



Date: 22 June 2012

5. TURBINE TECHNICAL DATA**a) Initial Condition**

Turbine General Specification –		
Type	Multi-Stage Geared Back Pressure	
Stages	5 WL type	
Speed	5400 / 1,800 rpm	
HP inlet bore	2 x 10" dia.	
Exhaust bore	48" dia. Downwards	
		T 2518
Steam Conditions and Duty		
Inlet steam flow	kg/h	216,000
Inlet steam temperature	°C	430
Inlet steam pressure	Bara	45.8
Exhaust steam pressure	Bara	2.38
Power	MW	33

The steam consumption is based on steam conditions as stated above at the turbine stop valve and power delivered at the generator terminals and takes account of all mechanical and electrical losses.

Note:-

The output is offered at the generator terminals, without negative tolerance, based upon a mutually agreed upon test procedure and uncertainty.

The turbine rotors are interchangeable, however there will be a change in performance when rotors are changed between units.

Mechanical Design Limit of Inlet Case 62.068 BARG/ 482.2°C (900 PSIG/ 900°F)
(Continuous Operation at this Pressure/ Temperature Requires Some New Steam Path Components)

Minimum Allowable Inlet Pressure and Temperature 35 BARG/ 350°C
Minimum Allowable Exhaust Pressure Atmospheric

1.2 – TECHNICAL DATA AND SYSTEM COMPONENTS

1.2.1 TURBINE SPECIFICATION (TR 56245)

Inlet Pressure	45.8 Bar A.
Inlet Temperature	430°C
Exhaust Pressure	2.23 Bar A.
Power Rating (At Generator Terminals)	33000 kW
Normal Turbine Speed	5606 RPM
Normal Alternator Speed	1800 RPM
Turbine Trip Speed Electrical	6160 RPM
Turbine Trip Speed Mechanical	6170 - 6450 RPM
Turbine Critical Speed Band	1800-2800 RPM
Turbine Rotation	Anti-Clockwise viewed on steam end
Turbine Staging	5 Rateau Stages

1.2.2 OIL SYSTEM

Reservoir	7500 litres (1650 Imp. Gal)
Control Oil Pressure	20.7 bar G (300 psig)
Stable Control Oil Quantity	120 litres/min (26.5 l.gpm)
Lubricating Pressure	1.70 bar G (25 psig)
Lubricating Oil Quantity	1500 litres/min

Main Oil Pump (supplied as part of gearbox)

Make	Kral
Model Ref No	Screw Type
Speed	1800 RPM
Displacement	1565 litres/min
	At 3.5 bar G (50 psig)
Driver	Gearbox Low Speed Shaft

Auxiliary Oil Pump (Motor Driven)

Make	SPX Plenty
Pump Type	Vertical top tank mounted E110 4SL
Speed	1750 RPM
Capacity	1500 litres/min
	At 3.5 bar G (50 psig)
Driver	30 kW 440V / 3ph / 60 Hz AC Motor

Emergency Oil Pump

Make	SPX Plenty
Pump Type	Vertical top tank mounted KEA 90 3NL
Speed	1750 RPM
Capacity	1100 litres/min
	At 1.0 bar G (14.5 psig)
Driver	15 kW 110V DC Motor

Lubricating Oil Cooler

Make	Klima
Type	Twin Shell
Oil Capacity	1500 litres/min
Rated Outlet Oil Temperature	50°C (122°F)

Lubricating Oil Filter

Make	Internormen Technology
Type	Duplex
Capacity	1500 l/min
Filtration	10 micron

Control Oil Filter

Make	Internormen Technology
Type	Duplex
Capacity	120 l/min (26.0 l gpm)
Filtration	10 micron

Oil Tank Heater

Supplier	Eltron Chromalox
Rating	7.0 kW 2-off
Voltage	400V / 3ph / 60 Hz

Hydraulic Accumulator

Make	Fawcett Christie Hydraulics
Type	Rubber Bladder
Capacity	28 litres (6.2 l gpm)
Nitrogen Pre-charge Pressure	21.0 Bar G (300 psig)

Thermostatic Valve

Make	Amot
Type	Wax Element – Non Adjustable
Opening Temperature	49°C

Pressure Regulating and Relief Valves

Lubricating Oil Pressure Regulating	Zwicky ¾" BSP 1.4 – 2.4 Bar g
Control Oil Pressure Regulating	Zwicky 1" BSP 4.1 – 5.5 Bar g
Auxiliary Lube Oil Pump Relief	Zwicky 2" ANSI 150 5.5 – 6.2 Bar g

1.2.3 GOVERNING SYSTEM**Governor**

Maker	Woodward Governor Co
Type	505
Part No	9907-164
Power Supply	24V DC

Actuator

Maker	Woodward Governor Co
Type	TG-17E Direct acting
Driven by	Hydraulic Oil
Pressure	13.8 Bar g

Magnetic Pick-ups

Maker	Woodward Governor Co
Part No (MPU)	1680-649

1.2.4 TRIPS (MECHANICAL)**Overspeed**

Maker	Dresser-Rand Company Ltd
Type	Eccentric spring loaded oil dump valve
Set Point	2.2 Bar g

High Exhaust Pressure

Source	Turbine Exhaust Casing
Type	Pressure Transmitter
Setpoint	3.0 bar g

Low Lubricating Oil Pressure

Source	Lub Oil Supply System
Type	Pressure Transmitter
Set Point	1.0 bar g

Hand Trip

Maker	Dresser-Rand Company Ltd
Type	Block and dump valve in trip oil line
Operation	Local hand level

Solenoid Trip

Maker	Schubert & Salzer
Type	SOV 2 way
Action	De-energise to open
Electrical Supply	24V DC
Operation	Remote pushbutton or electric signals from other trips

1.2.5 GEARBOX AND BARRING GEAR**Gearbox**

Manufacturer	Lufkin, France
Type	Single Reduction Model NF3019E

Barring Gear

Manufacturer	5EW
Drive Motor	37 kW
Supply	415V / 3ph / 60 Hz
Speed (Turbine Shaft)	204 RPM

1.2.6 THRUST AND JOURNAL BEARINGS**(a) Turbine Thrust Bearing**

Maker	Waukesha Ltd
Type	Tilting Pad, with off-set pivot direct Lubricated
Ref	M11

(b) Turbine Journal Bearing (Steam End)

Maker	Waukesha Ltd
Type	Offset Halves
Size	250 dia x 60mm long

(c) Turbine Journal Bearing (Exhaust End)

Maker	Waukesha Ltd
Type	Offset Halves
Size	250 mm dia x 60mm long

For details of bearings in Gearbox refer to separate gearbox operation and maintenance manual in Section 3.2.2.

1.2.7 COUPLINGS**(a) High Speed Coupling – Turbine to Pinion**

Maker	Bibby Transmissions
Type	Double element spacer coupling
Model No	HF258001

(b) Low Speed Coupling – Gearshaft to Generator

Maker	Bibby Transmissions
Type	Double element spacer coupling
Model No	HF 33200L

1.2.8 GENERATOR

Jeumont Electrics

1.2.9 GLAND SEAL STEAM SYSTEM**Gland Steam Condenser**

Manufacturer	VDL Klima BV
Type	2-Pass Shell & Tube
Heat Load	311 kW

1.2.10 TURBINE / GENERATOR / PERFORMANCE (TR 56265)

Power	Steam Flow
kW	kg/hr
33000	216000

1.2.11 SUMMARY OF ELECTRICAL ALARMS AND TRIPS

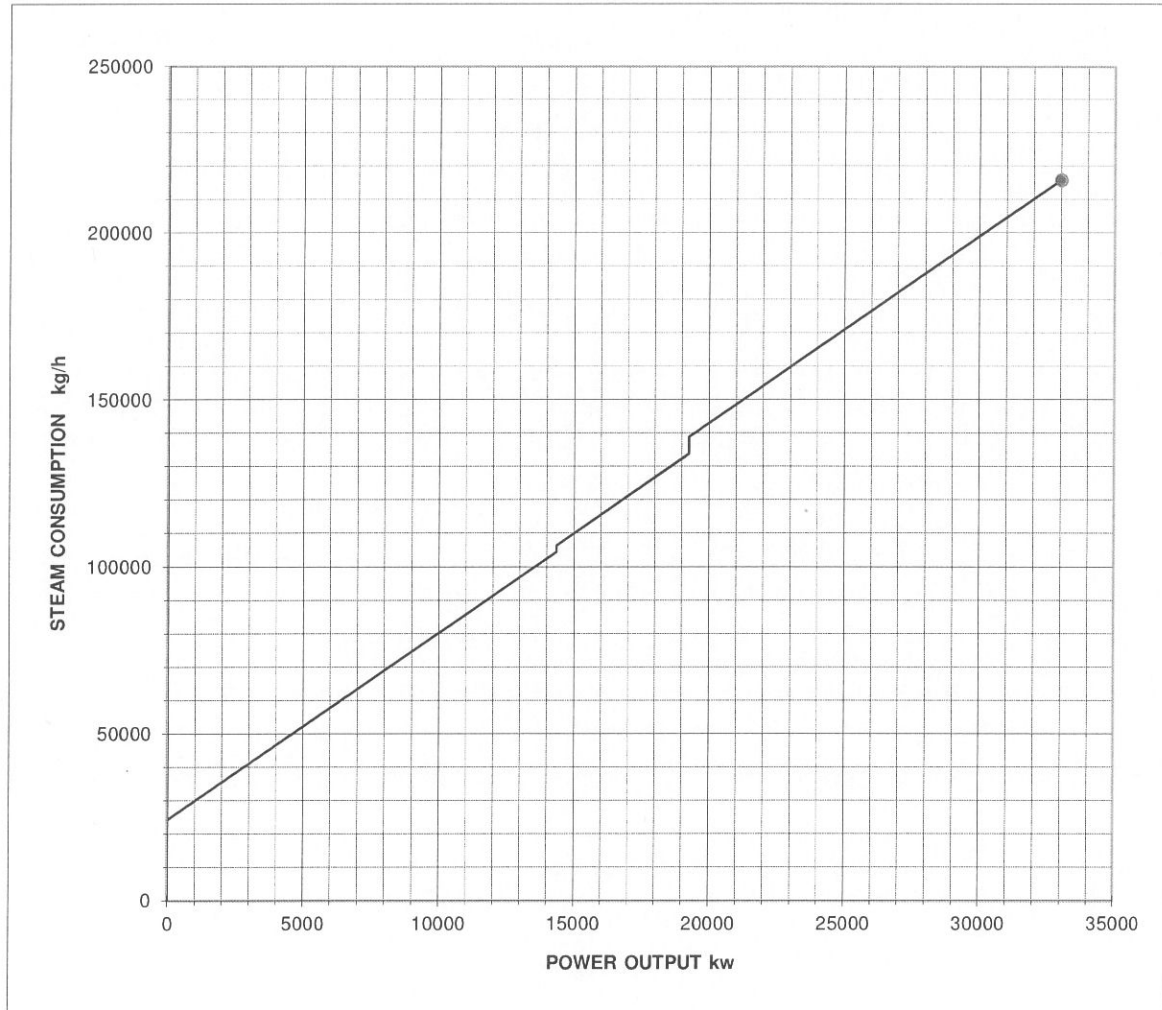
FUNCTION	ALARM LEVEL	TRIP LEVEL
Overspeed electrical	N/A	6170 RPM
Turbine journal bearing temperatures	90 deg C	105 deg C
Thrust bearing temperatures	95 deg C	105 deg C
Gearbox journal bearing temperatures	107 deg C	116 deg C
Lube oil temperature – after oil cooler	55 deg C	65 deg C
Lubricating oil pressure – low	1.2 bar g	1.0 bar g
Control oil pressure – low	15.0 bar g	13.0 bar g
Vibration – turbine rotor (steam end probes)	3.0 mils	4.0 mils
Vibration – turbine rotor (exhaust end probes)	3.0 mils	4.0 mils
Vibration – gearbox (pinion shaft probes)	3.0 mils	4.0 mils
Vibration – gearbox (gearwheel shaft probes)	3.0 mils	4.0 mils
Turbine rotor – axial displacement	10.0 mils	15.0 mils
Inlet steam pressure – low	32.0 bar g	N / A
Inlet stem temperature – low	320 deg C	285 deg C
Exhaust steam pressure – high	1.8 bar g	2.0 bar g
Exhaust steam temperature - high	160 deg.C	185

WILLANS LINE DIAGRAM

Peter Brotherhood

Project Name: Mexico

D/N: TR50/15
Engineer: A. P. ...
Date: 13/05/2016



Note 1) Except for the design point (o) the lines in the diagram are for guidance only and are not guaranteed.

Note 2) Design Inlet Conditions = 45.8 barA 430.0 degC
Design Exhaust Pressure = 2.380 barA
Exhaust Enthalpy = 2700 kJ/kg
Exhaust Temperature = 126 degC



Program file:
willan.xls

Diagram No: TD.....C
Issue..... Date.....
Signed.....

DATA SHEET ALTERNATEUR SYNCHRON

GENERATOR TECHNICAL CHARACTERISTICS



F	10-07-2012	L. Djoudi	G. Lancigu	J. Audouard	Efficiencies improvement
Rev	Date	Rédacteur/ Written by	Vérificateur/ Checked by	Emetteur/ Issued by	MODIFICATIONS

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1. GENERAL DATA :

1.1. Driving machine	Steam Turbine
1.2. Installation	Indoor on concrete
1.3. Climate	Temperate
1.4. Site conditions	Industrial
1.5. Area classification	safe

2. ELECTRICAL DATA :

2.1. Rated power	Pn	33000	kW
2.2. Rated apparent power		41250	kVA
2.3. Rated voltage	Un	13800	V+/-5%
2.4. Rated current	In	1725	A
2.5. Rated frequency	f	60	Hz+/-2%
2.6. Rated power factor		0.80	
2.7. Rated speed		1800	rpm
2.8. Overspeed		2160	rpm
2.9. Number of poles		4	
2.10. Number of phases		3	
2.11. Number of H.V. connections		6	
2.12. Coupling		star	
2.13. Altitude		1300	m
2.14. Ambient temperature mini/maxi		-10 / +40	°C
2.15. Cooling fluid type		water	
2.16. Cooling mode		IC 8A1W7	
2.17. Cooling fluid temperature		30	°C
2.18. Service		S1	
2.19. Insulation class (stator/rotor)		F / F	
2.20. Temperature rise class (stator/rotor)		B / B	
2.21. Norms/standards		IEC	
2.22. Excitation currents :			
at no load		204.1	A
at full load		525.0	A
2.23. Excitation voltages :			
at no load		52.3	V
at full load		188.5	V
2.24. Efficiencies at rated power factor			
at 4/4 load		97.63	%
at 3/4 load		97.18	%
at 2/4 load		96.20	%
2.25. Efficiencies at power factor =1 :			
at 4/4 load		97.90	%
at 3/4 load		97.42	%
at 2/4 load		96.38	%
2.26. Unsaturated reactances:			
direct synchronous	Xd	187.6	%
direct axis transient	X'd	14.5	%
direct axis subtransient	X''d	14.2	%
quadrature axis synchronous	Xq	177.0	%
quadrature axis subtransient	X''q	29.0	%
negative sequence	Xi	20.3	%
de Potier	Xp	12.8	%

	zero sequence	Xo	12.2	%
2.27.	Time constants :			
	direct axis short circuit transient	T'd	0.44	s
	direct axis open circuit transient	T'do	5.71	s
	direct axis short circuit subtransient	T''d	0.0242	s
	direct axis open circuit subtransient	T''do	0.0247	s
	armature short circuit	Ta	0.3411	s
	quadrature axis short circuit subtransient	T''q	0.0242	s
	quadrature axis open circuit subtransient	T''qo	0.1477	s
2.28.	Saturated reactances :			
	direct axis synchronous	Xds	175.89	%
	direct axis transient	X'ds	13.02	%
	direct axis subtransient	X''ds	12.69	%
	quadrature axis synchronous	Xqs	165.90	%
	quadrature axis subtransient	X''qs	25.77	%
	negative sequence	Xis	18.08	%
	zero sequence	Xos	10.96	%
2.29.	excitation resistance	Raf	0.300	Ω
2.30.	positive sequence armature winding resistance	R1	0.016	Ω
2.31.	negative sequence resistance	R2	0.070	Ω
2.32.	Short circuit ratio	SCR	0.569	
2.33.	Air gap		23	mm
2.34.	Three phase short circuit current at rated excitation point			
	subtransient component		8.52	Pu
	transient component		8.32	Pu
	permanent		1.46	Pu
	peak value		23.47	Pu
2.35.	Constant of inertia	H	1.93	
2.36.	Losses at rated point :			
	mechanical		445	kW
	stator copper		65	kW
	rotor copper		84	kW
	stator iron		134	kW
	stray		73	kW
	total		803	kW

3. MECHANICAL DATA :

3.1.	Rotor type	Cylindrical Laminated		
3.2.	Protection degree	IP 54		
3.3.	Mounting form	IM 1005		
3.4.	Noise level at 1 meter	<= 88		dB(A)
3.5.	Rotor balancing class	G=2.5 (ISO1940)		
3.6.	Weights :			
	rotor	21 500		kg
	stator	44 000		kg
	total	75 000		kg
	maxi handling at erection	72 000		kg
3.7.	Generator inertia	MR2	4 482	kgm2

4. BEARING DATA :

4.1.	Oil pressure drop at bearing inlet	0.8 min	bars
4.2.	Sleeve bearing type	2 lobe-insulated	
4.3.	Lubrication type	Forced	
4.4.	Bearing losses :		
	driving end side	30000	W
	side opposed to driving end	30000	W
4.5.	Oil flow per bearing	55	l/min
4.6.	Oil quality	ISO-VG46	
4.7.	Oil temperature at inlet	50	°C

5. WATER HEAT EXCHANGERS DATA :

5.1.	Norms	Manufacturer standard	
5.2.	Water nature	Fresh water	
5.3.	Capability	2 x 67%	
5.4.	Material used :		
5.5.	tubes	Single / copper	
5.6.	fins	Aluminium	
5.7.	tubes plates	Double-Steel & Epoxy	
5.8.	water box	Steel & Rilsan	
5.9.	cover	Painted Steel	
5.10.	Temperatures :		
5.11.	water inlet	30 max	°C
5.12.	water outlet	35 max	°C
5.13.	Water pressure drop (will be confirmed after order)	< 100	kPa
5.14.	Pressures :		
5.15.	duty	6	bar
5.16.	testing	9	bar
5.17.	Fouling factor	11000	W/m ² °C
5.18.	Water flow (will be confirmed after order)	143	m ³ /h

6. EXCITATION DATA :

6.1.	EXCITATION GENERATOR :		
6.1.1.	Number of poles	12	
6.1.2.	Ceiling	2.00	
6.1.3.	Response time	< 1s	
6.1.4.	Protection degree	Integrated to the generator	
6.1.5.	Cooling mode	Derivated from main circuit	
6.1.6.	Insulation class (stator/rotor)	F / F	
6.1.7.	Temperature rise class	B / B	
6.2.	PERMANENT MAGNET GENERATOR :		
6.2.1.	Number of poles	12	
6.2.2.	Ceiling	2.00	
6.2.3.	Response time	< 1s	
6.2.4.	Cooling mode	Natural	
6.2.5.	Insulation class (stator/rotor)	F / F	
6.2.6.	Temperature rise class	B / B	
6.3.	RECTIFIER ASSEMBLY :		
6.3.1.	Type of mounting	Graetz connection	
6.3.2.	Rectifier number	12	

7. REGULATOR DATA :

7.1. Type	BASLER DECS 200
7.2. Accuracy	+/-0.25 % of Un
7.3. Voltage display range at no load	+/-10 % of Un
7.4. Droop compensation ajustable	0 to 5 % of Un
7.5. Permanent frequency range	+/-5 % of fn
7.6. Time delay of the current ceiling limitation	10 s

8. DOCUMENTS ENCLOSED :

8.1. Curves :

- no load saturation and short circuit
- V curves
- capability curve (active/reactive power)

8.2. Drawings :

preliminary outline drawing N°

4SB11920 for GIGA 458

