Press Release

March 6, 2019

OSAKI CoolGen Corporation
New Energy and Industrial Technology Development Organization

Completion of Oxygen-blown IGCC Demonstration Tests as the First Step of the "OSAKI CoolGen Project"

- Targets Achieved in All Test Items, Including High-Efficiency High-Load Change Rate -

On February 28, OSAKI CoolGen Corporation (founded through joint funding by The Chugoku Electric Power Co., Inc. and Electric Power Development Co., Ltd. (J-POWER)) successfully completed demonstration tests of oxygen-blown integrated coal gasification combined cycle (oxygen-blown IGCC) technology, the first step of the "OSAKI CoolGen Project" that is being implemented as a project subsidized by New Energy and Industrial Technology Development Organization (NEDO).

In the nearly 2 years since the start of demonstration tests in March 2017, we have verified basic performance, controllability and operability (See Figure 3.) in an effort to commercialize oxygen-blown IGCC plants. As a result, we have successfully achieved our targets in all test items for the first step.

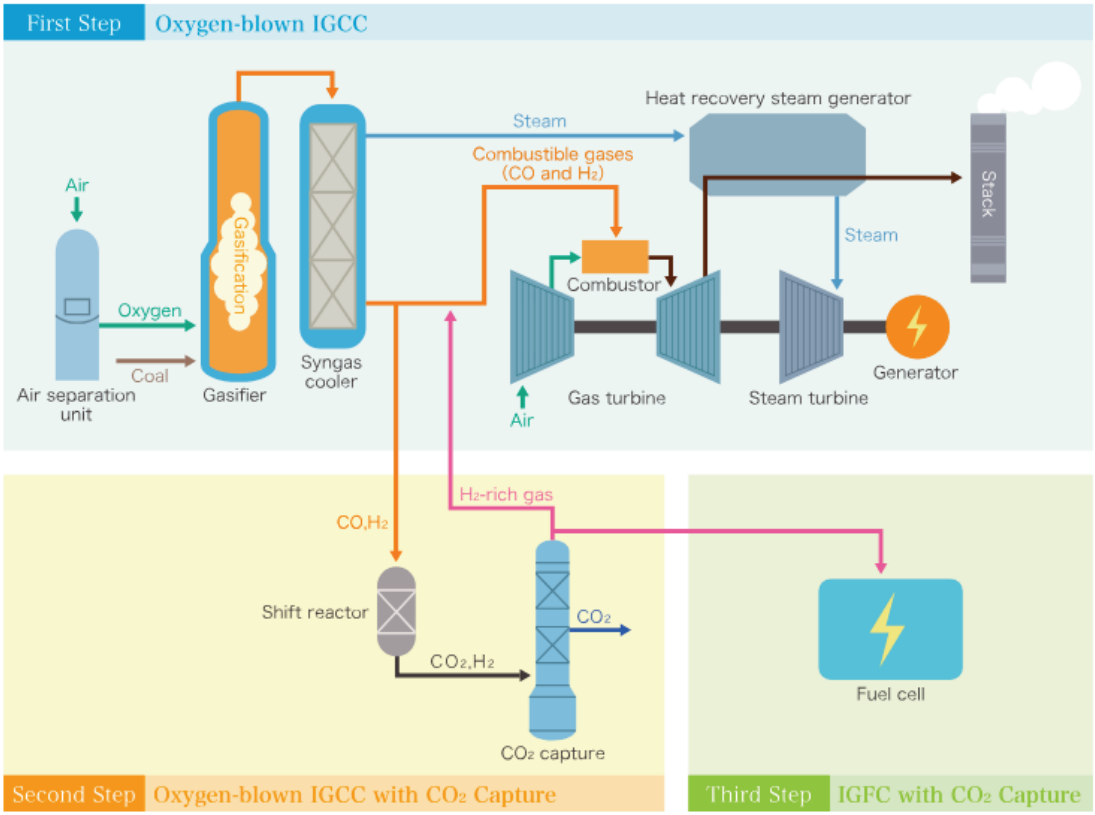
The results of these demonstration tests will contribute greatly to the reduction of carbon dioxide (CO_2) emissions through higher efficiency, which is required for modern coal-fired power generation, and the improvement of load adjustment capabilities for handling fluctuations in output from renewable energy due to weather.

Figure 1　Oxygen-blown IGCC Demonstration Test Power Station (within the Osaki Power Station of Chugoku Electric Power Co., Inc.) where First Step Demonstration Tests were Completed

1. Overview

As a project subsidized by NEDO, OSAKI CoolGen Corporation is engaged in an "integrated coal gasification fuel cell combined cycle (IGFC) demonstration project" that aims to achieve revolutionary low carbon coal-fired power generation through the combination of IGFC, the ultimate high-efficiency generating technology, with CO_2 separation and capture technology, in order to greatly reduce CO_2 emissions during coal-fired power generation.

The IGFC demonstration project is comprised of a demonstration of oxygen-blown IGCC (first step), a demonstration of oxygen-blown IGCC with CO_2 separation and capture (second step), and a demonstration of IGFC with CO_2 separation and capture (third step). (See Figure 2.) We constructed a demonstration test facility within the grounds of the Osaki Power Station of The Chugoku Electric Power Co., Inc. During the demonstration tests, which started in March 2017, we gasified coal particles in a gasifier to operate a 1300°C-class gas turbine, while also using the heat generated to operate a steam turbine for combined cycle power generation. We verified performance, operability, reliability and economic feasibility as a coal-fired power generation system, with a target of achieving a net thermal efficiency of 40.5% (higher heating value) for oxygen-blown IGCC using a 1300°C- class gas turbine.



F Y	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
First Step Oxygen-Blown IGCC	Detailed design and construction					Demonstration			Demonstration		
Second Step Oxygen-Blown IGCC with CO_2 Capture						Detailed design and construction				Demonstration	
Third Step IGFC with CO_2 Capture								Detailed design and construction			

Figure 2 Overview and Overall Schedule for Integrated Coal Gasification Fuel Cell Combined Cycle (IGFC) Demonstration

2. Primary Results of Demonstration Tests

○ Basic performance, plant performance

We achieved a net thermal efficiency of 40.8% (HHV), which is the highest level of performance in the world for a 170,000 kW level demonstration plant. We forecast that a net thermal efficiency of approximately 46% will be achieved with a commercial plant that uses a 1500°C-class gas turbine (with a capacity of 2,000 to 3,000 tons of coal per day). Based on these results, we can expect to reduce CO_2 emissions by about 15% compared to ultra-supercritical pressure pulverized coal-fired power generation (USC).

○ Plant controllability & operability

We achieved a maximum load change rate of 16%/min, significantly exceeding the target. Furthermore, we confirmed stable operation at a net power output of 0 MW, indicating that power generation output can be controlled flexibly. We also verified a high level of operability when used as a power supply for handling sudden fluctuations in output, such as can be experienced with renewable energy as it is being introduced more broadly.

Item	Targets	Results
Basic performance (Plant performance)	➢ Net thermal efficiency: 40.5% (HHV)	➢ Net thermal efficiency: 40.8% (HHV) Target achieved
Basic performance (Environmental performance)	➢ SOx: 8 ppm ➢ NOx: 5 ppm ➢ Particulate: 3 mg/m^{3}N (O_2 equivalent 16%)	➢ SOx: Less than 8 ppm ➢ NOx: Less than 5 ppm ➢ Particulate: Less than 3 mg/m^{3}N (O_2 equivalent 16%) Target achieved
Coal variety compatibility	➢ Determination of compatible coal property range	➢ Tested 4 coal varieties and confirmed favorable compatibility ➢ Confirmed stable plant conditions while switching coal varieties during continuous operation Target achieved
Facility reliability	➢ Forecast of commercial plant-level annual plant utilization factor of 70% or higher (5,000-hour prolonged endurance test)	➢ Prolonged endurance test: 5,119 hours ➢ Continuous operation: 2,168 hours Target achieved
Plant controllability & operability	➢ Operating characteristics and controllability that are necessary for commercial thermal power station (Load change rate: 1 to 3%/min., etc.)	➢ Confirmed safe stoppage in emergency stop test ➢ Load change rate: Confirmed up to 16%/min. ➢ Confirmed stable operation with net power output at 0 MW ➢ Confirmed favorable operability in net power output control ➢ Obtained forecast of cold start-up time (GT start-up to rated load) of about 7 hours Target achieved
Economic feasibility	➢ Forecast that the generating cost at a commercial plant-level will be the same as or less than with pulverized coal power generation	➢ Confirmed the forecast that the generating cost at a commercial plant-level will be the same as with pulverized coal power generation Target achieved

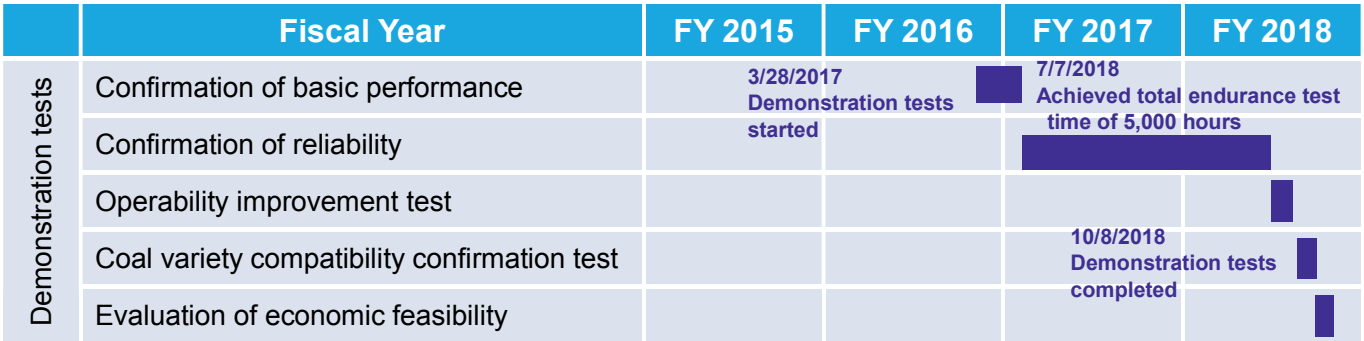


Figure 3 Targets/Results of Oxygen-blown IGCC Demonstration Tests and the Test Schedule

3. Future Plans

During the second step (FY 2016 to FY 2020) we will add a CO_2 separation and capture unit to the oxygen-blown IGCC in the first step, in order to implement demonstration tests of IGCC with CO_2 separation and capture. We are currently moving forward with construction in order to start the demonstration tests in FY 2019.

Further, during the third step (FY 2018 to 2022) we plan to implement a demonstration project for IGFC with CO_2 separation and capture, by integrating fuel cells with the CO_2 separation and capture IGCC facility.

We will push forward steadily with this project and our efforts to achieve "revolutionary low carbon coal-fired power generation" while placing priority on ensuring safety and preserving the environment, in order to achieve the targets we have set for the "OSAKI CoolGen Project".

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