JCM Model Project
“Power generation by waste heat recovery in cement industry”

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Global Business Development
JFE Engineering Corporation

- About JFE Engineering
- Project Summary
- Project Methodology
- Reference / Another JCM Project
Group Structure

JFE Holdings
(holding company)

Turnover: 39 billion $
Employees: 57,500
Fortune Global 500:
Ranked in 278

JFE Engineering

Net Sales (million $)
3,700
Employees
8,500

JFE Steel

Net Sales (million $)
29,000
Employees
43,000

JFE Shoji Trade

Net Sales (million $)
19,000
Employees
6,000

Japan Marine United

Net Sales (million $)
3,600
Employees
6,000

Business Field

Steel Structure

Net Sales (mil USD) 3,700

Environment

Industrial Machinery & Others

Energy Plant & Pipeline

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JCM Model Project Summary

<table>
<thead>
<tr>
<th>Counterpart</th>
<th>PT Semen Indonesia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td>Tuban Plant East Jawa</td>
</tr>
<tr>
<td>Power Generation</td>
<td>28MW</td>
</tr>
<tr>
<td>GHG Emission Reduction</td>
<td>122,000t-CO2/year</td>
</tr>
</tbody>
</table>
Waste Heat Recovery Benefits

**Benefits**

- **CO₂ Emission Reduction**
- **No Additional Fuel Required**
- **Electricity Reserve for the Community**
- **Savings on Production Costs**

**JFE’s WHR Technology**

- Environmentally Friendly Power Generation

**Waste Heat Source**

- Cement Production
- Waste Heat from Exhaust Gas

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Typical System Flow

Clinker Production Process

Waste Heat Recovery System

Cement Production – Baseline

Electricity

100%

CO₂ emission due to Fossil Fuel Combustion

Coal-fired Power Plant

Cement Production Process
After WHR System Installation

Reduction of grid power supply = Reduction of CO₂

20%  80%

Electricity

Turbine Generator

Steam

SP Boiler

AQC Boiler

Hot Exhaust Gas

Cement Production Process

Suspension Preheater

Raw Mill

Rotary Klin

Clinker Cooler

Stack

About JFE Engineering

Project Summary

Project Methodology

Reference / Another JCM Project
Eligibility Criteria

Criterion 1: The project utilizes waste heat from a cement production facility by waste heat recovery system (WHR) to generate electricity.

Criterion 2: WHR system consists of a Suspension Preheater boiler (SP boiler) and/or Air Quenching Cooler boiler (AQC boiler), turbine generator and cooling tower.

Criterion 3: WHR system utilizes only waste heat and does not utilize fossil fuels as a heat source to generate steam for power generation.

Criterion 4: WHR system has not been introduced to a corresponding cement kiln of the project prior to its implementation.

Criterion 5: Cement factory where the project is implemented is connected to a grid system and the theoretical maximum electricity output of the WHR system, which is calculated by multiplying maximum electricity output of the WHR system by the maximum hours per year (24*365=8,760 hours), is not greater than the total amount of the electricity imported to the cement factory from the grid system:

- During the previous year before the validation, if the validation of the project is conducted before the operation of the project, or
- During the previous year before the operation of the project, if the validation of the project is conducted after the operation of the project.

Calculation of Reference Emissions

<table>
<thead>
<tr>
<th>Quantity of Electricity Generation</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E(A<em>B</em>C*D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Season</td>
<td>28</td>
<td>182.5</td>
<td>24</td>
<td>0.85</td>
<td>104,244</td>
</tr>
<tr>
<td>Rainy Season</td>
<td>22</td>
<td>182.5</td>
<td>24</td>
<td>0.85</td>
<td>81,906</td>
</tr>
<tr>
<td>The quantity of electricity consumption</td>
<td>2.4</td>
<td>365</td>
<td>24</td>
<td>1</td>
<td>21,024</td>
</tr>
<tr>
<td>The quantity of net electricity generation by the WHR system which replaced grid electricity import</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>165,126</td>
</tr>
</tbody>
</table>

\[ RE_y = EG_y \times EF_{grid} \]

\[ = 165,126 \text{ MWh/y} \times 0.741 \text{ tCO}_2\text{e/MWh} \]

\[ = 122,358 \text{ tCO}_2\text{e/y} \]
Reference Emissions

Reference

Reference is the situation where WHR system has not been introduced. Diffusion rate of WHR system is very low in Indonesian Cement Industry
1 plant installed / 25 plants total

Conservativeness

Electricity consumption of WHR system is calculated by the theoretically maximum load of auxiliary equipment

\[ \Rightarrow \text{Rated capacity of installed equipment (}\text{EG}_{\text{CAP}}\text{)} \]
related to WHR system and max. hours/period

The quantity of gross electricity generation by waste heat

\[ \text{EG}_{\text{AUX,y}} : 2.4\text{MW}(\text{EG}_{\text{CAP}})*24\text{h/d}*365\text{days} \]

1.9MW(Designed capacity)*24h/d*365days

Reference Emissions

\[ \text{RE}_y = \text{EG}_y \times \text{EF}_{\text{grid}} \]

\( \text{RE}_y \): Reference emissions
\( \text{EG}_y \): The quantity of net electricity generation
\( \text{EF}_{\text{grid}} \): CO₂ emission factor for an Indonesian regional grid system

Determination of \( \text{EG}_y \)

\[ \text{EG}_y = \text{EG}_{\text{GEN}} - \text{EG}_{\text{AUX}} \]

\( \text{EG}_{\text{GEN}} \): The quantity of gross electricity generation by waste heat
\( \text{EG}_{\text{AUX}} \): The quantity of electricity consumption by WHR system

Determination of \( \text{EG}_{\text{AUX}} \)

\[ \text{EG}_{\text{AUX}} = \text{EG}_{\text{CAP}} \times 24 \times 365 \]

\( \text{EG}_{\text{CAP}} \): The total maximum rated capacity of equipments of WHR system
### Emission Reductions

Emission Reductions = Reference Emissions

#### Replacement of Grid Electricity Generation

- Calculation of reference/project emissions
  - Emissions to be calculated in the methodology are those replaced by power generation of WHR system

- Emission Reductions = Reference Emissions – Project Emissions

- No additional fuel
  - Project Emissions = 0

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**Data and parameters fixed ex ante**

- **EF\text{grid}**: CO$_2$ emission factor
  - National Committee on Clean Development Mechanism Indonesian DNA for CDM, Updates on Emission Factors of Electricity Interconnection System(2011)

- **EG\text{CAP}**: Total max. rated capacity of equipments of the WHR system which consumes electricity
  - Rated capacity of all installed equipments of the WHR system which consumes electricity
Monitoring

- $EG_{\text{GEN},y}$: Quantity of gross electricity generation

Watt meter log data are saved:
every one minute
in both electronic data in a server and on printed paper

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Project Schedule

Power Generation will be envisaged in the beginning of 2017

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
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</thead>
<tbody>
<tr>
<td>Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Construction</td>
<td></td>
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<td></td>
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<tr>
<td>Commissioning</td>
<td></td>
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</tbody>
</table>

No.4 SP Boiler Area  No.4 AQC Damper  Steam Turbine
### Waste to Energy Plant in Yangon - JCM Model Project -

**First WTE Project with JCM**

**First WTE Project in Myanmar**

<table>
<thead>
<tr>
<th>Counterpart</th>
<th>Yangon City Development Committee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td>Mingalardon area, Yangon City, MYANMAR</td>
</tr>
<tr>
<td>Technology</td>
<td>Waste to Energy(WTE) Incinerator : 60ton/day Generator : 0.7MW</td>
</tr>
<tr>
<td>GHG Emission Reduction</td>
<td>4,700t-CO₂/year</td>
</tr>
</tbody>
</table>

Ground Breaking Ceremony on Oct. 10th 2015
Baseline vs. Project Scenario

Baseline Scenario

Project Scenario

Power generation (exported to the grid)

Reduction of CO2 emission from fossil fuel consumption at power plant

GHG Emission Reductions

GHG emission reductions 4,732 tCO2e/year

Reference emissions 12,198

(CH4 emissions from landfill site) 8,032

(CO2 emissions from electricity) 4,166

Project emissions 7,466

(CO2 emissions from waste incineration) 5,263

(N2O emissions from waste incineration) 395

(CO2 emissions from electricity) 1,786

(CO2 emissions from fossil fuel consumption) 22
Thank you for your kind attention.