



High-Efficiency Gas Turbine Combined Cycle Plant for PGE in the U.S. Starts Commercial Operation

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The Port Westward Combined Cycle Plant of Portland General Electric (hereinafter referred to as PGE) in the United States started commercial operation on June 11, 2007. This plant, one of the highest-efficiency gas turbine combined cycle plants on the U.S. West Coast, is now mainly performing rated operation.

This is a multi-shaft, reheat type combined-cycle plant. MHI's scope was to supply the main equipment, including the GT, ST, HRSG (Heat Recovery Stream Generator), and generators, together with technical advisors (TA) for installation and commissioning. BV, meanwhile, took part in installation and commissioning in the field. MPSA (Mitsubishi Power Systems Americas Inc.), an MHI subsidiary in the U.S., handles communications with the customer (PGE) and EPC contractor (BV).

1. Outline of the plant

The plant is located in Oregon, a state well known for its bountiful wilderness. It stands along the banks of the Columbia River in the northern part of Clatskanie, about 100 km north-northwest of Portland, the state capital. The site is within a reserve, on lands once peopled by the indigenous native population. Mitsubishi Heavy Industries, Ltd. (MHI) received the order for the plant in September 2004, during the tail end of the GT (gas turbine) boom in the U.S. Starting from 1999, MHI had delivered six F-type GT units and eleven G-type GT units to U.S. utilities and owners before this order from PGE.

2. Special notes on the main equipment

(1) M501G1 type gas turbine

For the gas turbine, MHI adopted the M501G1, a modified version of the M501G, a GT with a track record of 11 deliveries in the U.S. The M501G1 is state of the art, with enhancements in both efficiency and reliability compared to the original model, and a GT combustion temperature of 1,500°C. An actual loading test was completed in the verification power generation facility within Takasago Machinery Works in 2003. Principal improvements from the M501G type include an improved exhaust diffuser, and a turbine blade with enhanced aerodynamic characteristics and cooling efficiency. Compared with the M501G, the M501G1 produces about 3% more output with an approximately 1% improvement in efficiency.

MHI delivered the GT/ST (steam turbine), the generator, and the rest of the main equipment into the field in January 2006, after completing the design, manufacture, and transportation. The delivery took place about half a month earlier than the contracted date. Next, MHI dispatched technical advisers (TA) to the field for the construction and a trial run, at the request of Black & Veatch Corporation (BV), the EPC (Engineering, Procurement and Construction) contractor. PGE started commercial operation upon completion of the construction and commissioning by BV. The specifications of the main plant equipment are shown in **Table 1**.

(2) TCA (turbine cooling air) cooler for gas turbines

This is a vertical type cooler designed to use boiler feed water as cooling water. MHI has adopted its most advanced type, incorporating numerous special element technologies developed in-house (multiple-stage tubes, thermal sleeve structural nozzle, etc.).

(3) FGH (fuel gas heater) for gas turbines

MHI has adopted a shell-and-tube type FGH (fuel gas heater) with high compactness, maintainability, and reliability.

Table 1 Plant and specifications for the main equipment

Outline of plant	1-on-1 gas turbine combined cycle plant
Guaranteed output	398 000kW (Without duct firing), 423 700kW (During duct firing)
Guaranteed efficiency	52.1% (Without duct firing) 51.0% (During duct firing)
Guaranteed emission	NOx-2.5ppm CO-4.9ppm VOC-7.74lb/H NH ₃ -8ppm
Specifications for main equipment	
Gas turbine	M501G1 GT, indoor type, premixed type, gas firing; 1unit
Steam turbine	TC2F-29.5"; 1unit
HRSG	Triple-pressure natural-circulation reheat boiler; with duct firing
Generator and others	For GT: Hydrogen gas cooling, For ST: Air cooling, Static excitation system

3. Summary

As the first M501G1 type GT combined cycle in the United States, service at loads close to the rated load has been continued since the start of commercial operation. MHI has also obtained favorable comments from the customer on the performance and reliability of every piece of MHI-made equipment, including the GT and ST. An LTSA (Long-Term Service Agreement) contract has already been concluded. We would like to continue to support long-term commercial operation by working closely and cooperatively with MPSA in response to electric power demands in the U.S. northwest while also trying to conserve the bountiful wilderness of Oregon state.