**Joint Crediting Mechanism Approved Methodology BD_AM004**

**"Installation of energy-saving conductors for transmission lines in the Bangladesh grid"**

## A. Title of the methodology

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| Installation of energy-saving conductors for transmission lines in the Bangladesh grid, Version 01.0 |

## 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.

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| 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 the family of HTLS, which includes heat-resistant aluminum alloys or materials whose high temperatures have been mitigated by reinforced conductors (see Section B). |

## 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.

| Parameter | Description of data | Source |
|---|---|---|
| $R_{DC\_PJ,L}$ | Direct current resistance of transmission line L using HTLS (@20 deg. C) [Ω/km] | Measured according to IEC 60468 (Method of measurement of resistivity of metallic materials). |
| $R_{DC\_RF,,L}$ | Direct current resistance of transmission Line L using reference ACSR (@20 deg. C) [Ω/km]<br><br>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.<br>Example of default $R_{DC\_RE,L}$ Value: | Based on ASTM International Standard B232 |

| | | |
|---|---|---|
| | <table><tr><td>ASCR Code</td><td>Overall diameter (mm)</td><td>$R_{DC\_RF,,L}$ (Direct current resistance @20 deg. C) (Ω/km)</td></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> | |
| $EF_{Grid}$ | For transmission loss in both reference and project scenario, the most recent emission factor of Bangladesh grid [$tCO_2/MWh$] available at the time of validation. | The most recent value available at the time of validation is applied and fixed for the monitoring period thereafter.<br>The data is sourced from "Grid Emission Factor (GEF) of Bangladesh", endorsed by National CDM Committee unless otherwise instructed by the Joint Committee. |

History of the document

| Version | Date | Contents revised |
|---|---|---|
| 01.0 | 4 January 2023 | Electronic decision by the Joint Committee<br>Initial approval. |
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