Joint Crediting Mechanism Approved Methodology LA_AM003

"Installation of energy efficient transformers in a power distribution grid"

A. Title of the methodology

Installation of energy efficient transformers in a power distribution grid, Version 1.0

B. Terms and definitions

Terms	Definitions
Power distribution grid	The portion of the electric system that is dedicated to delivering electricity to the end-users.
No-load losses	Losses of electricity due to transformer core magnetizing or energizing. These losses occur whenever a transformer is energized and remain constant regardless of the amount of electricity flowing through it.
Load losses	Losses of electricity due to resistance in the electrical winding of the transformer. Contrary to no-load losses, the amount of load losses depends on the electrical current. These losses include eddy current losses in the primary and secondary conductors of the transformer. These losses occur when the electricity flows through the transformer.

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	Installation of energy efficient transformers (transformers with amorphous metal core) in a power distribution grid reduces no-load losses by transformers, which leads to reduction of losses for grid electricity, thus reduction of GHG emissions.
Calculation of reference emissions	Reference emissions are calculated by no-load losses of the reference transformer, blackout rate and CO_2 emission factor of the grid.

Calculation of project emissions	Project emissions are calculated by no-load losses of the project transformer, maximum allowable uncertainty for the no-load losses of the project transformer, blackout rate and CO_2 emission factor of the grid.
Monitoring parameters	● Energizing time of the project transformer

D. Eligibility criteria

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

Criterion 1	Single-phase and/or three-phase oil-immersed transformer with amorphous metal core is installed in the distribution grid.
Criterion 2	Load losses of the project transformer determined in line with IEC 60076-1 or national/industrial standards complying with IEC 60076-1 is equal or smaller than the standard values or specification values of load loss, required by the power company of the grid where the project transformer is installed, corresponding to its capacity and number of phases.

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
No-load losses of grid electricity by reference transformers	CO_2
Project emissions	
Emission sources	GHG types
No-load losses of grid electricity by project transformers	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Transformer with silicon steel core is commonly installed in Lao PDR. On the other hand, transformer with amorphous metal core has been installed to a very limited extent. Also, power companies in Lao PDR have the standard for no-load losses when procuring transformers, and such no-load losses are established on the basis of transformer with silicon steel core.

Reference emissions are calculated by applying no-load loss of the reference transformer and blackout rate conservatively. The no-load losses of the reference transformer are determined *ex ante* by applying the lower value of the latest standard for no-load losses or the specification value of no-load losses where applicable, required by the power companies where the project transformer is installed. Blackout rate varies among the regions, and it is improving year by year. The default value of blackout rate in Lao PDR is set by selecting the worst (highest) value among all areas.

F.2. Calculation of reference emissions

The reference emissions, RE_p, during the period p are given by:

$$RE_p = \sum_i \left(NLL_{RE,i,j,k} \times H_{i,p}\right) \times \left(1 - Br_p\right) \times EF_{grid} \times 10^{-6}$$

Where:

RE_p	: Reference emissions during the period *p* [tCO_2/p]
i	: Identification number of the reference transformer
j	: Identification number of the power company where the transformer *i* is installed
k	: Index which represents type of the reference transformer defined by its capacity and number of phases
$NLL_{RE,i,j,k}$	: No-load losses of the reference transformer *i* of capacity category *k* for the power company *j* [W]
$H_{i,p}$	: Energizing time of the project transformer *i* during the period *p* [hour/p]
Br_p	: Blackout rate during the period *p* [fraction]
EF_{grid}	: CO_2 emission factor of the grid [tCO_2/MWh]

G. Calculation of project emissions

The project emissions, PE_p, during the period *p* are given by:

$$PE_p = \sum_i \left[NLL_{PJ,i,j,k} \times (1 + UNC_i) \times H_{i,p}\right] \times \left(1 - Br_p\right) \times EF_{grid} \times 10^{-6}$$

Where:

PE_p	: Project emissions during the period *p* [tCO_2/p]
i	: Identification number of the project transformer
j	: Identification number of the power company where the transformer *i* is installed

k	: Index which represents type of the project transformer defined by its capacity and number of phases
$NLL_{PJ,i,j,k}$	: No-load losses of the project transformer *i* of capacity category *k* for the power company *j* [W]
UNC_i	: Maximum allowable uncertainty for the no-load losses of the project transformer *i* [fraction]
$H_{i,p}$	: Energizing time of the project transformer *i* during the period *p* [hour/p]
Br_p	: Blackout rate during the period *p* [fraction]
EF_{grid}	: CO_2 emission factor of the grid [tCO_2/MWh]

H. Calculation of emissions reductions

The emission reductions, ER_p, during the period *p* are given by:

$$ER_p = RE_p - PE_p$$

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.

Parameter	Description of data	Source
$NLL_{RE,i,j,k}$	No-load losses of the reference transformer *i* of capacity category *k* for the power company *j*. The no-load losses of the reference transformer *i* are determined *ex ante* by applying the lower value of the latest standard for no-load losses or the specification value of no-load losses where applicable, required by the power companies where the project transformer is installed, corresponding to the capacity and number of phases of the project transformer *i*.	The latest standard for no-load loss required by the power companies, or the specification value of no-load losses set by the power companies

$NLL_{PJ,i,j,k}$	No-load losses of the project transformer *i* of capacity category *k* for the power company *j*.	Values sourced from manufacturer's performance test report measured at the time of pre-delivery inspection or those defined in the tender specification of the power companies
Br_p	Blackout rate during the period *p*. Default value: 1.55%	Data obtained from power companies
UNC_i	Maximum allowable uncertainty for the no-load losses of the project transformer *i*.	Manufacturer's performance test report measured at the time of pre-delivery inspection or 0.15 as specified in IEC 60076 in case the value is not specified in the performance test report
EF_{grid}	CO_2 emission factor of the grid.	The most recent value announced by the Ministry of Natural Resources and Environment (MONRE), DNA for CDM available at the time of validation is applied and fixed for the monitoring period thereafter, unless otherwise instructed by the Joint Committee

History of the document

Version	Date	Contents revised
01.0	10 August 2018	JC4, annex 2 Initial approval.