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"Advanced Electric Power Management - Thermal Power Generation against Huge Impact by Renewable Energy Penetration -"

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Abstract

Title: Development of High-Efficiency Oxy-Fuel IGCC System
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As Japan depend its energy mainly on imported fuel, coal is expected as important fuel for base-load power stations. To prevent global warming, Japanese utilities are making efforts to improve efficiency and to expand biomass co-firing. On the other hand, western countries are running numbers of CCS projects, and one Japanese large-scale CCS demonstration project at Tomakomai has started in 2012. Generally speaking, conventional CCS systems lose efficiency when they capture CO2. As a solution, NEDO has offered a project to develop fundamental technologies necessary for the Oxy-fuel IGCC system, which can keep high efficiency even after capturing CO2. The Oxy-fuel IGCC substitutes oxygen diluted by exhaust gas recirculated from gas turbine combustor for gasifying agent and gas turbine combustion air. The target of this project was set as to achieve net efficiency of 42% at HHV, considering 3 brands of imported coal from countries in pacific rim. Following 4 approaches were done, and it was clarified that high efficiency more than 43% will be achieved when 3 brands of coal, one Indonesian coal, one Chinese coal and one Australian coal, are supplied individually.

1) The mechanism of Oxy-fuel IGCC which can keep high efficiency was examined by simplified heat and mass analysis, coal gasification tests and fundamental thermo-gravimetric experiments.

2) Following fundamental technologies necessary for the Oxy-fuel IGCC were established. (i) Numerical simulation method to evaluate performance of commercial scale coal gasifier, (ii) countermeasure for carbon deposition on low temperature area, such as hot-gas de-sulfurization, (iii) gasification test method to evaluate effect of CO2 enrichment on gasification performance. As a result, performance of commercial scale gasifier and effect of operating conditions were evaluated. Carbon deposition will be prevented with small efficiency penalty less than 0.2%. And it was confirmed that CO2 enrichment improves gasification performance when 6 different brand of imported coal was fed individually.

3) Construction of feasible system. System configurations were examined and revised to improve its feasibility. Especially for ASU and Regenerative heat exchanger, customized units were designed for the Oxy-fuel IGCC.

4) Preliminary examination on the next phase. The approach to commercialize the oxy-fuel IGCC was examined, to clarify the target of the next phase. Bench scale gasifier and other components required at the next phase were designed. And fundamental combustion experiments using single burner were done to clarify combustion characteristics under O2/CO2 atmosphere.