JCM Proposed Methodology Form

Cover sheet of the Proposed Methodology Form

Form for submitting the proposed methodology

Host Country	The People's Republic of Bangladesh
Name of the methodology proponents submitting this form	Nippon Koei Co., Ltd.
Sectoral scope(s) to which the Proposed Methodology applies	2. Energy distribution
Title of the proposed methodology, and version number	Installation of energy-saving conductors for transmission lines in the Bangladesh grid (Ver.1.0)
List of documents to be attached to this form (please check):	☐The attached draft JCM-PDD: ☒Additional information
Date of completion	23/03/2022

History of the proposed methodology

Version	Date	Contents revised
Ver.1.0	23/03/2022	First version

A. Title of the methodology

Installation of energy-saving conductors for transmission lines in the Bangladesh grid (Ver.1.0)

B. Terms and definitions

Terms	Definitions
ACSR (Aluminum Conductor Steel Reinforced), (reference conductors)	ACSR is a conductor whose structure consists of the steel center strand(s), covered by outer strands of aluminum.
HTLS (High-Temperature Low-Sag conductors), (project conductors)	HTLS are conductors which have less sag at high temperatures, higher capacity and less energy loss with cores made of steel alloys, composite-reinforced metal, or carbon fiber composite material compared to conventional ACSR.

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	Reduction of transmission loss by introduction of HTLS.
Calculation of reference emissions	Calculation of GHG emissions due to transmission loss in ACSR, based on the parameters derived from ASTM International Standard B232 (Standard Specification for ACSR).
Calculation of project emissions	GHG emissions due to transmission loss in HTLS, based on monitored transmission loss.
Monitoring parameters	Power sent from the point of origin/supply to the transmission line, power received at the point of end/receipt of the transmission line.

D. Eligibility criteria

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

Criterion 1	The transmission line constitutes of a single or double circuit(s) directly connecting a substation and another substation within the country with no branching in between, and does not constitute a part of a loop.

Criterion 2	The type of conductor used by the project is a family of HTLS. Definition and types of HTLS are explained in additional information.

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Transmission loss in reference conductors	CO_2
Project emissions	
Emission sources	GHG types
Transmission loss in project conductors	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Reference emissions (RE_p) are calculated by multiplying transmission loss in ACSR ($LOSS_{RF,L,p}$) by the emission factor of the grid (EF_{Grid}). The $LOSS_{RF,L,p}$ is derived by multiplying the project transmission loss in HTLS ($LOSS_{PJ,L,p}$) by the ratio of direct current (DC) resistance between ACSR and HTLS.

To ensure conservativeness in establishing the reference emissions to achieve net emission reductions, the following assumptions are applied:

- The ratio of DC resistance between ACSR and HTLS, instead of the ratio of alternative current (AC) resistance, is used because the ratio of DC resistance is smaller than that of AC resistance under the standard condition.
- The same temperature at 20 deg. C. is assumed for the ACSR and HTLS to calculate the ratio of DC resistance between ACSR and HTLS. This ratio of direct current resistance derived at 20 deg. C. is smaller than the ratio at the actual temperature (the actual temperature of ACSR conductors would be higher than that of HTLS at the same ambient temperature due to higher resistance of ACSR).
- The default value of DC resistance of ACSR (reference transmission line, $Rdc_{RF,L}$) is set by discounting by 2% the direct current resistance of ACSR code in ASTM International Standard B232 for the same overall diameter used in Bangladesh. The diameter of each strand of the reference conductor is assumed 1% larger than its

specification, which is the maximum allowable tolerance of major international standard such as the International Electrotechnical Commission (IEC), resulting in 2% increase in cross-sectional area and thus 2% reduction in resistance (the value of resistance is inversely proportional to that of the cross-sectional area).

F.2. Calculation of reference emissions

Reference emissions are calculated by the following equation.

$$RE_p = \sum_L \left(LOSS_{RF,L,p} \times EF_{Grid} \right) \quad (1)$$

$$LOSS_{RE,L,p} = LOSS_{PJ,L,p} \times \frac{R_{DC\_RE,L}}{R_{DC\_PJ,L}} \quad (2)$$

Where

RE_p	=	Reference emissions during the period p [tCO_2/p]
$LOSS_{RF,L,p}$	=	Reference transmission loss at transmission line L during the period p [MWh/p]
EF_{Grid}	=	CO_2 emission factor of the grid [tCO_2/MWh]
$LOSS_{PJ,L,p}$	=	Project transmission loss at transmission line L during the period p [MWh/p]
$R_{DC\_RF,L}$	=	Direct current resistance of transmission line L using reference ACSR (@20 deg. C) [Ω/km]
$R_{DC\_PJ,L}$	=	Direct current resistance of transmission line L using HTLS (@20 deg. C) [Ω/km]

G. Calculation of project emissions

Project emissions are calculated by multiplying transmission loss in the project ($LOSS_{PJ,L,p}$) by the CO_2 emission factor of the grid (EF_{Grid}).

$$PE_p = \sum_L \left(LOSS_{PJ,L,p} \times EF_{Grid} \right) \quad (3)$$

$$LOSS_{PJ,L,p} = E_{L,send,p} - E_{L,receive,p} \quad (4)$$

Where

PE_p	=	Project emissions during the period p [tCO_2/p]
$LOSS_{PJ,L,p}$	=	Project transmission loss at transmission line L during the period p [MWh/p]

$E_{L,send,p}$	=	Power sent from the point of origin/supply to the transmission line L during the period *p* [MWh/p]
$E_{L,receive,p}$	=	Power received at the point of receipt of the transmission line L during the period *p* [MWh/p]
EF_{Grid}	=	CO_2 emission factor of the grid [tCO_2/MWh]

H. Calculation of emissions reductions

Emission reductions are calculated by the following equation.

$$ER_p = RE_p - PE_p \quad (5)$$

Where

ER_p	=	Emission reduction during the period *p* [tCO_2/p]
RE_p	=	Reference emission during the period *p* [tCO_2/p]
PE_p	=	Project emission 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>$R_{DC\_PJ,L}$</td><td>Direct current resistance of transmission line L using HTLS (@20 deg. C) [Ω/km]</td><td>Measured according to IEC 60468 (Method of measurement of resistivity of metallic materials).</td></tr>
<tr><td>$R_{DC\_RF,,L}$</td><td>Direct current resistance of transmission Line L using reference ACSR (@20 deg. C) [Ω/km]

Reference value is calculated by discounting 2% of the direct current resistance of a type of ACSR of which specified in ASTM International Standard B232 which has same overall diameter as one of project HTLS.
Example of default $R_{DC\_RE,L}$ Value:
<table>
<tr><th>ASCR Code</th><th>Overall diameter (mm)</th><th>$R_{DC\_RF,,L}$ (Direct current resistance @20 deg. C) (Ω/km)</th></tr>
<tr><td>Flamingo</td><td>25.34</td><td>0.0838</td></tr>
<tr><td>Mallard</td><td>28.96</td><td>0.0702</td></tr>
<tr><td>Cardinal</td><td>30.42</td><td>0.0584</td></tr>
</table></td><td>Based on ASTM International Standard B232</td></tr>
<tr><td>EF_{Grid}</td><td>For transmission loss in both reference and</td><td>The most recent value</td></tr>
</table>

	project scenario, the most recent emission factor of Bangladesh grid [tCO2/MWh] available at the time of validation.	available at the time of validation is applied and fixed for the monitoring period thereafter. The data is sourced from "Grid Emission Factor (GEF) of Bangladesh", endorsed by National CDM Committee unless otherwise instructed by the Joint Committee.