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Abstract

This document provides a detailed description of the technical characteristics and condition of a GE FS5-1S gas turbine, serial number SN 147793. The turbine, relocated and refurbished in 1999, has a rated power output of 14,000 kW.



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2. Main data

GT 1	
Manufacturer	General Electric
Model	GE Frame FS5-1S
Nominal power	14 MW
Year of construction	1965
Compressor	12
Speed (rpm)	5100
Alternator	
Manufacturer	GEC
Mode	ATB 2
SN	8354744
Date of manufacture	1965
Installation date	1999
Alternator type	Synchronous
Power (MVA)	14.7
Voltage Generation (kV)	11.5
Nominal stator current (A)	738
Excitement	Self excited
Frequency (Hz)	50
Operating speed (rpm)	3000
Full load cooling	Air
Power factor	0.85
Control	
Type	Mark V
Main transformer	
Manufacturer	OASA
Type	Three-phase
Rated power	14.000 kVA ONAN 17.500 kVA ONAF
Frequency	50 Hz
Service	Contunous – outdoor installation
Vector group	YNd11
Short circuit Voltage (%)	15.3
Standard	CS-76
Year of manufacture	1999
SN	36938
Primary Voltage	16.5 kV
Secondary Voltage	11.5 kV
Insulations level	50 kV – Neutral to line 125 kV – Primary

	95 kV – Secondary
Max copper temperature rise	55 °C
Insulating oil	Repsol-T
Oil volume to be drained for inspection	6,825 liters
Weights	
Active part:	15,520 kg
Oil	6,825 kg
Accessories	5,544 kg
Total weight	28,174 kg

Table 1 Main data

3. Operating hours

Detailed operating hours since 1999, the year in which the turbine was relocated to the Formentera plant.

	TG		
	N° Couplings	Hours per Year	Cumulative hours
After 1998	2675	11262.00	11262.00
1999		51.00	11313.00
2000		23.75	11336.75
2001		3.78	11340.53
2002		2.25	11342.78
2003		47.47	11390.25
2004		6.00	11396.25
2005		343.00	11739.25
2006		774.33	12513.58
2007	107	1057.22	13570.80
2008	82	630.77	14201.57
2009	68	792.58	14994.15
2010	97	1218.45	16212.60
2011	45	214.23	16426.83
2012	52	178.72	16605.55
2013	71	514.35	17119.90
2014	119	1052.85	18172.75
2015	178	1200.92	19373.67
2016	85	713.25	20086.92
2017	99	892.27	20979.18
2018	34	219.30	21198.48
2019	44	135.30	21333.78
2020	52	509.35	21843.13
2021	24	71.65	21914.78
2022	86	764.20	22678.98
2023	41	258.77	22937.75
2024	17	63.68	23001.43
Tot	1'301	23001.43	

Table 2 Operation hours

4. Maintenance

During the period March 7–19, 2016, a forced outage was carried out on Gas Turbine Frame 5, Unit 147793, installed in Formentera power station.

The intervention was required due to high vibration levels, excessive smoke at exhaust, and a borescope inspection which revealed a completely broken transition piece.

The scope of work included:

- **Combustion System:**
 - Replacement of all fuel nozzles and combustion liners due to erosion, carbon deposits, and thermal coating damage.
 - Complete replacement of transition pieces (one was fully broken, others severely worn).
 - Inspection and cleaning of combustion cans, which were returned to service.
- **Hot Gas Path:**
 - Replacement of 1st and 2nd stage nozzles with refurbished GE components.
 - On-site repair (blending) of 1st stage buckets, left in service due to lack of spares.
 - Visual inspection of 2nd stage buckets, found in acceptable condition and kept in service.
- **Bearings & Lubrication:**
 - Journal bearing #2 was replaced due to wear, along with a new oil deflector to correct severe leakage and vibration issues.
 - Post-repair checks confirmed elimination of oil leaks and significant vibration reduction.
- **Enclosure:**
 - The acoustic enclosure was found completely deteriorated and removed. The turbine is currently operating without the enclosure; replacement is scheduled by the customer.
- **Operational Test:**
 - The unit successfully completed a **Full Speed No Load test**.
 - Synchronized to the grid, achieving **4 MW output** with **acceptable vibration**.

The intervention restored unit reliability and resolved the immediate issues affecting combustion performance, turbine efficiency, and lubrication. The unit is back in service under stable operating conditions, although follow-up actions are recommended for enclosure replacement and monitoring of the 1st stage buckets.

5. General conditions

The plant is in good overall condition, having operated regularly until the end of 2024. Its continuous operation until recently is a concrete guarantee of its full efficiency and the correct functioning of its main systems.

Critical components – including the power transformer and auxiliary equipment – have undergone technical checks, the results of which have confirmed the positive and reliable condition of the whole system.

The relevant documentation (inspection and test reports) is available in the annexes, in support of the technical assessment.

5.1 Auxiliary generator



Figure 2 Auxiliary generator

5.2 Main Tranformer



Figure 3 Main Transformer

5.3 Reactance transformer



Figure 4 Reactance transformer

5.4 Combustion Chamber



Figure 5 Combustion chamber

5.5 Air intake



Figure 6 Air intake

5.6 Start Engine



Figure 7 Start engine

5.7 Reduction gearbox



Figure 8 Reduction gearbox

5.8 Generator

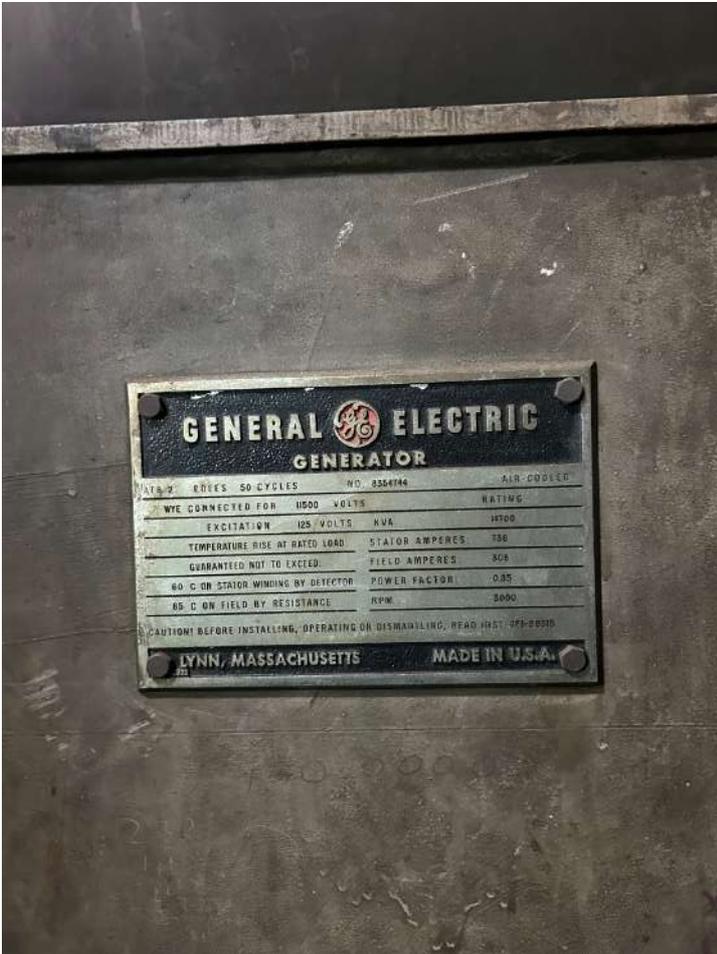


Figure 9 Generator

5.9 Exciter



Figure 10 Exciter

5.10 MCC and control cabinet

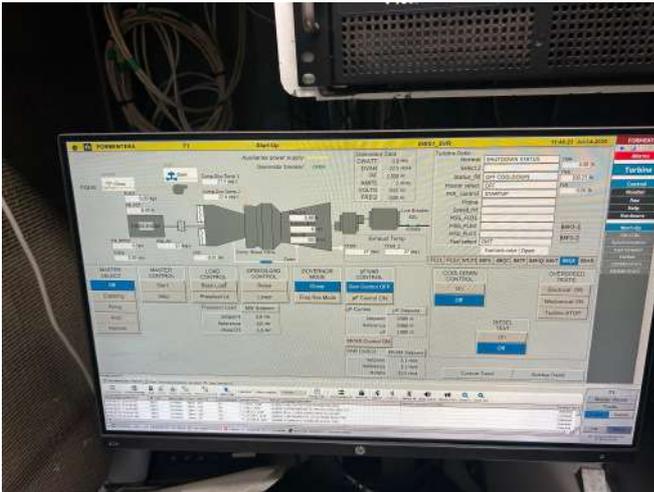


Figure 11 MCC

5.11 Diesel fuel filtration system

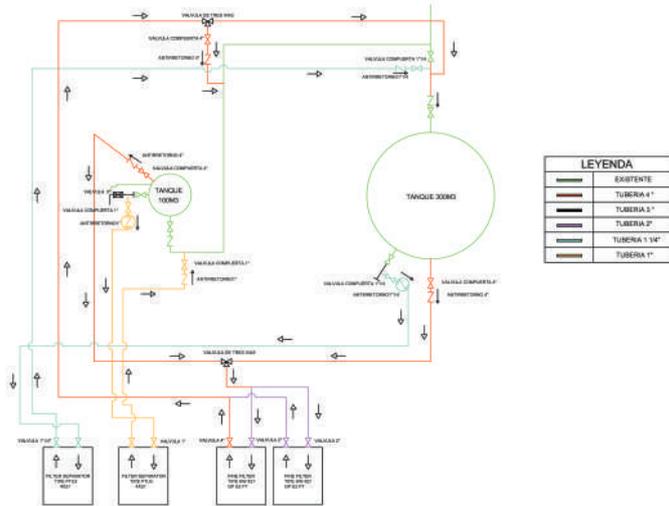


Figure 12 Diesel fuel filtration system

5.12 Diesel Tank



Figure 13 Tank

5.13 Diesel pump system

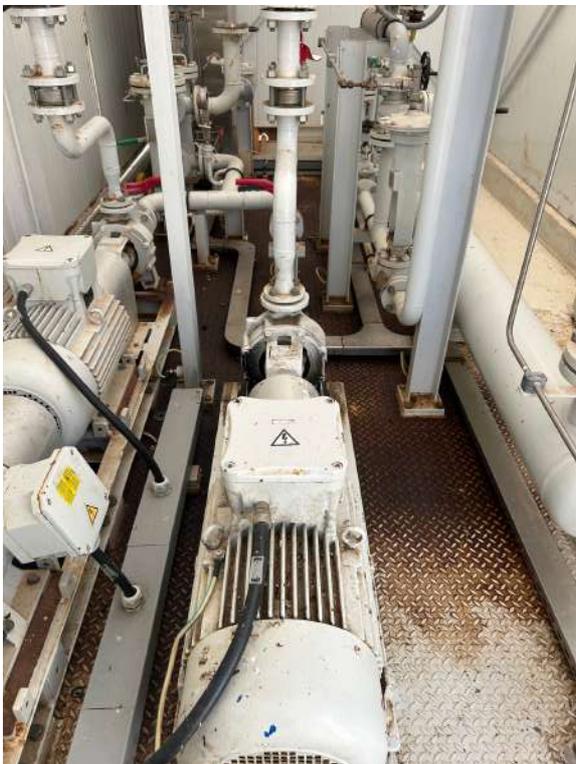


Figure 14 Diesel pump system