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, verifying, 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 multi-generation thermal power systems, such as integrated coal gasification combined cycle (IGCC) power plants, thermal power plants, geothermal power plants, air quality control systems (AQCS) and digital solutions (MHPS-TOMONI™). 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
GTCC Power Plants
Delivering high-efficiency energy through combined cycle power generation

- Worldclass Highest Efficiency: More than 64% (LHV)
- Wide Output Range: 30-1,285 MW (1 on 1/2 on 1/3 on 1)
- Combined Cycle Power Plants: Verification Testing, MHPS On-grid Facility
- CO₂ Emission: About 50% Lower Compared with those of Coal-fired thermal power generation

What makes GTCC the most suitable choice?

- High level of thermal efficiency
- Less impact on the natural environment:
  - Less carbon dioxide (CO₂)
  - Less nitrogen oxides (NOx) and sulphur oxides (SOx)
  - Less high-temperature emissions
  - Less water consumption compared to coal generation

Close, high-efficiency power
Gas turbine combined cycle (GTCC) power plants use natural gas to drive one of the chiller and most efficient forms of power plants. Also, they are more efficient than conventional coal-fired power plants and have achieved the world’s highest level of efficiency of more than 64%.

What’s more, the system’s high efficiency reduces CO₂ emissions by about 50%, making it the first combined cycle power plant for a large-scale power company in 1971. Since then, we have installed numerous units for various customers who demand an MRQ cost only for the supply and installation of power plants, but also a wide range of ongoing services including operations, maintenance and MHPS/TOMIZUMI joint solutions.
How MHPS helped deliver low-emission GTCC power to Oklahoma

In 2014, MHPS signed a contract to supply a natural gas-powered MHPS Gas Turbine, Steam Turbine and associated electric generation to the Grand River Dam Authority (GRDA). The power generation equipment was designed for the GRDA’s new Unit 3 power generation facility in Cherokee, Oklahoma, USA, as part of the project, GRDA signed a 25-year long term service agreement with MHPS. The MHPS turbine was delivered on time to the site and commissioned fine on its first attempt on March 14, 2017, with two days being sanctioned by the grid’s interconnection for GRDA. Since then, the facility has achieved a grid-allowable 90% scheduled availability and performance rating. The plant has been generating revenue for GRDA since its commercial operation started on April 15, 2017. The plant has been successfully started up and operating in combination with an existing 110 MWe steam power plant.

Project Details

- **Grand River Energy Center Unit 3** (USA)
- **Nuon Magnum Power Plant** (Netherlands)
- **Ulsan Power Plant** (Korea)
- **Dahan Power Plant** (Thailand)

**Customer**
- Grand River Energy Authority
- GRDA
- Oi Shikoku Electric Power Co., Ltd.
- Jenergo
- Florida Power Company
- Tonkin Electric Company

**Output**
- 305 MW
- 1,166 MW
- 305 MW
- 305 MW (Stag-1/2/3E)
- 305 MW

**Start of operation**
- 2017
- 2013
- 2016
- 2016
- 2017

**Model**
- M530F
- M530F
- M530F
- M530F
- M530F/6

**Customer**
- Grand River Dam Authority
- GRDA
- Oi Shikoku Electric Power Co., Ltd.
- Jenergo
- Florida Power Company
- Tonkin Electric Company

**Outage**
- 305 MW
- 305 MW
- 305 MW
- 305 MW
- 305 MW

**Model**
- M530F
- M530F
- M530F
- M530F
- M530F/6
Gas Turbines
Raising the world’s standards for capacity and efficiency

MHPS gas turbines made with cutting-edge technology

- Small modular capacity gas turbines (60 MW to 117 MW)
  - H2S师范
  - H3S师范
- Large capacity gas turbines (754 MW to 460 MW)
  - F75* Model
  - F105* Model
  - F105 S* Model
  - F105 S* Model

Powering the world with a full range of gas turbines

To meet the power demands of industries and societies around the world, MHPS produces a wide range of gas turbines from the 60 MWs to the 504 MWs (697 MWs for power generation and industrial use). These turbines drive the development and growth of

Gas Turbines and Combined Cycle Output

[Graph showing power output and efficiency of gas turbines]

Anniversary Gas Turbines (56 MW to 149 MW)

- F75* Model
- F105* Model
- F105 S* Model
- F105 S* Model

Thermal Efficiency of Combined Cycle Systems

[Graph showing thermal efficiency of combined cycle systems]
High-capacity gas turbines for power generation
Incorporating cutting-edge technologies

New gas turbines built on the proven Genius design with advanced technologies involved as part of a Japanese government’s nationwide project to develop a class of gas turbines that have a relative net efficiency of 36%. This series, with a T1 of 1,660°C as is well as to meet the project’s goal.

**Development of the air-cooled JAC-series**

The JAC-series gas turbines are air cooling for combustion instead of steam cooling. With performance equivalent to the genius gas turbines, they provide a high level of reliability including a shorter startup time.

**Advantages of the MCorseto**

While the basic part of the compressor and the turbine has the same shape as that of the MCorseto, the JAC-series has a cooling structure for the blades and veins of the turbine, which is optimized according to the specific conditions. The compressor uses the air cooling system that has been proven to improve more homogeneous mixture of fuel and air. The advanced MCorseto with improved contributions such as operational stability by eliminating the need for steam cooling in the bottoming cycle.

**Turbine**

The blades of turbine have 1s to 6s are cooled by compressor bleed air, which is cooled by an external water-cooler. The series of turbine has 6s to 1s are all air-cooled, with 1s to 6s being cooled by compressor discharge air, and its remaining areas are cooled by compressor bleed air at the stage levels respectively. The cooling structure is improved for the Genius turbine, and steam cycle is also improved. The application of high-temperature cooling for the cooling developed as part of the Japanese government’s National Research Project’s further offers the temperature increase.

The residual temperature is maintained at the same level in the series by adding the 1s, 2s, and 3s for the temperature increase in the TAC series. The turbine in the JAC series is a result of being part of an external thermal barrier coating (TBC).
Gas turbines for power generation to accommodate diverse fuels

IN 1995, MHI developed the F-series gas turbines for 450 MW power generation. The following year, it developed the M701F Series for 600 MW power generation with single design features.

Since then, MHI has continued to improve the design of the F-series gas turbines. MHI introduced advanced demand and material technologies, settled by the Cosmos*1 power plant record, the Cosmos attains continuous performance enhancements.

Compressor

Variable inlet guide vane ensures operability at startup and enhanced performance at part load in combined cycle operation.

Combustor

A premixed, low NOx combustor is composed of a dual burner surrounded by eight twin burners. The combustor has an air bypass mechanism that makes the combustor flexible to control the fuel ratio in the combustion region.

Turbine

The existing blade on the F701H stage is being replaced with a new blade that is able to withstand higher temperatures due to better aerodynamic efficiency.

High capacity to high output gas turbines for power generation

In February 1997, the first M701G gas turbine with a 10% of 1,500MW external commercial operation. The series features the use of steam for cooling applications, the M701G, which is the current mainstay model, uses the latest advanced combustor technology in place of conventional steam-cooled combustor, using compressor discharge air for cooling application to achieve additional reliability by reducing the need for steam for cooling from the topping cycle.

G-series

The G-series gas turbines feature a 90 aerodynamic design in a free vortex cooling turbine. The M701G is also equipped with traditional steam-cooling (TS) and water-cooling (WC) for the first stage and the first stage of the second stage are cooled. The blade design is optimized for durability and efficiency, ensuring a high level of performance.

Table

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<tr>
<th>Model</th>
<th>Single Cycle Input</th>
<th>Combined Cycle Output</th>
<th>Keijido Compatible with Blast Furnace Gas</th>
<th>Utilizes Hi-Temperature and Hi-Speedity Technology</th>
<th>Combined Cycle Efficiency</th>
<th>Combined Cycle Output</th>
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<tr>
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<td>206 MW</td>
<td>555 MW</td>
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Symbols for the power plant: G: Cosmos, G: M701G, B: M701B, C: M701C.
Remote monitoring centers

Remote monitoring centers (RMCs) have been established in key regions around the world. All our experts in operations and maintenance monitor operating conditions under 24/7
system. The system provides warning and detection of anomalies, as well as diagnosis of threshold performance on operating data that is remotely updated. Customers are provided with options depending on the situation of Antarctica, relating to remote trouble and maintenance such as plant operation.

- Providing tripable products that use the latest technologies
- Optimizing maintenance initiatives such as replacement of inspection model and diagnostic analysis of operating conditions
- Using remote monitoring services for early problem or detection for reduced failure rates

Solutions to improve plant availability

Due to an increase in remanufacturing, more flexible operations are required to gas turbines combined cycle power generation plants. Airlines have identified various programs to improve market needs that reduce gas turbines starting time, improve start boost times, reduce downtimes, optimize system times and reduce emissions to enable operation at lower costs with improving efficiency.

Solutions for power augmentation

We provide solutions that respond to the market in output of existing GTCC plants. Our solutions vary depending on the application needs to reduce gas turbines starting time, improve start boost times, reduce downtimes, optimize system times and reduce emissions to enable operation at lower costs with improving efficiency. We provide solutions that respond to the market in output of existing GTCC plants.
MHPS-TOMONI™ Unlocks the Advantages of Digital Power Plants by Leveraging Customer Collaboration

The purpose of Tomahawk

The verification facility

The Tpye-to-Point facility features a combined cycle power plant with a total capacity of 150 MW. It is scheduled to begin operations in late 2020.

Comprehensive Efforts from Development to Manufacturing

MHPS is one of the only companies in Japan that handles the entire production process, from development, design, manufacturing, construction and commissioning of all necessary equipment, from the front to the back. To ensure the necessary level of quality, we can carry out our comprehensive approach to the power plants.
### Simple Cycle Spec

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### Annular/Dual Annular Gas Turbine

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### Performance

- **Simple Cycle Spec**
- **Combined Cycle Spec**
- **Mechanical Drive Spec**
- **Annular/Dual Annular Gas Turbine**

Note: 
- All data points are for a fixed design point at 40% NPSHR and 100% efficiency. 
- 100% efficiency is assumed at all loads. 
- Variations in these values could occur with operational changes. 
- Do not assume that this data is applicable to all sizes of the same model. 

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