Introduction of Hitachinaka Thermal Power Station Unit 2, Tokyo Electric Power Company
(Commercial operation starts under the largest ever mixed ratio of subbituminous coal in Japan, overcoming the earthquake disaster)

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In the Hitachinaka Thermal Power Station of Tokyo Electric Power Company, the boiler of Unit 2 was designed to have the largest mixing ratio of subbituminous coal in Japan. This design was determined based on the needs of our client, which had arisen from the practical experience with the previous boiler (i.e., Unit 1 at the same power station). The commercial operation of Unit 2 continues under the circumstances in which societal dependence on coal-fired power generation as a steady, stable power supply is significantly increasing.

1. Introduction

The construction of Unit 2 of the Hitachinaka Thermal Power Station (owned by Tokyo Electric Power Company) started in October 2009 and commercial operation commenced in December 2013. Mitsubishi Hitachi Power Systems, Ltd. (MHPS) provided the major facilities of the unit, including the turbine, the boiler and the flue gas treatment facility. As a result, a 1,000 MW coal-fired power plant was completed, one that boasts the world's highest efficiency and reliability through our combined superiority in plant engineering and technological capabilities related to the main equipment. This report presents the features of the boiler and flue gas treatment facility and provides an outline of the applied technologies.

2. Positioning of Unit 2 of Hitachinaka Thermal Power Station

Figure 1 shows the upgrades of the boiler's basic specifications leading to Unit 2 of the Hitachinaka Thermal Power Station.

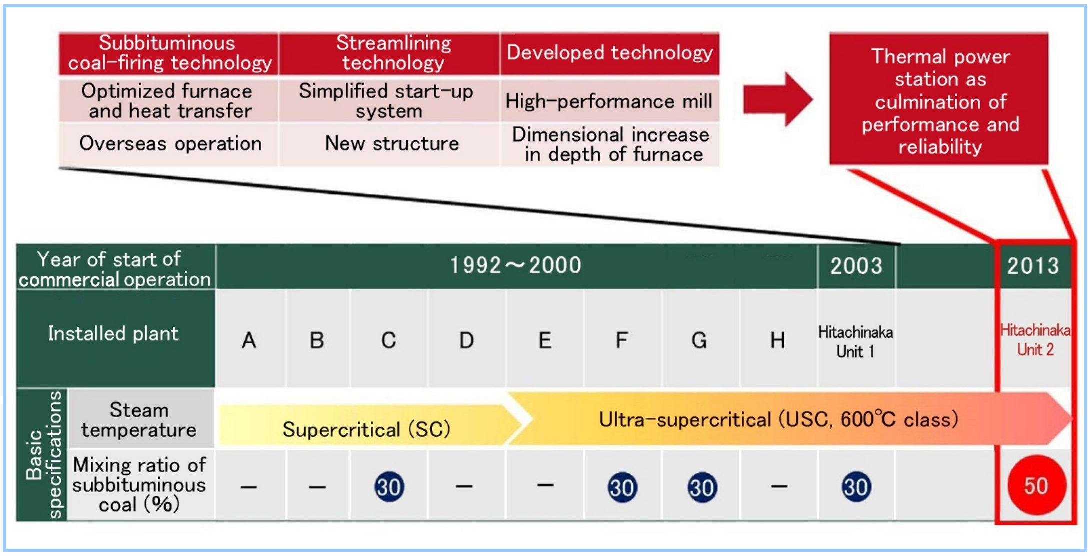

Figure 1　Upgrades of boiler basic specifications

The previous boiler (Unit 1) was developed based on the concept of better maintainability and operating characteristics and simplified mechanics, and started commercial operation in December 2003. In spite of the growth of domestic power demand weakening afterward, MHPS has accumulated practical knowledge and experience of various streamlining technologies and subbituminous coal-firing technologies through our business development related to coal-fired power plant facilities mainly in Asia, the U.S., Australia and Europe. Furthermore, by incorporating new technologies developed in the meantime, we designed a boiler for Unit 2 of the Hitachinaka Thermal Power Station as the culmination of both performance and reliability.

3. Summary of plant specifications

In **Table 1**, the power plant specifications of Unit 2 are compared with Unit 1 at the same power station (previous boiler). As the basic plan, the bottom line is that while conditions such as steam remain unchanged, the range of applicable coal is expanded by adding about twice the varieties of bituminous coal with some varieties of subbituminous coal, increasing the mixed fuel burning ratio from 30% to 50%. To make this increase in the ratio possible, we have employed subbituminous coal-firing technologies such as increased mill (coal pulverizer) capacity and the optimization of the gas temperature at the rear heating surface by means of increased pendant coils (heat tube) and dimensional increase in the depth of the furnace.

Table 1 Comparison of plant specifications

Item	Hitachinaka Thermal Power Station	
	Unit 1	Unit 2
Boiler type	Variable pressure once through boiler reheat type	
Output	1,000MW	
Steam flow rate	2,870t/h	
Steam conditions	25.4MPa/604°C/602°C	
Mixing ratio of subbituminous coal	30%	50%
Start of commercial operation	Dec. 2003	Dec. 2013

4. Shortening of construction period

Figure 2 gives a rough construction workflow from design to commercial operation.

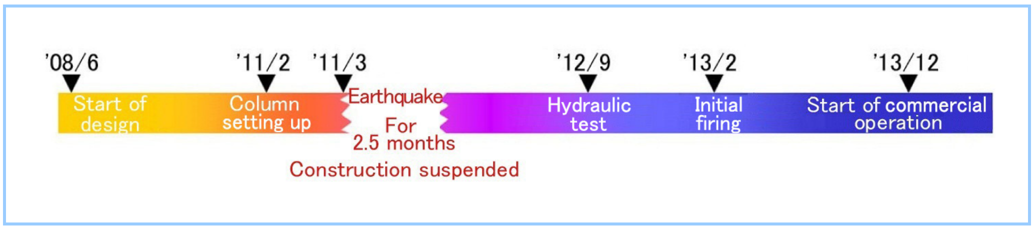

Figure 2 Rough construction workflow

We cooperated with Hitachi Plant Construction, Ltd. on installation construction to shorten the time span from the setting up of the column until the initial firing. Based on the previous experience with Unit 1 at the same power station, we planned to reduce on-site man-hours and achieve better work efficiency by making further improvements including side modularization, steel frame synchronization, blocking and the enlargement of the pressure parts component, thus satisfying the needs of our client.

However in 2011, the Great East Japan Earthquake occurred soon after the setting up of the columns and we had no choice but to suspend the installation work. To catch up on the schedule, with help from our client, we resumed the construction approximately two and a half months after the earthquake, and faced challenges such as achieving translational movement in the process of the jack-up method, treating coil and furnace width in a single block, streamlining the installation structure of the outer casing of the boiler, and deploying night and day shifts.

As a result, despite the interruption due to the earthquake, we completed the process in a shorter period than the scheduled time span from the setting up of the column until the initial firing.

5. Summary of flue gas treatment facility

The flue gas treatment facility is characterized by the optimal combination of electrostatic precipitator (EP), desulfurization equipment and gas-gas heat exchanger (GGH) to reduce the amount of emitted soot and dust. This is a high-performance flue gas treatment system, by which soot and dust in boiler flue gas can be removed very efficiently. An exterior view of the facility is shown in **Figure 3**.

For the absorption tower of the desulfurization equipment, we selected the latest spray tower which can be compact and yet exhibit excellent desulfurization and dust removal performance owing to technologies such as the high gas flow speed. For GGH, the heat medium circulation type has been adopted, and together with the application of other highly reliable technologies for control and ancillary devices, the operation stability and operability have been improved.

Figure 3 Exterior view of flue gas treatment facility

6. Operational results

In test operation with a subbituminous coal-mixed ratio of 50%, the obtained data (e.g., steam temperature and combustibility) corresponded to the designed boiler specification, demonstrating stable operation without causing problems.

In Unit 2 of the Hitachinaka Thermal Power Station, the intended use with a subbituminous coal-mixed ratio of 50% may make it susceptible to slagging and fouling.[*1)] Because of this, we designed the furnace to have a depth larger than Unit 1 and installed a pendant reheater to reduce the gas temperature at the inlet of the horizontal coils. As a result, no abnormal ash deposition or growths were found under the condition with a subbituminous coal-mixed ratio of 50%. The inlet gas temperature of the horizontal coils was successfully lowered compared with Unit 1. Continuous operation has been enabled without problems.

*1) Slagging is a phenomenon in which melted coal ash is deposited on the surface of the heat exchanger tubes in the high-temperature combustion gas region. Fouling is a phenomenon of ash deposition on the surface of the heat exchanger tubes in the gas temperature region below the coal ash softening temperature. Either can cause poor heat transfer, the obstruction of gas flow passage and disturbance in operation.