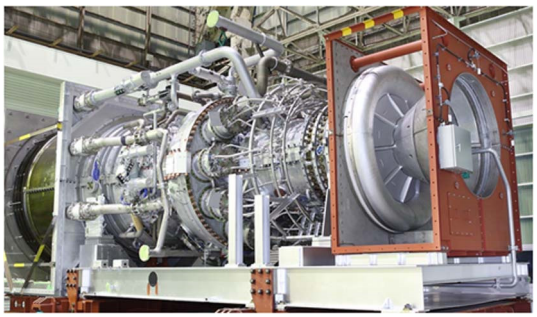
TEPCO Fuel & Power, Inc. Futtsu Thermal Power Station, Group 2, H-100 Series Gas Turbine Replacement Work



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Due to its high efficiency being recognized, the H-100 series gas turbine has been adopted by customers who are aiming at improvement in the efficiency of existing power plants to replace existing, older types of gas turbines. Recently, the H-100 (50 Hz) was adopted as the replacement for the Futtsu Thermal Power Station Group 2 of TEPCO Fuel & Power, Inc. This replacement also contributes to improvement in the plant efficiency of the power generation plant and a reduction in CO_2 emissions. Currently, the renewal of No. 1 and No. 5 of Group 2 has been completed and their commercial operation is underway.

1. Introduction

Futtsu Thermal Power Station Group 2 of TEPCO Fuel & Power, Inc. has been in operation for about 30 years since the commencement of its commercial operation. We replaced the existing 1100°C class gas turbine with the H-100 series gas turbine in a short period of time and achieved high efficiency. The H-100 series gas turbine delivered this time is the first 50 Hz machine developed by reflecting the operational results of the 60 Hz machines, the first one of which started commercial operation in 2010. This report presents an overview of this replacement.

2. Overview of replacement work

2.1 Basic policy of replacement work

Gas turbines No. 1 to No. 7 (7 axes) of Group 2 were replaced with H-100 series gas turbines sequentially. In this replacement, the following conditions were taken into consideration.

(1) The existing facilities would be reused as much as possible to minimize the scope of the renewal.
(2) The H-100 would be installed in the space of the existing gas turbine, and the peripheral equipment would be reused.
(3) The heat recovery steam generator (HRSG) and the steam turbine would be reused. The high-pressure superheater of the HRSG would be partially modified to achieve steam conditions equal to the existing steam conditions, since the HRSG inlet gas temperature rises due to the increased combustion temperature.
(4) As the gas turbine would be updated, the control device would also be partially modified.

2.2 Overview of H-100 series gas turbine

The H-100 series gas turbine was designed as the world's largest heavy duty two-axis gas turbine based on the proportional expansion of the H-25 series gas turbine, which has seen global deliveries of more than 170 units. There are two types in the H-100 series, 60 Hz and 50 Hz, and their basic specifications are shown in **Table 1**. **Figure 1** shows a sectional view of the H-100 series gas turbine and a photograph showing the upper half casing opened.

The air compressor air volume and the combustion temperature of the H-100 (50 Hz) were increased in comparison with the H-100 (60 Hz). The air compressor was a 17-stage axial flow compressor corresponding to the pressure ratio of 20 in response to the increase in air volume, and was adapted to variable speed operation. The combustor is a multi-can type that has ten cans. It realizes, based on a dry low NOx combustor that has been proven in H-25 series gas turbines, etc.,

even greater NOx reduction by improving the mixing characteristics of the fuel gas and air. The turbine is an axial flow type and has a two-shaft, four-stage structure (two high-pressure stages and two low-pressure stages). To improve the efficiency, the high-pressure turbine adopts the structure of the H-100 (60 Hz), while the low-pressure turbine has design-optimized turbine blades.

The output is 118 MW, and the standalone efficiency of the gas turbine is 38.3% (LHV: Lower Heating Value). This is top-in-class efficiency among heavy duty type gas turbines of the same class.

Table 1 H-100 series gas turbine basic specifications

Item		H-100 60Hz	H-100 50Hz
Type		2-shaft heavy duty	
Compressor		Axial flow 17-stage	
Combustor		Multi-can (10 cans)	
Turbine		Axial flow 4-stage (2 high-pressure stages and 2 low-pressure stages)	
Output		105.8MW	118MW
Efficiency		38.2% (LHV)	38.3% (LHV)
Rated rotation speed		4580/3600rpm	4580/3000rpm
1 on 1 combined cycle performance	Output	150MW	169.6MW
	Efficiency	55.1% (LHV)	55.8% (LHV)
2 on 1 combined cycle performance	Output	305.7MW	344.5MW
	Efficiency	56.1% (LHV)	56.7% (LHV)

LHV: Lower Heating Value

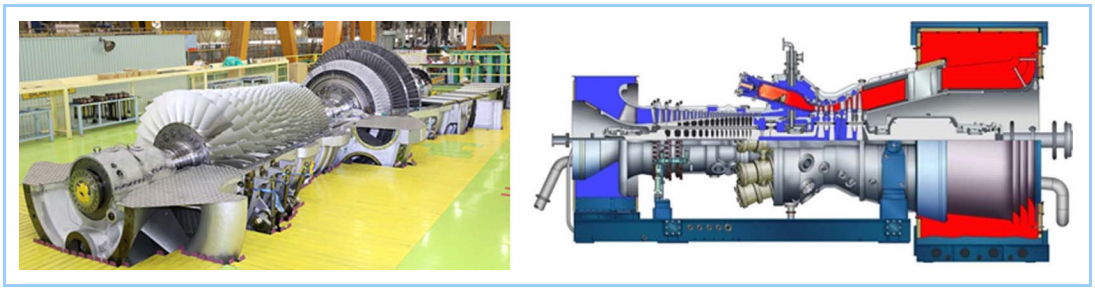

Figure 1 H-100 series gas turbine

3. Overview of plant plan

Table 2 shows the plant performance before and after the replacement. The replacement achieved performance beyond the initial plan and contributed to improvement in efficiency.

Table 2 Plant performance after replacement

	Before replacement	After replacement	
	Planned value	Planned value	Actual value
Plant output	167.6MW (15°C)	159.37MW (15°C)	168.48MW (15°C)
Increase in output	Base	-4.91% (relative value)	+0.53% (relative value)
Plant efficiency	48.66%LHV (15°C)	54.28%LHV (15°C)	54.40%LHV (15°C)
Improvement in efficiency	Base	+5.62% (absolute value)	+5.74% (absolute value)

LHV : Lower Heating Value

Note: Plant performance after replacement is in new and clean condition.
(Bottoming deterioration has been compensated.)

4. Future development

The H-100 series gas turbine is being developed to meet needs for further increased efficiency, higher output, and fuel diversification. Utilizing the characteristics of a two-shaft machine that has separate high-pressure and low-pressure rotors, the H-100 series gas turbine is also suitable for use as a driver for driving machinery, and can also be used in oil and gas plants.