

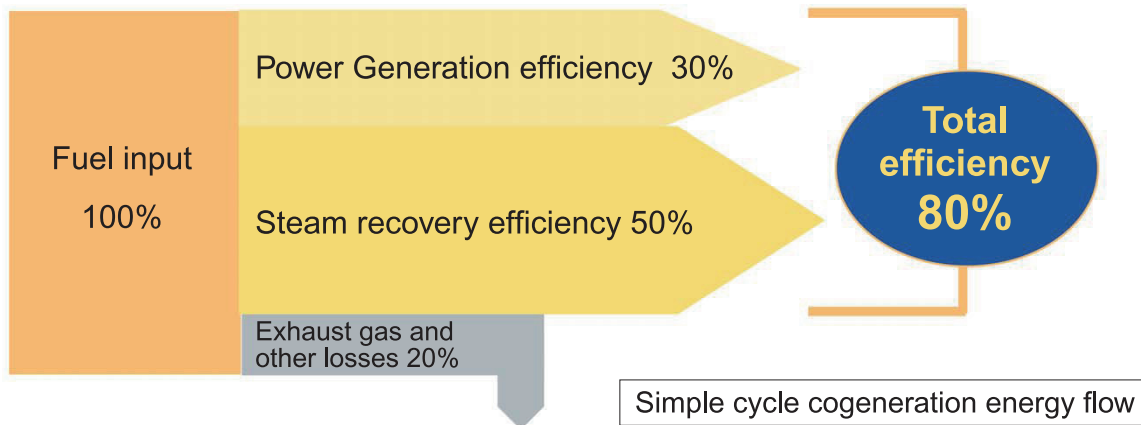
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|------|----------|----|-----------------------|------|-----------------|-----|---------------------------|
| E-09 | Keywords | Y3 | equipment or facility | Z2/3 | oil/natural gas | S4 | FEMS |
| | | | | | | E25 | general-purpose machinery |

Hitachi Zosen Corporation

Gas Turbine Cogeneration Systems

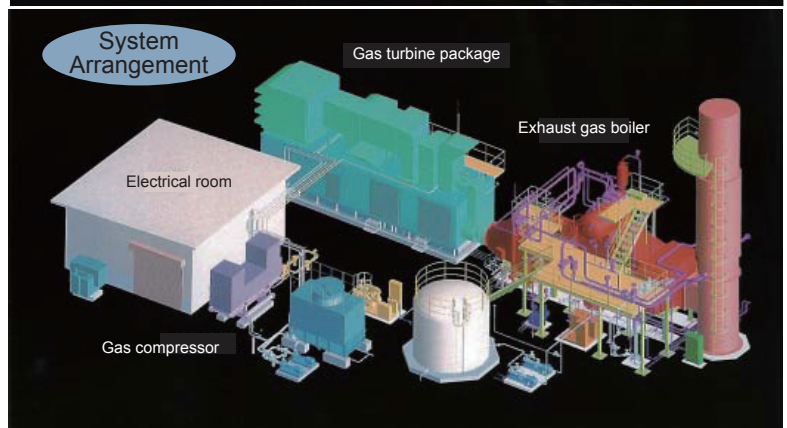
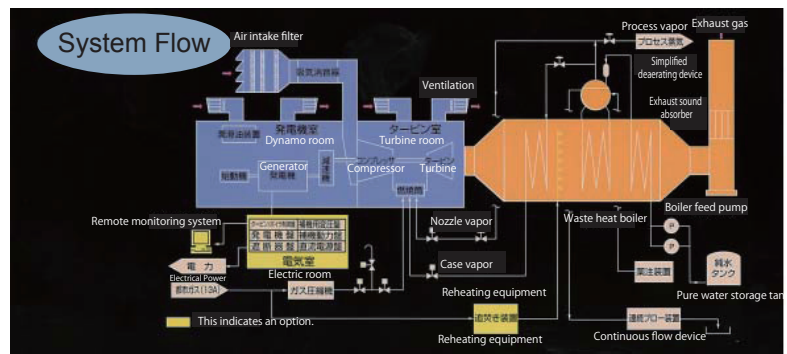
Features

- ◆ Energy system with a total efficiency exceeding 80% achieved by natural gas or other fuels fired power generation system with heat recovery from exhaust gas
- ◆ Power can be supplied from the cogeneration system even in the grid power black-out situation (emergency power generating facilities)
- ◆ Environmental-friendly system by reducing CO2 emissions
- ◆ Energy saving system by recovering waste heat from exhaust gas with generating power
- ◆ Peak-cut operation can contribute to load leveling
- ◆ Cost saving by avoiding the use of special high-voltage power supply systems from the grid



Basic Concept or Summary

- ◆ The system drives a gas turbine or gas engine using natural gas, etc. as a fuel, thereby turning the generator, and recovers the exhaust heat to be used for plants and/or for air conditioning in buildings.
- ◆ The system is called a cogeneration system, because two products (electricity and steam) are obtained from single fuel source.
- ◆ When surplus steam is generated, it is possible to put back the surplus steam into the gas turbine and mix it with the combustion gas to increase the generating power and efficiency by around 30%. This is called Variable Heat and Power system (VHP system).



- ◆ System installation can achieve energy savings of 5~10%, although the actual level depends on the user's operating conditions.

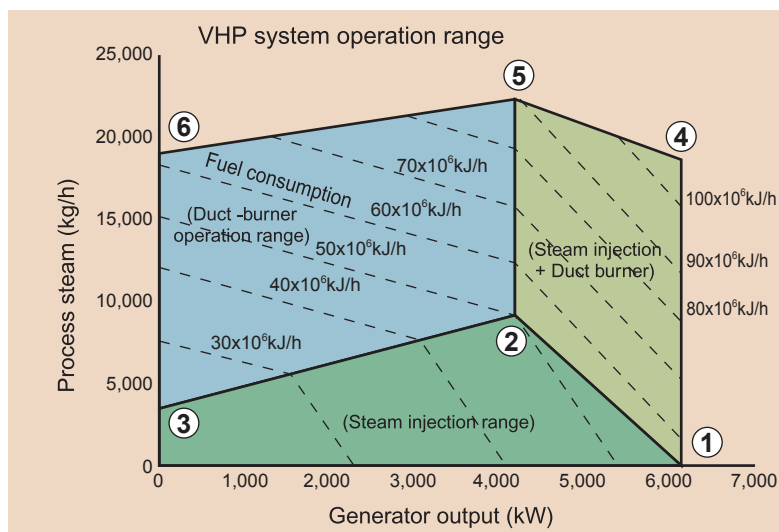
The performances of the Mark I (Electrical efficiency-oriented type) and Mark II (total efficiency-oriented type) are compared below.

Maximum power output operation
(Operation point: (1))

| Model | | Mark I | Mark II |
|-------------------------|------------------------|---------|---------|
| Ambient air temperature | °C | 15 | 15 |
| Generator output | kW | 6,100 | 6,120 |
| Steam | Injection steam volume | kg/h | 9,792 |
| | Process steam volume | kg/h | 400 |
| Fuel | Fuel consumption rate | kcal/kW | 2,207 |
| | Electrical efficiency | % | 39.0 |
| Efficiency | Total efficiency | % | 40.9 |

Maximum process steam operation
(Operation point: (2))

| Model | | Mark I | Mark II |
|-------------------------|------------------------|---------|---------|
| Ambient air temperature | °C | 15 | 15 |
| Generator output | kW | 4,200 | 4,220 |
| Steam | Injection steam volume | kg/h | 2,052 |
| | Process steam volume | kg/h | 8,678 |
| Fuel | Fuel consumption rate | kcal/kW | 2,878 |
| | Electrical efficiency | % | 29.9 |
| Efficiency | Total efficiency | % | 76.5 |



(Steam injection + additional burning)
Area surrounded by (1), (4), (5) and (2) is for a (Steam injection + Additional burning). The increase of power generation in the right side of (2) and (5) area is by Steam injection to Gas turbine. The increase of steam generation in the above (1) and (2) area is by additional burning to Heat recovery boiler.

(Steam injection)
The area surrounded by (1), (2) and (3) is for a (Steam injection), which is subject to partial load of and steam injection to Gas turbine.

(Additional burning)
The area surrounded by (2), (5), (6) and (3) is for a (Additional burning), which is subject to partial load of Gas turbine and additional burning to Heat recovery boiler.

Installation in Practice or Schedule

Domestic 48 plants in Japan/66 units/Total output: 627,080 kW

Overseas 8 plants in overseas countries/21 units/Total output: 108,100 kW

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