Geothermal
Power Plants

Power for a Brighter Future
Power grows when we all work together.

Today, one in six people around the world lives without reliable access to electricity, while global demand for power continues to grow. The mission of Mitsubishi Hitachi Power Systems, Ltd. (MHPS) is to address those needs by providing more affordable, highly reliable and cleaner energy solutions.

MHPS was born through the merger of the thermal power generation divisions of Mitsubishi Heavy Industries, Ltd. and Hitachi, Ltd. in 2014. Based on our parent companies’ long histories of product development and supply for more than a century, we have been dedicated to designing, manufacturing, supplying, engineering, installing and providing support services for a wide range of proprietary power generation systems.

One of our products is the gas turbine, the engine of gas turbine combined cycle (GTCC) power plants, which provides incredibly efficient electric power while reducing greenhouse gas emissions. We also provide next-generation thermal-power systems, such as integrated coal gasification combined cycle (IGCC) power plants, steam power plants, combined-cycle power plants, air quality control systems (AQCS) and digital solutions MHPS-DOMINO+. We will continue our mission to address power needs by developing technologies that enhance the global environment and provide affordable, sustainable, reliable power for the planet.

Power for a Brighter Future
High performance and reliability

MHP became the first in the world to introduce the horizontal flow transportation system and the double-blade type as technology for thermal power generation. We have been striving to develop new thermal power generation technologies based on research and development over a long period of time, our thermal power plants have been repeatedly suffering from high performances and high availability all over the world, for example, the Los Angeles, Florida, and thermal power plant is in Taiwan, which comes into operation in 2011, achieves an availability rate of 98%，demonstrating the reliability from the commencement of operation. MHP will continue to provide reliable electric power on the basis of our superior thermal power generation technologies.

Environmentally-friendly

Geothermal power generation involves the extraction of underground thermal resources. Hot water and steam can be produced by drilling into the Earth’s crust, and the extracted heat can be used to generate electricity. The extracted water and steam are then reintroduced into the Earth to maintain the geothermal resource. Geothermal power plants are highly sustainable and low in greenhouse gas emissions. Geothermal power plants are also highly efficient, producing electricity at a lower cost than many other forms of renewable energy.

Engineering, procurement and construction (EPC) services

MHP is a technology that designs and manufactures the equipment and devices required for geothermal power plants. We also provide EPC services, including project construction, in collaboration with partners. We delivered over 156 geothermal power plants since 1995 and were selected as the EPC contractor for more than 70% of them. According to our know-how, engineering, procurement, and construction services.

Our strong is the optimization and integration of power plants, including design, manufacturing, and construction to ensure maximum supply from limited geothermal energy and atmospheric properties within wide region to region.
Contribution to Kenya's expansion of environmentally-friendly energy sources

In Kenya, hydroelectric power has been the mainstay of the country’s power generation mostly due to several reasons, nonetheless, in recent years, power projects have focused on renewable energy, resulting in serious power shortages and a growing reliance on thermal energy sources to make up the shortfall. To stabilise the electricity supply and meet predictions for a sharp increase in energy demand, the government's Kenya Vision 2030 national development policy set targets to rapidly expand energy generation capacity by 2030. As part of the policy, it has made encouraging renewable power generation, harnessing the country's abundant geothermal resources, a top priority.

Cautiously evaluating the potential of geothermal power generation projects,

MIFP has been involved in geothermal development by the national electricity company, Kenya Electricity Generating Company Limited, to provide them with the project titles. The project in the Olkaria complex in the Great Rift Valley since the early 1990s. Beginning with the installation of a 15 MW power plant at Olkaria I, after being followed by two additional 15 MW power plants at Olkaria II & III. In 2006, Olkaria IV, which is combined to provide 32 MW (3x10.676 MW) and in 2018, Olkaria VI provided an additional 30 MW of power capacity. Currently, MIFP is engaged in a full inventory contract for the Olkaria VII. A 5 MW plant that will Supply 146 MW when it comes online in 2016. MIFP is designing the geothermal facilities and will help to manage the project, generating electricity and providing support and experience in an EPC (engineering, procurement, and construction contracts). MIFP will deliver equipment and support the site in accordance with the installation and commissioning.

MIFP’s superior reliability and technology

MIFP performance on the project has been excellent for its expected record of equipment delivery, technological strength, and EPC execution capabilities. The project is helping to achieve Kenya's power generation targets and is at the same time reducing greenhouse gas emissions and preserving our environment. Thanks to this investment in recent years, geothermal power is proving to maintain hydrocarbon in the country as a main source of power generation.

Geothermal energy is not only securing Kenya’s energy future. It is also an important source of employment, by contributing to the series, which is indispensable for stimulating industrial development and improving living standards. MIFP aims to contribute towards economic growth and environmental sustainability, while providing reliable and competitive electricity to the people of Kenya with our highly efficient and environmentally friendly technology.
Steam Turbines

Over the years MHI has supplied more than 100 steam turbines for geothermal plants, generating more than 3,000 MW of electricity and satisfying a wide range of output levels to meet various operational requirements.

Wide Output Range: 100 kW to 151 MW

Providing a flexible range of exhaust directions and characteristics

MHI offers a range of steam turbines with various steamward and exhaust directions to suit different turbine-generator (TG) building and condenser layouts. The different exhaust directions and turbine building layouts are shown below.

<table>
<thead>
<tr>
<th>Exhaust Direction</th>
<th>Steamward</th>
<th>Exhaust</th>
<th>TG Building</th>
<th>Condenser Layout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal High</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
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<tr>
<td>Vertical</td>
<td>High</td>
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<tbody>
<tr>
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<td>Low</td>
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<tr>
<td>Rear</td>
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Meeting demand with single flash and double flash cycles

MHI can offer single and double flash cycles to meet the varied demands of different geothermal conditions.

Single Flash Cycle

Double Flash Cycle
MHPs in technologies for geothermal power plants

As geothermal power plants contain corrosive gases and impurities (such as sulfur, alkalis, and chlorides), steam turbines designed for geothermal applications need to be very robust and efficient. One of the leading technologies used for such turbines is the MHPs. These turbines exhibit high reliability and efficiency. The following technologies are applied in all turbines for geothermal power plants.

Low-temperature MHPs with blades

- Usually 12% Cr stainless steel is used for the blades, but for low-blades where stresses are higher, and for high-alloy alloys when scaling issues occur, 12% Cr steel is used. Compared to 22% Cr stainless steel, 12% Cr has better corrosion resistance against elements, such as sulfur, alkalis, chlorides, and other impurities. This makes it ideal for high-temperature conditions and provides increased power density and durability.

Steam turbines are core elements in steam power plants, enabling efficient conversion of heat energy into mechanical energy to drive generators. Steam turbines are categorized into different types based on their steam conditions, operating pressures, and temperatures. Typically, steam turbines are designed to work with saturated steam or superheated steam. The choice of steam condition significantly affects the efficiency and output of the turbine.

MHP applications for steam turbine technologies

- MHPs also play an essential role in steam turbine technologies. They are designed to improve steam turbine efficiency and reliability in various power generation systems, such as those using geothermal power.

R&D activities on MHPs

The R&D activities on MHPs focus on developing novel materials and technologies to enhance their performance and durability. Key areas of focus include material science, heat transfer, and fluid dynamics. The research efforts are aimed at creating more efficient and reliable turbine components, thereby improving overall system efficiency and reducing maintenance requirements.

Conclusion

In conclusion, MHPs play a crucial role in the advancement of steam turbine technologies, particularly in the context of geothermal power generation. Their ability to withstand harsh conditions, along with their high efficiency and reliability, make them an indispensable component in power plants. Continued R&D efforts in this field are expected to further enhance the performance and optimization of steam turbines, contributing to more sustainable and efficient power generation systems.