Installation of Co-Generation Plant for On-Site Energy Supply in Motorcycle Factory

NS-OG Energy Solutions (Thailand) Ltd. (‘‘NSET’’)
Dr. Go TAKEI | Managing Director
Content

- Project overview
  - Project implementation
  - GHG emission reduction and MRV
NSET installs gas engine co-generation and turbo chiller for onsite energy supply in Thai motorcycle factory.

Location

Bangkok
Ayutthaya
Rayong

Implementation structure

Motorcycle Factory
Thai Honda Manufacturing (“THM”)

- Electricity
- Steam
- Hot water
- Chilled water

JCM project consortium

NSET (Thailand)

Gas engine co-generation
Turbo chiller

EPC*1

NSENGI*2 (Japan)

Design

NPD*3 (Japan)

*1 EPC: Engineering, Procurement and Construction
*2 NSENGI: Nippon Steel & Sumikin Engineering Co., Ltd.
*3 NPD: NS Plant Designing Corporation
### Who is NSET?

<table>
<thead>
<tr>
<th>Company</th>
<th>NS-OG Energy Solutions (Thailand) Ltd. “NSET”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishment</td>
<td>June 2012</td>
</tr>
<tr>
<td># of employees</td>
<td>66 (as of Aug 2018)</td>
</tr>
<tr>
<td>Business</td>
<td>Production and supply of electricity, steam and water.</td>
</tr>
<tr>
<td>Capital</td>
<td>380 MMTHB</td>
</tr>
<tr>
<td>Shareholder</td>
<td>Nippon Steel &amp; Sumikin Engineering (70%)</td>
</tr>
<tr>
<td></td>
<td>Osaka Gas Singapore (30%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project name</th>
<th>Customer</th>
<th>Facility</th>
<th>COD</th>
</tr>
</thead>
<tbody>
<tr>
<td>HATC</td>
<td>Honda Automobile (Thailand)</td>
<td>Chiller, boiler</td>
<td>2015</td>
</tr>
<tr>
<td>LTC</td>
<td>Luckytex (Thailand)</td>
<td>6MW Gas turbine CHP</td>
<td>2016</td>
</tr>
<tr>
<td>YRT</td>
<td>Yokohama Tire Manufacturing (Thailand)</td>
<td>6MW Gas turbine CHP</td>
<td>2017</td>
</tr>
<tr>
<td>HATC2</td>
<td>Honda Automobile (Thailand)</td>
<td>7MW Gas engine CHP</td>
<td>2017</td>
</tr>
<tr>
<td>THM</td>
<td>Thai Honda Manufacturing</td>
<td>7MW Gas engine CHP</td>
<td>2018</td>
</tr>
</tbody>
</table>
On-site energy service business

NSET offers on-site energy service, where CHP facilities are designed, constructed, owned, operated and maintained, and Customers enjoys benefits without any significant investment burden.

On-site energy service business model

Customer
• Reduction in utility costs
• Reduction in CO2 emission reduction
• Stable electricity supply
• Save the investment fund

NSET
• Engineering and Construction
• Facility ownership
• Operation and Maintenance

EPC
Financial Co.
Fuel supplier

Customer benefits:
• Reduction in utility costs
• Reduction in CO2 emission reduction
• Stable electricity supply
• Save the investment fund
Content

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CHP attains highly efficient energy use by the maximum use of waste heat generated in power generation process.

Schematic illustration

Energy balance

<table>
<thead>
<tr>
<th>Natural gas 100</th>
<th>Electricity 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste heat</td>
<td>Transmission loss</td>
</tr>
<tr>
<td>Waste heat 60</td>
<td></td>
</tr>
</tbody>
</table>

Overall efficiency

<table>
<thead>
<tr>
<th>Natural gas 100</th>
<th>Electricity 45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam, HW 30</td>
<td>Waste heat 25</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

40

75

- Cost reduction caused by energy saving
- CO2 emission reduction
Gas engine co-generation is installed in this project.
Installed facility

NSET installs 7.8MW Gas engine co-generation and 1,500 RT chiller.
NSET has proven outstanding primary energy saving and GHG emission reduction but still has a room for improvement for waste hot water utilization.

**PES: Primary Energy Saving (%)**

- **Heat generation**
  - Ref. boiler: \( \eta = 85\% \), \( \eta = 98\% \)
  - NSET co-generation: \( \eta = 16\% \), \( \eta = 27\% \)

- **Power generation**
  - Ref. GTCC: \( \eta = 45\% \), \( \eta = 53\% \)
  - NSET co-generation: \( \eta = 16\% \), \( \eta = 27\% \)

**GHG emission reduction (T-CO2/year)**

- **Actual (Apr-Jul’18)**: 6,200
- **Plan**: 7,414

Improvement potential by utilization of more hot water recovered from GE
As a result of successful technology transfer and support, the higher utilization than 99% has been achieved.

(1) Transfer of operation management method from Japan

- Management method (Operation manual, check list, training method) has been transferred from Japan to Thailand.

(2) Utilization of NSET Operation and Maintenance (O&M) network in Thailand

- NSET operates 4 sites in Thailand
- NSET conducts root-cause analyses for trouble. Countermeasures against the trouble are deployed to other sites.
- NSET have spare parts of main machines and auxiliaries in common with other sites.

(3) O&M Support via remote monitoring by NSENGI in Japan

- Remote monitoring and data collection system is installed
- Expert staff at NSET Bangkok Office and NSENGI in Japan can see the current operation status and provide advices.

Utilization: 99.8% (=1,556hr/1,560hr)
Project benefit (3/3) Stable power supply

NSET’s co-generation system can contribute to stable production by continuous power supply at the occasion of power grid trouble.

Schematic illustration of island operation

1. Voltage drop happens in the grid
2. Switchgear is activated and open
3. GE continues to supply power to THM important load

NSET’s track record of stable power supply by island operation

<table>
<thead>
<tr>
<th>Items</th>
<th>THM</th>
<th>NSET site Best practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terms</td>
<td>Apr-Jul ’18 (4M)</td>
<td>Aug ‘17-Jul ’18 (12M)</td>
</tr>
<tr>
<td>Voltage drop and shutdown [times]</td>
<td>3</td>
<td>32</td>
</tr>
<tr>
<td>Successful island operation [times]</td>
<td>3</td>
<td>32</td>
</tr>
<tr>
<td>Success ratio</td>
<td>100%</td>
<td>100 %</td>
</tr>
</tbody>
</table>

NSET’s co-generation system can contribute to stable production by continuous power supply at the occasion of power grid trouble.
Content

- Project overview
- Project implementation

**GHG emission reduction and MRV**
We plan to complete the methodology development by October 2018 and the project registration by March 2019.

<table>
<thead>
<tr>
<th>Current status</th>
<th>Action plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commencement of operation</td>
<td>• Already started to operate the installed facilities</td>
</tr>
<tr>
<td>Methodology development</td>
<td>• Currently developing with Mitsubishi UFJ Research and Consulting Co., Ltd.</td>
</tr>
<tr>
<td>Project registration</td>
<td>• Currently developing PDD with Mitsubishi UFJ Research and Consulting Co., Ltd.</td>
</tr>
<tr>
<td>Credit issuance</td>
<td>• Report CO2 actual reduction amount to Japan Ministry of Environment</td>
</tr>
<tr>
<td></td>
<td>• N/A</td>
</tr>
<tr>
<td></td>
<td>• Plan to complete developing methodology by October 2018</td>
</tr>
<tr>
<td></td>
<td>• Plan to complete the project registration by March 2019</td>
</tr>
<tr>
<td></td>
<td>• Plan to firstly receive the credit by around June 2019</td>
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</tbody>
</table>