JCM Proposed Methodology Form

Cover sheet of the Proposed Methodology Form

Form for submitting the proposed methodology

Host Country	Indonesia
Name of the methodology proponents submitting this form	Nippon Koei 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 Once-through Boiler, ver.01.0
List of documents to be attached to this form (please check):	☐The attached draft JCM-PDD: ☒Additional information Appendix 1. Additional Information for the Proposed Methodology
Date of completion	22/03/2018

History of the proposed methodology

Version	Date	Contents revised
01.0	22/03/2018	First Edition

A. Title of the methodology

Energy Saving by Introduction of High Efficiency Once-through Boiler, Version.01.0

B. Terms and definitions

Terms	Definitions
Once-through boiler	A once-through boiler is a boiler without recirculation where water flows through the economizer, furnace wall, and evaporating and superheating tubes, sequentially. Once-through boiler is used to supply heat in factory and commercial facility.
Periodical check	Periodical check is a scheduled examination of the project boiler conducted by manufacturer or agent who is authorized by the manufacturer in order to maintain performance of the boiler.
Boiler efficiency	Boiler efficiency is the percentage of heat quantity used to generate steam against total heat quantity provided by a fuel.
Blow flow rate	Blow flow rate is the percentage of boiler blow volume against feed water volume to prevent condensation of water in the boiler. The rate will be reduced by introducing water purification and demineralization system such as Reverse Osmosis (RO)
Fuel switching	Fuel switching involves the change of fuel from the one with higher GHG emissions factor to lower GHG emission factor (i.e. from coal to natural gas).

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	This methodology involves the installation of high efficiency once-through boiler. Compared with the fire tube boilers which dominate Indonesian market, the efficiency of

	once-through boiler is higher and fuel consumption is less. Thus the introduction of once-through boiler will contribute to the GHG emission reductions.
Calculation of reference emissions	Reference emissions are calculated based on the efficiency of the boiler currently dominant in the Indonesian market. Conservative estimation of reference emissions is made by taking into consideration of the following points: (i) lower CO_2 emission factor is selected from IPCC guideline with regard to the fuel used in reference boiler, (ii) higher efficiency is applied for the reference boiler especially in low load range.
Calculation of project emissions	Project emissions are calculated on the basis of monitored fuel consumption and emission factor of the fuel of the project boiler.
Monitoring parameters	- The amount of fuel consumption

D. Eligibility criteria

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

Criterion 1	The project boiler is a once-through boiler with a rated capacity of 7 ton/hour per unit or less (equivalent evaporation)
Criterion 2	Periodical check and maintenance by the manufacturer of boiler or authorized agent is implemented in accordance with the manufacturer's requirement.
Criterion 3	Appropriate water purification/demineralization system such as Reverse Osmosis (RO) membrane treatment is installed.

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Fuel consumption by reference boiler	CO_2
Project emissions	
Emission sources	GHG types
Fuel consumption by project boiler	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Reference emissions are calculated based on the efficiency of the fire tube boilers which dominates the Indonesian boiler market for industries. The fuel types widely used in Indonesia are coal, followed by oil (heavy fuel oil and diesel). In order to ensure the net emission reductions, the higher efficiency of the reference boiler (89%) is adopted to calculate the reference emissions. In addition, 1) compared with reference boiler (oil and gas type), once-through boiler (project boiler) can maintain high efficiency even at low load range, which improves the operating efficiency of project boiler and 2) compared with reference boiler (coal), operational efficiency of the project boiler is higher due to better combustion control, which also ensures the net emission reductions. Besides, to calculate the reference emissions conservatively, lower emission factor stated in 2006 IPCC guidelines is adopted to secure the net emission reductions.

Introduction of water purification/demineralization system such as the RO also enables the reduction of blow flow of boiler water, which can save fuel consumption compared with the conventional water treatment system such as softener. The amount of fuel saving is inversely proportional to the boiler blow flow rate.

F.2. Calculation of reference emissions

$$RE_p = \sum_i \sum_j \left(FC_{p,i,j,PJ} \times NCV_{i,j,PJ} \times EF_{RE} \times \frac{\eta_{i,PJ}}{\eta_{RE}} \times \frac{100-BF_{i,PJ}}{100-BF_{RE}} \right)$$

RE_p : Reference emissions during the period *p* [tCO_2/p]

$FC_{p,i,j,PJ}$: The amount of fuel consumption of project boiler *i* for the fuel type *j* during the period p [mass or volume unit/p]

$NCV_{i,j,PJ}$: Net calorific value of fuel used by project boiler *i* for the fuel type *j* [GJ/mass or volume unit]

EF_{RE} : CO_2 emission factor of fuel used by reference boiler [tCO_2/GJ]

$\eta_{i,PJ}$: Efficiency of project boiler *i* [dimensionless]

η_{RE} : Efficiency of reference boiler [dimensionless]

$BF_{i,PJ}$: Blow flow rate setting of project boiler *i* [%]

BF_{RE} : Blow flow rate setting of reference boiler [%]

G. Calculation of project emissions

$$PE_p = \sum_i \sum_j \left(FC_{p,i,j,PJ} \times NCV_{i,j,PJ} \times EF_{i,j,PJ} \right)$$

PE_p : Project emissions during the period *p* [tCO_2/p]

$FC_{p,i,j,PJ}$: The amount of fuel consumption of project boiler *i* for the fuel type *j* during the period *p* [mass or volume unit]

$NCV_{i,j,PJ}$: Net calorific value of fuel used by project boiler *i* for the fuel type *j* [GJ/mass or volume unit]

$EF_{i,j,PJ}$: CO_2 emission factor of fuel used by project boiler *i* for the fuel type *j* [tCO_2/GJ]

H. Calculation of emissions reductions

$$\mathbf{ER_p = RE_p - PE_p}$$

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.

Parameter	Description of data	Source
$NCV_{i,j,PJ}$	Net calorific value of fuel used by project boiler *i* for the fuel type *j* [GJ/mass or volume unit]	(1) Net calorific value (lower heating value) provided by fuel supplier or boiler manufacturer, (2) IPCC default values at the lower limit in Table 1.2 of Chapter 1 of Vol. 2 of the "2006 IPCC Guidelines for National GHG Inventories" (when (1) is not available, apply (2))
$EF_{i,j,PJ}$	CO_2 emission factor of fuel used by the project boiler *i* for the fuel type *j* [tCO_2/GJ]	IPCC default value at the lower limit in Table 1.4 of Chapter 1 of Vol. 2 from "2006 IPCC Guidelines for National

		Greenhouse Gas Inventories"
EF_{RE}	CO_2 emission factor of fuel used by the reference boiler [tCO_2/GJ] In case the project boiler replaces the existing boiler or the planned boiler whose plan is once approved officially such as with boiler installation permit or environmental impact assessment, the fuel of the existing or planned boiler is applied. Otherwise, the value is the same with $EF_{i,j,PJ}$.	IPCC default value at the lower limit in Table 1.4 of Chapter 1 of Vol. 2 from "2006 IPCC Guidelines for National Greenhouse Gas Inventories"
$\eta_{i,PJ}$	Efficiency of project boiler *i* [dimensionless]	Specifications of the project boiler or factory test data of the project boiler by the manufacturer
η_{RE}	Efficiency of reference boiler [dimensionless] The default value of η_{RE} is set as 0.89.	Default value in the methodology
$BF_{i,PJ}$	Blow flow rate setting of the project boiler *i* [%]	Blow flow rate setting specified in the boiler water treatment program for a water purification/demineralization system such as RO based on the test result
BF_{RE}	Blow flow rate setting of reference boiler [%]	Blow flow rate specified in the boiler water treatment program for a water softener based on the test result