JCM Proposed Methodology Form

Cover sheet of the Proposed Methodology Form

Form for submitting the proposed methodology

Host Country	Socialist Republic of Viet Nam
Name of the methodology proponents submitting this form	Yokohama Water Co., Ltd.
Sectoral scope(s) to which the Proposed Methodology applies	3. Energy demand
Title of the proposed methodology, and version number	Energy saving by introduction of high-efficiency double suction volute pumps in water supply system, Version 01.0
List of documents to be attached to this form (please check):	☐The attached draft JCM-PDD: ☐Additional information
Date of completion	07/08/2018

History of the proposed methodology

Version	Date	Contents revised
1.0	07/08/2018	First edition

A. Title of the methodology

Energy saving by introduction of high-efficiency double suction volute pumps in water supply system, Version 01.0

B. Terms and definitions

Terms	Definitions
Double suction volute pump	A pump with a double-suction impeller which has a double suction flow path in upstream and a double volute flow path in downstream.
Pump efficiency	Ratio of water horsepower output from the pump to the shaft horsepower input for the pump, which is expressed in percentage (%) and is calculated by dividing water horsepower output (kW) by shaft horsepower input (kW).

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	High-efficiency double suction volute pump is introduced in water supply system to save energy, which leads to GHG emission reductions.
Calculation of reference emissions	Reference emissions are GHG emissions from power consumption by reference pumps, calculated with the monitored power consumption of project pumps, ratio of pump efficiency of reference/project pumps and CO_2 emission factor for consumed electricity.
Calculation of project emissions	Project emissions are GHG emissions from power consumption by project pumps, calculated with the monitored power consumption of project pumps and CO_2 emission factor for consumed electricity.
Monitoring parameters	● Electricity consumption of project pumps ● The amount of fuel consumption and the amount of electricity generated by captive power, where applicable

D. Eligibility criteria

This methodology is applicable to projects that satisfy all of the following criteria.

Criterion 1	Double suction volute pump(s) with efficiency of more than 80% at a condition for operational use is installed for water supply system at a water treatment plant.
Criterion 2	Project pump uses environmental friendly paints such as paints with 0.1% or less lead, cadmium and tar during the production process.

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Electricity consumption by reference pumps	CO_2
Project emissions	
Emission sources	GHG types
Electricity consumption by project pumps	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Reference emissions are calculated with the monitored power consumption of project pumps, ratio of pump efficiency of reference/project pumps and CO_2 emission factor for consumed electricity.
The pump efficiency of reference pump is conservatively set as a default value in the following manner to ensure the net emission reductions.

Pump efficiencies for high-efficiency double suction volute pump are determined in the Japanese Industrial Standard JIS B 8322 “Double suction volute pumps” based on the collected data of high-efficiency double suction volute pumps actually marketed in Japan. Application of those pump efficiencies as default values for reference pumps in consideration of pump efficiency commonly observed in Viet Nam ensures conservativeness and the net emission reductions in this methodology.

F.2. Calculation of reference emissions

$$RE_p = \sum_i \{EC_{PJ,i,p} \times (\eta_{PJ,i} \div \eta_{RE,i})\} \times EF_{elec}$$

Where

RE_p	Reference emissions during the period *p* [tCO_2/p]
$EC_{PJ,i,p}$	Power consumption of project pump *i* during the period *p* [MWh/p]
$\eta_{PJ,i}$	Pump efficiency of project pump *i* at a condition for operational use [%]
$\eta_{RE,i}$	Pump efficiency of reference pump *i* [%]
EF_{elec}	CO_2 emission factor for consumed electricity [tCO_2/MWh]
i	Identification number of pump [-]

G. Calculation of project emissions

$$PE_p = \sum_i (EC_{PJ,i,p} \times EF_{elec})$$

Where

PE_p	Project emissions during the period *p* [tCO_2/p]
$EC_{PJ,i,p}$	Power consumption of project pump *i* during the period *p* [MWh/p]
EF_{elec}	CO_2 emission factor for consumed electricity [tCO_2/MWh]
i	Identification number of pump [-]

H. Calculation of emissions reductions

$$ER_p = RE_p - PE_p$$

Where

ER_p	Emission reductions during the period *p* [tCO_2/p]
RE_p	Reference emissions during the period *p* [tCO_2/p]
PE_p	Project emissions during the period *p* [tCO_2/p]

I. Data and parameters fixed *ex ante*

The source of each data and parameter fixed *ex ante* is listed as below.

<table>
<tr><th>Parameter</th><th>Description of data</th><th>Source</th></tr>
<tr><td>$\eta_{PJ,i}$</td><td>Pump efficiency of project pump *i* at a condition for operational use [%]</td><td>Specifications of project pump *i* prepared for the quotation or factory acceptance test data by manufacturer.</td></tr>
<tr><td>$\eta_{RE,i}$</td><td>Pump efficiency of reference pump *i* [%]

$\eta_{RE,i}$ is selected from the default values in the following table in line with the capacity of project pump *i*. (“x” in the table denotes capacity per unit.)

<table>
<tr><td>Capacity (m^3/min)</td><td>x≤2</td><td>2<x≤3</td><td>3<x≤4</td><td>4<x≤5</td></tr>
<tr><td>$\eta_{RE,i}$</td><td>70.5</td><td>73.0</td><td>74.0</td><td>74.5</td></tr>
</table>
<table>
<tr><td>Capacity (m^3/min)</td><td>5<x≤6</td><td>6<x≤8</td><td>8<x≤10</td><td>10<x≤15</td></tr>
<tr><td>$\eta_{RE,i}$</td><td>75.0</td><td>75.5</td><td>76.0</td><td>76.5</td></tr>
</table>
<table>
<tr><td>Capacity (m^3/min)</td><td>15<x≤20</td><td>20<x≤30</td><td>30<x≤40</td></tr>
<tr><td>$\eta_{RE,i}$</td><td>77.0</td><td>78.0</td><td>78.5</td></tr>
</table>
<table>
<tr><td>Capacity (m^3/min)</td><td>40<x≤50</td><td>50<x≤60</td><td>60<x≤70</td></tr>
<tr><td>$\eta_{RE,i}$</td><td>79.0</td><td>79.5</td><td>80.0</td></tr>
</table>
</td><td>Specifications of project pump *i* prepared for the quotation or factory acceptance test data by manufacturer.

The default values $\eta_{RE,i}$ are derived from the Japanese Industrial Standard JIS B 8322 “Double suction volute pumps”. Revision of default values $\eta_{RE,i}$ should be considered if JIS B 8322 is revised.</td></tr>
<tr><td>EF_{elec}</td><td>CO_2 emission factor of consumed electricity.</td><td>[Grid electricity]
Ministry of Natural</td></tr>
</table>

	When project pumps consume only grid electricity or captive electricity, the project participant applies the CO_2 emission factor respectively. When project pumps may consume both grid electricity and captive electricity, the project participant applies the CO_2 emission factor with lower value. [CO_2 emission factor] For grid electricity: The most recent value available from the source stated in this table at the time of validation For captive electricity, it is determined based on the following options: a) Calculated from its power generation efficiency ($\eta_{elec,CG}$ [%]) obtained from manufacturer's specification The power generation efficiency based on lower heating value (LHV) of the captive power generation system from the manufacturer's specification is applied; $$EF_{elec} = 3.6 \times \frac{100}{\eta_{elec,CG}} \times EF_{fuel,CG}$$ b) Calculated from measured data The power generation efficiency calculated from monitored data of the amount of fuel input for power generation ($FC_{PJ,CG,p}$) and the amount of electricity generated ($EG_{PJ,CG,p}$) during the monitoring period *p* is applied. The measurement is conducted with the monitoring equipment to which calibration certificate is issued by an entity accredited under national/international standards;	Resources and Environment of Vietnam (MONRE), Vietnamese DNA for CDM unless otherwise instructed by the Joint Committee. [Captive electricity] For the option a) Specification of the captive power generation system provided by the manufacturer ($\eta_{elec,CG}$ [%]). CO_2 emission factor of the fossil fuel type used in the captive power generation system ($EF_{fuel,CG}$ [tCO_2/GJ]) For the option b) Generated and supplied electricity by the captive power generation system ($EG_{PJ,CG,p}$ [MWh/p]). Fuel amount consumed by the captive power generation system ($FC_{PJ,CG,p}$ [mass or volume/p]). Net calorific value ($NCV_{fuel,CG}$ [GJ/mass or volume]) and CO_2 emission factor ($EF_{fuel,CG}$ [tCO_2/GJ]) of the fuel consumed by the captive power generation system

	$$EF_{elec} = FC_{PJ,CG,p} \times NCV_{fuel,CG} \times EF_{fuel,CG} \times \frac{1}{EG_{PJ,CG,p}}$$ Where: $NCV_{fuel,CG}$: Net calorific value of fuel consumed by the captive power generation system [GJ/mass or volume] Note: In case the captive electricity generation system meets all of the following conditions, the value in the following table may be applied to EF_{elec} depending on the consumed fuel type. ● The system is non-renewable generation system ● Electricity generation capacity of the system is less than or equal to 15 MW <table><tr><th>fuel type</th><th>Diesel fuel</th><th>Natural gas</th></tr><tr><td>EF_{elec}</td><td>0.8 *1</td><td>0.46 *2</td></tr></table> *1 The most recent value at the time of validation is applied. *2 The value is calculated with the equation in the option a) above. The lower value of default effective CO_2 emission factor for natural gas (0.0543 tCO_2/GJ), and the most efficient value of default efficiency for off-grid gas turbine systems (42%) are applied.	in order of preference: 1) values provided by the fuel supplier; 2) measurement by the project participants; 3) regional or national default values; 4) IPCC default values provided in tables 1.2 and 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied. [Captive electricity with diesel fuel] CDM approved small scale methodology: AMS-I.A. [Captive electricity with natural gas] 2006 IPCC Guidelines on National GHG Inventories for the source of EF of natural gas. CDM Methodological tool "Determining the baseline efficiency of thermal or electric energy generation systems version02.0" for the default efficiency for off-grid power plants.