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Improvement of Gas Turbine Efficiency by Advanced Utilization of Moisture

and

Energy Payback Consideration on the Introduction of Renewable Energy

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Summary

The development efforts of technology for mitigation of carbon dioxide in power sector may be categorized into three phases, i.e. short, intermediate and long-terms. The short-term tactics aims to develop an advanced cycle with a higher efficiency using an available fossil fuel. The intermediate-term includes technologies regarding the confinement of CO2 within the cycle as well as the utilization of carbon free but exhaustible energies most of which are believed to be exhausted within this century. Thus, the long-term effort implies ultimate usage of renewable energy. Among them, this presentation picks up two topics relating to the short and the long-term development efforts.

The first topic is an advanced utilization of moisture in gas turbine system for the purpose of improving efficiency and power output. Several concepts are overviewed〔1〕 and their features extracted to enhance an early practice of industrial application. MAT〔2〕and AHAT〔3〕cycles are explained in detail, whose feasibility study was conducted as a national project of Japan in 1999 and 2000. MAT, sometimes termed as 'Inlet Fogging' in engineering practice, proved 10% power augmentation to an addition of 1% moisture by the retrofit installation of simple injection equipment. AHAT, combination of MAT with HAT, is expected to have 5% higher efficiency over combined cycle using the same turbine.

The second topic deals with a perspective of CO2 mitigation during introducing renewable energy in this century in view of energy balance with economical parameter excluded. The model proposed predicts the future of world energy production and consumption in the long run when a certain renewable energy is fully introduced〔4〕. Renewable energy as a whole is distributed on the earth and has a thinner energy density. Thus, energy payback time of its power source is larger than that of fossil plant and cannot be ignored in its production plan. This approach, in turn may provide direction of developing a certain resource and also good reasoning to delivering subsidy. Photovoltaic cell, wind power, small and intermediate hydropower and nuclear power have been considered. It is predicted that photovoltaic cell needs much shorter energy payback time by improving manufacturing process to avoid energy expense and resultant CO2 emissions during replacement.

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