Explanation of JCM Feasibility Study in Thailand & Applicable Low CO2 Emission Technology

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We are working for the District Cooling and Heating Plant Engineering using Centrifugal Chiller and Heat Pump.

- Centrifugal Chiller
  - To generate hot water (40°C-50°C) for heating

- Centrifugal Chiller
  - To generate chilled water (4°C-7°C) for cooling

- No.1 DHC Plant
- No.2 DHC Plant

DHC Plant
Chilled water and hot water supply for Air Conditioning
Marina Bay District Cooling Plant in Singapore

No.1 Plant Area

No.2 Plant Area (Marina Bay Sands)

Centrifugal Chiller & Heat Pump

Image of No.1 Plant
JCM Feasibility Study for DCS Plant and Cogeneration plant
In Thailand
SPP Power Generation in Thailand

SPP (Small Power Produce) power generation (110MW) business developed in Thailand.

Thai International Airport DCS (District Cooling System) Plant is operated under SPP business license.
SPP Business in Thai land

- SPP Business
  - 90 MW power sales to EGAT
  - Power sales to Industrial Park
  - Steam sales
  - Chilled water sales

Industrial Park Location in Thailand

- SPP Program: Started in 1992
- SPP Plant: 25 Location
- Existing SPP power generation capacity: 2,908 MW
  (Power Supply To EGAT 1,800 MW)

EGAT: Electricity Generating Authority Thailand
Mechanism of Gas Turbine Inlet Air Cooling System

Gas Turbine Power Output will be determined by Inlet Air Temperature. If inlet air temperature rise, Gas Turbine Power Output will decrease.

Gas Turbine Inlet Air System
Cool down inlet air temperature by chiller

Power Output Increase
By Gas Turbine Characteristic
Current CO2 Emission Factor in Thailand: 0.5994 kg/kWh

EGAT Planning: Increase Coal Fired Power Plant

- Production down of Natural Gas in Gulf of Thailand
- Coal Fired Plant Increase
- Increasing depending on Myanmar
- CO2 Emission Increase

Electricity Emission factor in Thailand:

- Coal Fired: 1.0
- Oil Fired: 0.864
- LNG Fired: 0.695
- 100MW Gas Turbine Combined Cycle: 0.476
- 400MW Gas Turbine Combined Cycle: 0.368
- 400MW Gas Turbine Combined Cycle: 0.343

Power Plant Type

Natural Gas Field

Map to Fluct LNG
Target of CO2 reduction in Gas Turbine Co-generation System

- Increase of Gas Turbine power generation by inlet air cooling

**Gas Turbine Efficiency 4.5% Increase**

**By Cooling Inter Air**

- Total Power Output Increase
- Gas Turbine Efficiency Improve
Climate Condition and Gas Turbine Output

The climate condition in Thailand is high temperature and performance and power generation of Gas Turbine combined cycle power plant are affected by the climate.

Gas turbine in Thailand can not achieve the rated output by high temperature.
# Effectiveness of CO2 Reduction for Gas Turbine inlet air cooling

## SPP Class Gas Turbine

<table>
<thead>
<tr>
<th>System</th>
<th>CO2 Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>GT x 2 + ST x 1 Combined Cycle</td>
<td>39,922 ton-CO2/ Year</td>
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## 250MW Class IPP class Gas Turbine Case

<table>
<thead>
<tr>
<th>System</th>
<th>CO2 Reduction</th>
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</thead>
<tbody>
<tr>
<td>GT x 2 + ST x 1 Combined Cycle</td>
<td>130,500 ton-CO2/ Year</td>
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How to Install Air Cooler

Gas Turbine

Air Cooler

Air Filter Unit For Gas Turbine

Gas Turbine

Chiller Module

Inlet Air Coil
Low Carbon Emission Technology
Used in Building System
What activity to emission CO\textsubscript{2}?

- 22% of CO\textsubscript{2} Emission is generated in private house and commercial building.
- Equipment for air conditioning emit the 44% of CO2 on building.

Energy conservation technology for air conditioning is important.
Cogeneration System

### Centralized Power system

- **Fuel Energy 100%**
- **Electric Power Plant**
- **Thermal Efficiency 44%**
- **Distribution Loss 4%**
- **Distributed Electric Power 40%**
- **Grid**

**Total Efficiency 40%**

### Distributed Power system (Co-generation system)

- **Fuel Energy 100%**
- **Gas Tank**
- **Pipe Line**
- **Co-generation System**
- **Recovered Heat Energy 34%**
- **Electric Efficiency 42%**

**Total Efficiency 76-85%**
District Cooling Plant combined with Cogeneration System

Energy Network

- Energy Station
- Electric Power
- Hot Water
- Chilled Water
- Communication network

Supply Chilled Water for Cooling
District Cooling Plant combined with Cogeneration System

The electricity CO2 emission assumption 0.60Co2–kg/kWh
The natural gas CO2 emission assumption 2.702kg–Co2/m3
River Water Energy Use Heat Pump System

Cooling operation in summer

Heating operation in winter

River has large amount of energy for heating

CO2 emission can be deduced in 40-50% compared with boiler.
Energy Recovery from Sewage Treatment System

Sewage water correct exhaust energy of city and temperature in winter is around 15degC even in ambient temperature around -10℃

Sewage treated water is low temperature in Summer Compared with Cooling Water of Cooling Tower

Sewage flow in

Heat Pump

Hot water (40℃-50℃) supply for heating in Winter

Sewage Treated water Temperature is 10℃-15℃ Even in Winter

River