with half life inspection, clean strainer or replace if any damage.	TE-3200 - Fuel gas strainer

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1 year	***Occasion***	Mech	*Failure finding*	1) Check compressor drain piping to ensure no blockage or valve leakage before start	K-3200-Compressor drain valve
1 year	***Occasion***	Mech	On condition maint	1) Occasion planned inherently with bore scope inspection, inspect blade condition and belt tension or replace belt if required. 2) Visual check belt condition	A-3260 fan blade Drive belt
4 years	***Occasion***	Mech	Scheduled overhaul	Clean and check condition of ventilation fan blades	TE-3200, Enclosure ventilation fan
4 years	***Occasion***	Mech	Scheduled overhaul	Overhaul the starter by replacement by spare module then send to factory for recondition	TS-3200
4 years	***Occasion***	Mech	On condition maint	Visual inspection wash tank	T-42605 T-42600
4 years	***Occasion***	Mech	Scheduled overhaul	1) Occasion planned inherently with half life inspection, disassemble & clean or replace damaged parts if required. 2) Shutdown status inherent indicates the integrity	EI-3222 EI-3252
4 years	***Occasion***	Mech	On condition maint	Replace DGS when exhibit the rejection limit from the analysis	DGS
4 years	***Occasion***	Mech	Scheduled overhaul	Occasion planned inherently with half life inspection, to clean RO	RO-42726 RO-42727 PDSL-44713 & 14
4 years	***Occasion***	Mech	On condition maint	1) During compressor shutdown, check condition, performance on the cool-down pump. 2) Record PDI 42855 during cool down pump running. 3) Schedule replace or clean filter	P-42850 PDI-42855
4 years	***Occasion***	Mech	*Failure finding*	Occasion scheduled clean & calibrate	PI-42230
4 years	***Occasion***	Mech	*Failure finding*	During compressor shutdown, to observe and record PDI42855 in order to monitor filter blockage or deteriorated.	F-42855 PDI-42855
8 years	***Occasion***	Mech	Scheduled overhaul	Occasion, planned inherently with GG exchange to clean and inspect internal tubing.	A-3230 TI-3230/TI-3232 A-3260
8 years	***Occasion***	Mech	Scheduled overhaul	Occasions planned inherently with GG exchange, clean and inspect, replace damaged parts if required.	TEK-3200 , Flame arrester
10 years	Off line	Mech	Corrective maint	1) Monitor pump discharge pressure during water wash and plan to repair when washed pressure drop	P-42610
6 months	***Occasion***	***Elect***	Scheduled overhaul	Service motor bearings and observe any noise and vibration as standard motor maintenance.	M-42500 M-42501

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1 year	***Occasion***	***Elect***	On condition maint	1) Clean or replace heater.	H-42605
1 year	***Occasion***	***Elect***	Scheduled overhaul	Grease motor bearings and observe any noise and vibration.	M-42502
4 years	***Occasion***	***Elect***	Scheduled overhaul	Occasion planned to replace bearings from trending as necessary	M-42805 M-42810
4 years	***Occasion***	***Elect***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	PSH-42844
4 years	***Occasion***	***Elect***	*Failure finding*	Function test to verify the function	M-42502
daily	On line	***Instr***	On condition maint	1) Monitor lube oil temp in oil tank (TI 42100) 2) to monitor and record oil temp at oil passage.	TCV-42147 TI-42100
monthly	On line	***Instr***	On condition maint	Visual check for noise and temp profile from internal passing leak	PSV-3220 PSV-3258
6 months	***Occasion***	***Instr***	*Failure finding*	Surge stimulation to verify anti-surge function	Anti-surge function, FE-3220, FT-3221, FT-3220, EI-3220
1 year	***Occasion***	***Instr***	Scheduled overhaul	1) Occasion to clean the heat exchanger from trend analysis 2) Calibrate and function test instrument	A-42145 TI-42144 TI-42145
1 year	***Occasion***	***Instr***	On condition maint	Check calibration or Replace Temp sensors if required.	T5 element
1 year	***Occasion***	***Instr***	*Failure finding*	1) Clean and check calibration of the vibration switch. 2) Verify the function.	VSH-42820 VSH-42825
1 year	***Occasion***	***Instr***	*Failure finding*	1) Function test & calibration of flame detectors, heat detectors, gas detectors, etc. 2) Check and test fire extinguishing system. 3) Verify Fire suppression are ready for function	BE-42500/01 HD-42500-04 GD-42500
1 year	***Occasion***	***Instr***	*Failure finding*	1) Inspect and Clean fire dampers. 2) Lubricate and function test on fire dampers and actuator and related system.	TE-3200-Fire damper
1 year	***Occasion***	***Instr***	*Failure finding*	1) Clean, check calibration and function test	LAHH-3211 LG-3213
1 year	***Occasion***	***Instr***	*Failure finding*	1) Check calibration and function test.	GD-42700 GD-42710 GD-42720 GD-42730
1 year	***Occasion***	***Instr***	*Failure finding*	1) Occasion, When compressor shutdown, record PDI 42855 during cool down pump running. 2) If stuck or improper reading, to calibrate or replace is required.	PDI-42855
1 year	***Occasion***	***Instr***	*Failure finding*	Check calibration and function test.	TSH-42823
1 year	***Occasion***	***Instr***	*Failure finding*	Check calibration and function test.	PSH-42725

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1 year	*Occasion*	*Instr*	*Failure finding*	Occasion planned inherently with borescope inspection, check calibration and function test.	SDV-3214
1 year	*Occasion*	*Instr*	*Failure finding*	Occasion planned inherently with borescope inspection, check calibration and function test.	PT-3223 PI-3222
1 year	*Occasion*	*Instr*	*Failure finding*	Occasion planned inherently with borescope inspection, check calibration and function test.	TT-3220 TI-3220
1 year	*Occasion*	*Instr*	*Failure finding*	Occasion planned inherently with borescope inspection, check calibration and function test.	PT-3226 PT-3225 PI-3224
1 year	*Occasion*	*Instr*	*Failure finding*	Occasion planned inherently with borescope inspection, check calibration and function test.	TT-3223 TT-3222
1 year	*Occasion*	*Instr*	*Failure finding*	Occasion planned inherently with borescope inspection, check calibration and function test.	PALL-3253
1 year	*Occasion*	*Instr*	*Failure finding*	Occasion planned inherently with borescope inspection, check calibration and function test.	PALL-3254
1 year	*Occasion*	*Instr*	*Failure finding*	Occasion planned inherently with borescope inspection, check calibration and function test.	TAHH-3253
1 year	*Occasion*	*Instr*	*Failure finding*	Occasion planned inherently with borescope inspection, check calibration and function test.	PAHH-3259
1 year	*Occasion*	*Instr*	*Failure finding*	Function test (1 yearly)	SDV-3210 SDV-3211 PDH-3212, inlet check valve
4 years	*Occasion*	*Instr*	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test or overhaul if required.	P-2160
4 years	*Occasion*	*Instr*	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test or overhaul if required.	XV-42215 P-42216-18
4 years	*Occasion*	*Instr*	Scheduled overhaul	To scheduled overhaul fuel metering valve train	FV-42215 FV-42220 XV-42225 XV-42230
4 years	*Occasion*	*Instr*	*Failure finding*	Occasion planned inherently with half life inspection, clean & check calibration and function test.	LSH-42211 LG-42210
4 years	*Occasion*	*Instr*	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	SDV-42200
4 years	*Occasion*	*Instr*	Scheduled overhaul	1) Replace all instrument filters. .2) Check calibration or function test. 3)	SOV-42251 PCV-42252

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Interval	On line Off line Occasion	Resource	Maintenance strategy	Work description	Tag
				Inspect and clean the valves and orifices as necessary	SOV-42253 SOV-42256 PCV-42257 XV-42250 FV-42255
4 years	***Occasion***	***Instr***	*Failure finding*	Function test and calibrate	HD-42500 to 04 TSHH-42501 TSHH-42502
4 years	***Occasion***	***Instr***	Scheduled overhaul	1) Occasion planned inherently with half life inspection, check calibration and function test.	LSLL-3242
4 years	***Occasion***	***Instr***	*Failure finding*	1) Occasion planned inherently with half life inspection, 2) Check calibration and function test.	LV-3214 SDV-3214
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration	SDV-3210 SDV-3211 PDH-3212, inlet check valve PI-3210
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion, planned inherently with half life inspection, check calibration and function test.	FV-3220
4 years	***Occasion***	***Instr***	*Failure finding*	1) Occasion planned inherently with half life inspection, check calibration and function test.	XV-3221
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	XV-42211
4 years	***Occasion***	***Instr***	Scheduled overhaul	1) Occasion planned inherently with half life inspection, check calibration and function test. 2) Measure & record oil pressure	PCV-42813 PI ???
4 years	***Occasion***	***Instr***	Scheduled overhaul	Occasion planned inherently with half life inspection, check calibration and function test.	PCV-42840
4 years	***Occasion***	***Instr***	Scheduled overhaul	1) Occasion planned inherently with half life inspection, clean and calibrate.	TV-42821 TIC-42821
4 years	***Occasion***	***Instr***	Scheduled overhaul	1) Occasion check any blockage and clean the vent lines. 2) Inspect, clean and adjust needle valves properly. 3) Inspect and clean rupture disc or replace if required.	DGS FV-42710 FV-42711 PSE-42720 PSE-42723
4 years	***Occasion***	***Instr***	Scheduled overhaul	Occasion planned inherently with half life inspection, check calibration and function test.	PDCV-42710
4 years	***Occasion***	***Instr***	Scheduled overhaul	Occasion planned inherently with half life inspection, check calibration and function test.	PCV-42725
4 years	***Occasion***	***Instr***	Scheduled overhaul	1) Yearly borescope inspection, inspect & clean spark plugs. 2) Replace if spark gap out of tolerance. 3) Function test on	TE-3200, Igniter

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Interval	On line Off line Occasion	Resource	Maintenance strategy	Work description	Tag
				igniter system.	
4 years	***Occasion***	***Instr***	*Failure finding*	Clean and function test	PSLL-42843
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	LSL-42801
4 years	***Occasion***	***Instr***	Scheduled overhaul	Occasion planned inherently with half life inspection, check calibration and function test.	PSL-42812
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion, planned inherently with half life inspection, check calibration and function test.	PT-42215 PT-42216 PT-42217 PT-42218
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	TSL-42211 TI-42210
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	PSL-42173 PI-42172
4 years	***Occasion***	***Instr***	*Failure finding*	Record data for trending.	PI-42172
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	PDSH-42171 PI-40172
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	PDI-42170
4 years	***Occasion***	***Instr***	*Failure finding*	Occasions planned inherently with half life inspection, clean & inspect, replace damaged parts if required.	ARV-42162
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	PSV-42160
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	PSV-42110
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	PDSL-42713 PDSL-42715
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	PDT-42710
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	PDSL-42710
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	PDAHH-229
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	LV-3244 SDV-3242

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Interval	On line Off line Occasion	Resource	Maintenance strategy	Work description	Tag
4 years	***Occasion***	***Instr***	*Failure finding*	Clean, check calibration and function test on Occasion planned inherently with half life inspection.	LAHH-3241 LG-3243
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	SDV-3241 SDV-3242
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	FV-3250 FE-3250
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion Check calibration and function test.	SDV-3211
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, clean and check calibration.	FT-3200
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	PT-42842 PSL-42842 PAL-42842 PI-42842 PI-42841
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	PSL-42851
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	PSH-42831
4 years	***Occasion***	***Instr***	Scheduled overhaul	1) Operation inherent indicates the status 2) Occasion to lubricate the moving parts and function test	FDP-42500 FDP-42501 FDP-42502 SOV-42500 SOV-42501 SOV-42502
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	TSHH-42502 TSH-42501
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	FSL-42500 FSL-42501 FSL-42502
4 years	***Occasion***	***Instr***	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	PDSH-42501 PDSHH-42502 PDSHH-42503
4 years	***Occasion***	***Instr***	*Failure finding*	1) Occasion planned inherently with half life inspection, check calibration and function test.	PDSL-42508 PDI-42507
4 years	***Occasion***	***Instr***	Scheduled overhaul	1) Occasion planned inherently with half life inspection, check calibration and function test. 2) Lubricate moving parts and function test	FDP-42503 FDP-42504 SOV-42503 SOV-42504
8 years	***Occasion***	***Instr***	On condition maint	Clean, disassemble to inspect and replace damaged parts Calibration test as required as standard RV certification.	PSV-3210
8 years	***Occasion***	***Instr***	Scheduled overhaul	Occasion planned inherently with half	PSV-42210

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Interval	On line Off line Occasion	Resource	Maintenance strategy	Work description	Tag
				life inspection, clean and calibrate.	
8 years	*Occasion*	*Instr*	Scheduled overhaul	Occasions planned inherently with GG exchange, clean & inspect and calibrate.	PSV-42246
8 years	*Occasion*	*Instr*	Scheduled overhaul	Occasions planned inherently with GG exchange, clean and check calibration.	PSV-3220 PSV-3258
8 years	*Occasion*	*Instr*	Scheduled overhaul	1) Occasion planned inherently with half life inspection, check calibration and function test. 2) Static or dynamic test for probe sensitivity calibration.	VE-42402-5 VE-2840-3 ZE-42400-1 ZE-42840, 2
8 years	*Occasion*	*Instr*	Scheduled overhaul	1) Occasion planned inherently with half life inspection, check calibration and function test. 2) Check probe sensitivity on vibration exciter.	VE-42300 VE-42301 VE-42302
8 years	*Occasion*	*Instr*	Scheduled overhaul	1) Occasion planned inherently with half life inspection, check calibration and function test. 2) Check probe sensitivity on vibration exciter.	VE-42400 VE-42401
8 years	*Occasion*	*Instr*	Scheduled overhaul	Occasion planned inherently with half life inspection, check calibration and function test.	SE-42840
8 years	*Occasion*	*Instr*	Scheduled overhaul	Occasion planned inherently with half life inspection, check calibration and function test.	SE-42301-2 SE-42401-3
8 years	*Occasion*	*Instr*	Corrective maint	Occasion planned inherently with half life inspection, check calibration and function test.	TCP System
8 years	*Occasion*	*Instr*	Corrective maint	Occasion planned inherently with half life inspection, check calibration and function test.	Vibration system "Bently Nevada System"
8 years	*Occasion*	*Instr*	*Failure finding*	Clean, check diameter, calibrate and function test.	FE-3220 FT-3221 FT-3220 EI-3220
8 years	*Occasion*	*Instr*	*Failure finding*	Occasion planned inherently with half life inspection, check calibration and function test.	BDV-3251 RO-3251
monthly	On line	Specialist	On condition maint	Perform vibration analysis, trend analysis on related parameters and performance analysis.	TE3200-Vibration monitoring system
3 months	On line	Specialist	On condition maint	1) Take lube oil sampling and oil analysis. 2) Recommended RBOT analysis of oil degradation if possible	T-42100-Oil sampling
3 months	On line	Specialist	On condition maint	1) Take lube oil sampling and oil analysis. 2) Recommended RBOT analysis of oil degradation is required. 3) Metal chip analysis	T-42800-Oil sampling
3 months	On line	Specialist	On condition maint	1) Monitor VSV angle and observe its trending in order to predict time for VSV replacement. 2) Measure and record GG performance	TE-3200 - VSV control

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Interval	On line Off line Occasion	Resource	Maintenance strategy	Work description	Tag
1 year	***Occasion***	Specialist	Scheduled overhaul	Carry out RBI fan blades to check any cracks or damage.	A-42145 A-42845
1 year	***Occasion***	Specialist	On condition maint	1) Collect transient vibration during startup and shutdown in order to perform rotor dynamics analysis on Occasion planned inherently with yearly borescope inspection, 2) Occasion planned to replace the bearing as necessary	TE-3200-Vibration monitoring system
1 year	Off line	Specialist	Scheduled overhaul	Perform bore scope inspection	TE-3200
4 years	***Occasion***	GE	Scheduled overhaul	Occasion half life inspection: to overhaul (done by GE).	P-42110
4 years	***Occasion***	GE	Scheduled overhaul	Occasion during half life inspection, pump overhaul done by GE.	P-42160 PSV-42160
4 years	***Occasion***	Specialist	Scheduled overhaul	Occasion planned inherently with half life inspection, check calibration or replace VSV control.	TE-3200 - VSV control
4 years	***Occasion***	Specialist	Scheduled overhaul	1) Occasion planned inherently with half life inspection, inspect air intake and exhaust ducts, all frame structures. 2) Check condition or replace all seal gaskets, acoustic thermal insulation. 3) Check any drain piping to ensure no any plug. 4 Check any loose part or corroded	TE-3200, Air intake and Exhaust Ducts
4 years	***Occasion***	Specialist	On condition maint	1) Perform vibration monitoring. 2) Opportunity planned to inspect couplings condition and looseness and check alignment.	K-3200 PGT-3200 Vibration monitoring system
4 years	***Occasion***	Specialist	On condition maint	1) Occasion planned inherently with half life inspection, check calibration and function test.	A-3230, fan blade
4 years	Off line	Specialist	On condition maint	Blade inspection & assessment	TE-3200
4 years	***Occasion***	GE	Scheduled overhaul	Half life inspection, equipment overhaul done by GE.	T-42130
4 years	***Occasion***	Specialist	On condition maint	Carry out RBI shell thickness	D-3210 D-3240
4 years	***Occasion***	Specialist	On condition maint	Occasion planned inherently with half life inspection, clean and inspect.	A-3230 A-3240
5 years	On line	Specialist	On condition maint	Carry out RBI (Note: Stainless steel drum.)	D-42210
5 years	On line	Specialist	On condition maint	Carry out RBI oil tank thickness.	T-42100
5 years	On line	Specialist	On condition maint	Carry out RBI tank shell thickness	T-42800
6 months	***Occasion***	Specialist	*Failure finding*	Stimulate surge to verify the Anti surge function	Anti surge function, FV-3220
6 months	***Occasion***	Specialist	*Failure finding*	Stimulate surge to verify anti surge integrity	Anti surge function, FV-3250, FE-3250
8 years	***Occasion***	GE	Scheduled overhaul	Occasion GG exchange to replace pump (done by GE).	P-42140 P-42141 P-42242 P-42103

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Interval	On line Off line Occasion	Resource	Maintenance strategy	Work description	Tag
8 years	***Occasion***	Specialist	On condition maint	Occasion planned inherently with half life inspection; perform internal cleaning and inspection (RBI, check wall thickness and corrosion rate, etc.).	D-3210 D-3240
8 years	***Occasion***	Specialist	On condition maint	Visual inspection and clean if necessary	T-42800
8 years	Off line	Specialist	***Scheduled replacement***	Exchange GG , Inherently , inspect power turbine for life assessment	Gas generator
8 years	***Occasion***	GE	On condition maint	Life assessment during removing/exchange GG	Power turbine
10 years	Off line	***Instr***	***Redesign***	Redesign to alarm instead of shutdown	TT-3220 TI-3220
10 years	Off line	Specialist	***Redesign***	Redesign to relocate buffer gas off-take point to the final discharge line	DGS
10 years	Off line	Specialist	***Redesign***	Consider to cool inlet air temp or steam injection as power augmentation	Gas generator
10 years	Off line	Specialist	***Redesign***	Redesign online water wash to extend off line water wash interval	TE-3200
10 years	Off line	Specialist	***Redesign***	Redesign gas compressor on line washing using ZOC 27	K-3200-Compressor

6. Manpower and Resources

Estimated manpower and resources for each turbocompressor in loop of 8-10 years life cycle are as follows:

Turbocompressor (only one unit - TEK3200):	**Avg. Man-hr/year (loop of 8-10 years life cycle)**
Prod	255.5
Mech	1813.7
Elect	7.8
Instr	202.2
Specialist	173.2

Note: Manpower will be based on estimated effective work only (not included preparation, downtime and contingency works).
4 years interval will be turnaround period that may be extended to 5-6 years.

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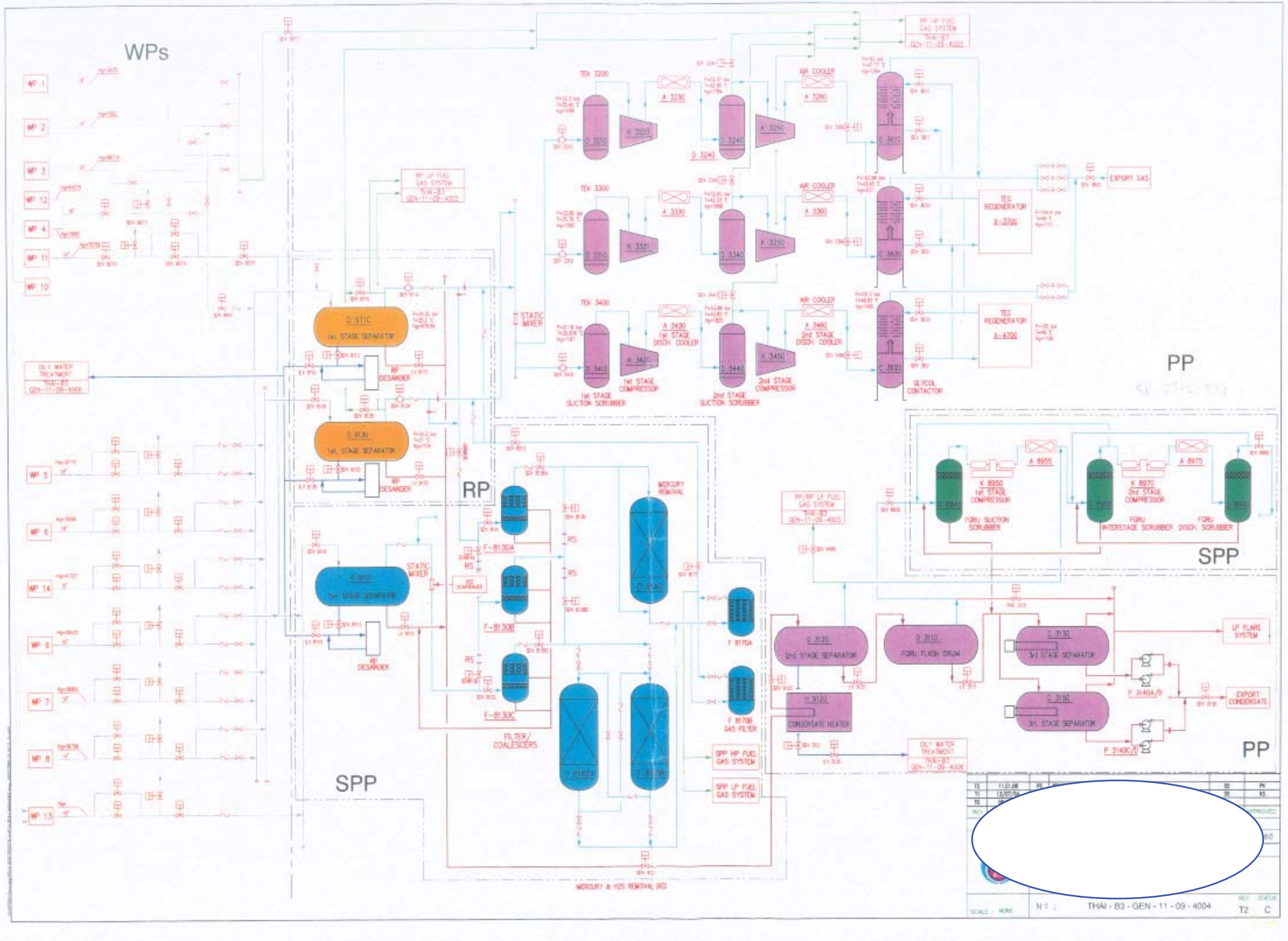
7. Attachments

All information of Turbocompressor - RCM had been kept in a spread sheet (Excel file) Additionally concerned information also kept together in the same CD addressed accordingly.

- Drawings: PFD, P&ID
- Data Sheets: Gas Turbine & Compressor
- Drawings: Schematic Diagrams (LM2500 & NP compressor)
- Cross-sectional drawings: Gas turbine & Compressor
- Daily Log Sheets
- Lube Oil Analysis
- GT Compressor Cleaning


WPs
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WP 2
WP 3
WP 12
WP 4
WP 11
WP 10
WP 5
WP 6
WP 14
WP 9
WP 7
WP 8
WP 13
RP
SPP
PP
PP
SPP
STATIC MIXER
1st STAGE SEPARATOR
RP DESANDER
MP DESANDER
OILY WATER TREATMENT
MERCURY REMOVAL
FILTER/ COALESCERS
MERCURY & H2S REMOVAL (M3)
TEK 3200
TEK 3300
TEK 3400
AIR COOLER
1st STAGE SUCTION SCRUBBER
2nd STAGE SUCTION SCRUBBER
1st STAGE COMPRESSOR
2nd STAGE COMPRESSOR
1st STAGE DISCH. COOLER
2nd STAGE DISCH. COOLER
GLYCOL CONTACTOR
TEG REGENERATOR
EXPORT GAS
K 8950 1st STAGE COMPRESSOR
K 8970 2nd STAGE COMPRESSOR
FORU SUCTION SCRUBBER
FORU INTERSTAGE SCRUBBER
FORU DISCH. SCRUBBER
2nd STAGE SEPARATOR
FORU FLASH DRUM
3rd STAGE SEPARATOR
3rd STAGE SEPARATOR
CONDENSATE HEATER
GAS FILTER
SPP HP FUEL GAS SYSTEM
SPP LP FUEL GAS SYSTEM
LP FLARE SYSTEM
EXPORT CONDENSATE
THAI - B3 - GEN - 11 - 09 - 4004
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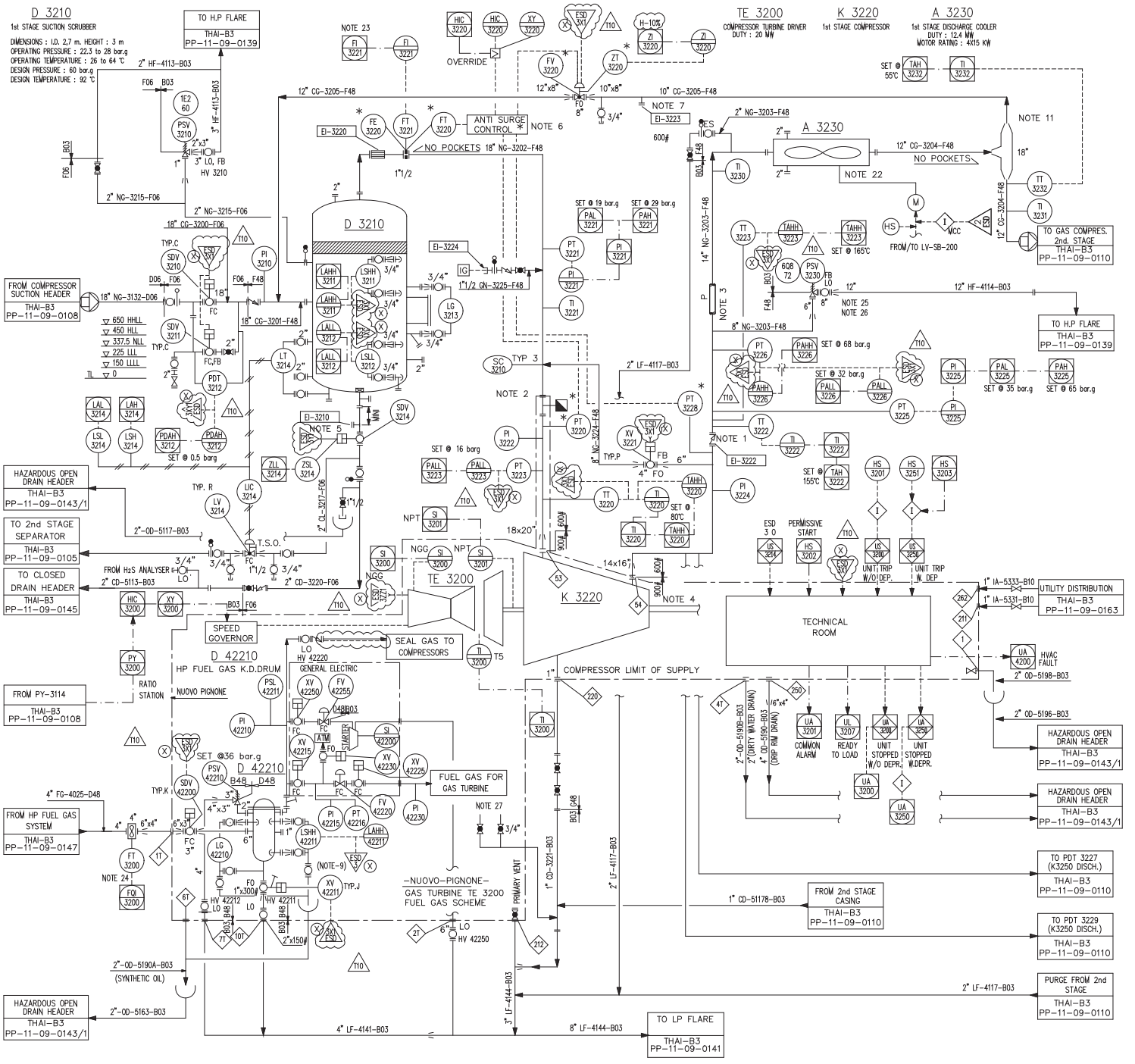


NOTES

1 – NON–SLAM CHECK VALVE
2 – WITCH HAT TYPE STRAINER ON REMOVABLE SPOOL PIECE.
3 – INSULATION FOR PERSONNEL PROTECTION (PP)
4 – COMPRESSORS K 3220 & K 3250 ARE GAS TURBINE DRIVEN ON COMMON SHAFT
5 – PROVISION FOR CORROSION INHIBITOR INJECTION
6 – ANTISURGE CONTROL IN TURBO COMP. TECHNICAL ROOM
7 – FOR MeOH INJECTION (PROVISION ONLY)
8 – CANCELLED
9– DRAIN POT CLOSE TO TE 3200
10 – VALVE FOR FUEL GAS LINE PURGE BEFORE START UP, ACTUATED BY GAS TURBINE START UP SYSTEM
11 – HIGH POINT
12 – DELETED.

13 – NOT USED

14 – NOT USED

15 – NOT USED

16 – INSTRUMENT HOOK UP WILL BE DONE ACCORDING TO SINGLE VALVE MOUNTING SCHEME
17 – DELETED
18 – NOT USED
19 – NOT USED
20 – NOT USED

21 – ESD 3 SHUTDOWN THRU PLC SYSTEM SUPPLIED BY COMPRESSOR VENDOR FOR ITEMS MARKED (X)

22 – THE FOLLOWING I/O LIST DETAILS INCLUDED FOR EACH MOTOR OF A3230. (TOTAL 4 NOS.)
– RUN/STOP STATUS
– FAULT STATUS. FOR TYPICAL DETAILS REFER TO LEGEND SHEET, GEN–2002.

23 – LOOP WITH PRES/TEMP COMPENSATION USING PI–3221 AND TI–3220.

24 – LOOP WITH PRES/TEMP COMPENSATION USING PI–4010 AND TI–4043 B.

25 – FB VALVE IS FLANGED TO PSV FLANGE AND REDUCER 8"x12" IS DIRECTLY DOWNSTREAM VALVE

26 – DELETED

INSTRUMENTS SUPPLIED BY COMPRESSOR SUPPLIER ARE SHOWN AS : * OR

27 – LIQUID DRAIN FROM AUTOMATIC TRAPS INSIDE GAS COMPRESSION SYSTEM.

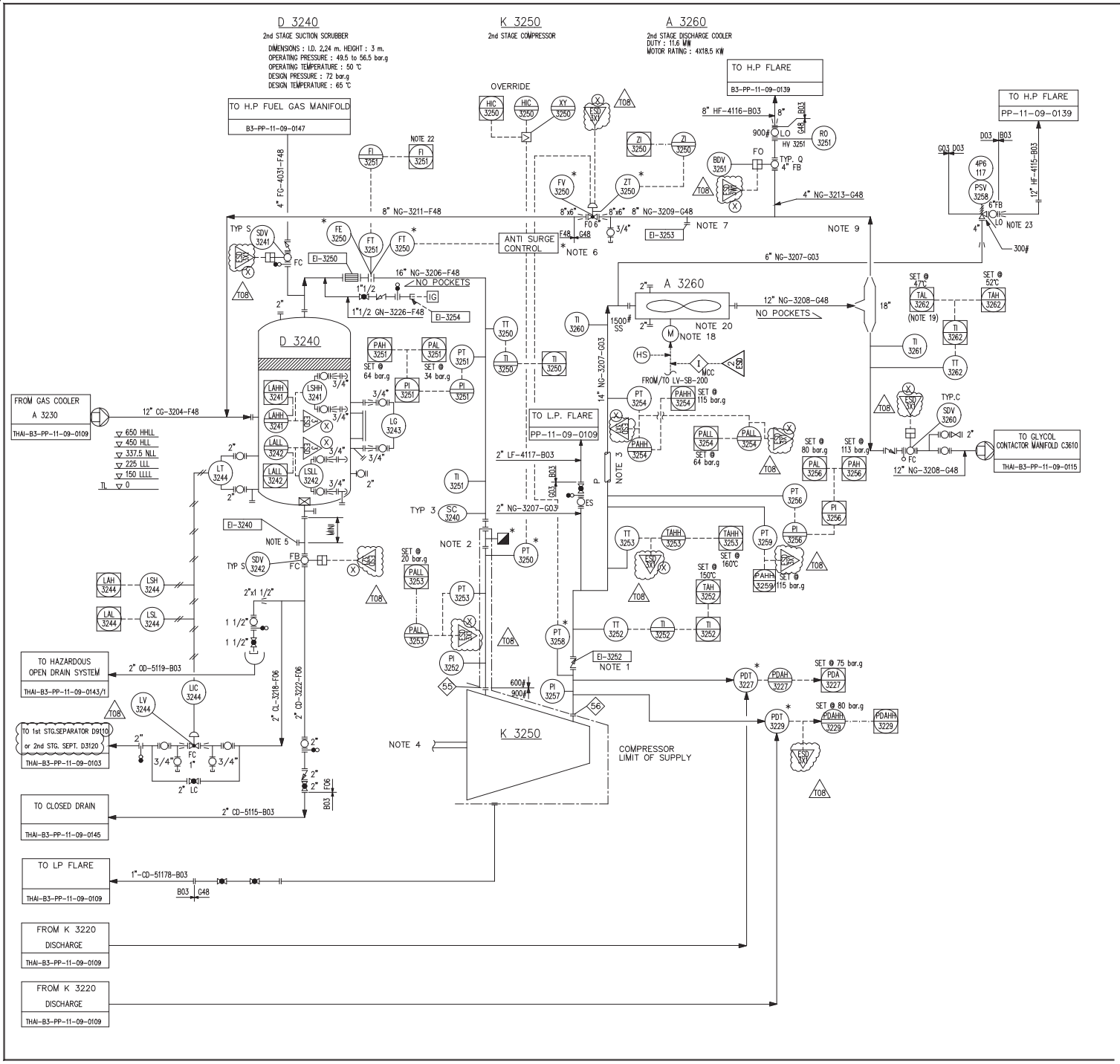
– 2" NG–3503–F48 (DISCHARGE COMPRESS TO LP FLARE) IS LOCATED U/S OF A3230 (D/S TI 3230)

– PT 3225 IS LOCATED D/S OF TT 3222

– PT 3226 IS LOCATED D/S OF PT 3225

– SC 3710 IS LOCATED D/S TI 3221

– IG 1 1/2" GN–3225–F48 IS LOCATED U/S TI 3221



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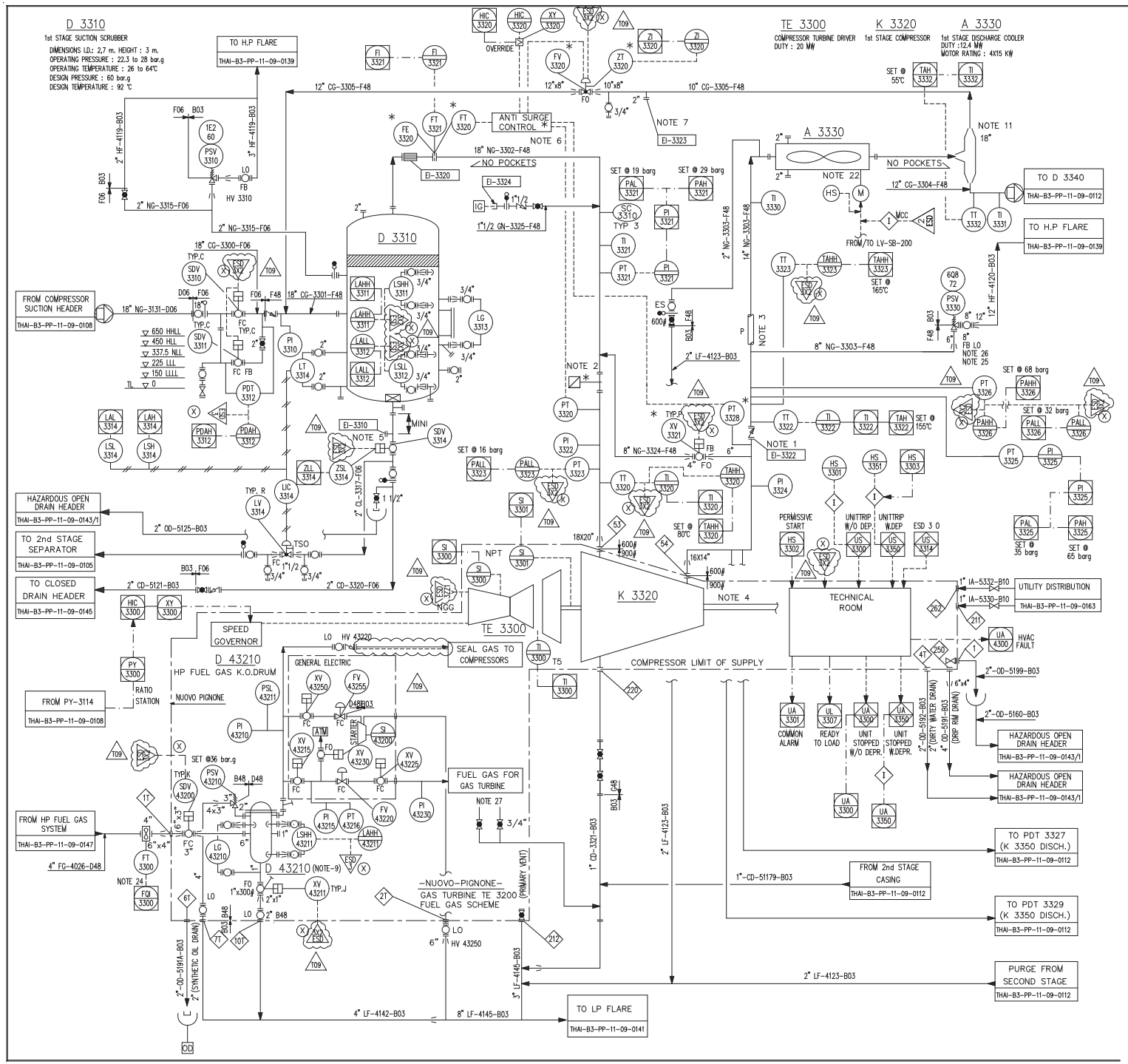
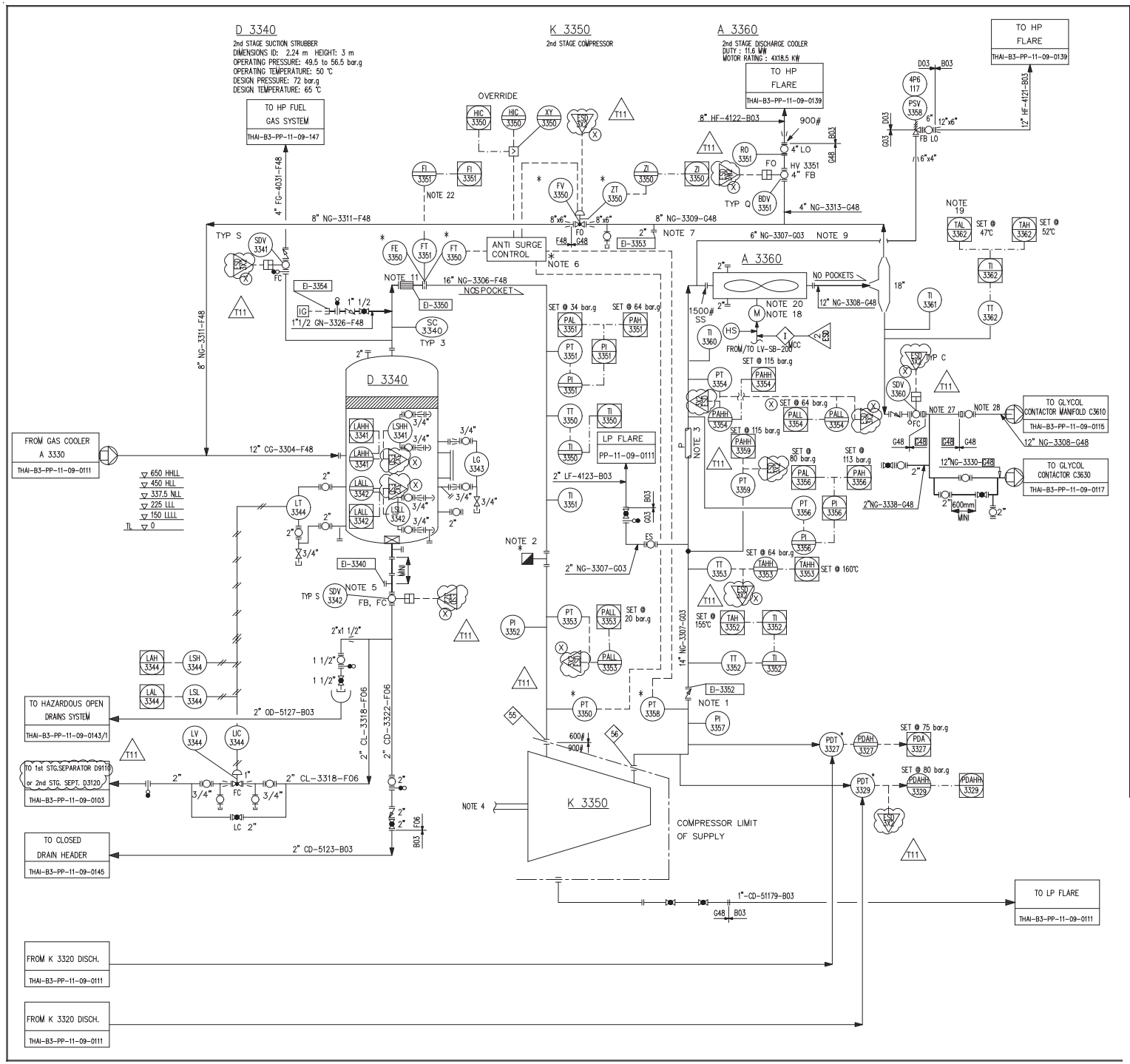
4 – COMPRESSORS K 3220 & K 3250 ARE GAS TURBINE DRIVEN ON COMMON SHAFT
5 – PROVISION FOR CORROSION INHIBITOR INJECTION
6 – ANTISURGE CONTROL IN TURBO COMP. TECHNICAL ROOM
7 – FOR MeOH INJECTION
8 – CANCELLED
9 – HIGH POINT
10 – DELETED.
11 – NOT USED
12 – F48 SINGLE VALVE INSTRUMENT HOOK–UP
G48 DOUBLE VALVE INSTRUMENT HOOK–UP
13 – DELETED
14 – NOT USED
15 – NOT USED
16 – NOT USED
17 – ESD 3 SHUTDOWN THRU PLC SYSTEM SUPPLIED BY COMPRESSOR VENDOR FOR ITEMS MARKED (X)
18 – THE FOLLOWING I/O LIST DETAILS INCLUDED FOR EACH MOTOR OF A3260. (TOTAL 4 NOS.)
– ON/OFF STATUS
– FAULT STATUS. FOR TYPICAL DETAILS REFER TO LEGEND SHEET.
19 – WITH OPERATING PRESSURES GREATER THAN OR EQUAL TO 110 BAR.G, IF TEMPERATURE FALLS BELOW 45°C AT FV–3250 INLET, HYDRATES MAY FORM. HENCE TAL 3262 IS SET AT 47°C.
20 – DURING START–UP, A3260 MOTORS MAY HAVE TO BE STOPPED, TO PREVENT HYDRATES ACROSS FV–3250 DUE TO EXCESSIVE COOLING.
21 – NOT USED
22 – LOOP WITH PRES/TEMP COMPENSATION USING PI–3251 AND TI–3250.
23 – FB VALVE IS FLANGED TO PSV FLANGE AND REDUCER 6x12" IS DIRECTLY DOWNSTREAM VALVE.
24 – DELETED
25 – DELETED
26 – DELETED

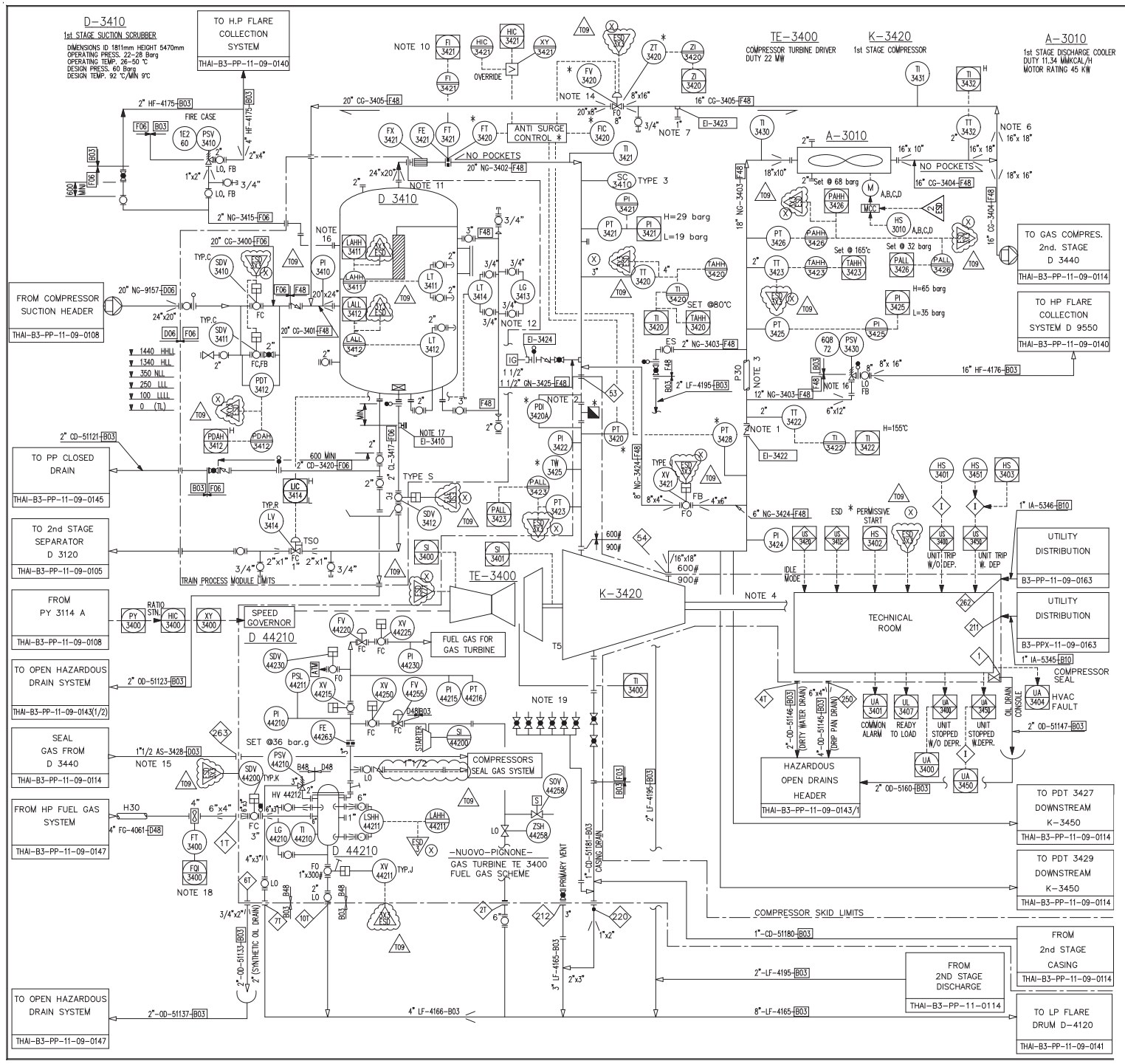

D 3310
1st STAGE SUCTION SCRUBBER
DIMENSIONS I.D.: 2,7 m. HEIGHT : 3 m.
OPERATING PRESSURE : 22,3 to 28 bar.g
OPERATING TEMPERATURE : 26 to 64°C
DESIGN PRESSURE : 60 bar.g
DESIGN TEMPERATURE : 92 °C
TE 3300
COMPRESSOR TURBINE DRIVER
DUTY : 20 MW
K 3320
1st STAGE COMPRESSOR
A 3330
1st STAGE DISCHARGE COOLER
DUTY :12,4 MW
MOTOR RATING : 4X15 KW
TO H.P FLARE
THAI-B3-PP-11-09-0139
ANTI SURGE CONTROL
NOTE 6
NO POCKETS
NOTE 7
NOTE 11
NOTE 22
TO D 3340
THAI-B3-PP-11-09-0112
TO H.P FLARE
THAI-B3-PP-11-09-0139
FROM/TO LV-SB-200
FROM COMPRESSOR SUCTION HEADER
THAI-B3-PP-11-09-0108
HAZARDOUS OPEN DRAIN HEADER
THAI-B3-PP-11-09-0143/1
TO 2nd STAGE SEPARATOR
THAI-B3-PP-11-09-0105
TO CLOSED DRAIN HEADER
THAI-B3-PP-11-09-0145
SPEED GOVERNOR
D 43210
HP FUEL GAS K.O.DRUM
GENERAL ELECTRIC
NUOVO PIGNONE
FROM PY-3114
THAI-B3-PP-11-09-0108
FROM HP FUEL GAS SYSTEM
THAI-B3-PP-11-09-0147
SEAL GAS TO COMPRESSORS
COMPRESSOR LIMIT OF SUPPLY
TECHNICAL ROOM
UTILITY DISTRIBUTION
THAI-B3-PP-11-09-0163
HVAC FAULT
COMMON ALARM
READY TO LOAD
UNIT STOPPED W/O DEPR.
UNIT STOPPED W.DEPR.
HAZARDOUS OPEN DRAIN HEADER
THAI-B3-PP-11-09-0143/1
HAZARDOUS OPEN DRAIN HEADER
THAI-B3-PP-11-09-0143/1
FUEL GAS FOR GAS TURBINE
NOTE 27
FROM 2nd STAGE CASING
THAI-B3-PP-11-09-0112
TO PDT 3327 (K 3350 DISCH.)
THAI-B3-PP-11-09-0112
TO PDT 3329 (K 3350 DISCH.)
THAI-B3-PP-11-09-0112
PURGE FROM SECOND STAGE
THAI-B3-PP-11-09-0112
TO LP FLARE
THAI-B3-PP-11-09-0141
-NUOVO-PIGNONE-
GAS TURBINE TE 3200 (PRIMARY VENT)
FUEL GAS SCHEME
NOTES
1 – NON-SLAM CHECK VALVE
2 – WITCH HAT TYPE STRAINER ON REMOVABLE SPOOL PIECE
3 – INSULATION FOR PERSONNEL PROTECTION (PP)
4 – COMPRESSORS K 3320 & K 3350 ARE GAS TURBINE DRIVEN ON COMMON SHAFT
5 – PROVISION FOR CORROSION INHIBITOR INJECTION
6 – ANTISURGE CONTROL IN TURBO COMP. TECHNICAL ROOM
7 – PROVISION FOR MeOH INJECTION
8 – CANCELLED
9 – DRAIN POT CLOSE TO T 3300
10 – VALVE FOR FUEL GAS LINE PURGE BEFORE START UP, ACTUATED BY GAS TURBINE START UP SYSTEM
11 – HIGH POINT
12 – DELETED.
13 – BY PASS VALVE FOR PRESSURIZATION WILL BE INSTALLED ON SDV 3310 BY PASS IN CASE OF FULLY AUTOMATIC SEQUENCE START UP
14 – NOT USED
15 – NOT USED
16 – F48 SINGLE VALVE FOR INSTRUMENT HOOK-UP
17 – DELETED
18 – NOT USED
19 – NOT USED
20 – NOT USED
21 – ESD 3 SHUTDOWN THRU PLC SYSTEM SUPPLIED BY COMPRESSOR VENDOR FOR ITEMS MARKED (X)
22 – THE FOLLOWING I/O LIST DETAILS INCLUDED FOR EACH MOTOR OF A3330. (TOTAL 4 NOS.)
-RUN/STOP STATUS
– FAULT STATUS, GEN–2020. FOR TYPICAL DETAILS REFER TO LEGEND SHEETS, GEN–2020.
23 – LOOP WITH PRES/TEMP COMPENSATION USING PI–3321 AND TI–3320
24 – LOOP WITH PRES/TEMP COMPENSATION USING PI–4010 AND TI–4043B
25 – FB VALVE IS FLANGED TO PSV FLANGE AND REDUCER 8"x12" IS DIRECTLY DOWNSTREAM VALVE
26 – DELETED
27 – LIQUID DRAIN FROM AUTOMATIC TRAPS INSIDE GAS COMPRESSION SYSTEM.
* INSTRUMENTS SUPPLIED BY COMPRESSOR SUPPLIER ARE SHOWN AS : OR

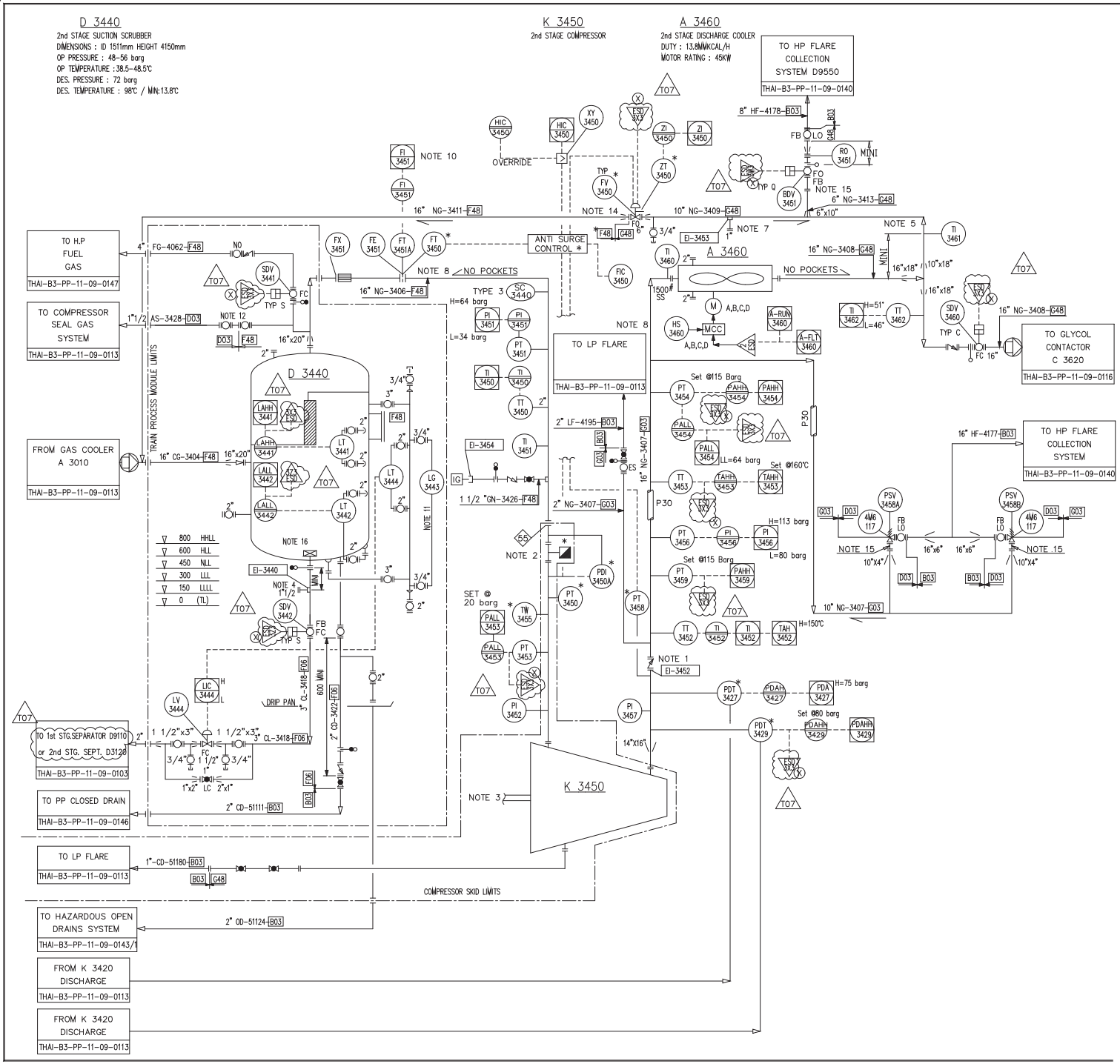


NOTES:

1 – NON-SLAM CHECK VALVE
2 – WITCH HAT TYPE STRAINER ON REMOVABLE SPOOL PIECE
3 – INSULATION FOR PERSONNEL PROTECTION (PP)
4 – COMPRESSORS K 3320 & K 3350 ARE GAS TURBINE DRIVEN ON COMMON SHAFT
5 – PROVISION FOR CORROSION INHIBITOR INJECTION
6 – ANTISURGE CONTROL IN TURBO COMP. TECHNICAL ROOM
7 – FOR MeOH INJECTION
9 – HIGH POINT
10 – DELETED.
11 – NOT USED
12 – F48 SINGLE VALVE INSTRUMENT HOOK-UP
G48 DOUBLE VALVE INSTRUMENT HOOK-UP
13 – DELETED
14 – NOT USED
15 – NOT USED
16 – NOT USED
17 – ESD 3 SHUTDOWN THRU PLC SYSTEM SUPPLIED BY COMPRESSOR VENDOR FOR ITEMS MARKED (X)
18 – THE FOLLOWING I/O LIST DETAILS INCLUDED FOR EACH MOTOR OF A3360. (TOTAL 4 NOS.)
– ON/OFF STATUS
– FAULT STATUS. FOR TYPICAL DETAILS REFER TO LEGEND SHEET.
19 – WITH OPERATING PRESSURES GREATER THAN OR EQUAL TO 110 BAR.G, IF TEMPERATURE FALLS BELOW 45°C AT FV-3350 INLET, HYDRATES MAY FORM. HENCE TAL 3362 IS SET @ 47°C.
20 – DURING START-UP A3360 MOTORS MAY HAVE TO BE STOPPED, TO PREVENT HYDRATES ACROSS FV-3350 DUE TO EXCESSIVE COOLING.
21 – NOT USED
22 – LOOP WITH PRES/TEMP COMPENSATION USING PI-3251 AND TI-3350
23 – DELETED.
24 – DELETED
25 – DELETED
26 – RO3351 4" 900# DANIEL R37
27 – SPACER REQUIRED.
28 – PRESSURISATION OF C-3610 WHEN IT IS ALREADY LINEUP TO C-3630 WITH TRAIN 2 COMPRESSOR SHALL NOT BE MADE IN ORDER TO AVOID DAMAGE TO FIRST BLOCK VALVE ON C-3610

* INSTRUMENTS SUPPLIED BY COMPRESSOR SUPPLIER ARE SHOWN AS : ○* OR ⊖


D-3410
1st STAGE SUCTION SCRUBBER
DIMENSIONS ID 1811mm HEIGHT 5470mm
OPERATING PRESS. 22-28 Barg
OPERATING TEMP. 26-50 °C
DESIGN PRESS. 60 Barg
DESIGN TEMP. 92 °C/MIN 9°C
TO H.P FLARE COLLECTION SYSTEM
THAI-B3-PP-11-09-0140
TE-3400
COMPRESSOR TURBINE DRIVER
DUTY 22 MW
K-3420
1st STAGE COMPRESSOR
A-3010
1st STAGE DISCHARGE COOLER
DUTY 11.34 MMKCAL/H
MOTOR RATING 45 KW
NOTES
1 - NON SLAM CHECK-VALVE
2 - REMOVABLE STRAINER.
3 - INSULATION FOR PERSONNEL PROTECTION (PP).
4 - COMPRESSORS K-3420 & K-3450 ARE GAS TURBINE DRIVEN ON COMMON SHAFT.
5 - DELETED.
6 - HIGH POINT.
7 - PROVISION FOR METHANOL INJECTION.
8 - DELETED.
9 - DELETED
10 - LOOP WITH PRESSURE/TEMPERATURE COMPENSATION.
11 - FLANGES TAPPING.
12 - LG TO COVER ALL SET POINTS.
13 - DELETED
14 - VALVE LOCATED AT HIGH POINT IN LINE AND FREE DRAINING EITHER SIDE
15 - TO BE USED FOR SEAL/BUFFER GAS DURING COMMISSIONNING ON AIR/N2.
16 - REMOVABLE SPOOL.
17 - PROVISION FOR CORROSSION INHIBITOR INJECTION.
18 - LOOP WITH PRESSURE/TEMPERATURE COMPENSATION USING PT-4015 AND TT-4070.
19 - LIQUID DRAIN FROM AUTOMATIC TRAPS INSIDE GAS COMPRESSION SYSTEM.
OR
BY COMPRESSOR SUPPLIER
COMPRESSOR SUPPLIER SHUT DOWN LOGIC SYSTEM
FROM COMPRESSOR SUCTION HEADER
THAI-B3-PP-11-09-0108
TO GAS COMPRES. 2nd. STAGE D 3440
THAI-B3-PP-11-09-0114
TO HP FLARE COLLECTION SYSTEM D 9550
THAI-B3-PP-11-09-0140
TO PP CLOSED DRAIN
THAI-B3-PP-11-09-0145
TO 2nd STAGE SEPARATOR D 3120
THAI-B3-PP-11-09-0105
FROM PY 3114 A
THAI-B3-PP-11-09-0108
TO OPEN HAZARDOUS DRAIN SYSTEM
THAI-B3-PP-11-09-0143(1/2)
SEAL GAS FROM D 3440
THAI-B3-PP-11-09-0114
FROM HP FUEL GAS SYSTEM
THAI-B3-PP-11-09-0147
TO OPEN HAZARDOUS DRAIN SYSTEM
THAI-B3-PP-11-09-0147
UTILITY DISTRIBUTION
B3-PP-11-09-0163
UTILITY DISTRIBUTION
B3-PPX-11-09-0163
TECHNICAL ROOM
HAZARDOUS OPEN DRAINS HEADER
THAI-B3-PP-11-09-0143/1
TO PDT 3427 DOWNSTREAM K-3450
THAI-B3-PP-11-09-0114
TO PDT 3429 DOWNSTREAM K-3450
THAI-B3-PP-11-09-0114
FROM 2nd STAGE CASING
THAI-B3-PP-11-09-0114
FROM 2ND STAGE DISCHARGE
THAI-B3-PP-11-0114
TO LP FLARE DRUM D-4120
THAI-B3-PP-11-09-0141
TRAIN PROCESS MODULE LIMITS
COMPRESSOR SKID LIMITS
SPEED GOVERNOR
D 44210
FUEL GAS FOR GAS TURBINE
COMPRESSORS SEAL GAS SYSTEM
-NUOVO-PIGNONE-
GAS TURBINE TE 3400
FUEL GAS SCHEME
ANTI SURGE CONTROL
NO POCKETS
D 3410
TYPE 3
TYPE S
SET @80°C
SET @ 165°c
SET @ 32 barg
SET @36 bar.g
H=29 barg
L=19 barg
H=65 barg
L=35 barg
H=155°C
IDLE MODE
ESD * PERMISSIVE START
UNIT TRIP W/O DEP.
UNIT TRIP W. DEP
COMMON ALARM
READY TO LOAD
UNIT STOPPED W/O DEPR.
UNIT STOPPED W.DEPR.
HVAC FAULT
COMPRESSOR SEAL OIL DRAIN CONSOLE
DIRTY WATER DRAIN
DRIP PAN DRAIN
CASING DRAIN
PRIMARY VENT
OVERRIDE
FIRE CASE
NOTE 1
NOTE 2
NOTE 3
NOTE 4
NOTE 6
NOTE 7
NOTE 10
NOTE 11
NOTE 12
NOTE 14
NOTE 15
NOTE 16
NOTE 17
NOTE 18
NOTE 19



NOTES

1 – NON SLAM CHECK–VALVE.

2 – REMOVABLE STRAINER.

3 – COMPRESSORS K–3420 & K–3450 ARE GAS TURBINE DRIVEN ON COMMON SHAFT.

4 – PROVISION FOR CORROSION INHIBITOR INJECTION.

5 – HIGH POINT.

6 – DELETED

7 – PROVISION FOR MeOH INJECTION

8 – FLANGE TAPPING.

9 – DELETED

10 – LOOP WITH PRESSURE/TEMPERATURE COMPENSATION.

11 – LG TO COVER ALL SET POINTS.

12 – FOR SUPPLY OF AIR/N2 TO SEAL GAS SYSTEM. CONNECTION REQUIRED DURING COMMISSIONING ONLY, REMOVE SPOOL AND BLANK AFTER COMMISSIONING.

13 – DELETED

14 – FV 3451 LOCATED AT HIGH POINT : FREE DRAINING ON EITHER SIDE

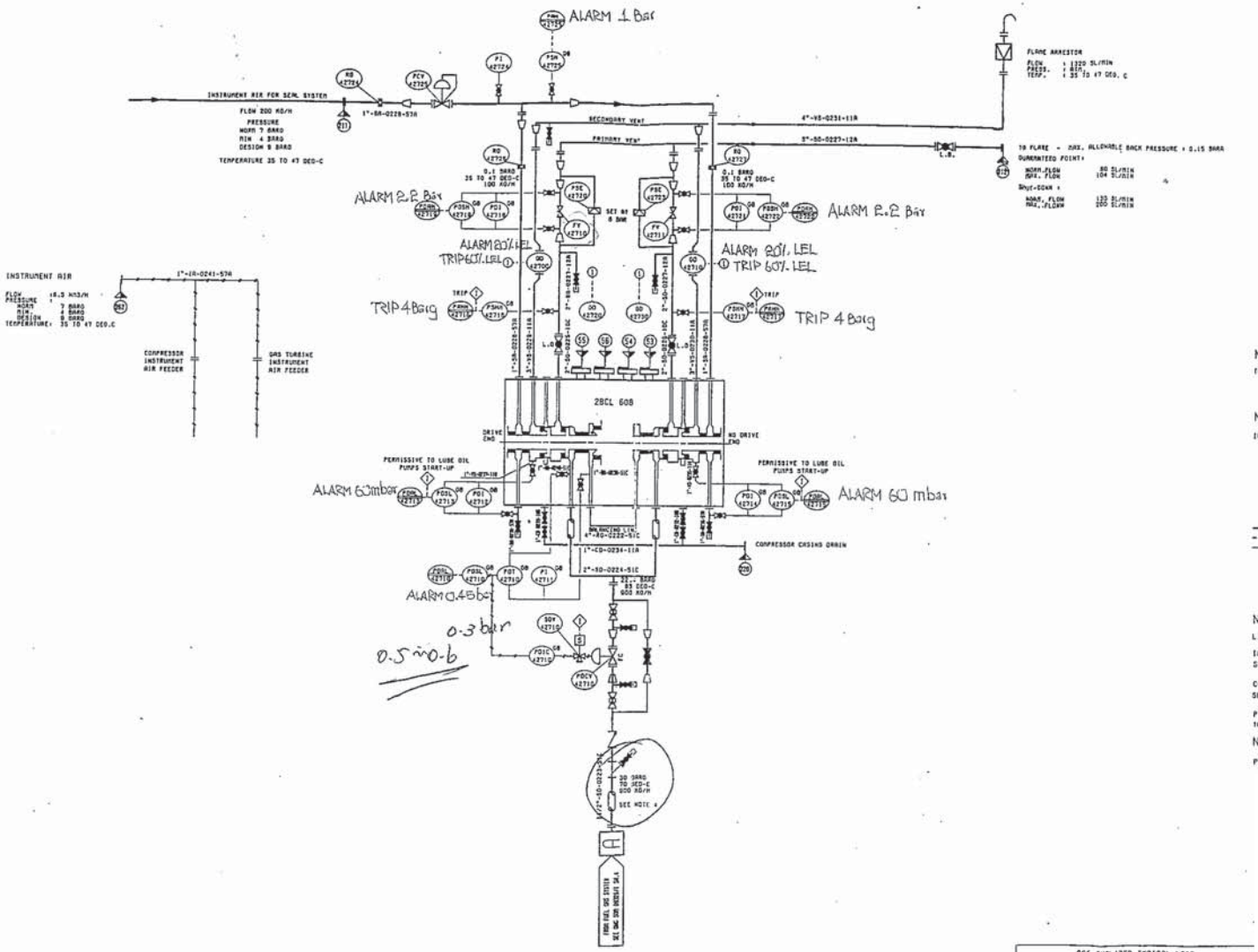
15 – SPOOL PIECE.

16 – DELETED

LEGEND :

* VENDOR SUPPLIED ITEMS

(X) VENDOR LOGIC SYSTEM.



NOTE 1:

TAGGING TRAIN 1 427XX

TRAIN 2 437XX

NOTE 2:

INSTRUMENT AND PIPING SYMBOLS

- DISC VALVE N.O.
- DISC VALVE N.C.
- BALL VALVE N.O.
- BALL VALVE N.C.
- GATE VALVE N.O.
- GATE VALVE N.C.
- NEEDLE VALVE N.O.
- NEEDLE VALVE N.C.
- PNEUMATIC LINE
- ELECTRIC LINE
- CAPILLARY TUBING
- INTERLOCK
- LOCAL INSTRUMENT
- INSTRUMENT ON C.C.P.
- LOCAL SHUDE BOARD INSTRUMENT
- INSTRUMENT ON C.C.P.

NOTE 3:

LIMIT OF SUPPLY SEE DWG SOS 30950/4

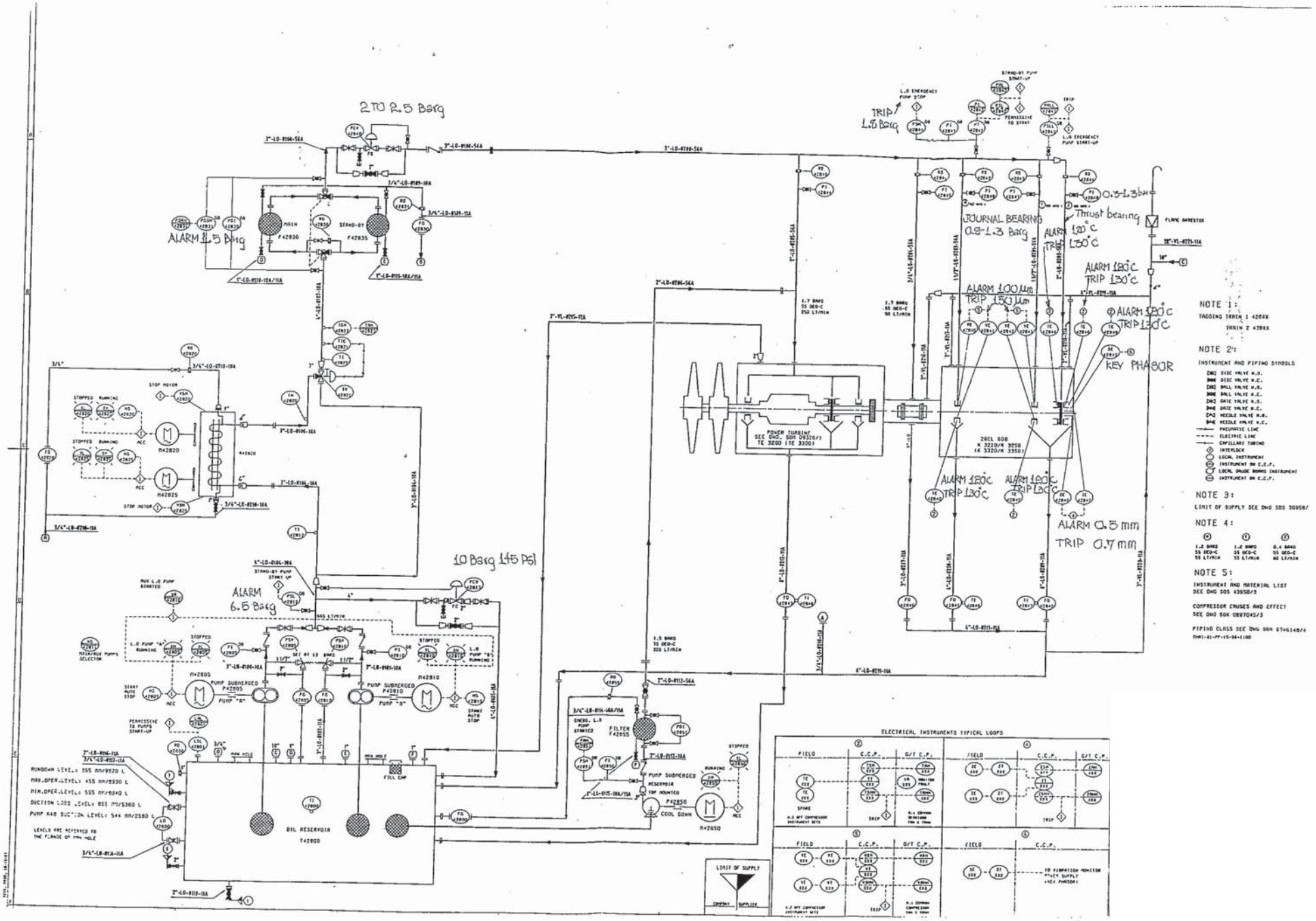
INSTRUMENT LIST AND MATERIAL LIST
SEE DWG SOS 43950/3

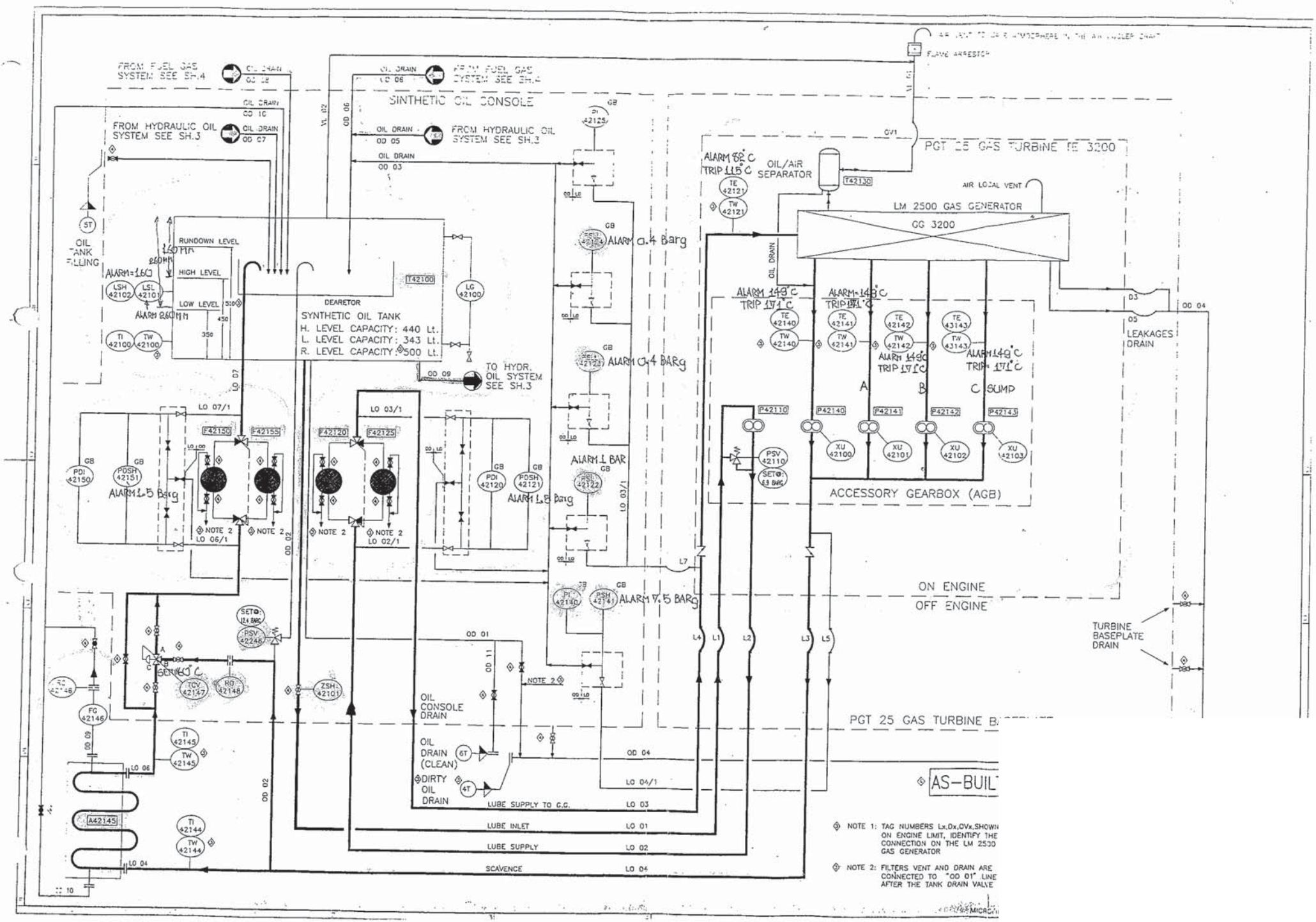
COMPRESSOR CAUSES AND EFFECTS
SEE DWG SOK 0897045/3

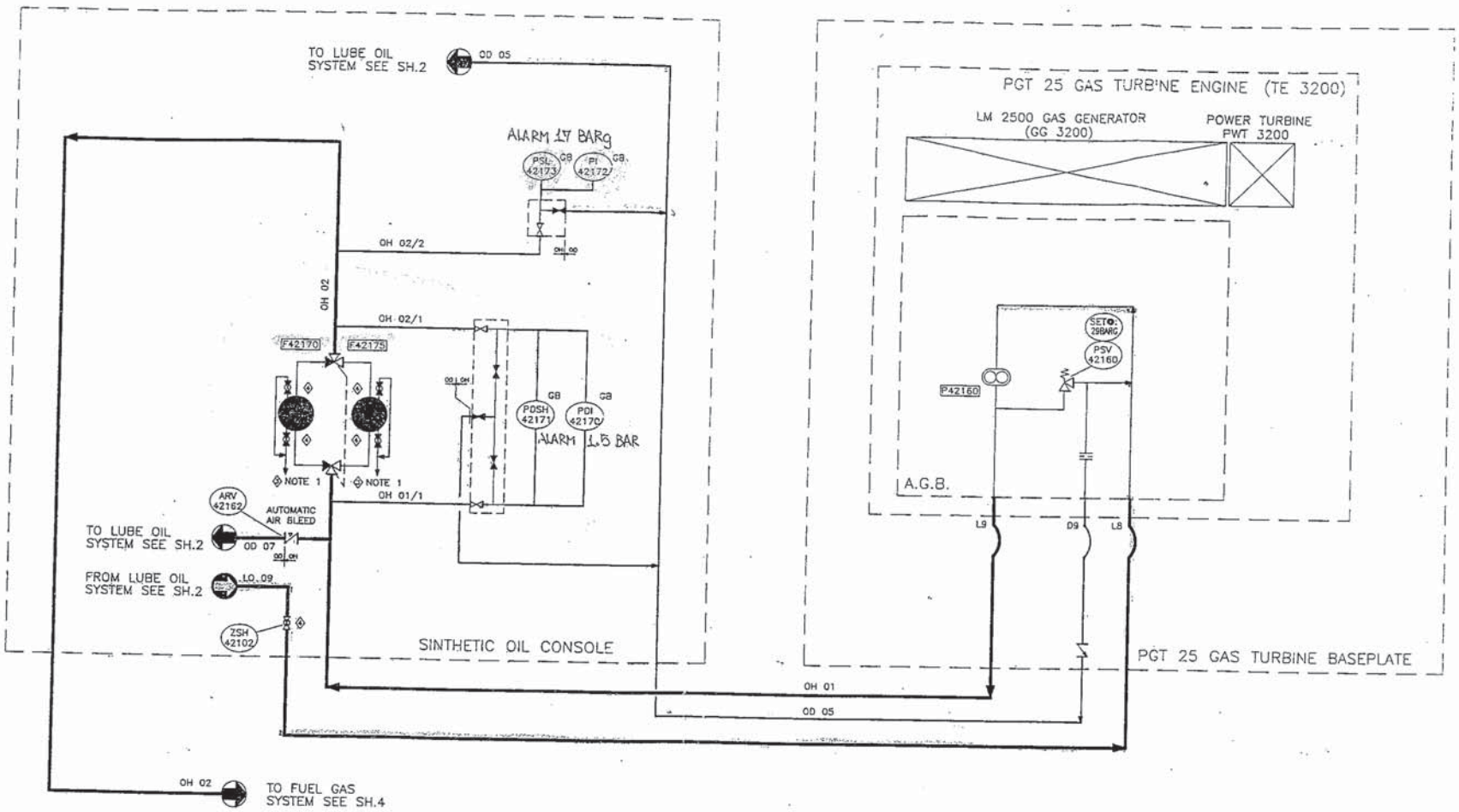
PIPING CLASSES SEE DWG SOK 5746148/4
TOTAL REF.-THAI-B1-PP-15.05.1100

NOTE 4:

PIPING INSULATION IS IN N.P. SCOPE OF/SUPPLY

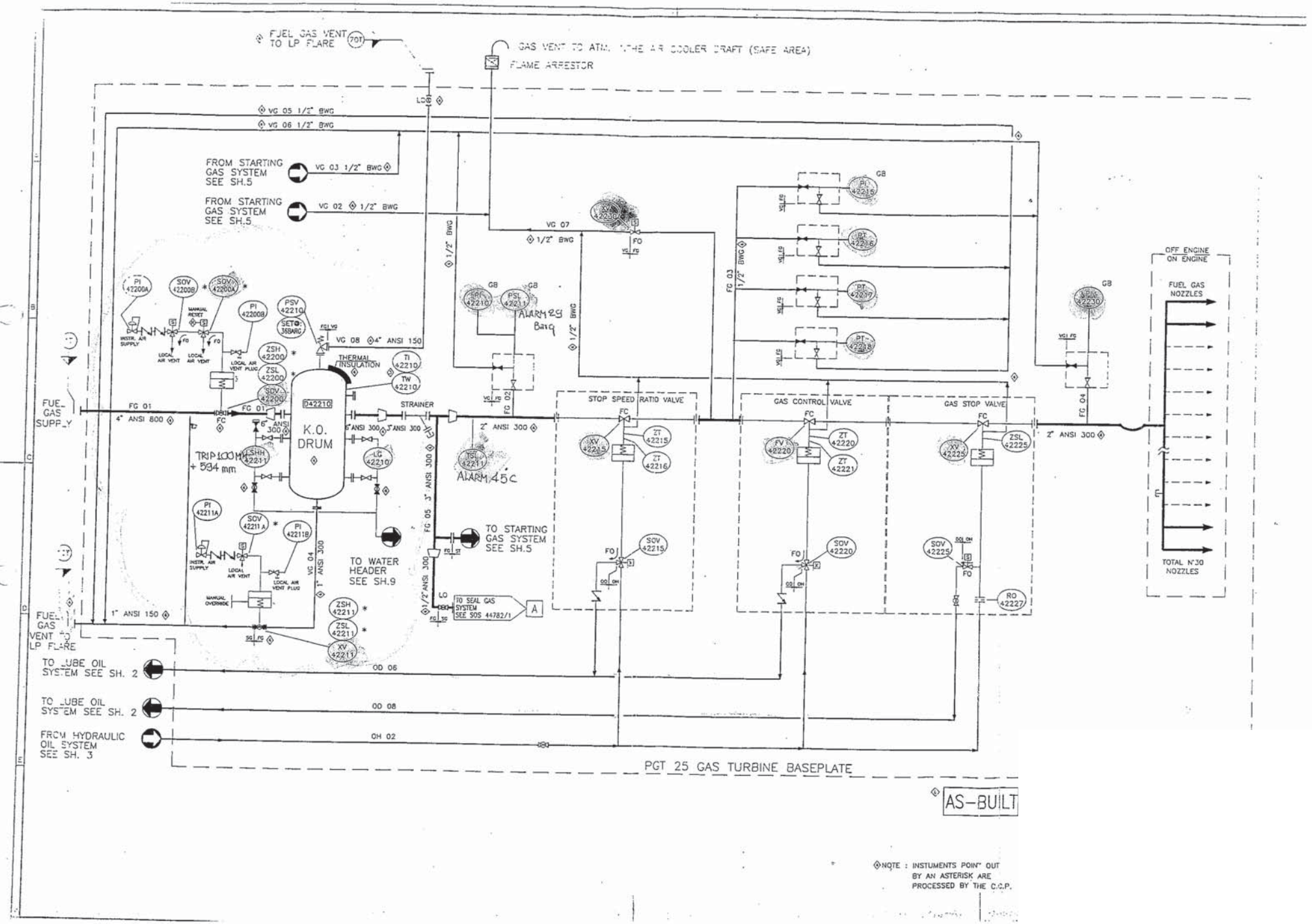

2 TO 2.5 Barg
TRIP 1.5 Barg
ALARM 1.5 Barg
JOURNAL BEARING 0.9-1.3 Barg
Thrust bearing
ALARM 120°C TRIP 130°C
ALARM 100 µm TRIP 150 µm
KEY PHASOR
ALARM 0.5 mm TRIP 0.7 mm
10 Barg 145 PSI
ALARM 6.5 Barg
OIL RESERVOIR F42800
NOTE 1:
NOTE 2:
NOTE 3:
LIMIT OF SUPPLY SEE DWG SOS 30958/
NOTE 4:
NOTE 5:
INSTRUMENT AND MATERIAL LIST SEE DWG SOS 43950/3
COMPRESSOR CAUSES AND EFFECT SEE DWG SOK 089704S/3
ELECTRICAL INSTRUMENTS TYPICAL LOOPS
LIMIT OF SUPPLY

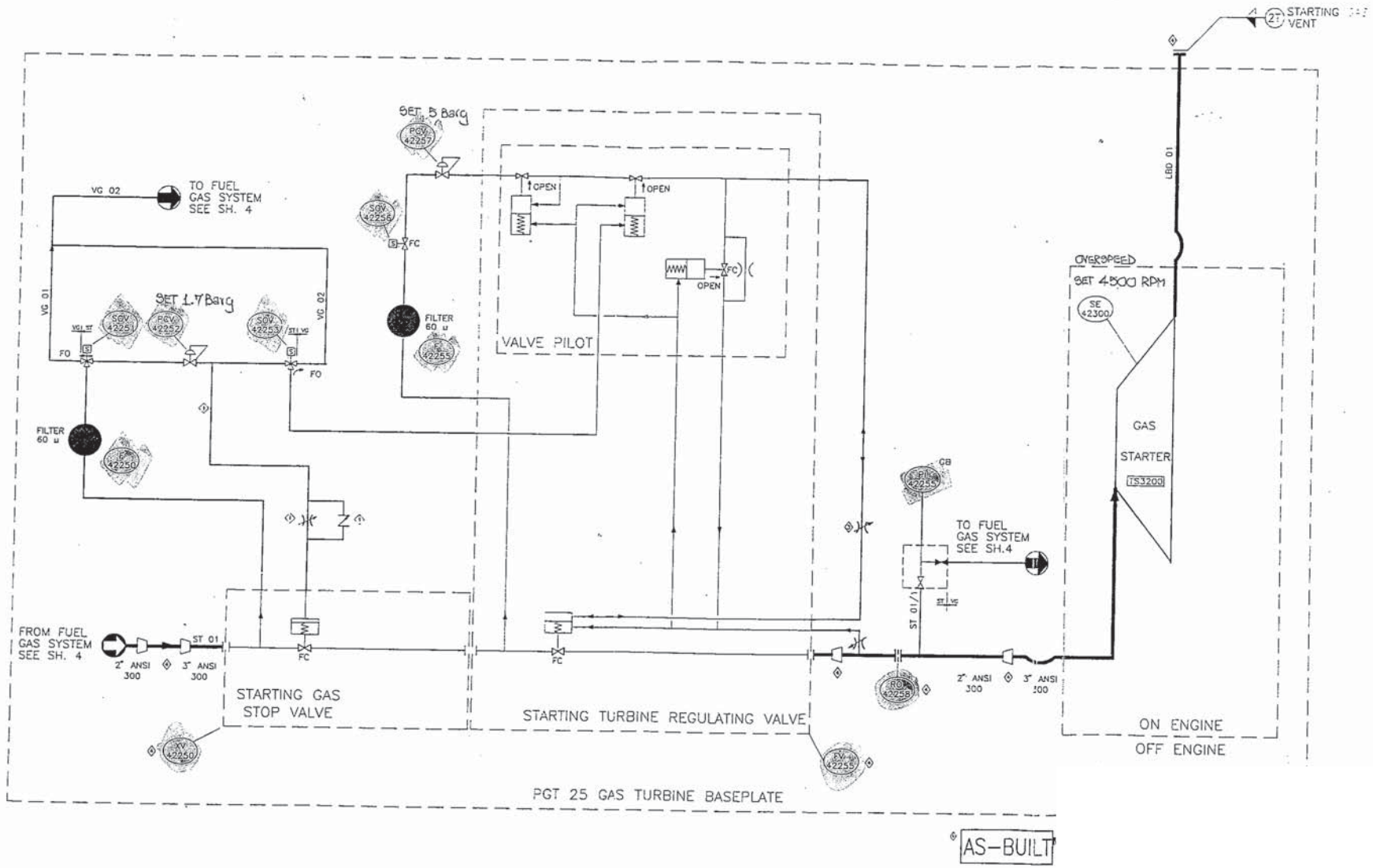

SINTHETIC OIL CONSOLE
PGT 25 GAS TURBINE TE 3200
LM 2500 GAS GENERATOR
GG 3200
OIL/AIR SEPARATOR
FLAME ARRESTOR
AIR LOCAL VENT
OIL TANK FILLING
RUNDOWN LEVEL
HIGH LEVEL
LOW LEVEL
DEARETOR
SYNTHETIC OIL TANK
H. LEVEL CAPACITY: 440 Lt.
L. LEVEL CAPACITY: 343 Lt.
R. LEVEL CAPACITY: 500 Lt.
TO HYDR. OIL SYSTEM SEE SH.3
FROM FUEL GAS SYSTEM SEE SH.4
FROM HYDRAULIC OIL SYSTEM SEE SH.3
OIL DRAIN
LEAKAGES DRAIN
ACCESSORY GEARBOX (AGB)
A
B
C SUMP
ON ENGINE
OFF ENGINE
TURBINE BASEPLATE DRAIN
OIL CONSOLE DRAIN
OIL DRAIN (CLEAN)
DIRTY OIL DRAIN
LUBE SUPPLY TO G.G.
LUBE INLET
LUBE SUPPLY
SCAVENCE
ALARM 0.4 Barg
ALARM 1 BAR
ALARM 1.5 Barg
ALARM 1.8 Barg
ALARM 7.5 BARg
ALARM 82°C TRIP 115°C
ALARM 143°C TRIP 171°C
ALARM 149°C TRIP 171°C
ALARM 160 mm
ALARM 260 mm
AS-BUILT
NOTE 1: TAG NUMBERS Lx,Dx,OVx,SHOWN ON ENGINE LIMIT, IDENTIFY THE CONNECTION ON THE LM 2500 GAS GENERATOR
NOTE 2: FILTERS VENT AND DRAIN ARE CONNECTED TO "OD 01" LINE AFTER THE TANK DRAIN VALVE

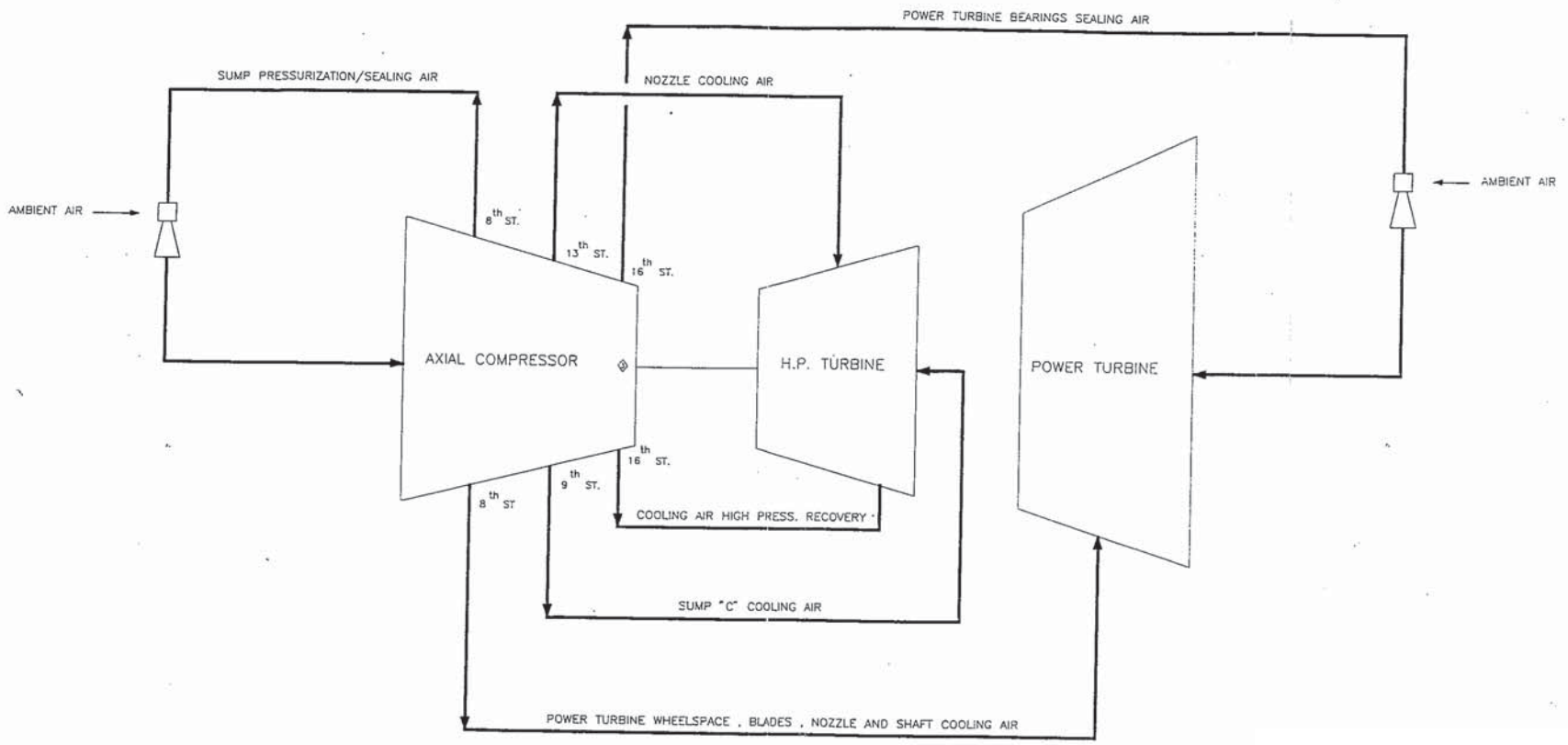


◊ AS-BUILT

◊ NOTA 1: FILTERS VENT AND DRAIN ARE CONNECTED TO "OD 01" LINE AFTER THE TANK DRAIN VALVE

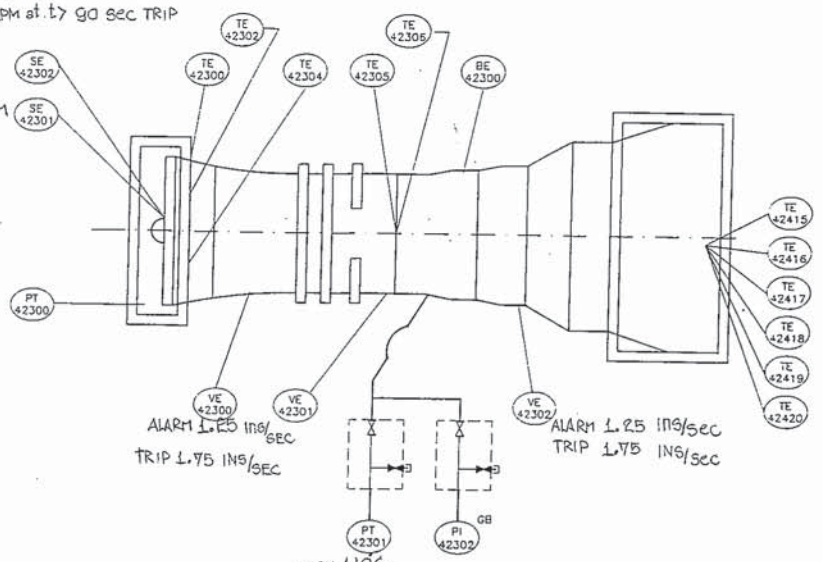

FUEL GAS VENT TO LP FLARE (70T)
GAS VENT TO ATM. THE AIR COOLER DRAFT (SAFE AREA)
FLAME ARRESTOR
VG 05 1/2" BWG
VG 06 1/2" BWG
FROM STARTING GAS SYSTEM SEE SH.5
VG 03 1/2" BWG
FROM STARTING GAS SYSTEM SEE SH.5
VG 02 1/2" BWG
VG 07
1/2" BWG
VG 08 4" ANSI 150
THERMAL INSULATION
FUEL GAS SUPPLY
FG 01
4" ANSI 800
K.O. DRUM
STRAINER
6" ANSI 300
3" ANSI 300
2" ANSI 300
TRIP 100 MM + 394 mm
ALARM 45c
ALARM 25 Barg
STOP SPEED RATIO VALVE
GAS CONTROL VALVE
GAS STOP VALVE
FUEL GAS NOZZLES
OFF ENGINE
ON ENGINE
TOTAL N°30 NOZZLES
TO STARTING GAS SYSTEM SEE SH.5
TO WATER HEADER SEE SH.9
TO SEAL GAS SYSTEM SEE SOS 44782/1
1" ANSI 150
FUEL GAS VENT TO LP FLARE
TO LUBE OIL SYSTEM SEE SH. 2
OD 06
TO LUBE OIL SYSTEM SEE SH. 2
OD 08
FROM HYDRAULIC OIL SYSTEM SEE SH. 3
OH 02
PGT 25 GAS TURBINE BASEPLATE
AS-BUILT
NOTE : INSTUMENTS POINT OUT BY AN ASTERISK ARE PROCESSED BY THE C.C.P.

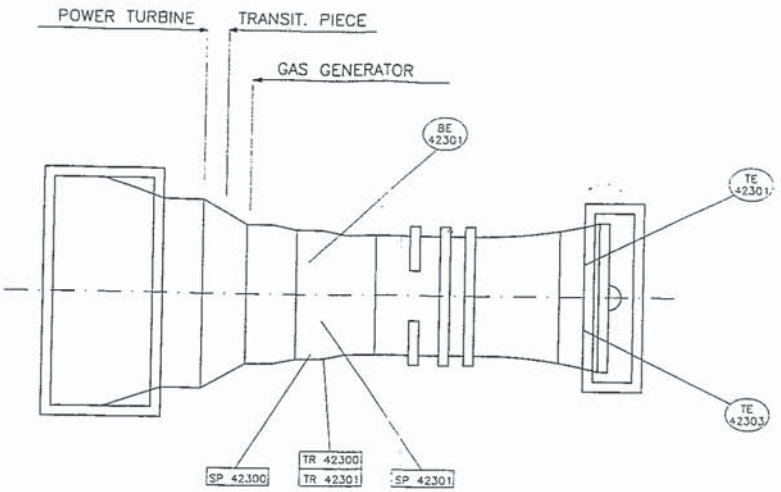

STARTING VENT
LBD 01
SET 5 Barg
PCV 42257
SOV 42256
FC
OPEN
OPEN
FC
OPEN
VG 02
TO FUEL GAS SYSTEM SEE SH. 4
VG 01
SET 1.7 Barg
SOV 42251
PCV 42252
SOV 42253
VG 02
VG1 ST
ST1 VG
FO
FO
FILTER 60 u
PI 42255
VALVE PILOT
OVERSPEED
SET 4500 RPM
SE 42300
GAS STARTER
TS3200
FILTER 60 u
PI 42250
GB
PI 42255
TO FUEL GAS SYSTEM SEE SH.4
ST 01/1
ST VG
FROM FUEL GAS SYSTEM SEE SH. 4
ST 01
2" ANSI 300
3" ANSI 300
FC
FC
RO 42258
2" ANSI 300
3" ANSI 300
STARTING GAS STOP VALVE
XV 42250
STARTING TURBINE REGULATING VALVE
PV 42255
ON ENGINE
OFF ENGINE
PGT 25 GAS TURBINE BASEPLATE
AS-BUILT

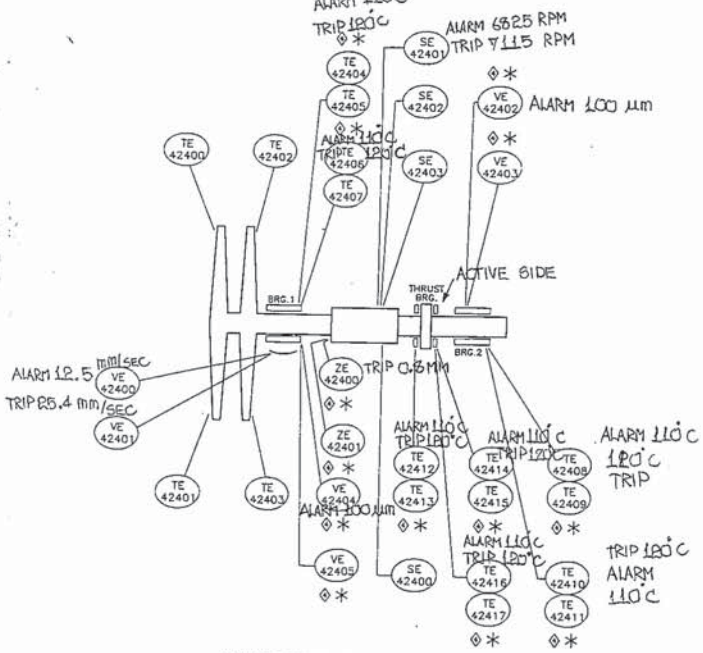

POWER TURBINE BEARINGS SEALING AIR
SUMP PRESSURIZATION/SEALING AIR
NOZZLE COOLING AIR
AMBIENT AIR
AMBIENT AIR
8th ST.
13th ST.
16th ST.
AXIAL COMPRESSOR
H.P. TURBINE
POWER TURBINE
16th ST.
9th ST.
8th ST
COOLING AIR HIGH PRESS. RECOVERY
SUMP "C" COOLING AIR
POWER TURBINE WHEELSPACE , BLADES , NOZZLE AND SHAFT COOLING AIR

AS-BUIL

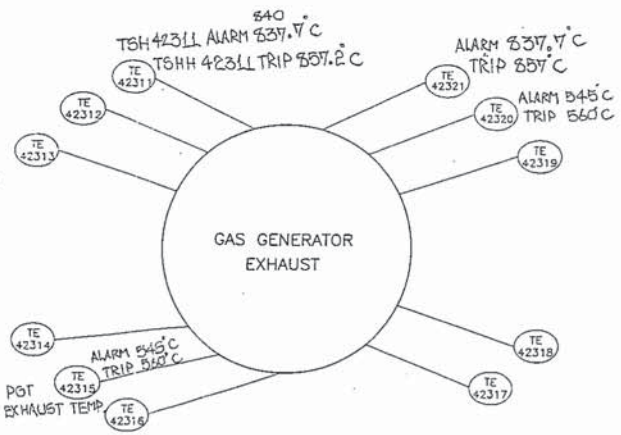
>10000 RPM CORR : ALARM
>10200 RPM TRIP
<1700 RPM at t>30 sec TRIP
<4500 RPM at t> 90 sec TRIP





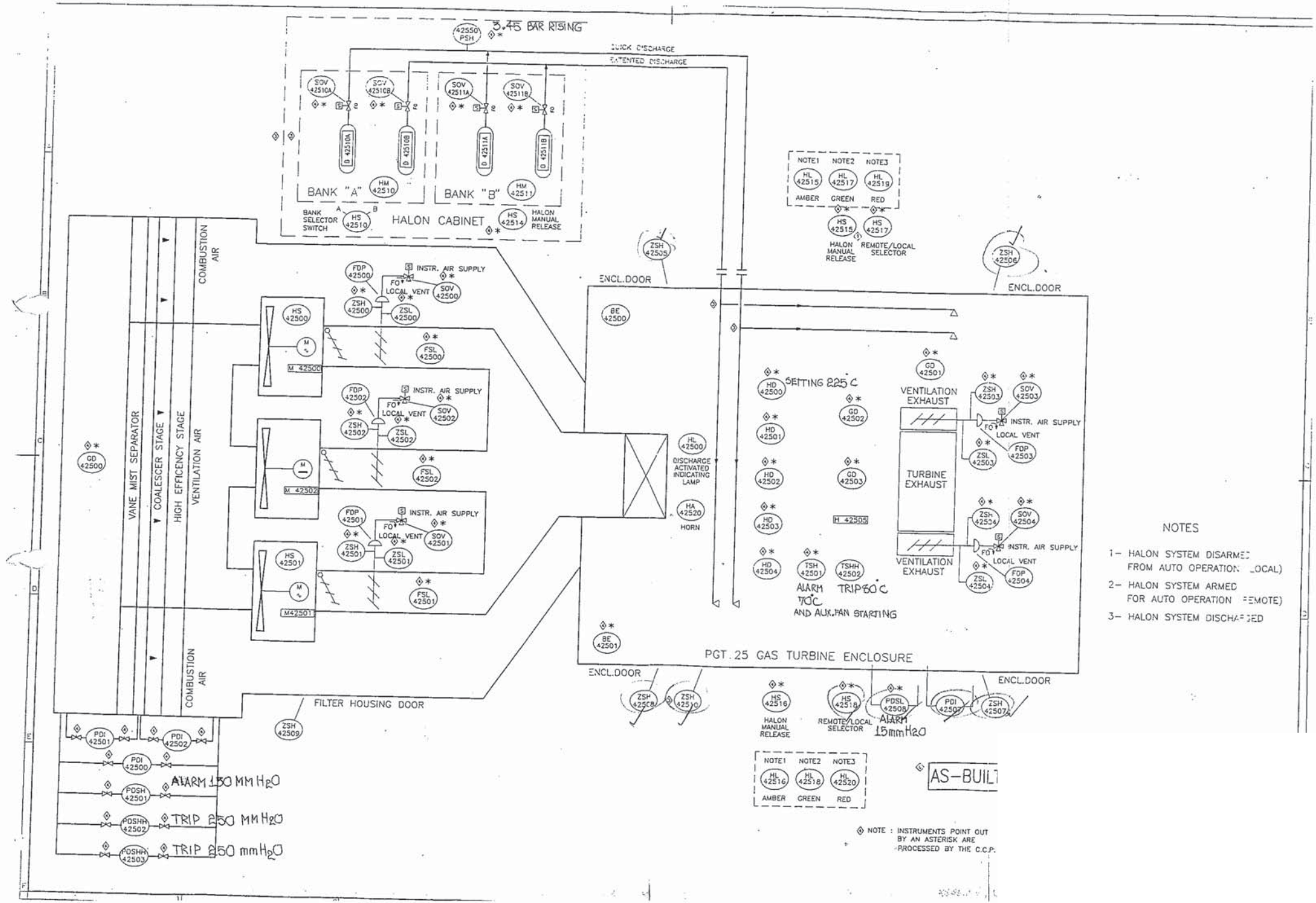


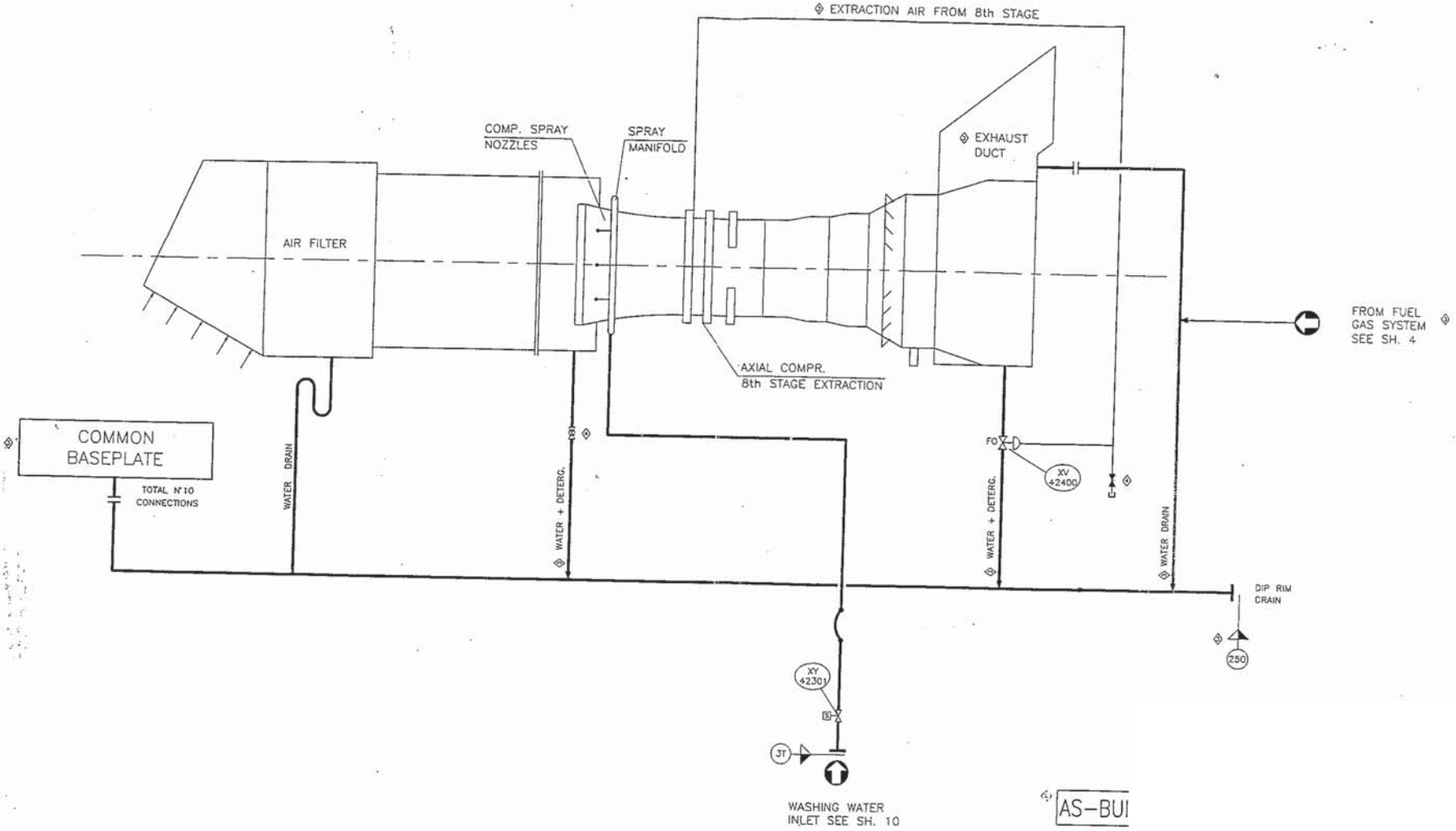
POWER TURBINE INSTRUMENTATION

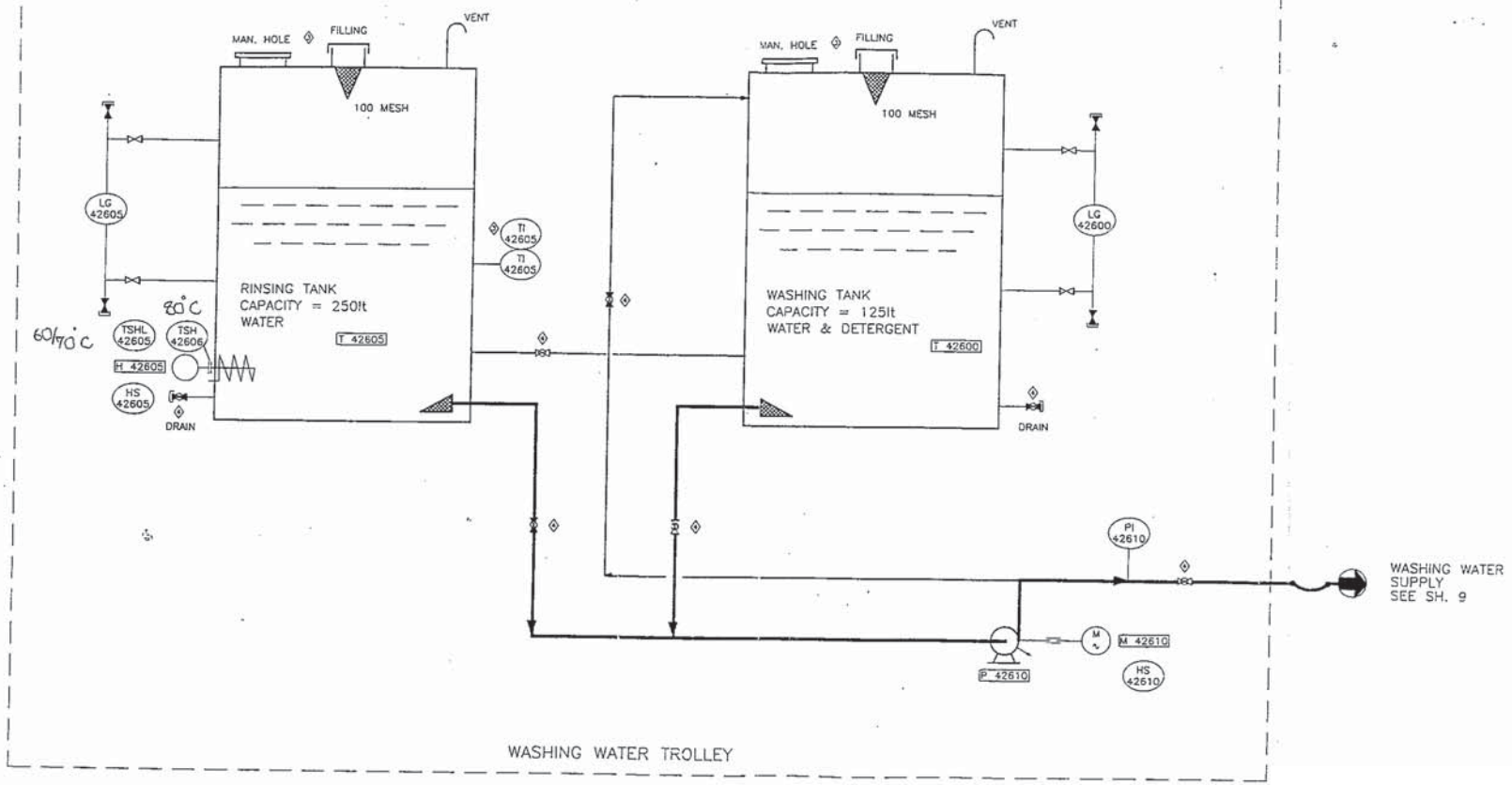


◊ AS-BUIL

◊ NOTE : INSTRUMENTS POINT OUT BY AN ASTERISK ARE PROCESSED BYTHE C.C.P.


42550 PSH
3.45 BAR RISING
QUICK DISCHARGE
DELAYED DISCHARGE
SOV 42510A
SOV 42510B
SOV 42511A
SOV 42511B
D 42510A
D 42510B
D 42511A
D 42511B
BANK "A"
BANK "B"
HM 42510
HM 42511
BANK SELECTOR SWITCH
HS 42510
HALON CABINET
HS 42514
HALON MANUAL RELEASE
NOTE1 NOTE2 NOTE3
HL 42515 HL 42517 HL 42519
AMBER GREEN RED
HS 42515
HS 42517
HALON MANUAL RELEASE
REMOTE/LOCAL SELECTOR
ZSH 42505
ZSH 42506
ENCL.DOOR
ENCL.DOOR
COMBUSTION AIR
VANE MIST SEPARATOR
COALESCER STAGE
HIGH EFFICENCY STAGE
VENTILATION AIR
COMBUSTION AIR
FDP 42500
INSTR. AIR SUPPLY
FO
LOCAL VENT
SOV 42500
ZSH 42500
ZSL 42500
HS 42500
M 42500
FSL 42500
FDP 42502
SOV 42502
ZSH 42502
ZSL 42502
M 42502
FSL 42502
FDP 42501
SOV 42501
ZSH 42501
ZSL 42501
HS 42501
M42501
FSL 42501
FILTER HOUSING DOOR
ZSH 42509
GD 42500
BE 42500
HL 42500
DISCHARGE ACTIVATED INDICATING LAMP
HA 42520
HORN
HD 42500
SETTING 225°C
HD 42501
HD 42502
HD 42503
HD 42504
GD 42501
GD 42502
GD 42503
H 42505
TSH 42501
TSHH 42502
ALARM 170°C
AND AUX.FAN STARTING
TRIP 260°C
VENTILATION EXHAUST
TURBINE EXHAUST
VENTILATION EXHAUST
ZSH 42503
SOV 42503
FDP 42503
ZSL 42503
ZSH 42504
SOV 42504
FDP 42504
ZSL 42504
PGT.25 GAS TURBINE ENCLOSURE
BE 42501
ENCL.DOOR
ENCL.DOOR
ZSH 42508
ZSH 42510
HS 42516
HALON MANUAL RELEASE
HS 42518
REMOTE/LOCAL SELECTOR
PDSL 42508
ALARM 15mmH2O
PDI 42507
ZSH 42507A
NOTE1 NOTE2 NOTE3
HL 42516 HL 42518 HL 42520
AMBER GREEN RED
PDI 42501
PDI 42502
PDI 42500
ALARM 150 MM H2O
PDSH 42501
PDSHH 42502
TRIP 250 MM H2O
PDSHH 42503
TRIP 250 mmH2O
NOTES
1- HALON SYSTEM DISARMED FROM AUTO OPERATION (LOCAL)
2- HALON SYSTEM ARMED FOR AUTO OPERATION (REMOTE)
3- HALON SYSTEM DISCHARGED
AS-BUILT
NOTE : INSTRUMENTS POINT OUT BY AN ASTERISK ARE PROCESSED BY THE C.C.P.


EXTRACTION AIR FROM 8th STAGE
COMP. SPRAY NOZZLES
SPRAY MANIFOLD
EXHAUST DUCT
AIR FILTER
AXIAL COMPR. 8th STAGE EXTRACTION
FROM FUEL GAS SYSTEM SEE SH. 4
COMMON BASEPLATE
TOTAL N°10 CONNECTIONS
WATER DRAIN
WATER + DETERG.
FO
XV 42400
WATER + DETERG.
WATER DRAIN
DIP RIM DRAIN
250
XY 42301
J1
WASHING WATER INLET SEE SH. 10
AS-BUI


MAN. HOLE
FILLING
VENT
100 MESH
LG 42605
TI 42605
TI 42605
RINSING TANK
CAPACITY = 250lt
WATER
T 42605
80°C
60/70°C
TSHL 42605
TSH 42606
H 42605
HS 42605
DRAIN
MAN. HOLE
FILLING
VENT
100 MESH
LG 42600
WASHING TANK
CAPACITY = 125lt
WATER & DETERGENT
T 42600
DRAIN
PI 42610
WASHING WATER SUPPLY SEE SH. 9
M
M 42610
P 42610
HS 42610
WASHING WATER TROLLEY

AS-BUILT

DORIS

LOCATION THAILAND-B-STR	[illegible]E 3300						4
UNIT COMPRESSION							3
ENGINEERING	QUANTITY 2 UNITS						2
JOB N°							1
		DESIGNATION	1/6/10 DATE	BY	APPR		0 REV

1	Manufacturer NUOVO PIGNONE / GENERAL EL.	Manufacturing plant FLORENCE (ITALY) / EVENDALE (OHIO)	
2	Type and size PGT 25	Functionnal design : Units ☐ Package ☒	
3	Service : Continuous ☒ Intermittent ☐	ISO classification : A ☐ B ☐ C ☐ D ☒ (ISO 3977)	
4	Driven equipment CENTRIFUGAL COMPRESSOR	Transmission DIRECT COUPLING	
5	SERVICE CONDITIONS	APPLICABLE SPECIFICATIONS	
6	Simple cycle ☒	SEE MATERIAL REQUISITION	
7			
8	Driven equipment power requirement SEE COMPRESSOR D.S. kW	AUD JOB SPEC NO. THAI B1 PP 12-06-101	
9	Nominal power (ISO conditions) 22670 kW	SECTION 18 - ATTACHMENT 2	
10	Driven equipment speed SEE COMPRESSOR D.S. RPM	SITE DATA	
11	Power turbine speed 6500 (100%) RPM	Altitude SEA LEVEL m	
12	Starts : Frequency (ISO 3977) I ☒ II ☐ III ☐ IV ☐	Barometer 1013 m bar	
13	Auxiliaries starting : Manual ☐ Automatic ☐ (5)	Ambient temperature : Normal 29 °C	
14	Remote control ☐	Maxi 34 °C, Mini 25 °C, Design 32 °C	
15	Operation : Attended ☐ Unattended ☒	Humidity at design temperature 70%	
16	Remote control ☐ (5)	Wind speed 26 m/s	
17	Minimum continuous operation between maintenances 4380 hr	Atmospheric air	
18		Dust > 10u g/m³	
19		< 10u g/m³	

	SHOP TESTS / INSPECTION			PAINTING	
20					Corrosion by : SALT LADDEN AIR
21	Shop inspection ☒	Simple	Witnessed	Standard ☐	
22	By certification agency ☐	test	test	Other ☒	Location : Indoor ☐ Heated ☐
23	Manufacturer standard test	☒	☐	JOB SPEC THAI	Under roof ☐ Outdoor ☒ Offshore ☒
24	Mechanical test	☐	☒	B1 PP 12 06 101	Winterisation ☐ Tropicalisation ☒
25	Performance test	☐	☒	SECTION 10	Area classification (2)
26	Test with driven equipment	☐	☒	SHIPMENT	Starting : Local ☐ Remote ☐ (5)
27	Dismantling after test (4)	☐	☐	Standard ☐	(2) SEE JOB SPEC NO
28	Spare rotor fit in (Power turb)	☐	☐	Sea boxing ☒	THAI-B1-PP 12-06-101
29	Spare rotor mech test (Power turb) (1)	☐	☐	Long term ☐	SECTION 2.2
30	Spare gen. generator perf. test (4)		☐	AS PER	AVAILABLE UTILITIES
31				ADJC JOB SPEC	Cooling water : NOT AVAILABLE
32					Pressure — bar g

	ACCESSORIES SUPPLIED BY MANUFACTURER (M) OR OTHER (O)				Allowable ΔP — bar
33					Temperature — °C
34	Turbine baseplate	M			Allowable ΔT — °C
35	Driven equipment baseplate	M	Compressor cleaning system	M	Steam : NOT AVAILABLE
36	Anchor bolts	M	Handling device	M	Pressure — bar g
37	Driven equipment	M	Fire protection equipment	M	Temperature — °C
38	—		Special tools	M	Instrument air :
39	High speed coupling	M			Pressure 5 TO 8 bar g
40					Temperature 42 °C
41	Coupling guards	M	Batteries and chargers		Dew point -20 °C
42	Inlet system	M	Motor control center	M	Electricity
43	Exhaust system	M	Local control panel	M	
44	Turbine enclosure	M	Control module	M	
45	Driven equipment enclosure	(3)			
46					
47	Fuel treatment system	—	Vibration analysis	M	
48					
49					
50					

	AC/DC	Volts	Phase	Hertz
Control				

SEE JOB SPEC. THAI B1 PP 12-06-101 SECTION 18.0 ATTACHT 4

51 Remarks : (1) test conditions to be indicated

52 (3) IF NECESSARY TO MEET JOB REQUIREMENTS

53 (4) AS PER VENDOR STANDARDS / REMARKS OF PAINTER MANUFACTURER AS A MINIMUM

54 (5) SEE JOB SPECIFICATION IN THAI B1 PP 12-06-101 SECTION 5.0

55

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						4
						3
						2
						1
		1/6/90		M		0
DESIGNATION		DATE	BY	APPR		REV

LOCATION THAILAND-BY STR
UNIT COMPRESSION
ENGINEERING
JOB N°
TE-3300
QUANTITY: 2 UNITS

			Nominal	Maxi	Mini	RATED
1	PERFORMANCE (SITE CONDITIONS) (1) (4)					
2	Point					
3	Dry bulb temperature	°C	29	34	23	32
4	Turbine shaft power	kW	20942	20107	21903	20435
5	Turbine shaft speed	RPM	6500	6500	6500	6500
6	Heat rate	kJ/kWh ~~kcal/kWh~~	10198	10333	10070	10277
7	Air flow	kg/s	62.15	60.39	64.13	61.09
8	Exhaust flow	kg/s	63.84	62.04	65.90	62.75
9	Firing temperature	°C	NA	NA	NA	NA
10	First stage rotor blade metal temperature	°C	NA	NA	NA	NA
11	Exhaust temperature	°C	542	547	537	545
12						
13	Gear losses	kW	—	—	—	—
14	Net power at driven equipment coupling	kW	20942	20107	21903	20435
15	INLET LOSS	mm H_2O	150	150	150	150
16	EXHAUST LOSS	mm H_2O	100	100	100	100

17	FUEL SYSTEM							
18	Type : Gas ☒	Gas fuel analysis (% mole) IN/OUT TREATED						
19	Treatment required by Manufacturer:	Composition		Normal		Starting		other
20		H_2		10.868				0.866
21		H_2O		1.014				1.014
22		CO		-				-
23		CO_2		14.7				22.541
24	Filtration by vendor ☐	H_2S		-				-
25	Filter number	N_2		-				-
26	Filter material	CH_4	C_1	73.254				64.985
27	Filtration micron	~~C_2H_6~~	C_2	5.427				5.408
28	ΔP clean/maxi / bar	~~C_3H_8~~	C_3	2.491				2.857
29	Filter body material	~~C_4H_{10}~~	iC_4	0.701				0.704
30		~~C_4H_{10}~~	mC_4	0.610				0.689
31	Stainless steel piping ☒	~~C_5H_{12}~~	iC_5	0.290				0.277
32	Downstream filters ☒ Complete system ☐		mC_5	0.183				0.187
33		(2)	C_6	0.217				0.225
34		(3)	C_7+	0.247				0.247
35								
38				100.00		100.00		100.00
37								
38		Molecular weight		22.987				35.319
39		Cp/Cv						
40		LHV kJ/kg						
41		HHV kJ/kg						
42		Fuel heat		31.5				31.5
43		TEMP (IN/OUT) °C	64	84(*)			64	84
44		Dew point °C						
45								
46		(*) 84° NORMAL - 91° MAX WITH INLET TEMP OF 77°						
47		Gas for pneumatic starter ☒ : SAME AS FUEL GAS						
48		Pressure - 31.5 barA						
49		Temperature 61-41 °C Dew point °C						
50								

51 Remarks: (1) FOR GAS TURBINE PERFORMANCE VERSUS DRIVEN EQUIPMENT
52 POWER REQUIREMENT REFER TO UNIT SHAFT LINE POWER
53 BALANCE SHEETS PAGES 6 TO 8
54 (2) C_6 MW = 84 S.G. = 0.688 (3) C_7 MW = 130.8 S.G. = 0.770
55 (4) EXPECTED VALUES (5) NOT AVAILABLE

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CUSTOMER TOTAL	[illegible] - TE 3300				4
LOCATION THAILAND					3
UNIT COMPRESSION					2
ENGINEERING	QUANTITY : 2 UNITS				1
JOB N°		11/6/90		M	0
		DESIGNATION	DATE	BY	APPR	REV

CONSTRUCTION

Model PGT 25 Type			Power turbine : type AXIAL	
Number of shafts 2			Number of stages 2	
Direction of rotation (facing output coupling)			Number of stages with variable angle nozzles —	
Clockwise ☒ Counter-clockwise ☐			Minimum speed 3250 RPM Trip speed 7100	RPM
Critical speeds	1ST	2ND 3RD	Maximum tip speed (nominal head) 420	m/s
Gas generator lateral	22000	25000	Maximum temperature 824	°C
Power turbine lateral			Maximum pressure 3.5	bar
System torsional (1)	3261	22556	Rotor : Solid ☐ Built up ☒	
			Casing split : Horizontal ☐ Vertical ☒	
Gas generator : Type 7LM2500 GE			Number of openings for inspection	
Compressor : Type AXIAL			Bearings : Type TILTING PADS	
Number of stages 16			Number 2 Manufacturer GLACIER	
Number of stages with variable angle nozzles 6-16			Thrust bearing : Type TILTING PADS	
Compression ratio 20 : 1			Manufacturer GLACIER	
Minimum speed 4950 RPM Trip speed 10300	RPM		Load 16000 daN capacity 20000	daN
Maximum tip speed 390	m/s			
Maximum temperature 460	°C		Flanges size and orientation (facing output coupling)	
Maximum pressure 19	bar		Inlet : Size x	m
Rotor : Solid ☐ Built up ☒			Orientation : ↑☒ ↓☐ →☐ ←☐ Other ☐	
Casing split : Horizontal ☒ Vertical ☐			Exhaust : Size x	m
Number of openings for inspection 16			Orientation : ↑☒ ↓☐ →☐ ←☐ Other ☐	
Combustors : Type ANNULAR				
Single ☒ Multiple ☐ - Number			Materials	
Gas fuel ☒ [illegible]			Inlet casing BIG L S. Steel	
Temperature stratification N A	°C		Gas generator	
Number of nozzles per combustor 30			Compressor : Casing M152 Steel — INCO 718	
Number of opening for inspection 8			Stator/Rotor blades Ti-6Al-4V/A 286 / Ti-6Al-4V/A286	
Gas generator turbine(s) : Type AXIAL			Wheel/Shaft Ti-6Al-4V/INCO718/ INCO 718	
Number of stages 2			Combustor HASTELLOY X - HS188	
Maximum tip speed 480	m/s		Gas generator turbine	
Maximum temperature N.A.	°C			
Rotor : Solid ☐ Built up ☒				
Casing split : Horizontal ☐ Vertical ☒				
Number of openings for inspection 16				
Bearings : Type ROLLER				
Number 3 Manufacturer N.A.				
Thrust bearing : Type BALL				
Number 1 Manufacturer N.A.				
Load N.A. daN Capacity N.A.	daN			

Stage	1	2	3	4
Stator blade	X-40	Rene 80		
Rotor blade	Rene 80	Rene 80		
Wheel	INCO 718	INCO 718		

Power turbine

Stage	1	2	3	4
Stator blade	FSX 414	FSX 414		
Rotor blade	IN 738	U 500		
Wheel	CrMoV	Steel		

Output shaft CrMoV Steel

WEIGHTS AND DIMENSIONS

	Weight kg	Dimensions m		
Complete gas turbine	40000	3.5×8.65×3.65	Total shipping weight	kg
Gas generator	2200	ℓ = 3.0 ϕmax 1.3	Largest item : Weight	kg
Power turbine	8000	1.5×2×1.5	Dimensions x x	m
Air filtration	6500	5.1×5.7×1.85	Erected dimensions x x	m
Exhaust	13000	3.7×2.2×13	Maximum maintenance weight 4000	kg

Remarks :

(1) POWER TURBINE + CENTRIFUGAL COMPRESSOR

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E-BI-PP-12.08-1101

4/5

DORTS

CUSTOMER TOTAL	ITEM TE 3400 / TE 3300					4
LOCATION THAILAND						3
UNIT COMPRESSION						2
ENGINEERING						1
JOB N°			1/6/90		M	0
		DESIGNATION	DATE	BY	APPR	REV

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LUBE OIL SYSTEM (API 614 ☒)

Oil system : FOR GAS GENERATOR ☒.
Separate for driven equipment & power turbine ☐ (1)
Mounting on baseplate ☐ Separate console ☒
Capacity \ m³/hr Pressure \ bar
Relief valve setting 6.9 bar

Pumps	Main	Standby	Emergency
Type	GEAR		
Driver	ACC. G.B.		
Mounting	\		
Flow m³/hr	4.7	NOT PROVIDED	NOT PROVIDED
Pressure bar	7		
Power kW	\		
Speed RPM	\		
Material	\		

~~Standby pump shutdown : Manual ☐ Automatic ☐~~
Bearing scavenge pumps ☒
Type GEAR Number 4

Reservoir in baseplate ☐ Separate ☒ (ON BASEPLATE)
Material ST-STL AISI 316 L Coating —
Capacity 0.45 m³ Retention 0.35 m

Heater : type NOT PROVIDED
Manufacturer \ Power \ kW
Filter : Single ☐ Dual ☒
Filter material INORGANIC FIBERS
Filtration 12 µ ABSOLUTE micron
ΔP : Clean/maxi 0.2 / 1.4
Filter body material AISI 316L
Switch valve : Number INTEGRAL WITH FILTER
Type \ Manufacturer \
Material \
Cooler : Single ☒ Dual ☐ (Air Cooled)
Type AIR COOLED Manufacturer AERCO MARELLI
Duty 100 % Surface 8 m²
Fouling factor 0.000172 m² °C/W
Material AISI 316 L
Accumulator ☐ Capacity NOT PROV. l
Type Manufacturer
Stainless steel piping : 316L ☒ 321 ☐
Downstream filter ☐ Complete system ☒

ACCESSORIES

Inlet system : Number of filtration stages 2

Item	Make	Type	Material	ΔP mm WC
Prefilter	AAF	M 80	FIBERGLASS	8
Filter	AAF	XL 90	FIBERGLASS	18
Silencer	AAF	BAFFLES	AISI 316L	18
Ducting	AAF		AISI 316L	
Expansion joint	AAF		CHEMISITE	
Manometer				
Housing				

Anti-icing system ☐ Method
Support structure ☒ Height of air intake +33130 m
(By Vendor)

Exhaust system : Height of stack +43000 m

Item	Make	Type	Material	ΔP mm WC
Expansion joint	AAF		COMPOSITE	
Silencer	AAF	BAFFLES	A 387 Gr 11	70
Ducting	AAF		A 387 Gr 11	
Heat recovery	—	—	—	
Stack	AAF		A 387 Gr 11	
Manometer	—	—	—	

Support structure ☒ By Vendor

Starting system : Manual ☐ Automatic ☒
Semiautomatic ☐ Purge time
Electric motor ☐ Diesel ☐ Hydraulic ☐
Expansion turbine ☒ Other ☐
Make GARRET Type AXIAL TURB Power 75 kW
Shaft turning device (*) Manual ☐ Automatic ☐ (2)
Make Type Power kW
(*) NOT REQUIRED
Fire protection equipment ☒
Gas detection in turbine enclosure ☒
Number of gas detectors AS PER JOB SPEC
Fire detection in turbine enclosure ☒
Type of fire detectors Number AS PER JOB SPEC
Fire protection with CO2 ☐ Halon ☒
Other accessories ☒ AS PER JOB SPEC

Remarks : (1) see separate data sheet
(2) VENDOR TO SPECIFY TYPE / LOCATION / TYPE OF DRIVE

							4
							3
UNIT (COMPRESSION)							2
ENGINEERING	QUANTITY: 2 UNITS						1
JOB N°				11/6/90		N	C
			DESIGNATION	DATE	BY	APPR	REV

1	INSTRUMENTS AND CONTROLS (2)							
2	Panels	By vendor	Mounting	Particularity	Alarms and shutdowns			
3	Cage	☒	LOCAL	☐ (1)	Switches ☒ Type			
4	Starting	☒	FLOOR	☐ (1)	Annunciator ☒ Type ON CRT			
5	Control	☒	—"—	☐ (1)	Manufacturer			
6					Acoustic annunciator ☒ Type			
7	Governor : Standard ☐ Other ☒ ELECTRONIC MODEL:				Defect		Alarm	Shutdown
8	Manufacturer G.E. Type MARK IV				Standby oil pump operating		☒	☐
9	Constant speed ☐ Variable speed ☒				Low oil pressure		☒	☒
10	Mini/Maxi speed 3900 / 6825 RPM				Over speed trip		☐ NO	☒
11	Control signal : Pneumatic ☐ Hydraulic ☐				Low fuel pressure		☒	☐ NO
12	Electronic ☒ Manual ☐				Over temperature (EXHAUST)		☒	☒
13	Mini/Maxi signal				Temperature control failure		☒	☐
14	On signal failure : Mini speed ☒ Maxi speed ☐				Combustor flame out		☐	☒
15	Constant speed ☐				High inlet air filter ΔP		☒	☒
16	Limit switch for generator drive				Starter failure		☒	☐
17	Regulation NEMA class				or low oil level		☒	☐
18	Controlled process variable				High oil filter ΔP		☒	☐
19	Method of control Δ = 20 mA				High oil temperature cool. out		☒	☒
20					Bearing over temperature -		☒	☒
21	Safety fuel shut off valve ☒				Gas turbine vibration		☒	☒
22	Possible test during operation ☐ NO				Driven equipment vibration		☒	☒
23								
24	Alarm and shutdown switches							
25	To alarm : Switch closes ☐ Switch opens ☒							
26	To shutdown : Switch closes ☐ Switch opens ☒				Temperature Instruments			
27	Enclosures : Weather proof ☐ Explosion proof ☒				Indicators : Make ON CRT Type			
28	Possible test during operation NO				Recorders : Make — Type			
29	Alarm switches ☐ Shutdown switches ☒				Mounting	Indicator	Recorder (3)	
30	SPEED INDICATION ON CRT				Air inlet (air/air comp)	☒	☒	NO
31	SPEED SENSOR : Number 3 ON PT 2 ON GG				Compressor discharge	☒	☐	
32	Manufacturer AIRPAX Type HAGNETIC TYPE				Interturbine	☒	☐	
33	Locations 3 ON PT SHAFT CASING				Exhaust	☒	☒	NO
34	2 ON GG AUX GEAR BOX				Oil reservoir	☒	☐	
35	Vibration detectors : Number 2 ON PT 3 ON GG				Oil cooler outlet/inlet	☒	☐	
36	Manufacturer BELL & HOWELL Type SYSMIC (PT)				Bearings	☒	☐	
37	METRIX TYPE ACCELEROMETER (GG)				Fuel	☒	☐	
38	LOCATION PT: ON SHAFT SUPPORT CASING							
39	GG : ON AX. COMP FIRST FRAME ON							
40	AX. COMPRESSOR REAR FRAME, ON TURB MID FRAME							
41	TOTAL UTILITY CONSUMPTION SEE SOS 23965/4 REV 02							
42	Cooling water : Flow NOT AVAILABLE m³/hr				Electricity			
43	Heat duty kcal/hr				During	DC Power	AC Power	
44					Starting			
45	Steam : Nominal flow NOT AVAILABLE kg/hr				Operation			
46	Maxi flow kg/hr				Coast down			
47					Standstill			
48	Fuel : Nominal flow kg/hr							
49	Maxi flow kg/hr				Instrument air flow			kg/hr
50								
51	Remarks : (1) Separate listing							
52	(2) VENDOR TO COMPLETE AND REFER TO JOB SPEC NO THAI BI PP 12-06-101							
53	SECTION 18.0 - ATTACHMENT 6							
54	(3) RECORDER IS NOT PROVIDED							
55								

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TURBO COMPRESSOR UNIT SHAFTLINE POWER BALANCE

*VENDOR TO SPECIFY MAX OPERATING CASE (I.E CASE FOR WHICH ABS POWER IS HIGHEST)

	UNITS	OPERATING CASES (5)					
		NOR / MAX					
OPERATING CONDITIONS							
- Ambient temperature	°C	29 / 32					
- Atmospheric pressure	bar						
- Relative humidity	%						
CENTRIFUGAL COMPRESSOR							
1st stage AT SUCT. FLANGE							
- Weight flow INCL. FUEL GAS	kg/h	232940					
- Inlet temperature	°C	26					
- Inlet pressure	bar abs	23					
- Outlet pressure	bar abs	53.7					
- Outlet temperature	°C	105					
- Polytropic efficiency (including internal losses: balance drum leakage ...)	%	74.1					
- Polytropic comp. power	Kw	8780					
- Tolerance on above power	%						
- Max. Polytropic comp. power	Kw						
- Mechanical losses	Kw	30					
- Other allowances:	Kw						
- Power read at comp. shaft	Kw						
2nd Stage							
- Weight flow AT DISCH. FLANGE	Kg/h	226440					
- Inlet temperature	°C	50					
- Inlet pressure	bar abs	52.7					
- Outlet pressure	bar abs	112					
- Outlet temperature	°C	126					
- Polytropic efficiency (including internal losses:)	%	69.7					
- Polytropic comp. power	kw	8420					
- Tolerance on above power	%						
- Max. polytropic comp. power	Kw						
- Mechanical losses	Kw	30					
- Other allowances	Kw						
- Power read at comp. shaft	Kw	17250					
Total power required INCL. 4% API TOLER. at DRIVER shaft at operating speed	Kw at r.p.m.	17950 / 6440					

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	UNITS	OPERATING CASES ⑤	○			○	○
GEARBOX							
- Mechanical efficiency	%						
- Mechanical losses	Kw						
Total power required at gear box L.S. shaft at operating speed	Kw at r.p.m.						
GAS TURBINE		29° 32°					
Speeds	r.p.m						
- Gas generator		9285 9304					
- Power turbine		6440 6449					
ISO continuous power at above speeds	Kw	2305 2316					
Ambient temp. correction	%	-6.8 -9.2					
- Corrector factor	Kw	-1482 -2098					
- Power output ~~reduction~~							
Altitude correction	%	/ /					
- Correction factor	Kw	/ /					
- Output reduction							
Compressor fouling loss	%	/ /					
- Correction factor	Kw	/ /					
- Output reduction							
Intake loss	mm W.G	150 150					
- Pressure drop	%	-2.2 -2.2					
- Correction factor	Kw	-483 -474					
- Output reduction							
Exhaust loss	mm W.G	100 100					
- Pressure drop	%	-.5 -.5					
- Correction factor	Kw	-114 -113					
- Output reduction							
Direct deductible auxiliaires	Kw	INCLUDED					
- Shaft driven lube oil pump	Kw	/					
- Shaft driven generator	Kw	INCLUDED					
- Others: HYDRAULIC OIL PUMP & SCAVENGE PUMP	Kw						
Other allowances:							
-							
-							
Net continuous available power output at turbine coupling	Kw	2088 2035					

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DORTS

	UNITS	OPERATING CASES					
		(5)					
Heat rate	KJ/KWh Kcal/Kwh	10228	10296				
Firing temperature	°C	N.A.	N.A.				
Material temperature	°C	N.A.	N.A.				
- 1st stage nozzle GG							
- 1st stage blading GG		N.A	N.A.				
- 1st stage blading PT							
Exhaust temperature	°C	540	543				
Compressor inlet air flow	Kg/s	61	64				

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14/15
16/90

DORTS

CUSTOMER TOTAL	ITEM K3320/3350					1
LOCATION THAILAND-B-STR	K3320/3350					2
UNIT COMPRESSION						3
ENGINEERING	QUANTITY : 2 UNITS					4
JOB N°			9/6/90		M	0
		DESIGNATION	DATE	BY	APPR	REV

1	Manufacturer : NUOVO PIGNONE		Manufacturing plant : FLORENCE				
2	Size and type : 2BCL 603		Functional design : Units ☐ Package ☒				
3	Service : NATURAL GAS		Continuous ☒ Intermittent ☐ ISO classification A ☐ B ☐ C ☐ D ☒				
4	Driver Type : GAS TURBINE						(ISO 3977)
5	RATED OPERATING CONDTIONS						APPLICABLE SPECIFICATIONS
6	Operating case		(5)	(10)			SEE MATERIAL REQUISITION
7	Gas handled	CASE	(5)	(10)			AND JOB SPEC NO THAI BI PP 12.06.101
8	Capacity (1.013 bar.A-15.5°C)	Sm³/hr					SECTION 18- ATTACHMENT 2.
9	Specific weight (1.013 bar.A-15.5°C)	kg/m³					SITE DATA
10	Weight capacity (incl. Fuel)	kg/hr	232940	256460			Altitude SEA LEVEL m
11	Suction Capacity	m³/hr	10418	10322			Barometer 1013 m bar
12	Suction Pressure (1)	bar a	23	23			Ambient temperature : Normal 29 °C
13	Conditions Temperature	°C	26	26			Maxi 34 °C, Mini 25 °C, design 32 °C
14	Compressibility factor		0.931	0.931			Humidity at design temperature 70 %
15	Pressure (1)	bar a	112	112			Wind speed 26 m/s
16	Discharge Maxi temperature	°C	126	126			Atmospheric air
17	Conditions Compressibility factor		0.928	0.916			Dust > 10µ g/m³
18	Guarantee case		YES	NO			< 10µ g/m³
19							Corrosion by : SALT LADDEN AIR

20	SHOP TEST / INSPECTION			PAINTING				
21	Shop inspection (2) by control agency	☐		Standard	☐	Installation : Indoor ☐ Heated ☐		
22	Tests : Following SP-MEC-035 page 6	☐	(3) (4)	Other	☒	Under roof ☐ Outdoor ☒ Off shore ☒		
23	Hydrostatic test	☐	☒	JOB SPECIFICATION		Winterisation ☐ Tropicalisation ☒		
24	Helium test	☐	☐	THAI.BI.PP.12.06.101		Area classification		
25	Leak test	☐	☒	SECTION 10		Starting : Local ☒ Remote ☐		
26	Mechanical test : Single ☐ Tander ☐	☐	☒	SHIPMENT				
27	Performance test :	☐	☒	Standard	☐			
28	FOR DETAILS OF SHOP TEST/	☐	☐	Sea boxing	☒			
29	INSPECTION SEE JOB SPEC	☐	☐	Outdoor storage	☐			
30	THAI BI PP 12 06 101	☐	☐	AS PER APPLICABLE		AVAILABLE UTILITIES		
31	SECTIONS 12 & 13			JOB SPEC		Cooling water : NOT AVAILABLE		
32						Pressure	–	bar a
33	ACCESSORIES BY MANUFACTURER (M) OR OTHER (O)					Available Δ P	–	bar
34	Base plate	M	Process piping			Temperature	–	°C
35	Foundation bolts	M	Inter stages piping			Δ T	–	°C
36	Driver	M	Safety valves			Steam : NOT AVAILABLE		
37	Main gear	M	Cooling water piping			Pressure	–	bar a
38	Gear between casings	–	Check valve			Temperature	–	°C
39	Transmission guard		Intrumentation		M	Instrument air :		
40	Low speed coupling	M	Local panel		M	Pressure	5 TO 8	bar a
41	High speed coupling	M	Antisurge		M	Temperature	42	°C
42	Coupling guards	M	Control system		M	Dew point	-20	°C
43	Soundproof enclosure		Special tools		M	Electric supply :		
44	Barring device		Spare parts		M		AC/DC / Volts / Phase / Hertz	
45	Suction filter	M						
46	Silencer		Other					
47	Coolers (7)	M	As per job specification					
48	Moisture separator	–	THAI.BI.PP.12.06.101			Control		
49	Lube oil unit	M	Section 30			SEE JOB SPEC. THAI BI PP 12.06.01		
50	Seal oil unit	M				SECTION 18.0 ATTACHT 4		

51 Remarks : (1) Measured at limit of supply (2) Following SP-MEC-035 page 4 (3) not witnessed (4) witnessed

52

53 (7) WITH AIR COOLERS

54

55

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CUSTOMER TOTAL	ITEM K3220/K3250								4
LOCATION THAILAND B STR	" K3320/K3350								3
UNIT COMPRESSION									2
ENGINEERING	QUANTITY : 2 UNITS								1
JOB N°							7/6/90		0
					DESIGNATION		DATE	BY	APPR	REV

1	**OPERATING CONDITIONS**								
2	Operating cases	(1)		(2)		(3)		(4)	
3	Guarantee point								
4	Compressor casing	2BCL 603		2BCL 603		2BCL 603		2BCL 603	
5	Compression section	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND
6	Gas handled								
7	Flow (1.013BARA. 15.5°C) SNm³/h								
8	Weight Flow AT SUCT. FLANGES kg/h	180330 ◇	135069 ▽	174830 ◇	132434 ▽	209310 ◇	212654 ▽	209100 ◇	212463 ▽
9	**SUCTION CONDITIONS (1)**								
10	Volume flow m³/h	9144	4163	7320	3360	10643	4998	10622	4994
11	Pressure (5) bar a	23	47	23	50.4	23	45.2	23	45.2
12	Temperature (3) °C	64	50	26	50	64	50	64	50
13	Relative humidity %	100	100	100	64	100	100	100	100
14	Molecular weight	22.93	22.83	22.65	22.65	22.93	22.83	22.95	22.83
15	Cp/Cv	AS PER BWRS EQUATION →							
16	Compressibility factor	AS PER BWRS EQUATION →							
17	**DISCHARGE CONDITIONS (1)**								
18	Volume flow m³/h	5634	2309	4695	2250	6710	2954	6697	2951
19	Pressure bar a	48	100.5	51.4	100.5	46.2	90.5	46.2	90.5
20	Temperature °C	132	125	99	119	131	120	131	120
21	Cp/Cv	AS PER BWRS EQUATION →							
22	Compressibility factor	AS PER BWRS EQUATION →							
23	FLOW AT DISCH. FLANGES Kg/h	192654	172706	137434	169330	221022	201546	220216	201352
24	Pressure ratio	2.087	2.133	2.235	1.994	2.009	2.002	2.009	2.002
25	Head (2) (FLANGE / FLANGE) m	9640	9230	9050	8337	9120	8350	9140	8400
26	Efficiency (2) (FLANGE / FLANGE) %	77.3	70.4	75.1	70.2	74.1	68.4	74.2	68.4
27	Gas power kW	6470	6425	6130	5750	7355	6945	7335	6940
28	Compressor shaft power kW	12950		11930		14360		14340	
29	Drive shaft power kW	12950		11930		14360		14340	
30	Compressor speed RPM	6160		5380		6380		6380	
31	Drive shaft speed RPM	6160		5380		6380		6380	
32	Surge limit : flow m³/h	6400	3165	6025	2940	6715	3315	6715	3315
33	AT Speeds ABOVE RPM	6160	6160	5380	5380	6380	6380	6380	6380
34	Discharge pressure bar a	SEE CURVES →							
35	Performance curve N°	SOS 21832 →							

36 NOTE : ◇ PLANT FLOW + FUEL GAS
37 ▽ PLANT FLOW + FUEL GAS + LEAKAGES FROM LABYRINTS
o PLANT FLOW + LEAKAGES FROM LABYRINTS — CONDENSE FLOW

38	**CONTROL**				
39	Method	Suction throttling ☐	From to	By-pass ☐	From to
40		Speeed variation ☒	From to	Other ☐	
41	Action	Automatic ☒	Manual ☒	Local ☒	Remote ☒
42	Signal	Nature :	Localization :	Fuction :	
43	Treatment	Pneumatic ☐	Electronic ☒	Hydraulic ☐	
44	**ANTISURGE (4)**				
45	Method	By-pass ☒	From DISCH to SUCT	Discharge to atmosphere ☐	
46	Signal	Nature :	Localization :	Fuction :	
47	Correction	Pressure ☐	Temperature ☐	Other ☐	
48	Treatment	Pneumatic ☐	Electronic ☒	Hydraulic ☐	

49 (6) FOR ANY CASE, SUCTION PRESSURE MAY VARY BETWEEN 23 BARA AND 28.7 BAR A
50 (7) FOR ANY CASE, GAS ANALYSIS MAY BE IN THE RANGE OF COMPOSITIONS STATED IN SHEETS 18, 18A, 18B
51 Remarks : (1) At compressor flange ☒ At limit of supply ☐
52 (2) Polytropic ☒ Adiabatic ☐ (3) EXTREME TEMPERATURE MAY RISE UP TO 77°C AT
53 1ST STAGE INLET AND 55°C AT 2ND STAGE INLET
54 (4) ONE PER STAGE TO PREVENT HYDRATE FORMATION
55 (5) SUPPLIER TO CONSIDER A ΔP OF 1BAR BETWEEN 1ST STAGE DISCH. & 2ND STAGE SUCT.

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16/17

7/6/90

CUSTOMER TOTAL	ITEM K3220/3250						4
LOCATION THAILAND B-STR	K3320/3350						3
UNIT COMPRESSION							2
ENGINEERING	QUANTITY : 2 UNITS						1
JOB N°				7/6/90			0
		DESIGNATION		DATE	BY	APPR	REV

1	OPERATING CONDITIONS								
2	Operating cases	(5)		(6)		(7)		(8)	
3	Guarantee point	X	X						
4	Compressor casing	2BCL 603		2BCL 603		2BCL 603		2BCL 603	
5	Compression section	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND
6	Gas handled								
7	Flow Nm³/h								
8	Weight Flow AT SUCT. FLANGES kg/h	232940	240221	198130	203375	172070	180731	230730	234634
9	SUCTION CONDITIONS (1)								
10	Volume flow m³/h	10418	4830	9031	4128	6925	3038	10576	4975
11	Pressure (5) bar a	23	52.7	23	46.3	23	50.2	23	45
12	Temperature (3) °C	26	50	64	50	26	50	64	50
13	Relative humidity %	100	67	100	100	100	64	100	100
14	Molecular weight	22.65	22.65	25.31	25.24	25.0	25.0	25.31	25.24
15	Cp/Cv	AS PER BWRS EQUATION →							
16	Compressibility factor	AS PER BWRS EQUATION →							
17	DISCHARGE CONDITIONS (1)								
18	Volume flow m³/h	5939	2751	5599	2282	4182	1984	6701	2930
19	Pressure bar a	53.7	112	47.3	100.5	51.2	100.5	46.	90.5
20	Temperature °C	105	126	132	125	98	119	131	121
21	Cp/Cv	AS PER BWRS EQUATION →							
22	Compressibility factor	AS PER BWRS EQUATION →							
23	FLOW AT DISCH. FLANGES Kg/h	246422	226440	210936	190503	135582	167470	203036	222278
24	Pressure ratio	2.335	2.125	2.078	2.107	2.226	2.002	2.0	2.011
25	Head (2) (FLANGE TO FLANGE) m	10060	9195	8630	8330	8040	7550	8180	7585
26	Efficiency (2) (FLANGE TO FLANGE) %	74.1	69.7	76.8	70.4	74.9	70.	72.9	67.5
27	Gas power kW	8780	8420	6390	6330	5020	5135	7390	7005
28	Compressor shaft power kW	17260		12820		10600		10450	
29	Drive shaft power kW	17260		12820		10600		10450	
30	Compressor speed RPM	6400		5910		5500		6170	
31	Drive shaft speed RPM	6400		5910		5500		6170	
32	Surge limit : flow m³/h	6975	3390	6140	3075	5550	2750	6585	3290
33	AT Speeds ABOVE RPM	6400	6400	5910	5910	5500	5500	6170	6170
34	Discharge pressure bar a	SEE CURVES →							
35	Performance curve N°	SOS 21332 →							
36									
37									

38	CONTROL (SEE PAGE 15/16)					
39	Method	Suction throttling ☐	From	to	By-pass ☐ From	to
40		Speeed variation ☐	From	to	Other ☐	
41	Action	Automatic ☐	Manual ☐	Local ☐	Remote ☐	
42	Signal	Nature :	Localization :		Fuction :	
43	Treatment	Pneumatic ☐	Electronic ☐		Hydraulic ☐	
44	ANTISURGE (4) (SEE PAGE 15/16)					
45	Method	By-pass ☐	From	to	Discharge to atmosphere ☐	
46	Signal	Nature :	Localization :		Fuction :	
47	Correction	Pressure ☐	Temperature ☐	Other ☐		
48	Treatment	Pneumatic ☐	Electronic ☐	Hydraulic ☐		
49						
50						
51	Remarks: (1) At compressor flange ☒ At limit of supply ☐					
52	(2) Polytropic ☒ Adiabatic ☐					
53	NOTES OF SHEET 15/16 ARE VALID					
54						
55						

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7/18
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DORTS

CUSTOMER TOTAL	ITEM K3220/K3250					4
LOCATION THAILAND B STR	K3330/K3350					3
UNIT COMPRESSION						2
ENGINEERING	QUANTITY: 2 UNITS					1
JOB N°		DESIGNATION	7/6/90 DATE	BY	APPR	0 REV

1	OPERATING CONDITIONS								
2	Operating cases	(9)		(10)					
3	Guarantee point								
4	Compressor casing	2BCL 608		2BCL 608					
5	Compression section	1ST	2ND	1ST	2ND				
6	Gas handled								
7	Flow (1.013 BAR a. 15.5°C) Nm³/h								
8	Weight Flow AT SUCT. FLANGES kg/h	230640	238435	256860	264553				
9	SUCTION CONDITIONS (1)								
10	Volume flow m³/h	16533	4974	16322	4763				
11	Pressure (5) bar a	23	45	23	52.6				
12	Temperature (3) °C	64	50	26	50				
13	Relative humidity %	100	100	100	70				
14	Molecular weight	25.28	25.23	25.0	25.0				
15	Cp/Cv	AS PER RWRS EQUATION							
16	Compressibility factor	AS PER RWRS EQUATION							
17	DISCHARGE CONDITIONS (1)								
18	Volume flow m³/h	6713	2922	5536	2707				
19	Pressure bar a	46	90.5	53.6	112				
20	Temperature °C	131	121	104	126				
21	Cp/Cv	AS PER RWRS EQUATION							
22	Compressibility factor	AS PER RWRS EQUATION							
23	FLOW AT DISCH. FLANGES Kg/h	243014	222062	271055	249366				
24	Pressure ratio	2.0	2.011	2.330	2.129				
25	Head (2) (FLANGE TO FLANGE) m	8190	7625	9020	8290				
26	Efficiency (2) (FLANGE TO FLANGE) %	72.5	67.6	73.4	69.2				
27	Gas power kW	7000	4030	8755	8430				
28	Compressor shaft power kW	10890		17200					
29	Drive shaft power kW	10890		17200					
30	Compressor speed RPM	6170		6190					
31	Drive shaft speed RPM	6170		6190					
32	Surge limit : flow m³/h	6590	3295	6795	3305				
33	At Speeds ABOUT RPM	6170	6170	6190	6190				
34	Discharge pressure bar a	SEE CURVES →							
35	Performance curve N°	SOS 21832 →							
36									
37									

38	CONTROL (SEE PAGE 15/16)					
39	Method	Suction throttling ☐	From	to	By-pass ☐	From to
40		Speeed variation ☐	From	to	Other ☐	
41	Action	Automatic ☐	Manual ☐	Local ☐	Remote ☐	
42	Signal	Nature :	Localization :		Fuction :	
43	Treatment	Pneumatic ☐	Electronic ☐		Hydraulic ☐	
44	ANTISURGE(4) (SEE PAGE 15/16)					
45	Method	By-pass ☐	From	to	Discharge to atmosphere ☐	
46	Signal	Nature :		Localization :	Fuction :	
47	Correction	Pressure ☐	Temperature ☐	Other ☐		
48	Treatment	Pneumatic ☐	Electronic ☐	Hydraulic ☐		
49						
50						
51	Remarks: (1) At compressor flange ☒	At limit of supply ☐				
52	(2) Polytropic ☒	Adiabatic ☐				
53	NOTES OF SHEET 15/16 ARE VALID					
54						
55						

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18/18A
7/6/90

DORIS

LOCATION THAILAND-B-STR	K3320/3350			4
UNIT COMPRESSION				3
ENGINEERING	QUANTITY : 2 UNITS			2
JOB N°				1
	DESIGNATION	DATE	BY / APPR	REV
		7/6/90		0

GAS ANALYSIS

Analysis % — Weight ☐ Mole ☒

Component	M.W	OPERATING CASES	①		②		③		④	
		STAGE	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND
H_2O			1.014	0.262	0.157	→	1.014	0.272	0.833	0.273
N_2			0.868	0.876	0.881	→	0.868	0.876	0.870	0.876
CO_2			14.700	14.829	14.887	→	14.700	14.827	14.733	14.830
C_1			73.251	73.516	74.317	→	73.251	73.969	73.434	73.532
C_2			5.427	5.069	5.475	→	5.427	5.069	5.435	5.067
C_3			2.491	2.505	2.473	→	2.491	2.505	2.490	2.500
iC_4			0.701	0.711	0.676	→	0.701	0.711	0.699	0.700
mC_4			0.610	0.610	0.574	→	0.610	0.610	0.607	0.607
iC_5			0.290	0.287	0.249	→	0.290	0.287	0.287	0.285
mC_5			0.183	0.180	0.149	→	0.183	0.180	0.180	0.178
C_6 (SG = 0.668)	84		0.217	0.209	0.131	→	0.217	0.209	0.210	0.201
C_{7+} (SG = 0.77)	130.8		0.247	0.106	0.031	→	0.247	0.105	0.223	0.106
			(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)

MASS FLOWS (Kg/h)

PROCESS FLOW *	172 746	169 830	201 546	201 352
FUEL GAS FLOW	5250	5000	5650	5700
LEAKAGES FLOW	12323	12604	11113	11116
CONDENSATE FLOW	2334	0	2714	2048

NOTE * AT 2ND STAGE DISCHARGE FLANGE

Total								
Molecular weight, dry								
Molecular weight, wet (3)	22.98	22.83	22.65	22.65	22.98	22.83	22.95	22.83
Relative humidity %	100	100	100	64	100	100	100	100

Corrosion by CO_2

Solids GAS FROM WELLS THRU SEPARATOR

Remarks: (1) GAS ANALYSIS GIVEN AT 1ST STAGE INLET
(2) SUPPLIER TO SPECIFY GAS ANALYSIS AT 2ND STAGE INLET VERSUS SELECTED INTERSTAGE PRESSURE AND TEMPERATURE OF 50°C
(3) SUPPLIER TO CONFIRM AVERAGE MOLECULAR WEIGHT

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8A/18B
1/6/90

DORIS

CUSTOMER : TOTAL	ITEM K9320/3350			4
LOCATION THAILAND B-STR	K9320/3350			3
UNIT COMPRESSION				2
ENGINEERING	QUANTITY : 2 UNITS			1
JOB N°		7/6/90	AL	0
	DESIGNATION	DATE	BY / APPR	REV

GAS ANALYSIS

Analysis % — Weight ☐ Mole ☒

Component	M.W	(5) 1ST	(5) 2ND	(6) 1ST	(6) 2ND	(7) 1ST	(7) 2ND	(8) 1ST	(8) 2ND
OPERATING CASE									
STAGE	-	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND
H_2O		0.157	→	1.014	0.264	0.157	→	1.014	0.274
N_2		0.881	→	0.866	0.874	0.880	→	0.866	0.874
CO_2		14.887	→	22.541	22.241	22.834	→	22.541	22.735
C_1		74.317	→	64.985	65.533	65.953	→	64.985	65.576
C_2		5.475	→	5.408	5.451	5.457	→	5.408	5.451
C_3		2.473	→	2.857	2.373	2.836	→	2.857	2.373
iC_4		0.676	→	0.704	0.705	0.679	→	0.704	0.705
nC_4		0.574	→	0.689	0.689	0.649	→	0.689	0.683
iC_5		0.249	→	0.277	0.274	0.237	→	0.277	0.270
nC_5		0.149	→	0.187	0.184	0.153	→	0.187	0.184
C_6 (SG = 0.688)	84	0.131	→	0.225	0.216	0.136	→	0.225	0.216
C_{7+} (SG = 0.77)	130.8	0.031	→	0.247	0.146	0.030	→	0.247	0.145
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)

MASS FLOWS (Kg/h)

PROCESS FLOW *	226440		190508		167470		222278	
FUEL GAS FLOW	6500		5250		4600		5700	
LEAKAGES FLOW	13781		12867		13311		12356	
CONDENSATE FLOW	0		2372		0		2752	
Total								
Molecular weight, dry								
Molecular weight, wet (3)	22.65	22.65	25.31	25.24	25.0	25.0	25.31	25.24
Relative humidity %	100	67	100	100	100	64	100	100

NOTE * AT 2ND STAGE DISCH. FLANGE

Corrosion by CO2

Solids GAS FROM WELLS THRU SEPARATOR

Remarks: NOTES OF SHEET 18/18A ARE VALID

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HAI-BI_PP-12.08-1101

: 18B/19
: 7/6/90

DORIS

CUSTOMER TOTAL	ITEM K3320/K3350					4
LOCATION THAILAND B STR						3
UNIT COMPRESSION						2
ENGINEERING	QUANTITY: 2 UNITS					1
JOB N°		DESIGNATION	7/90 DATE	BY	APPR	0 REV

GAS ANALYSIS

Analysis % — Weight ☐ Mole ☐

Component	M.W	(9) 1ST	(9) 2ND	(10) 1ST	(10) 2ND
OPERATING CASE					
STAGE	-	1ST	2ND	1ST	2ND
H_2O		0.832	0.274	0.157	→
N_2		0.868	0.374	0.880	→
CO_2		22.592	22.701	22.834	→
C_1		65.150	65.596	65.953	→
C_2		5.417	5.449	5.457	→
C_3		2.856	2.368	2.836	→
iC_4		0.702	0.703	0.679	→
nC_4		0.686	0.636	0.649	→
iC_5		0.273	0.271	0.237	→
nC_5		0.184	0.182	0.153	→
C_6 (SG=0.688)		0.217	0.210	0.136	→
C_7+ (SG=0.77)		0.223	0.106	0.030	→
		(1)	(2)	(1)	(2)

MASS FLOWS (Kg/h)

PROCESS FLOW *	222062		249360	
FUEL GAS FLOW	6500		6500	
LEAKAGES FLOW	12377		14533	
CONDENSATE FLOW	2078		0	
Total				
Molecular weight, dry				
Molecular weight, wet (3)	25.28	25.22	25.0	25.0
Relative humidity %	100	100	100	70

NOTE * AT 2ND STAGE DISCH. FLANGE

Corrosion by CO2

Solids GAS FROM WELLS THRU SEPARATOR

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THAI-BI_PP-N_08-101

: 19,20

: 1/6/90

DORIS

CUSTOMER TOTAL	ITEM K 3320/3350					4
LOCATION THAILAND-B STR	K3320/3350					3
UNIT COMPRESSION						2
ENGINEERING	QUANTITY: 2 UNITS					1
JOB N°			1/6/90		M	0
		DESIGNATION	DATE	BY	APPR	REV

CONSTRUCTION

Casing designation	2 BCL 605			Shaft MATERIAL	EQ. TO AISI 4340	
Direction of rotation (view from driver)				Impellers fitting	KEYED & SHRUNK	
CW ☐	CCW ☒			Diameter at impellers	265	mm
Speed				Diameter at couplings	150	mm
Maximum continuous	6225		RPM	Shaft ends : tapered ☒	Cylindrical ☐	
Maximum tip speed AT M.C.S	257.5		m/s			
Critical speed	1 st	2 nd	3 rd	Balance drum MATERIAL	EQ. TO ASTM A280 GR CA6	
Lateral	3250	11700		Suface 688 / 379 cm²	Diameter 360 / 330	mm
Torsional	3261	22556	27232	Fitting method	KEYED & SHRUNK	
Damped ☒ Undamped ☒						
Found by : Calculation ☒	Test ☐			Shaft sleeves MATERIAL	EQ TO ASTM A 280 GR CA6	
				Between impellers ☒	At seals ☒	
Balancing AS PER API 617				Fitting method	SHRUNK	
Applicable code	Grade					
Static ☐ Dynamic ☒	speed 499 RPM			Labyrinths MATERIAL	ALUMINIUM ALLOY	
				Stationary ☒	Rotating ☐	
Overspeed test						
Individual ☒ Complete rotor ☒	speed 7166 RPM			Seals . DRY GAS SEALS "CRANE" 23 AT TANDEM		
* AS PER API MECHAN. RUNNING TEST				API 617 ☒	Figure n° 7	
Allowable vibration level during test *	microns			Circulating oil flow	—	l/mn
Peak to peak ☒	on shaft ☒			Oil leakage	—	l/day
				Oil supply : From lube ☐	Independent ☒	
Casing MATERIAL	EQ. TO ASTM A 216 GR. C			Maximum casing pressure at idle		bar
Cast ☐	Forged ☒	Welded ☐		Possible start up with idle pressure		☐
Split : Vertically	☒ Horizontally ☐			Buffer gas N/A ☐	Nature	
Thickness 120 mm	Corrosion allowance 3		mm	Gas flow : normal	kg/h at	bar
Maximum operating pressure R.V.S.(*)	117		barg	Maxi	kg/h at	bar
Design pressure	130		barg	Buffer gas used for :	start up ☐	
Test pressure : Hydrostatic	195		barg	Normal duty ☒	Running with air ☐	
Helium			bar	Buffer gas control ☐		
Maximum operating temperature	200		°C	SETTLING OUT PRESSURE : SEE SHEET 27/28		
Minimum operating temperature	- 20		°C	Seal test API 617 ☐	Pressure	bar
Maximum allowable number of impellers	3					
Maximum casing flow	≃ 20000		m³/h	Bearing housings MATERIAL	EQ TO AISI 9340	
				Bolted to casing ☒	Built in ☐	
				Split HORIZONTALLY		
Number of discharge volutes	2					
				Radial bearings MATERIAL	ASTM A 266 GR 3 + HOYT IIR	
Diffusors : without vanes ☒	with vanes ☐			Type TILTING PADS	Span 2370	mm
				Diameter 150 mm	Length 66	mm
Impellers MATERIAL	EQ TO ASTM A 240 GR 410			Load : Actual ≃ 9 bar	Allowed 20	bar
Number 4 + 4	Diameter 720		mm	Individual oil flow 55 l/mn	Pressure 1.2	barg
Number of vanes 17 / 15 / 13	outlet angle 40° ÷ 15°					
Design : Cast ☐	Forged ☒					
Welded ☒	Riveted ☐					
Open ☐	Closed ☒					
Smallest tip internal width	16		mm			
Maximum Mach number at impeller eye	0.9					
BACK TO BACK ARRANGEMENT						

Remarks :

(1) VENDOR TO SPECIFY

(*) RELIEF VALVE SET

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I-BI-PP-12-08-1101

0121 / 16/90

DORIS

CUSTOMER TOTAL	ITEM K3260/3270					4
LOCATION THAILAND-B-STR	K3320/3350					3
UNIT COMPRESSION						2
ENGINEERING	QUANTITY: 2 UNITS					1
JOB N°			1/6/90		M	0
		DESIGNATION	DATE	BY	APPR	REV

CONSTRUCTION (CONTINUED)

Thrust bearing (1) TILTING PADS - DBL ACTING

Location : Suction side EXTERNAL RAD. BEARING

Type TILTING PADS Make KINGSBURY

Diameter 16 1/2" Area 35550 mm²

Load: Actual 3.2 bar Allowed 27 bar

Gas thrust ≃ 11500 N

Thrust transmitted by coupling ≃ 2780 N

Coupling friction coefficient 0.15

Thrust taken by the balance pistons ≃ 12665 N

Oil flow 80 l/mn Pressure ≃ 0.4 barg

Lubrication : FLOODED

Thrustcollar : Replaceable

Thrust load at Surge & MCS: 1100 daN TOWARD 2ND SUCTION

Forces and moments allowable on flanges (3 x SM23)

	SUCTION		DISCHARGE			
	Force daN	Moment mdaN	Force daN	Moment mdaN		
Axial						
Vertical						
Horiz 90°						
SEE						
STEC DO. THAI BIPP 12.06.J01 TAB 7.1.2.5	Force daN	Moment mdaN	Force daN	Moment mdaN		

COUPLINGS

	DRIVER			
Attached data sheet				☒
Item				
Make	RENK			
Model	ZTKSU	STD COUPL. & G.T.		
Lubrication	YES			
Spacer	YES			
Limited end float	N/A			
Keyed	DO			
Hydraulic fit	YES			
— ' — -/r tools	YES			

MATERIALS EQUIVALENT TO :

Casing : Outer ASTM A216 GR WCB Inner ASTM A 217 GR C5

Diaphragms ASTM A 217 GR C5 INTERSTAGE ASTM A 182 F22

Impellers ASTM A 217 GR C5

Yield stress 535 N/mm² Brinell hardness 220 HB

Shaft AISI 4340

Balance piston ASTM A 217 GR C5

Shaft sleeves ASTM A 217 GR C5

Labyrinths : Impellers AVIONAL 14

Piston "

Shaft ends "

Bearing housings AISI 9840

Radial bearing babbitt HOYT

Thrust bearing babbitt AS PER MANUFACTURER STD

INLET WALLS AND INLET NOZZLES:

STAINLESS STEEL PLATED EQUIVAL. TO AISI 304

FLANGES AND CONNECTIONS

	Diam.	Class	Face	Posit.	Speed	47 G.P.
1ST SECTION		ANSI			m/s	
Suction	20"	300#	RJ	Down	20	
Discharge	16"	300#	RJ	UP DIAG	17	
2ND SECTION						
Suction	16"	300#	RJ	UP DIAG	14	
Discharge	14"	300#	RJ	Down	11	

Service	Diam.	Class	Face
Lube oil inlet (2)	2"	150#	RF
Lube oil outlet (2)	5"	150#	FF
LUBE oil inlet (3)	1½"	150#	RF
LUBE oil outlet (3)	3"	150#	FF
Casing drains	1"	1500#	RJ
Stage drains	N/A	N/A	N/A
LUBE OIL VENTS	2"	300#	RF
Liquid injection	N/A	N/A	N/A
Cooling water	N/A	N/A	N/A
Buffer gas	1½"	1500#	RJ
SEAL GAS INLETS	2"	1500#	RJ
SEAL GAS (4)	2"	1500#	RJ
SEAL GAS (5)	3"	150#	RF

WEIGHTS AND DIMENSIONS

Weights kg : Comp.: 33000 Casing only : 18000

Rotor: 2000 Inner Bundle: 15000

Dimensions mm : shaft height

Casing : Length 3500 Width 2036

Baseplate : Length Width

ROTOR : LENGTH 3062

Sketch attached ☐

Remarks : (1) Axial Forces considered in the most severe operating case

(2) THRUST BEARING ; (3) JOURNAL BEARINGS ;

(4) PRIMARY VENTS ; (5) SECONDARY VENTS.

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COUPLING DATA SHEET

Page : 24/25
Date : 1/6/90

DORIS

ELOPMENT PROJECT

Service COMPRESSION - GT TO COMPRESSOR | Item n°

APPLICABLE TO: ● PROPOSAL ○ PURCHASE ○ AS BUILT DATE _____ REVISION _____

● OWNER TOTAL NO. REQUIRED 2 SETS
SITE THAILAND - B - STR SERVICE GAS COMPRESSION

● DRIVER TYPE GAS TURBINE MANUFACTURER NUOVO PIGNONE MODEL PGT 25
SERIAL NO. _____ TAG NO. _____
DRIVEN UNIT CENTRIFUGAL COMPR MANUFACTURER NUOVO PIGNONE MODEL 2BCL 608
SERIAL NO. _____ TAG NO. _____

☑ COUPLING: TYPE GEAR
MANUFACTURER RENK TACKE MODEL ZTKH SIZE 90 NP/50
ASSEMBLY DRAWING NO. SOM 03425 / 458591

NOTE: INFORMATION TO BE COMPLETED: ● BY VENDOR ☑ BY COUPLING MANUFACTURER.

OPERATING CONDITIONS

● POWER TRANSMITTED (HP): NORMAL 22670 MAXIMUM CONTINUOUS 25500 KW @ 6825 RPM (1)
● SPEED (RPM): MINIMUM ALLOWABLE 3250 NORMAL 6500 MAXIMUM CONTINUOUS 6825 (1) TRIP 7150
● TORQUE M·kg MAXIMUM CONTINUOUS 44258 MAXIMUM TRANSIENT _____
○ FREQUENCY OF TRANSIENTS (EVENTS/TIME) (2.1.1) _____
APPLICATION FACTOR: ● MINIMUM REQUIRED 1.75 ☑ ACTUAL 1.86
● AMBIENT TEMPERATURE °C MAXIMUM 34 MINIMUM 23
ENVIRONMENT (3.5) ○ DUST ○ HYDROGEN SULFIDE ○ _____

LUBRICATION (2.2.9)
● CONTINUOUS ○ FILTRATION
○ GREASE-PACKED ○ VISCOSITY _____ ● _____
○ OIL-FILLED ○ PRESSURE NORMAL _____ MAXIMUM _____
○ NONLUBRICATED ○ TEMPERATURE NORMAL _____ MAXIMUM _____
☑ FLOW l/min NORMAL 20 MAXIMUM _____

○ _____
● ESTIMATED EQUILIBRIUM TEMPERATURE WITHIN COUPLING HOUSING : °C
AMBIENT [illegible] / [illegible] HEAT [illegible]

COUPLING DATA

☑ BOLTING TORQUE M·kg (2.1.11.4) 206 Nm ☒ LUBRICATED ☐ DRY
○ SHAFT SEPARATION AT OPERATING TEMP. B.S.E. _____ THERMAL GROWTH _____ FROM _____ AMBIENT
○ MOTOR ROTOR FLOAT _____ ○ LIMITED END FLOAT _____ (2.2.3) ○ ELECTRICALLY INSULATED (2.1.12)
○ MARINE TYPE REQUIRED (2.2.2) ○ FLEX-HUB TYPE REQUIRED (2.2.2)
☒ DESIGN RATING [illegible]/100 RPM) (2.1.1) 8.6 ☐ MAXIMUM CONTINUOUS TORQUE Nm) (6.2.8) 44258
○ REQUIRED MISALIGNMENT CAPABILITY: (2.1.3)
STEADY STATE: ANGULAR (DEG.) _____ PARALLEL OFFSET [illegible] 0.003 (3) AXIAL [illegible] 0.0056
TRANSIENT: ANGULAR (DEG.) _____ PARALLEL OFFSET [illegible] SAME AS S.S. AXIAL [illegible] SAME AS S.S.
☑ MAXIMUM ALLOWABLE MISALIGNMENT (6.2.6):
STEADY STATE: ANGULAR (DEG.) 0.083 PARALLEL OFFSET [illegible] 0.00145 AXIAL [illegible] ± 4
TRANSIENT: ANGULAR (DEG.) 0.083 PARALLEL OFFSET [illegible] 0.00145 AXIAL [illegible] ± 4
DYNAMIC BALANCE: (2.5.3.1) ○ COMPONENT BALANCE ONLY
○ COMPONENT BALANCE AND ASSEMBLY CHECK BALANCE ○ COMPONENT AND ASSEMBLY BALANCE
○ CHECK SENSITIVITY OF BALANCE MACHINE (2.5.1.5)
☑ MAXIMUM ALLOWABLE RESIDUAL UNBALANCE GRMM/KG DRIVER END 1.6 DRIVEN UNIT END 1.6
☐ MAXIMUM ACTUAL RESIDUAL UNBALANCE (GRMM) DRIVER END _____ DRIVEN UNIT END _____
☐ DIAPHRAGM COUPLING INITIAL DEFLECTION [illegible] (6.2.5) ☐ PRESTRETCH ☐ COMPRESSION
☐ DIAPHRAGM COUPLING AXIAL RESONANT FREQUENCY (HZ.): (2.3.4) (4.2.4.1) CALCULATED _____ ACTUAL _____
☐ TORSIONAL STIFFNESS [illegible]M/RAD (6.2.2) 7.55·10⁶
☐ AXIAL STIFFNESS MN/m (6.2.3) (6.2.4) NOT APPLICABLE
☒ WR² KG-M²) (6.2.2) 2.096
☐ ANGULAR (MISALIGNMENT) STIFFNESS (LB-IN.) (6.2.3) (6.2.4) NOT APPLICABLE

○ (1) BASED ON GAS TURBINE MAXIMUM CONTINUOUS SPEED
(2) 115% OF MAXIMUM CONTINUOUS SPEED
(3) COMBINATION OF OFFSET AND ANGULARITY

prior written authorization o...

...ATION & PROJECT...

COUPLING DATA SHEET

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DCRTS

...OFFSHORE PROJECT

Service COMPRESSION GT TO COMPRESSOR | Item n°

MATERIALS (3.2)

	DRIVE END MATERIALS	DRIVEN END MATERIALS
HUB/FLANGE	17 Cr Ni Mo 6 G	17 Cr Ni Mo 6 G
SPACER	30 Cr Mo V	30 Cr Mo V 9V
SLEEVE	42 Cr Mo 4 V	42 Cr Mo 4 V
DIAPHRAGMS		
DIAPHRAGMS GUARD		
BOLTS	8.8 DIN NT 61514	8.8 DIN NT 61514
NUTS	8 DIN NT 934	8 DIN NT 934

DIAPHRAGM PROTECTIVE COATING (3.4) ● VENDOR STANDARD ☐

● MATERIAL AND WELD HARDNESS TESTS REQUIRED (4.2.1.3)

INTERNAL TEETH HARDNESS (ROCKWELL C) (2.2.7) ☒ DRIVE END ACTUAL 49^{+11} ☐ DRIVEN END ACTUAL 49^{+11}

EXTERNAL TEETH HARDNESS (ROCKWELL C) (2.2.7) ☒ DRIVE END ACTUAL 51^{+7} ☐ DRIVEN END ACTUAL 51^{+7}

COUPLING HUB MACHINING

	DRIVE END	DRIVEN END
● TYPE (~~INTEGRAL~~, ~~CYLINDRICAL~~, TAPER) (2.1.5) (2.1.7.1)		
☑ TAPER (1 DEG I.A., ¾ IN. PER FT., ¾ IN. PER FT.) (2.1.8.1) (2.1.8.2)	1:20	1:20
☐ KEYED OR HYDRAULICALLY FITTED (2.1.7.1) OR FLANGED	HYDR.	HYDR.
☐ KEYWAY DIMENSIONS AND NUMBER (2.1.9.1)		
☒ NOMINAL BORE DIAMETER	170.55	149.6
☒ INTERFERENCE FIT) MAX./MIN. (2.1.7.1)	8.5	7.5
○ PULLER HOLES		
● BALANCING HOLES (2.5.4) UNLESS THEY ARE NOT AVAILABLE		

COUPLING GUARD (APPENDIX C)

● COORDINATOR (C.2.1) [illegible]

● FLANGED CYLINDRICAL ○ BASE MOUNT (C.2.2)

● AIR TIGHT (C.4.7.1)

● OIL TIGHT (C.2.7)

● SPARK RESISTANT (C.2.9)

○ TRANSPARENT WINDOW FOR EACH OIL SPRAY POINT (C.4.6.4)

VENT CONNECTION (C.4.3) ○ 1 INCH NPT WITH FILTER-BREATHER ● 1 INCH FLANGED, RATING & FACING

○ PURGE GAS _____ ○ DRY AIR PURGE (2.2.6) (C.4.4)

☐ CONNECTION SIZE & TYPE _____

☐ SCFM REQUIRED _____

○ OIL MIST COOLING _____ GAS COOLING _____

● CONTRACT GUARD TO BE USED DURING SHOP TEST (C.4.5)

○ _____

ACCESSORIES

● PRIME EQUIPMENT SUPPLIER TO FURNISH ONE SET OF PLUG AND RING GAGES (APPENDIX F)

● DRILL TEMPLATE FOR INTEGRAL FLANGED HUBS BY COUPLING MANUFACTURER (2.1.6)

● TWO-PIECE STOP RINGS BY COUPLING MANUFACTURER (4.2.2.3)

● ONE PUMP SET FURNISHED FOR ALL HYDRAULIC COUPLINGS AT EACH SITE BY COUPLING MANUFACTURER (TO INCLUDE HAND PUMP, PRESSURE GAGE, FITTINGS, AND HOSE) (4.2.2.1)

○ PULLER BY COUPLING MANUFACTURER (4.2.2.4)

○ _____

APPLICABLE SPECIFICATIONS

● API-671, SPECIAL PURPOSE COUPLINGS _____

PREPARATION FOR SHIPMENT

● OUTDOOR STORAGE FOR MORE THAN 3 MONTHS (4.2.1.2)

● EXPECTED STORAGE TIME 12 MONTHS

SHIPPING: ○ DOMESTIC ● EXPORT STORAGE: ○ INDOOR ○ OUTDOOR

○ SEE COUPLING PURCHASE ORDER FOR PRESERVATION, BOXING, AND SHIPPING INSTRUCTIONS

○ _____

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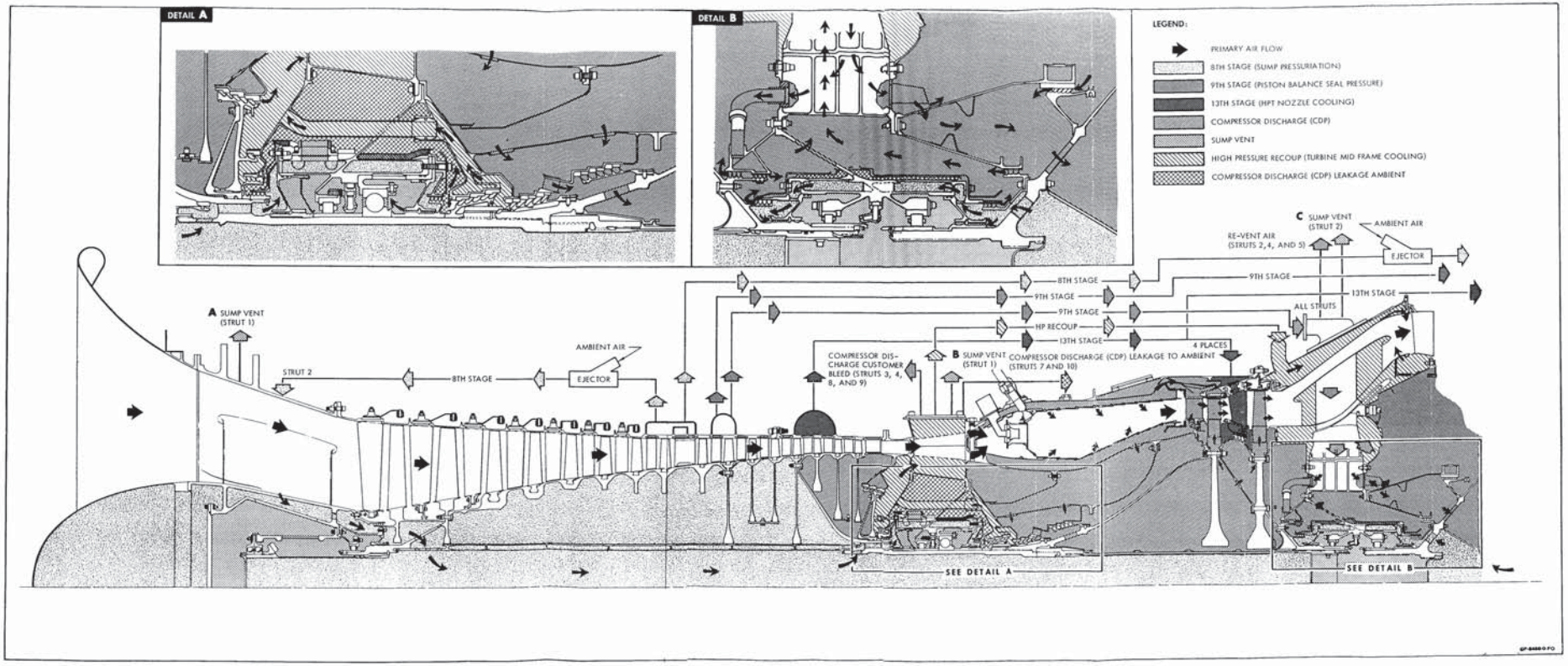
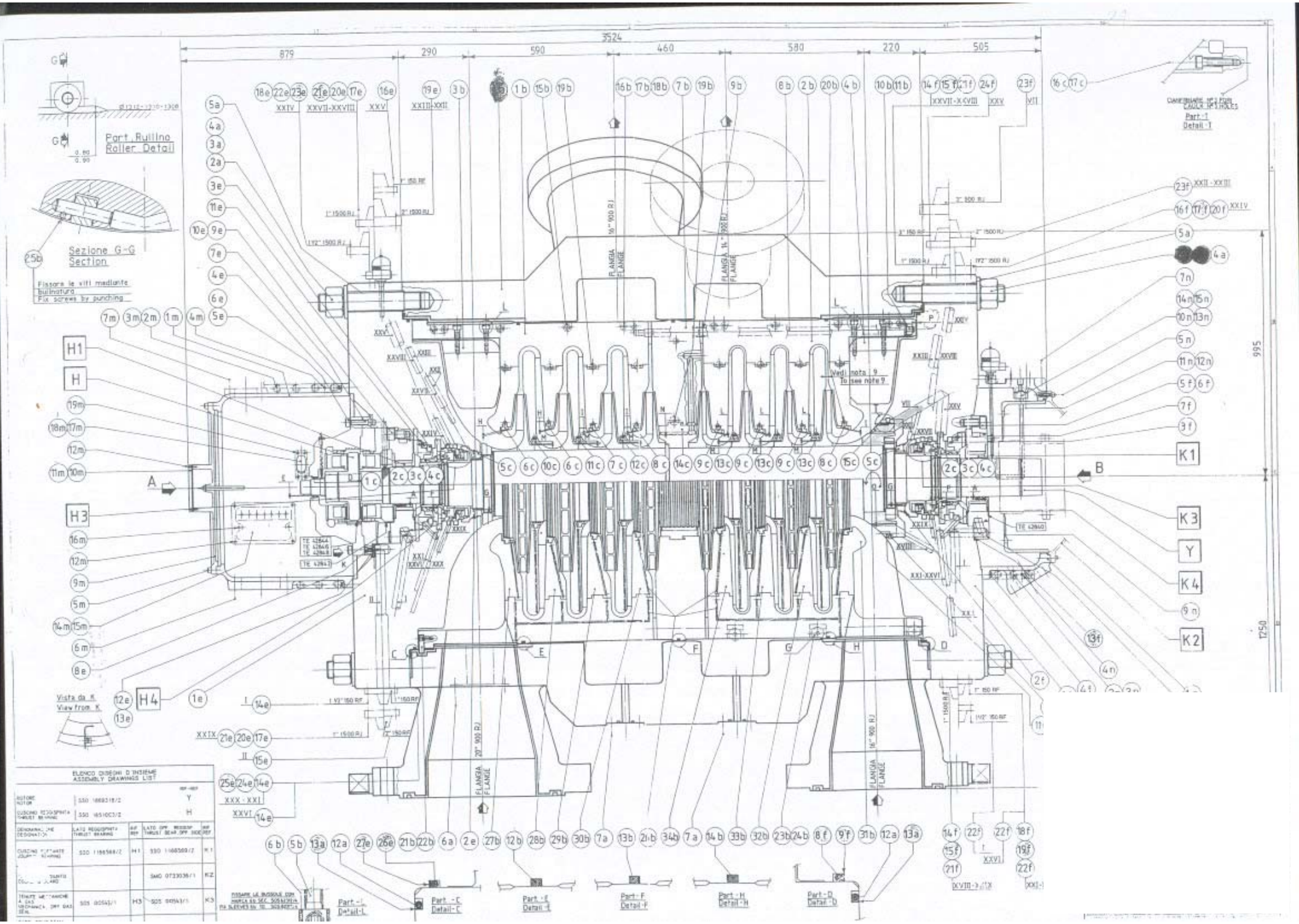


Figure 2-33. Typical Gas Turbine Air Flow (Sheet 1 of 2)

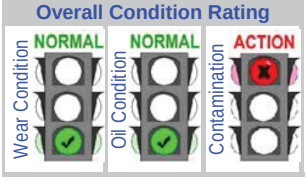

3524
879
290
590
460
580
220
505
995
1250
Part. Rullino
Roller Detail
Sezione G-G
Section
Fissare le viti mediante bullinatura
Fix screws by punching
Vista da K
View from K
Vedi nota 9
To see note 9
FLANGIA
FLANGE
Part -I
Detail -I
Part -C
Detail -C
Part -E
Detail -E
Part -F
Detail -F
Part -H
Detail -H
Part -D
Detail -D
ELENCO DISEGNI D'INSIEME
ASSEMBLY DRAWINGS LIST

Identification	Test Description	Purpose of Test
Machine Specific Analysis	Results from the following tests are reviewed by your Machine Condition Analyst and recommendations for your equipment is given with supporting data on each report.	Both Lubricant Condition & Equipment Condition are analyzed based on specific characteristics of your equipment, previous component performance, and test data.
Elemental Analysis	Elemental analysis is performed in accordance with atomic emission spectroscopy (AES). A specific volume of lubricant is energized using an electrical arc. The light frequencies and intensities are measured and reported in parts per million of various elements.	Elemental analysis is useful for identifying contamination, confirming additive content, and indicating system wear. The following elements are analyzed: Fe, Cr, Al, Pb, Sn, Cu, Ag, Ni, Na, V, Cd, Ti, Mo, Ca, Ba, P, Zn, B, K, Mg, and Si.
Water by Karl Fischer (ASTM D-4928)	Results from the following tests are reviewed by your Machine Condition Analyst and recommendations for your equipment is given with supporting data on each report.	Quantification of water contamination - water in a lubricant not only promotes corrosion and oxidation, but also may form an emulsion having the appearance of a soft sludge.
Total Acid Number (ASTM D664)	TAN is determined by titration of a known substance, such as KOH in order to determine an unknown quantity. Weighed samples are titrated using an automatic titration system	TAN of a used lubricant is one measure of its degree of degradation by oxidation.
Total Base Number (ASTM D4739)	TBN is determined by titration of a known substance, such as HCl, in order to determine an unknown quantity. Weighed samples are titrated using an automatic titration system.	TBN of a used lubricant is a measurement of its ability to neutralize the acid using basic buffers.
Infrared Analysis FT-IR	The infrared absorption spectrum of a lubricant furnishes a means of fingerprinting organic compounds and functional groups. Test results are trended and quantitative and qualitative determinations can be made.	Infrared analysis is often used for identifying additives and their concentrations, reaction products, and contamination by organic materials in used lubricants. Oxidation (carboxylic acids and esters), nitrate esters, water, soot, and glycol can be quantified.
Crackle	Eye Dropper test of lubricant on a hot plate heated to 100 deg C to determine presence of water. Detection can be made of water concentration > 800 ppm	This screening test is used by the analysts to check for water contamination and determination of whether more sensitive testing is required to determine more exact concentration.
Viscosity (Kinematic/Oil Bath ASTM D445/446)	ASTM test uses a constant temperature bath. The efflux time is measured between two points. The viscosity is computed by using a calibration constant and the efflux time. Viscosity is reported in centiStokes (cSt) at 40 or 100 deg C.	Viscosity is the single most important property of a lubricant. A reduction usually indicates that the system has been contaminated with a solvent or refrigerant fluid. A significant increase normally is traced to mixture with a high viscosity product, contamination, or oil oxidation. Normal measurement range for 40 deg C is +30% and -20% and for 100 deg C is +20% and -10%.
Fuel Dilution of Diesel Lubricants (ASTM D3524-90) Gas Chromatograph	The sample is mixed with a specific amount of an internal standard. One microliter of the mixture is injected into a 10 meter HP-1 WCOT capillary column, heated at a specified rate, detected via a Flame Ionizing Detector, and the results (in percentages/peak area) are displayed in a report generated from the computer software	Some fuel dilution of the engine oil may take place during normal operation. However, excessive fuel dilution (> 5%) is of concern in terms of possible performance problems. Immediate effects of high fuel dilution are decreased lubricant viscosity resulting in increased wear.
Flash Point (ASTM D92)	The lubricant sample temperature is raised at a constant rate as the flash point is approached. At specified intervals, a small test flame is passed across the cup containing the sample. The lowest temperature at which application of the test flame causes the vapors above the surface of the liquid to ignite is taken as the flash point.	Flash Point indicates the presence of highly volatile and flammable materials in a relatively nonvolatile or nonflammable material. Example: an abnormally low flash point on a test specimen of engine oil can indicate fuel contamination.

Identification	Test Description	Purpose of Test
Rotating Bomb Oxidation Test (ASTM D2272)	The test lubricant, water, and a copper catalyst coil contained in a covered glass container, are placed in a bomb equipped with a pressure gage. The bomb is charged with oxygen to a pressure of 620 kPa, placed in a constant-temperature oil bath set at 150 deg C, and rotated axially at 100 rpm at an angle of 30 deg from the horizontal. The number of minutes required to reach a specific drop in gage pressure is the oxidation stability of the test sample.	Test is used to assess the remaining oxidation test life of in-service lubricants.
Demulsibility (ASTM D1401-96)	40 ml of sample and 40 ml of distilled water are stirred for 5 min. at 54 deg C in a graduated cylinder. The time required for the separation of the emulsion thus formed is recorded or volumes of water, oil, and emulsion remaining after 30 minutes.	Test provides a guide for determining the water separation characteristics of oils subject to water contamination and turbulence.
Pour Point (ASTM D97)	After preliminary heating, the petroleum sample is cooled at a specified rate and examined at intervals of 3 deg C for flow characteristics. The lowest temperature at which movement of the specimen is observed is recorded as the pour point.	Determination of the lowest temperature at which a petroleum product may be used if fluidity is necessary to the application.
%Sulfur (ASTM D4294-90)	A petroleum sample is placed in the beam emitted from an X-ray source. The resultant excited characteristic X radiation is measured, and the accumulated count is compared with counts from previously prepared calibration samples to obtain the sulfur concentration in mass %.	The degree of sulfur concentrations in a petroleum product may be used to qualify the product's processing characteristics or compliance with environmental regulations.
Particle Count (ASTM D4406)	As particles in the lube flow pass a laser, the laser light is blocked allowing individual particles to be counted and sized. The resulting data is a distribution of the concentration of particles in various size ranges.	Since all contaminants in the oil are counted as particles, the particle count includes wear particles, soot, dirt, and other contaminates. This test provides information on lubricant cleanliness.
Foam Test (ASTM D892-95) Sequence I, II, III	A defined volume of air is forced through a set volume of sample lubricant at a specified temperature. The resulting volume of foam is measured	Determination of the foaming characteristics of lubricating oils at specified temperatures. Means of empirically rating the foam tendency and the stability of the foam.
Cone Penetration of Lubricating Grease (ASTM D 217)	A measured amount of grease sample is placed under a cone apparatus. The cone is attached to a gauge that measures from 85-475. The cone is dropped into the grease sample from a specified height and time. The measured amount that the cone penetrates into the grease is dropping point.	This test measures the consistency of grease. Harder grease will have a low NLGI rating number such as 00 or 1. Most industrial greases penetrate in the 265-295 ranges and have a NLGI rating of 2.
Dropping Point of Lubricating Greases (ASTM D566)	A grease sample is heated in the dropping point apparatus. The point where the grease starts separating and the oil drops out of the apparatus is the dropping point. The temperature is measured in degrees Celsius.	This test is a determination of the maximum operating temperature of grease.
% Sediment in Lubricating Oils	An oil sample is well shaken and dissolved in a solvent at a 1:1 ratio. The solvent: oil mixture is well shaken and 100 mls of sample is poured into two centrifuge tubes. The tubes are placed in the centrifuge at opposite ends and spun for 30 minutes. The sediment collected on the bottom is calculated and multiplied by two to give the total percentage of sediment in the oil.	This test is an excellent determination of sediments suspended in lubricating oil. Excessive amounts of sediments can impede oil capability

LubeCheck ™ - Oil Analysis for Predictive Maintenance

Overall Condition Rating



Recommendations and Notes

Particle count indicates that oil cleanliness level is dirty. Suggest using an off-line filtration system to clean up the oil system.
Recommend short sampling intervals of this sample point to monitor the abnormal conditions.

AS / Andy Sitton

Condition History	Test Method	Result	Current Sample Wear	Current Sample Oil	Current Sample Cont.	Previous Sample Wear	Previous Sample Oil	Previous Sample Cont.	Wear	Oil	Cont.
			N	N	A	N	N	N	N	N	N
FocusLab ID			82903			76072			70811		
Date sampled			03-Sep-07			07-May-07			06-Feb-07		
Hours on Oil			Not Given			108187			Not Given		
Hours on Unit			110996			108187			106096		
Bottle ID			866180			854065			854094		
Wear Condition											
Wear Element	Method	Unit	RDE fine	RFS coarse		RDE fine	RFS coarse		RDE fine	RFS coarse	
Iron	D-6595	PPM	0.0	1.4		0.1	0.0		0.9	0.0	
Chromium	D-6595	PPM	0.1	0.0		0.0	0.3		0.0	0.0	
Lead	D-6595	PPM	0.0	0.0		0.0	0.0		0.0	0.0	
Copper	D-6595	PPM	0.1	0.1		0.1	0.1		0.1	0.0	
Tin	D-6595	PPM	4.0	0.0		3.9	0.7		1.7	0.0	
Aluminum	D-6595	PPM	0.3	0.0		0.7	0.0		0.3	0.0	
Nickel	D-6595	PPM	0.0	0.0		0.0	0.0		0.0	0.0	
Silver	D-6595	PPM	0.0	0.3		0.0	0.1		0.0	0.0	
Molybdenum	D-6595	PPM	0.0	0.0		0.0	0.0		0.0	0.0	
Titanium	D-6595	PPM	0.2	0.0		0.4	0.0		0.4	0.0	
Oil Condition											
Viscosity @40°C	D-445	cSt	28.6			29.1			28.5		
Viscosity @100°C	D-445	cSt									
Oxidation	FTIR	Abs	247.3			239.7			153.9		
Nitration	FTIR	Abs	7.8			6.5			6.8		
TAN	D-974	mg KOH/g.	0.36			0.39			0.40		
TBN	D-4739	mg KOH/g.									
Contamination											
Water	T-H2O Check™	%(Wt.)	0.070			0.068			0.064		
Sodium	D-6595	PPM	0			0			0		
Silicon	D-6595	PPM	0.2	1.1		0.5	0.0		1.4	0.0	
Additive Element											
Boron	D-6595	PPM	0			0			0		
Magnesium	D-6595	PPM	0			0			0		
Calcium	D-6595	PPM	2			0			3		
Barium	D-6595	PPM	4			0			8		
Phosphorus	D-6595	PPM	1424			1462			1506		
Zinc	D-6595	PPM	1	2		0	0		1	0	
Additional Test											
Flash Point	D-3828	°C									
Viscosity Index	D-2270										
Other											

Alarm Limit Range

Limit Name (Equipment / Oil) :
Engine Turbine Gas GE Jet 530 (PTT E&P)

New Oil	RDE fine U-Caution	RDE fine U-Action	RFS coarse U-Caution	RFS coarse U-Action
	>2	>3	>2	>4
	>1	>2	>1	>2
	>1	>2	>5	>8
	>1	>2	>1	>2
	>5	>6	>2	>3
	>1	>2	>1	>2
	>2	>3	>1	>2
Oil Condition				
New Oil	L-Action	L-Caution	U-Caution	U-Action
28.1	<25.3	<26.7	>29.5	>30.9
0.49			>0.84	>1.2
Contamination				
New Oil			U-Caution	U-Action
0.042			>0.123	>0.205
	RDE fine		RFS coarse	
	>3	>5	>3	>5
Additive Element				
New Oil				
Additional Test				
New Oil	L-Action	L-Caution	U-Caution	U-Action
>				

Note: Alarm Limits are variable and dependent upon dataset size and to be used as general guideline.
No Sign or N : NORMAL , C or C : CAUTION (first level warning limit) , A or A : ACTION required (second level warning limit)

U-Caution : Upper CAUTION Level — L-Caution : Lower CAUTION Level — First level warning limit in Upper level and/or Lower level
U-Action : Upper ACTION required Level — L-Action : Lower ACTION required Level — Second level warning limit in Upper level and/or Lower level

Accuracy of interpretation and recommendation are based on representatives sample and information supplied — No warranty is expressed or implied for this report.

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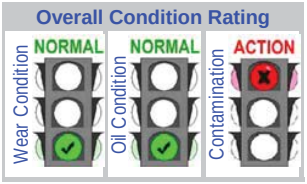
Overall Condition Rating



	Current Sample	Previous Sample	
FocusLab ID	82903	76072	70811
Date sampled	03-Sep-07	07-May-07	06-Feb-07
Hours on Oil	Not Given	108187	Not Given
Hours on Unit	110996	108187	106096
Bottle ID	866180	854065	854094

Alarm Limit Range

Limit Name (Equipment / Oil) :

Engine Turbine Gas GE Jet 530 (PTT E&P)

Particle Count — **NAS 1638: Number of Particles Per 100 Milliliter (Counts/100ml)**

Size Range	No. of Particles	Class		No. of Particles	Class	No. of Particles	Class	New Oil Class	U-Caution No. of Particles	U-Caution Class	U-Action No. of Particles	U-Action Class
5-15 microns	69,600	9		13,800	6	16,700	7					
15-25 microns	6,400	8	A	1,300	5	1,500	6			<6		<7
25-50 microns	1,800	8		300	6	400	6					
50-100 microns	100	8		<100	5	<100	5					
>100 microns	<100	6		<100	3	<100	3					

Particle Count — **ISO 4406:1999: Number of Particles Per Milliliter (Counts/ml)**

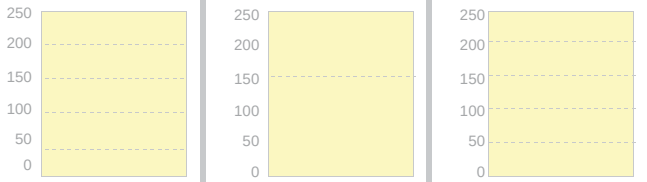
Size Range	No. of Particles	Class		No. of Particles	Class	No. of Particles	Class	New Oil Class	U-Caution No. of Particles	U-Caution Class	U-Action No. of Particles	U-Action Class
>4 microns	2,087	18	A	413	16	499	16		<1000		<1500	
>6 microns	584	16		116	14	140	14					
>14 microns	82	14		16	11	19	11					
ISO 4406 Result	18/16/14			16/14/11		16/14/11						

Recommendations and Notes

Particle count indicates that oil cleanliness level is dirty. Suggest using an off-line filtration system to clean up the oil system.

Option Test: Varnish and Sludge Potential Index ™ (VsPI™), Testing for Predicting Varnish and Sludge Buildup

VPI ™Value			
SPI ™Value			
VsPI ™ Value			
Sludge Weight	mg/100 ml	mg/100 ml	mg/100 ml
Condition			



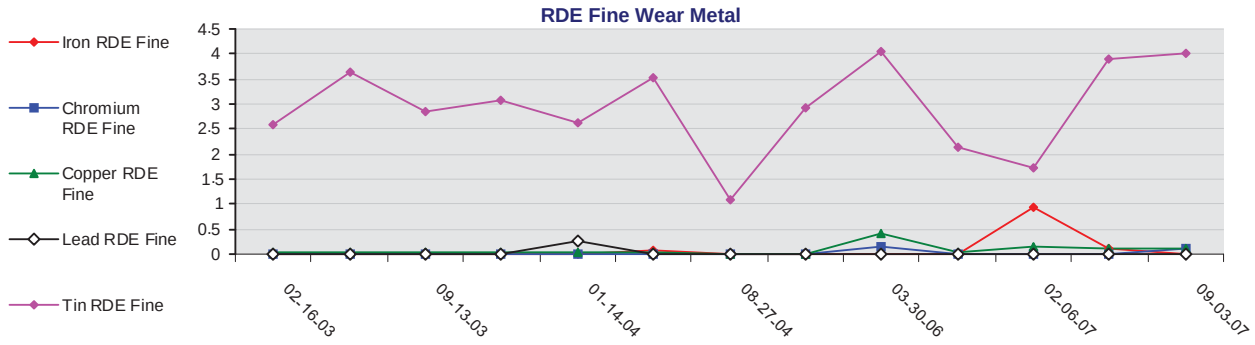
VsPI ™ Severity Limit Range Guideline

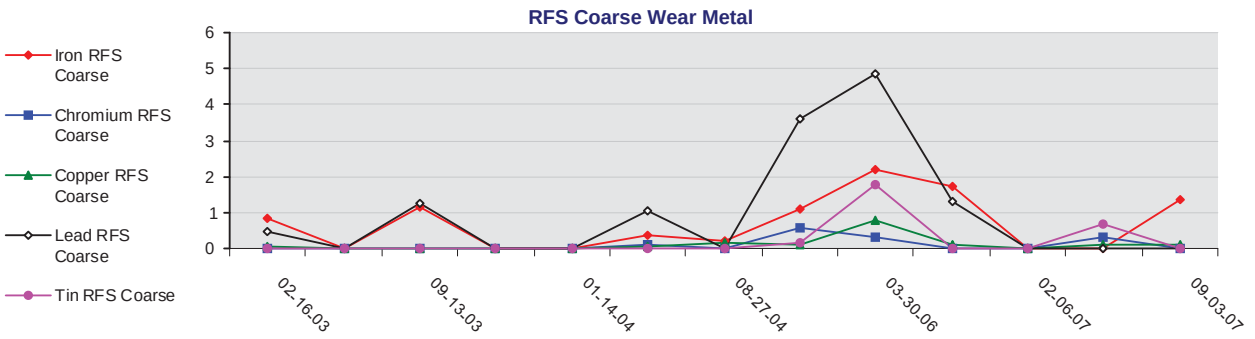
New Oil	U-Caution	U-Action

Option Test: RUL (Remain Useful Life), Testing for monitoring Percent Remaining Anti-Oxidant (AO) by ASTM D-6971

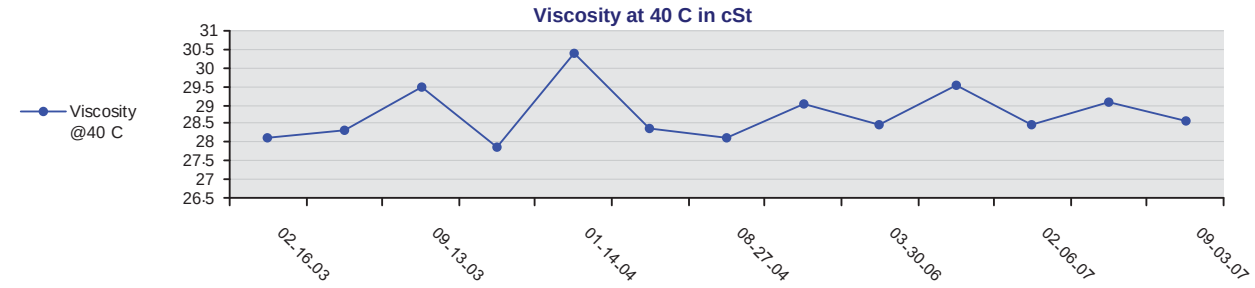
				New Oil	U-Caution	U-Action
% Remaining Antioxidant Additive				100	<50	<25

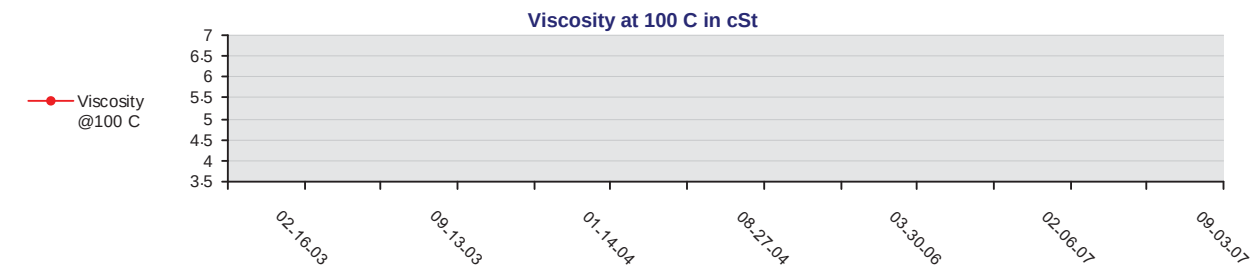
Wear Condition





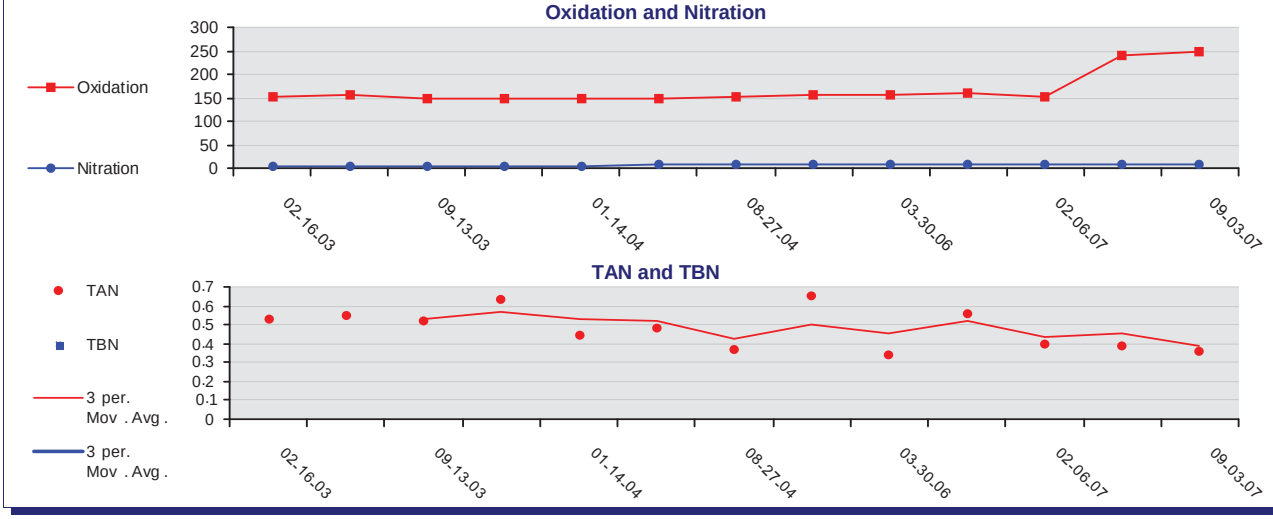
Oil Condition



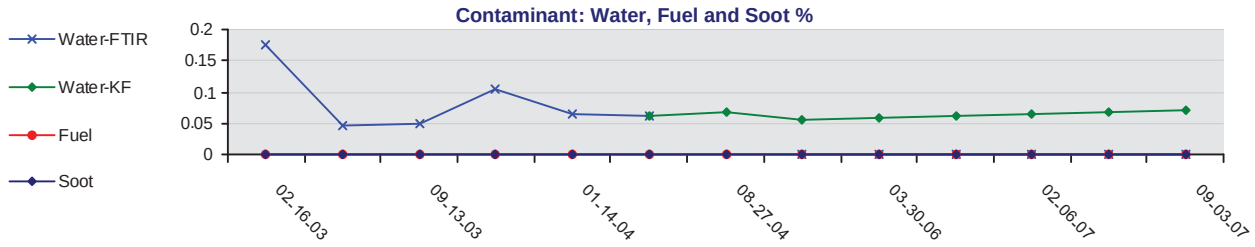


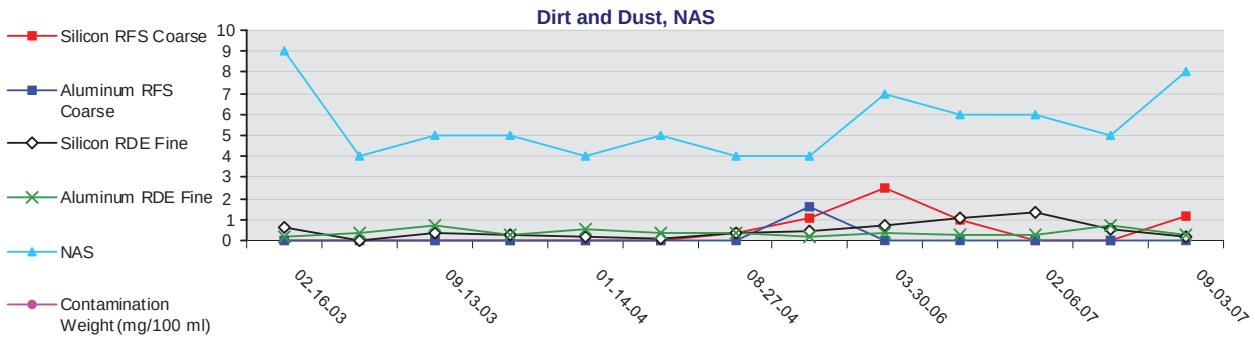
Lube System Capacity : 450 Liters **Location** :

Oil Condition

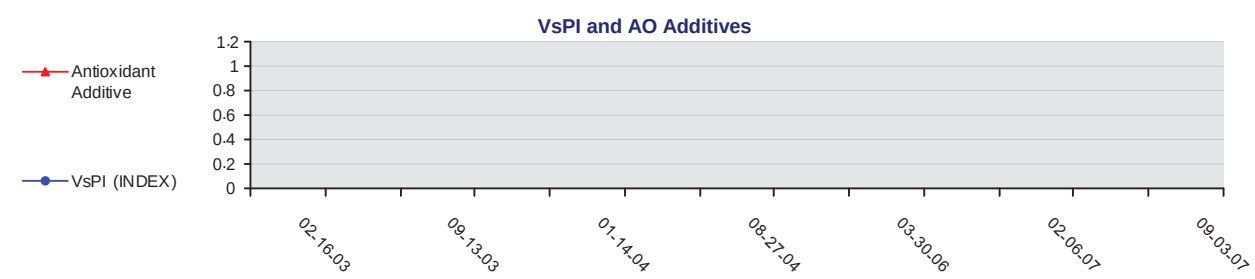


Contamination





Others



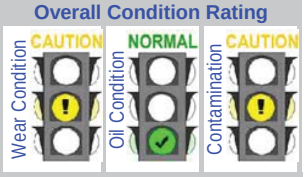
LubeCheck ™ - Oil Analysis for Predictive Maintenance

ISO 9001: 2000 Certified.

Customer Code : 25001

Unit ID Number : TEK 3200 Preslia 32

Overall Condition Rating



Recommendations and Notes

Note abnormal iron detected.
Particle count indicates that oil cleanliness level is in unacceptable range.
Suggest using an off-line filtration system to clean up the oil system.

AS / Andy Sitton

Condition History	Test Method	Result	Current Sample Wear	Current Sample Oil	Current Sample Cont.	Previous Sample Wear	Previous Sample Oil	Previous Sample Cont.	Wear	Oil	Cont.
			C	N	C	N	N	N	N	N	N
FocusLab ID			82904			76073			70812		
Date sampled			03-Sep-07			07-May-07			06-Feb-07		
Hours on Oil			Not Given			108187			Not Given		
Hours on Unit			110996			108187			106096		
Bottle ID			866183			854064			854095		
Wear Condition											
Wear Element	Method	Unit	RDE fine	RFS coarse		RDE fine	RFS coarse		RDE fine	RFS coarse	
Iron	D-6595	PPM	1.0	14.3	A	0.3	1.4		1.4	0.0	
Chromium	D-6595	PPM	0.4	0.3		0.0	0.0		0.0	0.0	
Lead	D-6595	PPM	0.7	1.0		0.0	0.2		0.0	0.0	
Copper	D-6595	PPM	0.3	0.7		0.3	0.2		0.2	0.2	
Tin	D-6595	PPM	0.7	0.0		0.6	1.0		0.0	0.0	
Aluminum	D-6595	PPM	0.1	0.0		0.0	0.0		0.0	0.0	
Nickel	D-6595	PPM	0.1	0.2		0.1	0.7		0.0	0.0	
Silver	D-6595	PPM	0.0	0.0		0.0	0.0		0.0	0.0	
Molybdenum	D-6595	PPM	0.0	0.0		0.0	0.0		0.1	0.0	
Titanium	D-6595	PPM	0.0	0.1		0.1	0.0		0.0	0.0	
Oil Condition											
Viscosity @40°C	D-445	cSt	32.1			33.0			32.7		
Viscosity @100°C	D-445	cSt									
Oxidation	FTIR	Abs	2.3			2.3			5.3		
Nitration	FTIR	Abs	2.7			2.5			4.0		
TAN	D-974	mg KOH/g.	0.11			0.13			0.12		
TBN	D-4739	mg KOH/g.									
Contamination											
Water	T-H2O Check™	%(Wt.)	0.009			0.014			0.011		
Sodium	D-6595	PPM	0			0			0		
Silicon	D-6595	PPM	0.8	2.8		0.6	0.9		2.2	C	0.0
Additive Element											
Boron	D-6595	PPM	0			0			0		
Magnesium	D-6595	PPM	0			0			0		
Calcium	D-6595	PPM	3			0			1		
Barium	D-6595	PPM	0			0			3		
Phosphorus	D-6595	PPM	26			11			14		
Zinc	D-6595	PPM	2	19		1	5		2	2	
Additional Test											
Flash Point	D-3828	°C									
Viscosity Index	D-2270										
Other											

Alarm Limit Range

Limit Name (Equipment / Oil) :
Comp Gas Nuovo Pignone, Preslia 32 (PTT)

	New Oil	RDE fine U-Caution	RDE fine U-Action	RFS coarse U-Caution	RFS coarse U-Action
		>2	>3	>4	>7
		>1	>2	>1	>2
		>1	>2	>5	>8
		>1	>2	>1	>2
		>1	>2	>2	>3
		>1	>2	>2	>3
		>1	>2	>1	>2

	New Oil	L-Action	L-Caution	U-Caution	U-Action
	31.7	<28.6	<30.1	>33.3	>34.9
	5.0			>7	>9
	3.0			>4	>6
	0.14			>0.22	>0.3

	New Oil	U-Caution	U-Action
	0.013	>0.045	>0.076

	RDE fine U-Caution	RDE fine U-Action	RFS coarse U-Caution	RFS coarse U-Action
	>2	>4	>3	>6

	New Oil	L-Action	L-Caution	U-Caution	U-Action
	>				

Note: Alarm Limits are variable and dependent upon dataset size and to be used as general guideline.
No Sign or N : NORMAL , C or c : CAUTION (first level warning limit) , A or A : ACTION required (second level warning limit)

U-Caution : Upper CAUTION Level — L-Caution : Lower CAUTION Level — First level warning limit in Upper level and/or Lower level
U-Action : Upper ACTION required Level — L-Action : Lower ACTION required Level — Second level warning limit in Upper level and/or Lower level

Accuracy of interpretation and recommendation are based on representatives sample and information supplied — No warranty is expressed or implied for this report.

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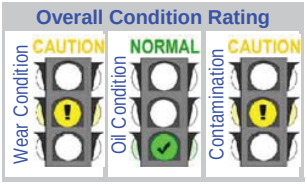
LubeCheck ™ - Oil Analysis for Predictive Maintenance

ISO 9001: 2000 Certified.

Customer Code : 25001

Unit ID Number : TEK 3200 Preslia 32

Overall Condition Rating



	Current Sample	Previous Sample		Alarm Limit Range
FocusLab ID	82904	76073	70812	**Limit Name (Equipment / Oil) :**
Date sampled	03-Sep-07	07-May-07	06-Feb-07	Comp Gas Nuovo Pignone, Preslia 32 (PTT)
Hours on Oil	Not Given	108187	Not Given	
Hours on Unit	110996	108187	106096	
Bottle ID	866183	854064	854095	

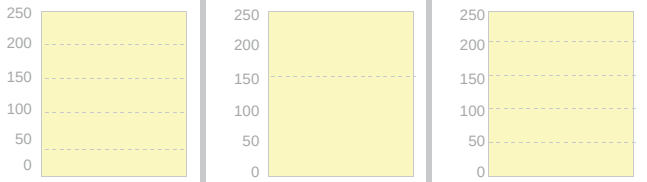
Particle Count	**NAS 1638: Number of Particles Per 100 Milliliter (Counts/100ml)**						New Oil	U-Caution		U-Action	
Size Range	**No. of Particles**	**Class**	**No. of Particles**	**Class**	**No. of Particles**	**Class**	**Class**	**No. of Particles**	**Class**	**No. of Particles**	**Class**
5-15 microns	116,400	9	29,800	7	54,500	8					
15-25 microns	10,600	8 C	2,700	6	5,000	7	<7		<8		<9
25-50 microns	3,000	9	800	7	1,400	8					
50-100 microns	300	8	<100	6	100	7					
>100 microns	<100	7	<100	5	<100	6					
Particle Count	**ISO 4406:1999: Number of Particles Per Milliliter (Counts/ml)**										
Size Range	**No. of Particles**	**Class**	**No. of Particles**	**Class**	**No. of Particles**	**Class**					
>4 microns	3,491 A	19	894	17	1,635	18		<1000		<1500	
>6 microns	977	17	250	15	458	16					
>14 microns	137	14	34	12	64	13					
ISO 4406 Result	19/17/14		17/15/12		18/16/13						

Recommendations and Notes

Particle count indicates that oil cleanliness level is dirty. Suggest using an off-line filtration system to clean up the oil system.

Option Test: Varnish and Sludge Potential Index ™ (VsPI™), Testing for Predicting Varnish and Sludge Buildup

VPI ™Value			
SPI ™Value			
VsPI ™ Value			
Sludge Weight	mg/100 ml	mg/100 ml	mg/100 ml
Condition			



VsPI ™ Severity Limit Range Guideline

New Oil	U-Caution	U-Action

Option Test: RUL (Remain Useful Life), Testing for monitoring Percent Remaining Anti-Oxidant (AO) by ASTM D-6971

% Remaining Antioxidant Additive				New Oil	U-Caution	U-Action
				100	<50	<25

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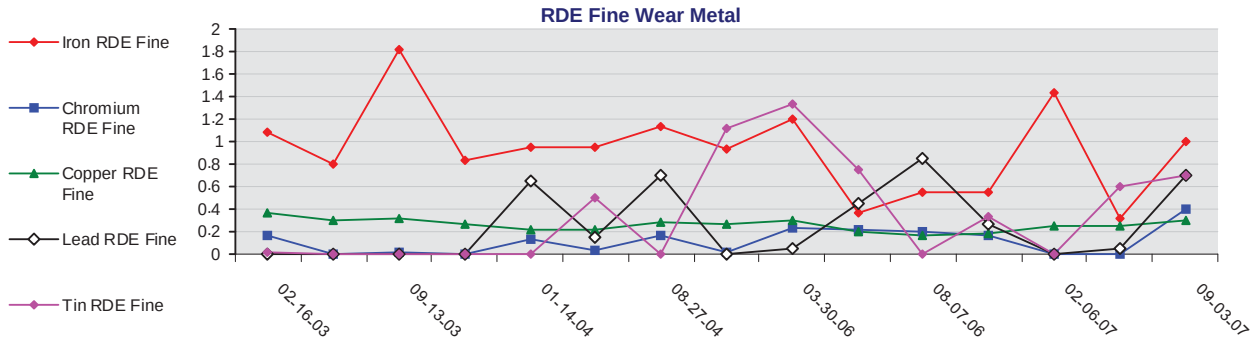
Email : focuslab@focuslab.co.th

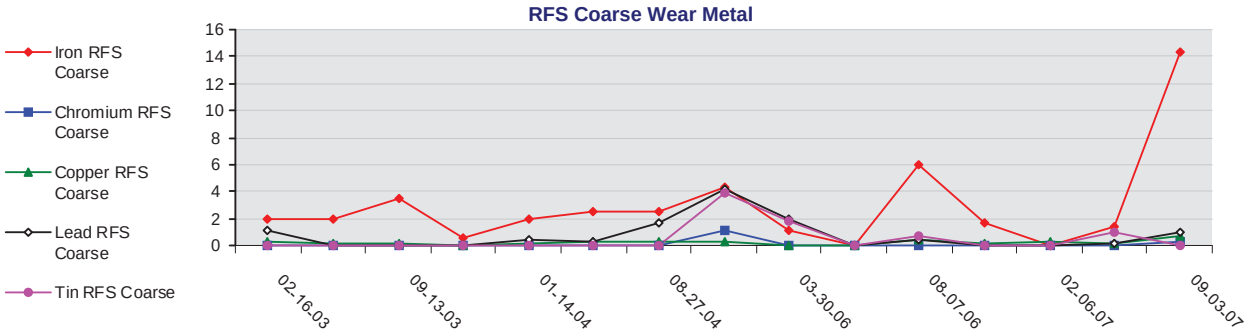
Customer Code : **25001**

Unit ID Number : **TEK 3200 Preslia 32**

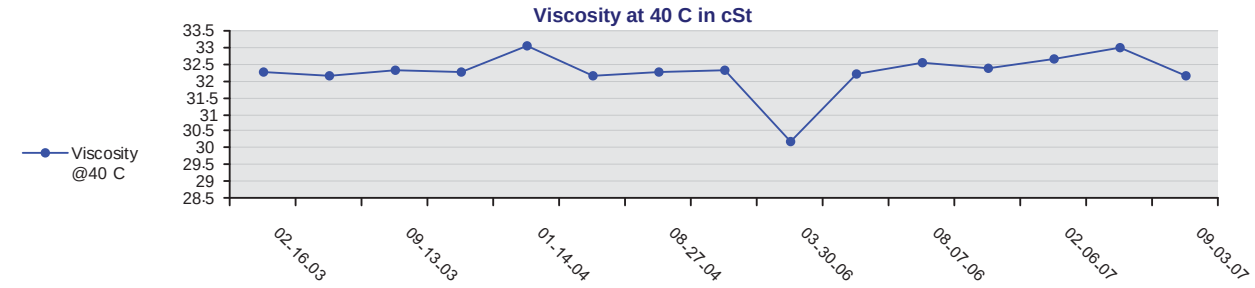
Lube System Capacity : 9400 Liters **Location** :

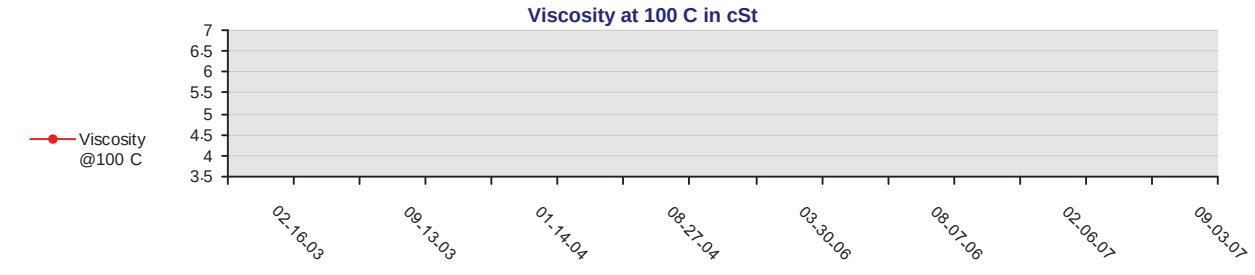
Wear Condition





Oil Condition



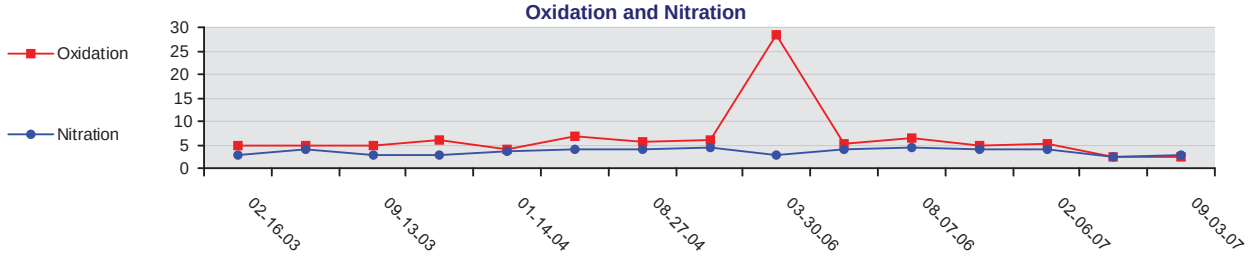


Customer Code : 25001

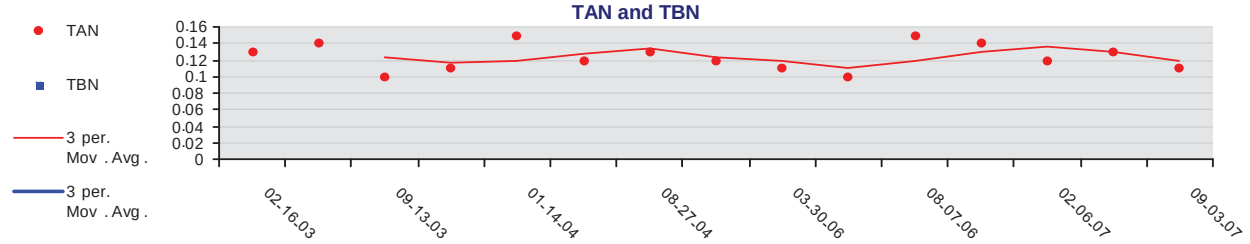
Unit ID Number : TEK 3200 Preslia 32

Oil Condition

Oxidation and Nitration

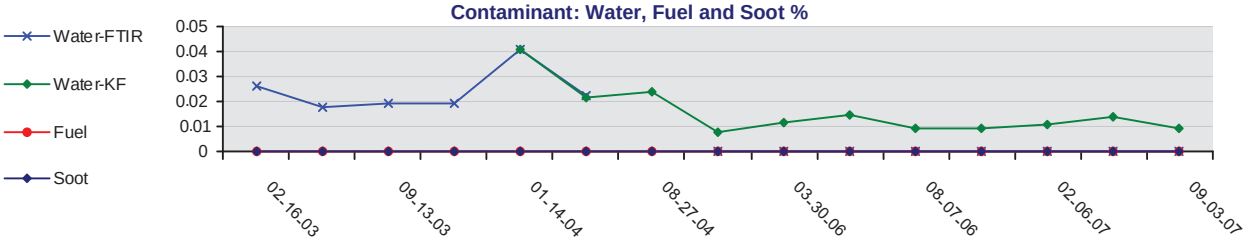


TAN and TBN

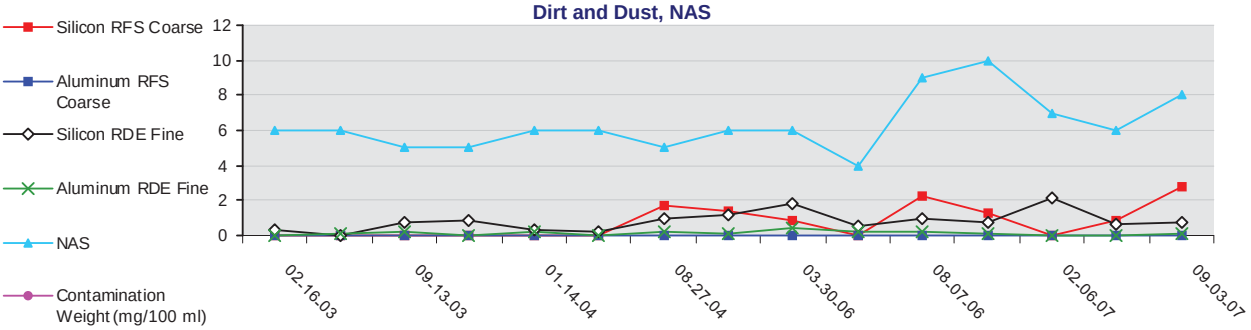


Contamination

Contaminant: Water, Fuel and Soot %

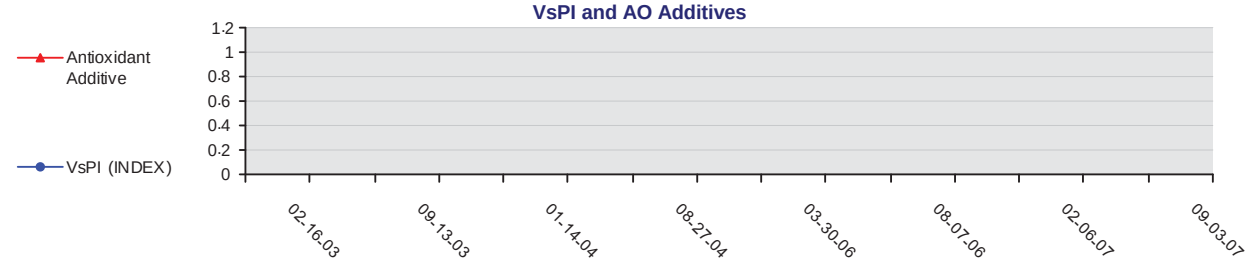


Dirt and Dust, NAS



Others

VsPI and AO Additives



5-4 SERVICING

5-4.1 Oil Tank. Service lube oil storage tank per packager's manual.

5-4.2 Water Servicing and Pumping Requirements (NOx Suppression). For gas generators equipped with Nox suppression systems, refer to Chapter 4.

5-4.3 Compressor Efficiency Trending.

a. General. The efficiency of an engine is adversely affected by a contaminated (dirty) compressor section. Cleaning the compressor section can return the engine to a high efficiency condition. A procedure for monitoring engine performance over extended operating periods is provided in succeeding sub–paragraphs. The procedure encompasses the collection and correction of certain engine operating data and the plotting of this data on a curve. The results are then compared with like data obtained when the engine was in a new and clean condition. This comparison will aid the operator in determining when to clean the engine compressor section.

b. Compressor Condition Trend Curve.

(1) The establishment of a Compressor Condition Trend Curve may be useful in determining the efficiency of the compressor. This data may be useful in establishing an optimum wash interval.

(2) In formulating a compressor condition trend curve it is necessary that good baseline data be obtained when the particular engine is known to be in a clean condition. This baseline data is used to develop the initial zero–time point on the trend curve and is represented by the A° line on the sample curve in figure 5-52.

(3) In order to eliminate as many variables as possible, an attempt should be made to record all data points at approximately the same gas generator speed (± 100 RPM).

(4) Any adjustment or change made to the gas generator variable stator system will have an effect on gas generator performance parameters. If a variable stator system adjustment is made, a new baseline curve must be established.

(5) A trend curve is valid only as long as the gas generator remains in the same installation, with the same instrumentation.

(6) The following operating data are suggested for monitoring the condition of the LM2500 engine compressor. These items should be recorded at a gas generator speed of 9000 RPM. Readings should be taken after a five minute stabilization period.

Item	Units	Accuracy
Discharge gas temperature (T5.4)	°F (°F=°C x 1.8 + 32)	±5°F(±3°C)
Ambient temperature (Tamb)	°F	1°F (0.5°C)
Discharge gas pressure (P5.4)	psig (psig= kPa/ 6.89476)	±1/4%
Inlet Pressure ($P_{2)}$	inches of water (inches = mm/25.4)	±0.1 inch (2.54 mm)
Ambient pressure (Pamb)	inches of mercury (absolute)	±0.1 inch (2.54 mm)

(7) Observed instrumentation readings must be converted to like units and corrected to standard conditions of pressure and temperature. The temperature correction factor is designated THETA (Θ) and the pressure correction is designated Pamb.

(a) Convert temperatures read in °C to °F, pressures read in kPa to psig, and pressures read in mm to inches per formulas in step (6).

(b) Calculate corrected gas generator discharge temperature as follows:

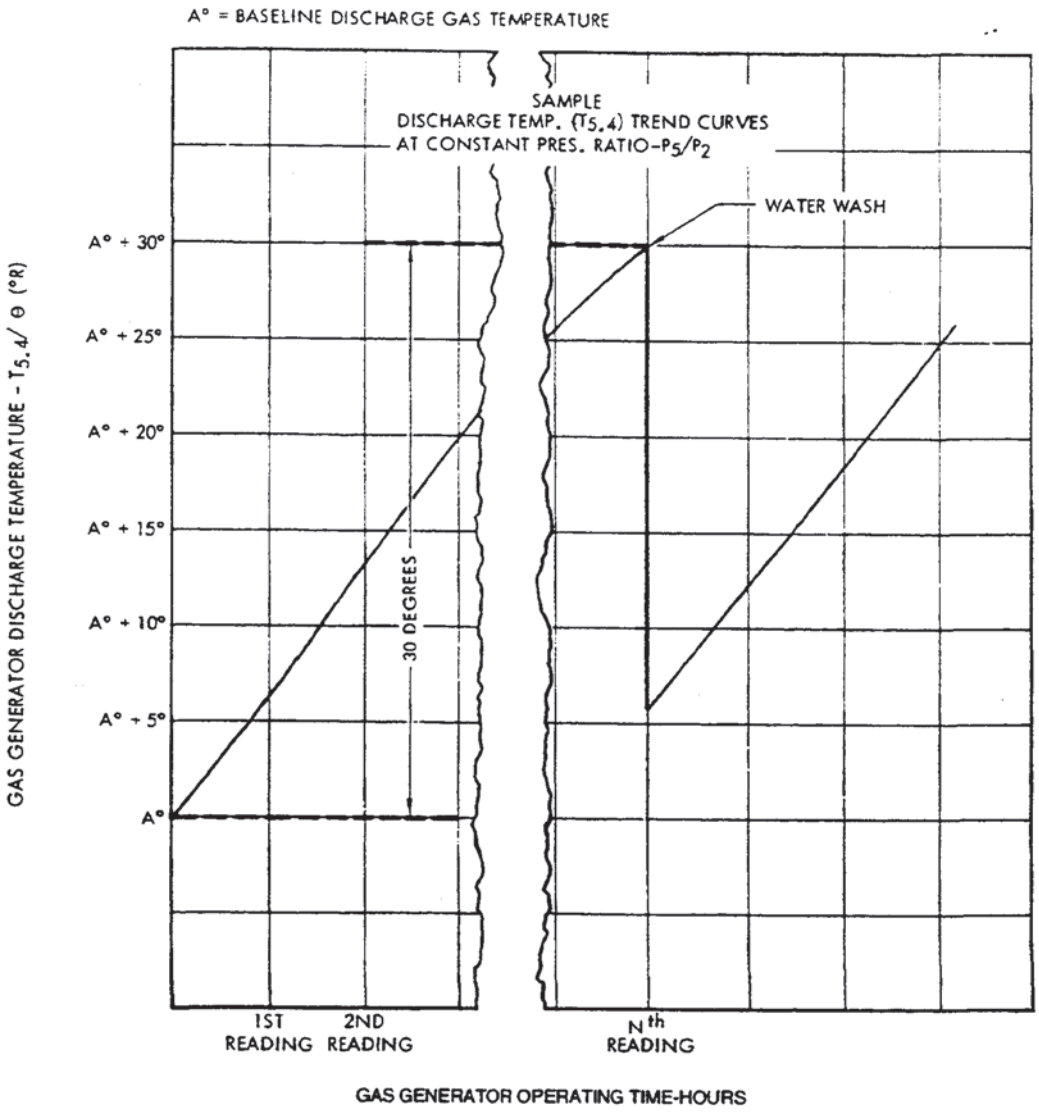


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Figure 5-52. Sample Trend Curve of Discharge Gas Temperature at a Constant Pressure Ratio vs. Operating Time

1 In Table 5-30, opposite the ambient temperature (°F), find Θ (theta).

NOTE

If the ambient temperature is beyond the range of the Table 5-30, calculate Θ using the following formula:

$$\Theta = \frac{\text{Ambient temperature (°F)} + 460}{519}$$

2 Convert observed gas generator discharge temperature, °F to °R by adding 460.

3 Divide gas generator discharge temperature, °R by Θ.

(c) Calculate gas generator pressure ratio (P5/P2).

1 Convert observed ambient pressure (inches of mercury absolute) to Pamb (ambient pressure in pounds per square inch absolute) by multiplying observed reading (step (6)) by 0.49116.

2 Convert observed gas generator inlet total pressure (inches of water) to P2 (gas generator inlet total pressure in pounds per square inch absolute) by using the formula P2 = Pamb — (observed reading x 0.03613).

3 Convert observed gas generator discharge gas pressure (pounds per square inch) to P5 (gas generator discharge pressure in pounds per square inch absolute) by adding Pamb to observed reading.

4 Divide P5 by P2.

(8) Using corrected data developed in step (7), plot a curve of corrected gas generator discharge temperature against gas generator pressure ratio. See sample shown in figure 5-53.

(9) Establish performance analysis curve as follows:

(a) Select pressure ratio within range plotted in step (7)(c). This pressure ratio will be used throughout the performance analysis period.

(b) Establish curve of corrected gas generator discharge temperature against gas generator operating hours (figure 5-52).

1 Periodically, as determined by the engine operator, repeat this procedure.

2 Using new curve plotted per step (8), and the same pressure ratio used to establish the first point on the performance curve, plot the second, third, etc. points.

(10) At any time corrected gas generator discharge temperature has increased a total of 30°F (16.6°C) above initial temperature (clean condition temperature), it is recommended that the compressor be cleaned.