

Overview of Kashima Thermal Power Station

1. Summary of power station

(1) Location 9, Touwada, Kamisu city, Ibaraki prefecture, Japan

(2) Station Chief Hirohisa Ishii

(3) Site area About 997,000 m²

(4) Output and fuel

| | Output | Fuel | Operation started in |
|---------|-----------------|----------------------|----------------------|
| Unit 1 | 600MW | Crude oil, Heavy oil | March 1971 |
| Unit 2 | 600MW | Crude oil, Heavy oil | September 1971 |
| Unit 3 | 600MW | Crude oil, Heavy oil | February 1972 |
| Unit 4 | 600MW | Crude oil, Heavy oil | April 1972 |
| Unit 5 | 1,000MW | Crude oil, Heavy oil | September 1974 |
| Unit 6 | 1,000MW | Crude oil, Heavy oil | June 1975 |
| Group 7 | 420MW x 3 Units | City gas | July 2014 (planned)* |

* Trial operation of Unit 1 of Group 7 started on May 1, 2014, and that of Unit 2 of Group 7 on February 5, 2014 and formal operation of Unit 2 of Group 7 will start in July 2014.

(5) Overview of Group 7 facilities

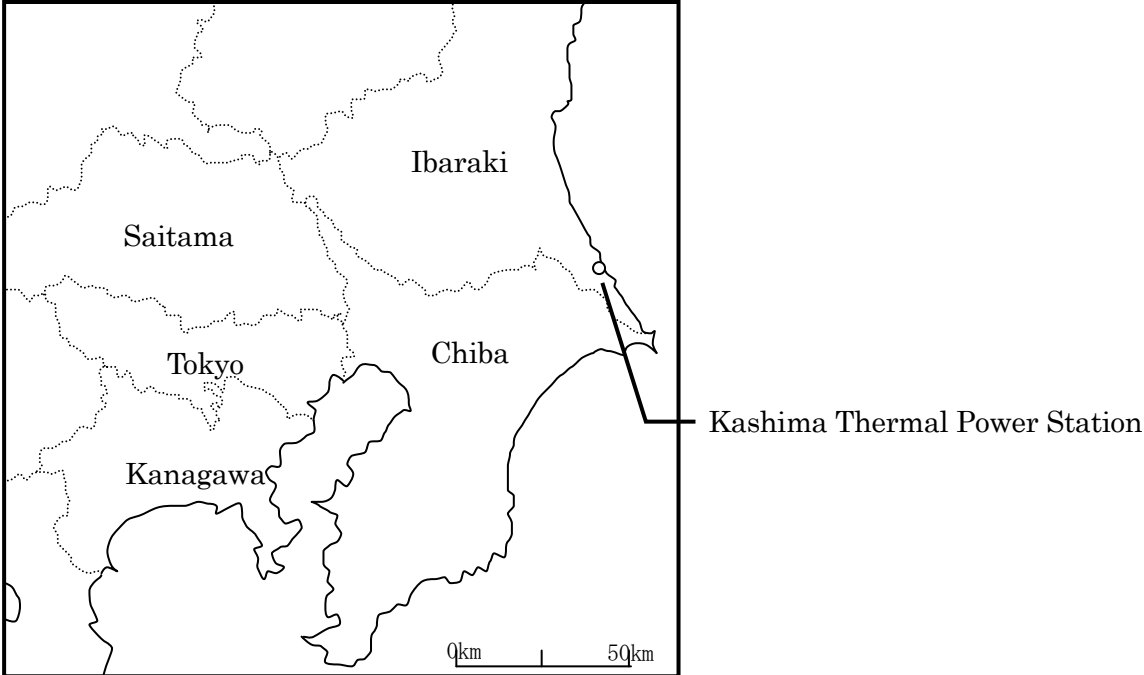
| | |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------|
| -Power generation system | 1,300°C grade combined cycle type (ACC) |
| -Thermal efficiency | About 57% (based on lower heating value) |
| -Gas turbine | Simple open cycle single shaft type |
| -Air compressor | Axial flow compressor |
| -Heat recovery steam generator | Triple pressure reheat natural circulation type heat recovery steam generator |
| -Steam turbine | Two cylinder, single exhaust, condensing and reheat type |
| -Starting system | Thyristor starting system |
| -Generator | Horizontal shaft tubular type revolving field three-phase AC synchronous generator |
| -Smoke treatment facility | Exhaust gas denitration equipment: Dry ammonium catalytic reduction system Stack: 59 m, Single stack type |

(6) Fuel City gas

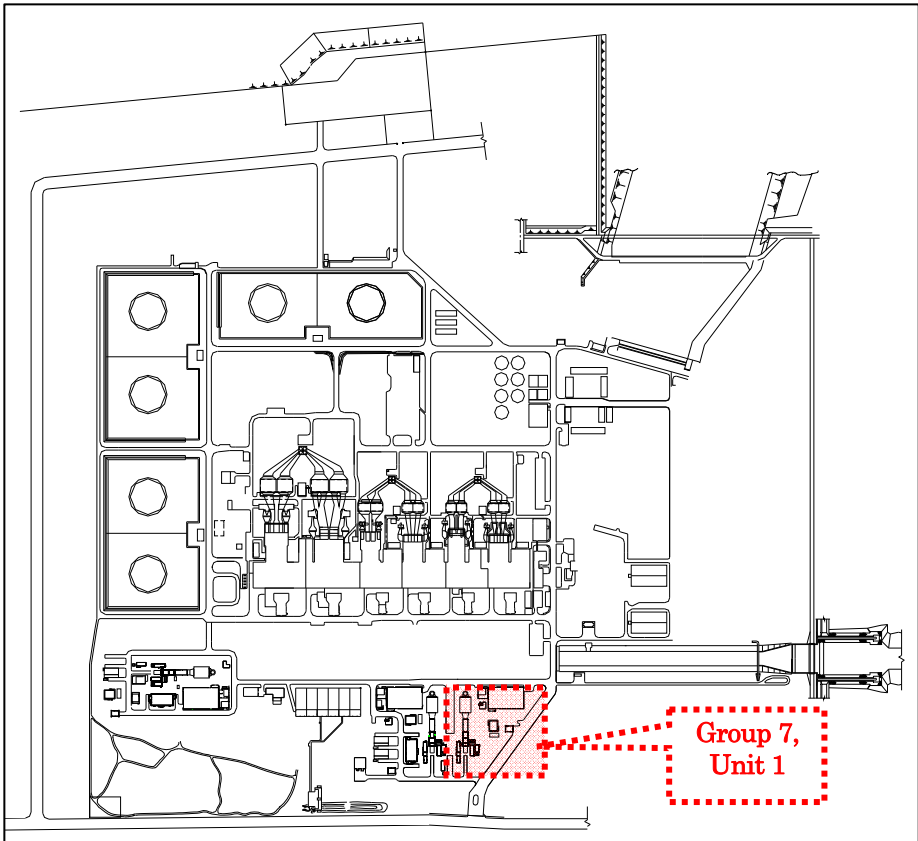
2. Construction history of Group 7, Unit 1

| | |
|------------------|-----------------------------------------------------------------------------------------------------------|
| August 3, 2011 | Gas turbine construction plan document was submitted (according to Article 48, Electricity Business Act). |
| March 29, 2012 | Combined cycle construction plan document was submitted. |
| July 12, 2012 | Gas turbine operation started. |
| December 2, 2013 | Trial operation started. |
| May 1, 2014 | Commercial operation started. |

3. Location of the power station



4. Layout of power plant (current)



5. View of the power station

<Before combined cycle construction>



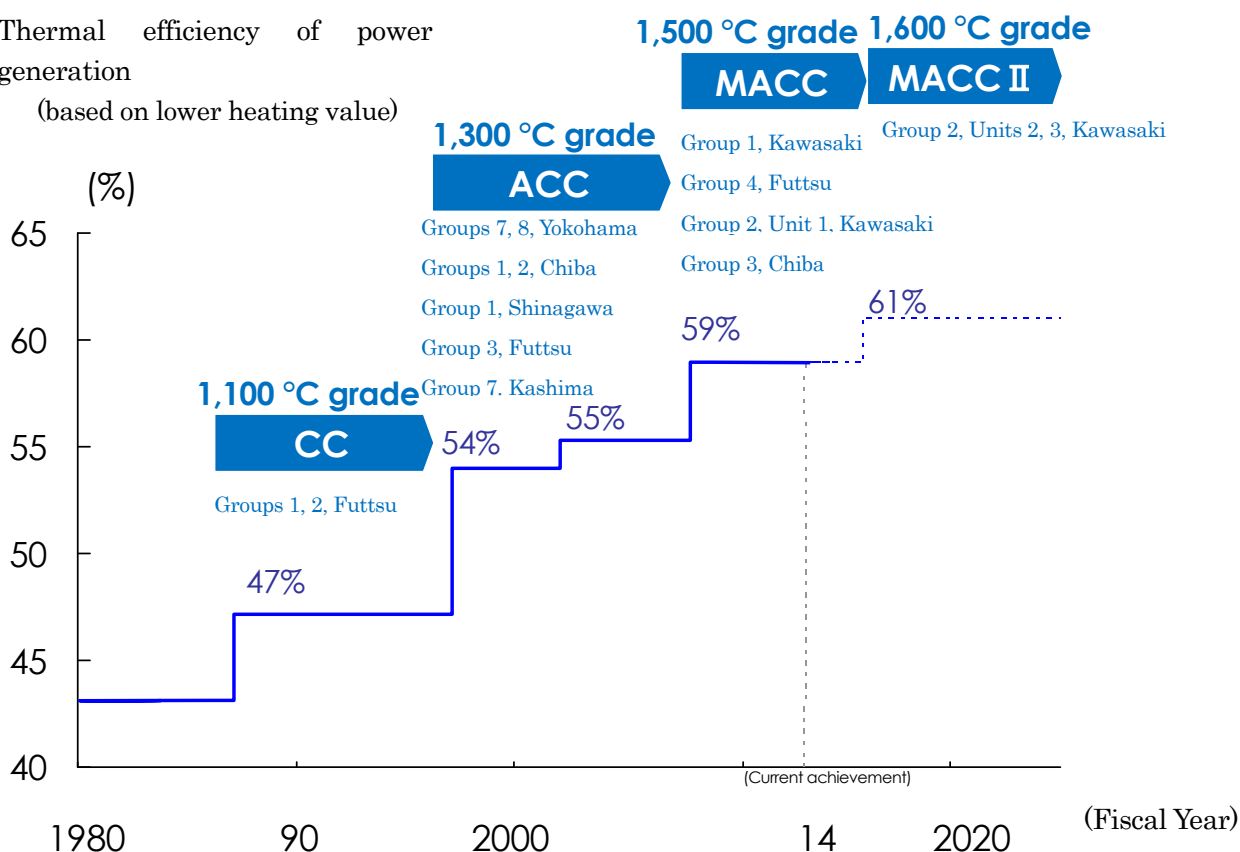
<After combined cycle construction>



*Units 1 and 2 of Group 7 from left to right (Unit 3 is located outside the photo)

<Data 1> Thermal efficiency improvement history

Thermal efficiency of power generation
(based on lower heating value)



<Data 2> Power stations of combined cycle power generation at 1,300°C grade (ACC)

| Power station name | Output | Thermal efficiency (%) | Operation started in |
|--------------------------------------------------------------|-----------------|------------------------|----------------------|
| Group 3, Units 1 to 4, Futtsu Thermal Power Station | 380MW x 4 Units | 55.0 | November 2003 |
| Groups 7 and 8, Units 1 to 4, Yokohama Thermal Power Station | 350MW x 8 Units | 54.0 | January 1998 |
| Groups 1 and 2, Units 1 to 4, Chiba Thermal Power Station | 360MW x 8 Units | 54.0 | June 2000 |
| Group 1, Units 1 to 3, Shinagawa Thermal Power Station | 380MW x 3 Units | 55.0 | August 2003 |
| Group 7, Unit 1, Kashima Thermal Power Station | 420MW x 1 Unit | About 57 | May 2014 |

Planned power station (ACC)

| Power station name | Output | Thermal efficiency (%) | Operation will start in |
|-------------------------------------------------------|-----------------|------------------------|-------------------------|
| Group 7, Units 2 and 3, Kashima Thermal Power Station | 420MW x 2 Units | About 57 | June 2014 |

<Data 3> Power stations of combined cycle power generation at 1,500°C grade (MACC)

| Power station name | Output | Thermal efficiency (%) | Operation started in |
|----------------------------------------------------------|-----------------|------------------------|----------------------|
| Group 1, Units 1 to 3, Kawasaki Thermal Power Station | 500MW x 3 Units | 58.6 | February 2009 |
| Group 2, Unit 1, Kawasaki Thermal Power Station | 500MW x 1 Unit* | 58.6 | February 2013 |
| Group 4, Units 1 to 3, Futtsu Thermal Power Station | 507MW x 3 Units | 58.6 | October 2010 |
| Group 3, Unit 1, Chiba Thermal Power Station | 500MW x 1 Unit | About 58 | April 2014 |

Planned power stations (MACC)

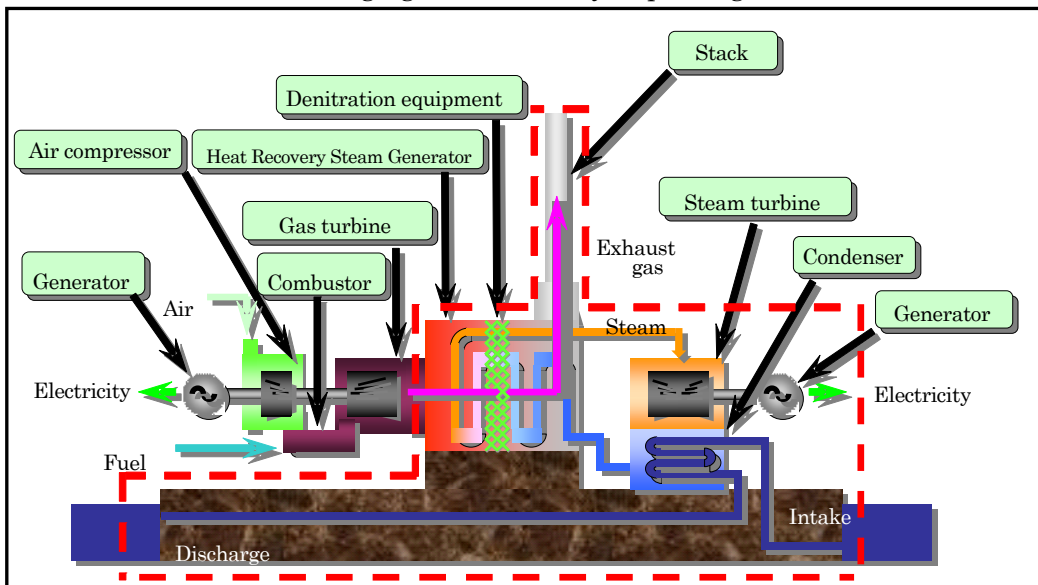
| Power station name | Output | Thermal efficiency (%) | Operation will start in |
|--------------------------------------------------------|-----------------|------------------------|-------------------------|
| Group 3, Units 2 and 3, Chiba Thermal Power Station | 500MW x 2 Units | About 58 | June and July 2014 |

*MACCII is under construction for Group 2, Units 2 and 3, Kawasaki Thermal Power Station.

<Data 4> Change of gas turbine power generation facilities to combined cycle power generation facilities

Reconstruction to combined cycle power generation facilities is performed by adding a heat recovery steam generator, steam turbine and power generator to the gas turbine power generation facilities. This type of facility effectively utilizes the exhaust heat from the gas turbine to increase the output by about 460MW for Group 7, without consuming additional fuel, and improve the thermal efficiency. In addition, by installing exhaust gas denitration equipment in the heat recovery steam generator, the emission of nitrogen oxide during operations can be suppressed to reduce the impact on the environment.

[Construction areas for changing to combined cycle power generation facilities]



The facilities enclosed by the red line are the equipment newly installed for the change to combined cycle type facilities