GTCC Contributes to Stable Power Supply in Singapore

High Uptime Operating Ratios Supported by LTSA

As economies develop and standards of living improve, demand for electricity inevitably increases. This phenomenon is now causing major problems around the world, problems related to both energy resources and the environment. And while some power is generated from renewable energy sources, such as hydro, nuclear, wind, solar and geothermal, most is still generated using fossil fuels — coal, oil, and natural gas — all of which emit CO_2 and thus contribute to global warming. Moreover, the supply of fossil fuels is limited: as the BRICS countries and other developing nations rise to prominence, competition for these resources is intensifying.

Improving Efficiency through Deregulation

Electricity is fundamental to both industry and people's everyday lives, and as such, a stable supply is vital. Customers demand cheaper and more stable supplies of electricity. Thus, suppliers must meet those needs. Toward the end of the twentieth century, a trend emerged, mainly in the U.S. and Europe, of energy market deregulation with the aim of improving efficiency. Furthermore, development of renewable energy sources and the high-efficiency use of fossil fuels were accelerated to bring about a low-carbon society.

Singapore has been quick to respond to this global trend of electric utility deregulation. The country took the plunge into privatization in October 1995 and trading on the National Electricity Market of Singapore (NEMS) began in January 2003. One distinguishing feature of Singapore's electricity is that currently 80% of the energy comes from natural gas, and that figure is expected to rise to 90% by 2014. Beside the fact that many neighboring countries produce natural gas — clean energy in comparison to coal or oil — tourism is a key industry in Singapore, and policies tend to prioritize the environment. For these reasons, natural gas plays a central role in the country's energy.

Among the power generation systems in operation at Singapore's electrical power companies are natural gas-fired gas turbine combined cycle (GTCC) power generation plants made by MHI. These plants produce electricity primarily by gas turbine, but also use the exhaust heat to drive a steam turbine, which generates additional power. The system optimizes the energy source, a kind of "two for the price of one." Since 2001, MHI has supplied four GTCC power plants to Tuas Power, one of Singapore's three largest power companies. Each turbine has a rated output of 360,000kW.

Remote Monitoring of Turbine Conditions

While MHI has supplied a total of four gas turbines to Tuas Power, it has done more than just deliver the power generation system. It has concluded a Long Term Service Agreement (LTSA), a long-term contract under which MHI provides high uptime operating ratios for the facility by undertaking regular inspections. In effect, MHI operates a business model whereby it provides hardware (equipment) and software (operational management) as a package. Two factors underpin the initiative: One was that maintaining a stable electricity supply was a top priority — and MHI could contribute to the creation of that stability; the other was the development of a remote monitoring system (RMS).

The RMS uses information and communications technology (ICT) to collect roughly 2,000 data points and to automatically analyze data every five minutes on more than 150 major components within each gas turbine with the aim of diagnosing potential problems. At present, MHI remotely monitors gas turbines in operation around the world under the LTSA, 24 hours a day, 365 days a year, from remote monitoring centers (RMCs) in Japan. Although there are gas turbine manufacturers in Europe and the U.S. and they work hard to improve their levels of customer satisfaction, none of them have developed such a thorough service or gone so far as to optimize uptime operating ratios.

In fact, according to Tuas Power, the operating ratios of MHI's GTCC have proved extremely high with an annual average of over 99%. This is partly due to the RMS, which prevents shutdowns due to malfunctions. At the same time, Tuas praises the energy efficiency of the GTCC, which is about 20% better than that of conventional oil-fired units. For an electric power company to thrive in a deregulated market, it is important to increase energy utilization efficiency, as well as cut equipment and fuel costs. In both areas, GTCC and LTSA are contributing to the success of Tuas Power.

Balancing Environmental Protection and Operational Efficiency

In order to provide society with a stable electricity supply, power generation systems must be operated efficiently. But it is also vital to secure fuel and accurately transmit power to areas where there is demand. Through the RMS, MHI can monitor peripheral areas, including fuel and transmission, as well as actual turbine operating conditions. If anomalous activity is detected, it is immediately reported and countermeasures are taken. At the heart of this system is a "spirit of good service," which could be described as the Japanese virtue of heartful hospitality. European and American electric companies think highly of it, regarding such complete service as leading to more efficient operation and better reliability.

The gas turbines supplied to Tuas Power have a combustion temperature of 1,350℃ class. MHI has already developed 1,500℃ class turbines and is about to launch 1,600℃ class turbines onto the market. Since there is a direct connection between increased combustion temperature and improved energy utilization efficiency, these advanced GTCC will help power companies operate even more efficiently, as well as promote the effective use of natural resources globally. Moreover, reduced CO_2 and other emissions will prove useful in resolving global environmental issues. For these reasons too, MHI looks forward to further global adoption of the GTCC/LTSA business model.

Lau Tai Hwee, Message to MHI

Tuas Power has had a long and positive relationship with MHI in power generation, beginning with the decision to invest in an MHI gas turbine combined cycle (GTCC) power plant in Singapore.

MHI was selected based on the proven reliability of its generation equipment. When we first considered a GTCC system, MHI took a very hands-on approach, providing us technical information through every step of our evaluation process in selecting the supplier for the GTCC turnkey project. During the execution of the project, MHI's team of experienced managers and engineers achieved on-schedule completion with high quality of work. After the plants commenced commercial operation, MHI has continued its strong support to us with an on-site resident engineer, and providing 24/7 remote monitoring service.

The GTCC system supplied by MHI has been in operation now for a decade and we have been very pleased with its performance – both in terms of its high energy utilization efficiency and actual operating conditions — and with MHI's outstanding support. Reliability has proved to be above 99%, with very few accidental shutdowns. This is especially important for us because Singapore is an actively traded market where the price of electricity is set every 30 minutes, so any downtime costs money.

In the area of support, our needs have been comprehensively met by MHI's Long Term Service Agreement (LTSA). Central to our operations is a remote monitoring system (RMS) that functions 24/7 and eliminates any confusion surrounding who to contact should an issue arise. Moreover, annual inspections and maintenance of gas turbines are handled by a team of MHI's specialist engineers coordinated by an on-site MHI engineer, and working closely with engineers of Tuas Power. We are confident that this combination of RMS and on-site engineer ensures problems are quickly identified and resolved.

Measures to curtail global warming need to be considered even in the face of rising demand for power in Singapore, and for this reason Tuas Power is planning to increase its use of GTCC power plants. We are also looking forward to the emergence of new generation of GTCC that is able to operate with wider variations in gas composition and higher plant efficiency during both full load and part-load operation.

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