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

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Deputy General Manager
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 Steel
- Net Sales (million $): 29,000
- Employees: 43,000

JFE Shoji Trade
- Net Sales (million $): 19,000
- Employees: 6,000

JFE Engineering
- Net Sales (million $): 3,700
- Employees: 8,500

Japan Marine United
- Net Sales (million $): 3,600
- Employees: 6,000

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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>

**PJ Site**: Tuban, Surabaya (apx 100km from Surabaya)

**Jakarta**

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Waste Heat Recovery Benefits

Cement Production
Waste Heat from Exhaust Gas

JFE’s WHR Technology

Environmentally Friendly Power Generation

Benefits

CO₂ Emission Reduction

Reduced Consumption from Grid-Connected Power Plants

No Additional Fuel Required

Electricity Generation Using Only Waste Heat

Electricity Reserve for the Community

Available Electricity for the Communities

Savings on Production Costs

Apx. 20% substituted with Electricity by WHR

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Cement Production – Baseline

Electricity

100%

CO₂ emission due to Fossil Fuel Combustion

Cement Production Process

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After WHR System Installation

Reduction of grid power supply = Reduction of CO₂

20% 80%

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### Eligibility Criteria

<table>
<thead>
<tr>
<th>Criterion 1</th>
<th>The project utilizes waste heat from a cement production facility by waste heat recovery system (WHR) to generate electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criterion 2</td>
<td>WHR system consists of a Suspension Preheater boiler (SP boiler) and/or Air Quenching Cooler boiler (AQC boiler), turbine generator and cooling tower</td>
</tr>
<tr>
<td>Criterion 3</td>
<td>WHR system utilizes only waste heat and does not utilize fossil fuels as a heat source to generate steam for power generation</td>
</tr>
<tr>
<td>Criterion 4</td>
<td>WHR system has not been introduced to a corresponding cement kiln of the project prior to its implementation</td>
</tr>
<tr>
<td>Criterion 5</td>
<td>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:</td>
</tr>
<tr>
<td></td>
<td>&gt; During the previous year before the validation, if the validation of the project is conducted before the operation of the project, or</td>
</tr>
<tr>
<td></td>
<td>&gt; During the previous year before the operation of the project, if the validation of the project is conducted after the operation of the project</td>
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<tr>
<td>165,126 MWh/y * 0.741 tCO2e/MWh</td>
<td>122,358 tCO2e/y</td>
</tr>
</tbody>
</table>
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
=> Rated capacity of installed equipment \( (EG_{\text{CAP}}) \) related to WHR system and max. hours/period

The quantity of gross electricity generation by waste heat

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

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

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

- \( RE_y \): Reference emissions
- \( EG_y \): The quantity of net electricity generation
- \( EF_{\text{grid}} \): \( CO_2 \) emission factor for an Indonesian regional grid system

**Determination of \( EG_y \)**

\[ EG_y = EG_{\text{GEN}} - EG_{\text{AUX}} \]

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

**Determination of \( EG_{\text{AUX}} \)**

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

- \( EG_{\text{CAP}} \): The total maximum rated capacity of equipments of WHR system
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

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
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>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td></td>
<td></td>
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<tr>
<td>Equipment</td>
<td></td>
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<tr>
<td>Construction</td>
<td></td>
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<tr>
<td>Commissioning</td>
<td></td>
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No.4 SP Boiler Area  No.4 AQC Damper  Steam Turbine
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Waste to Energy Plant in Yangon - JCM Model Project -

First WTE Project with JCM

First WTE Project in Myanmar

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

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

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Thank you for your kind attention.