CLEAN DEVELOPMENT MECHANISM

AMS-II.T.

Small-scale Methodology

Emission reduction through reactive power compensation in power distribution network

Version 01.0

Sectoral scope(s): 02

United Nations
Framework Convention on
Climate Change

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1. Introduction

1. The following table describes the key elements of the methodology:

Table 1. Methodology key elements

Typical project(s)	Installation of a reactive power compensation equipment at transformer substations
Type of GHG emissions mitigation action	Energy efficiency: GHG mitigation through energy savings in power distribution lines

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology covers project activities that are aiming at power factor improvement and energy losses (kWh) reduction in distribution lines through installation of either new or additional reactive power compensation facilities (RCF) at distribution transformer substations in industrial radial-power distribution network.

2.2. Applicability

3. The methodology is applicable under the following conditions:

   (a) Project activity consists of any or combination of the following:

      (i) Installation of a new RCF in one or more transformer substations in industrial radial-power distribution network, where no RCF existed prior to the implementation of the project;

      (ii) Installation of an additional RCF in one or more transformer substations in industrial radial-power distribution network, where RCF existed prior to the implementation of the project;

      (iii) Retrofitting the existing RCF in one or more transformer substations in industrial radial-power distribution network;

   (b) The energy losses reduction that can be claimed are only those associated with the distribution lines feeding distribution transformer substations or loads at which RCF are installed and where the reactive power flow is reduced. Please see the diagram under Project Boundary section.

4. The methodology is not applicable in case there is any branching in between the distribution lines included in the project boundary, for which power losses are calculated.

2.3. Entry into force

5. The date of entry into force is the date of the publication of the EB 94 meeting report on 4 May 2017.

2.4. Applicability of sectoral scopes

6. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology, application of sectoral scope 02 is mandatory.

3. Normative references

7. Project participants shall apply the “General guidelines for SSC CDM methodologies”, "Guidelines on the demonstration of additionality of small-scale project activities" available at: <http://cdm.unfccc.int/Reference/Guidclarif/index.html#meth> mutatis mutandis.

8. This draft new methodology is based on the proposed new methodology “SSC-NM101: Greenhouse gas emission reduction methodology for reactive compensation in Power Distribution Network” prepared by:

   (a) Shanghai Zhixin Carbon Asset Management Co., Ltd;

   (b) State Grid Fujian Electric Power Research Institute;

   (c) State Grid Fujian Electric Power Co., Ltd.

9. This methodology refers to the latest approved versions of the following tools:

   (a) “Tool to calculate the emission factor for an electricity system”;

   (b) “Combined tool to identify the baseline scenario and demonstrate additionality”.

4. Definitions

10. The definitions contained in the Glossary of CDM terms shall apply.

11. In addition, the following definitions apply:

   (a) **Industrial radial-power Distribution Network** - network that receives power from the national/regional grid at one location and allocates to various industrial users progressively (radial) by distribution facilities;

   (b) **Project activity unit** - for this methodology the unit consists of one transformer substation and the output lines/feeders which are connected to it directly;

   (c) **Reactive power compensation facilities (RCF)** - equipment that is installed at a project activity unit to regulate the reactive power to balance the supply and demand. It also could improve the power factor and the quality of power supply.

5. Baseline methodology

5.1. Project boundary

12. The input lines for which the emission reductions are calculated, are with the same voltage-level connected to the transformer substations and are included in the project activity unit boundary. The output lines of the transformer substations and the other remote

transformer substations connected to input lines are excluded from the project activity unit boundary.

13. Project activity unit boundary is shown in Figure 1 and Figure 2.

Figure 1. The project boundary of the one project activity unit under the baseline scenario

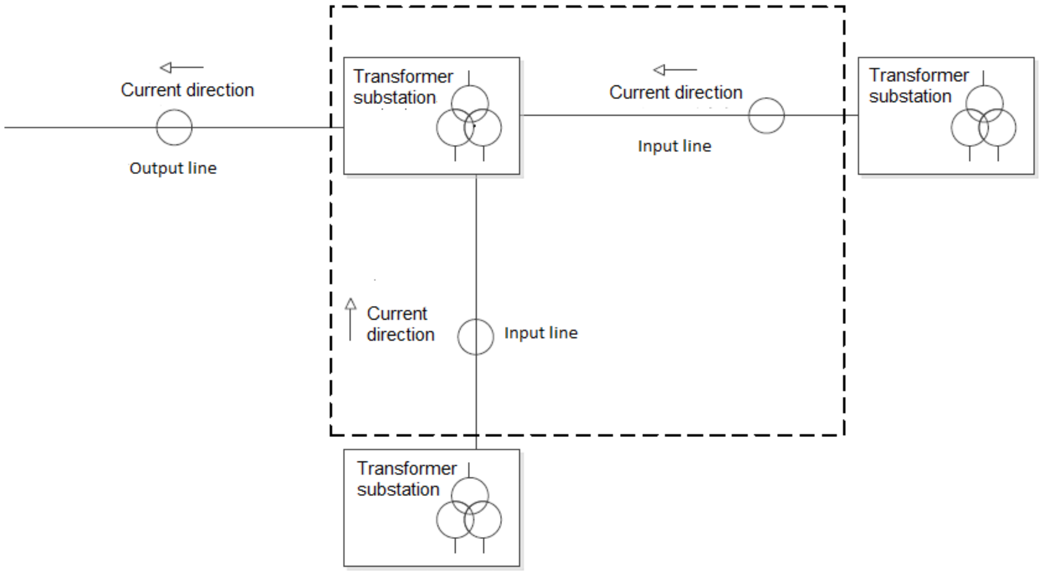
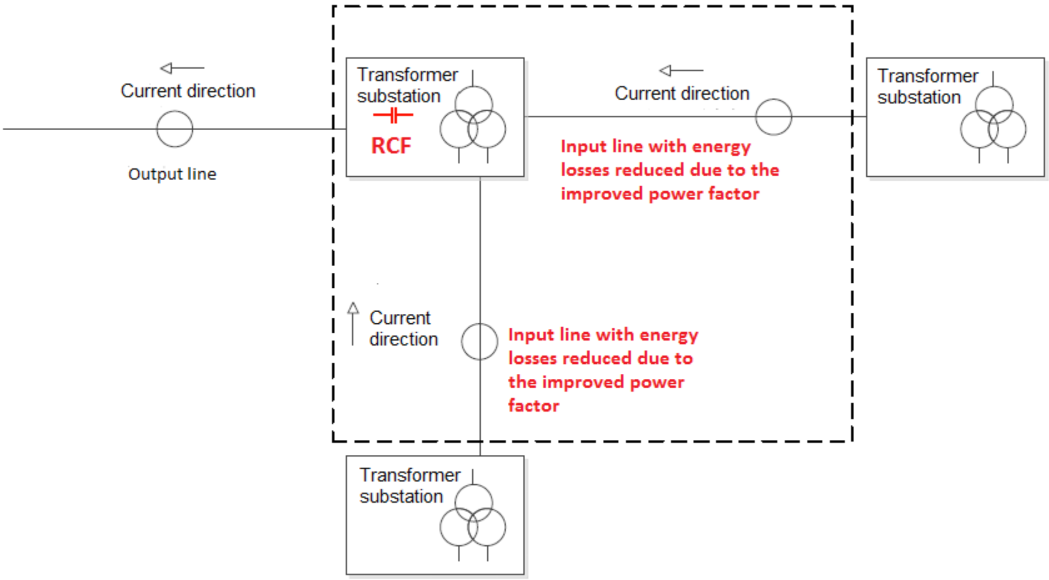


Figure 2. The project boundary of the one project activity unit under the project scenario



14. The greenhouse gases and emission sources included in or excluded from the project boundary are shown in Table 2.

Table 2. Emission sources included in or excluded from the project boundary

Source		Gas	Included	Justification/Explanation
Baseline	Transmission losses identified in the baseline scenario	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project activity	Transmission losses identified in the project scenario	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source

5.2. Identification of the baseline scenario

15. The baseline scenario is identified as the most plausible baseline scenario among all realistic and credible alternative(s). At least the following baseline scenarios should be considered:

(a) S1: Implementation of project activity without being registered as CDM;

(b) S2: The continuation of the current situation. By default, the current situation shall represent the current regulation in the host country. For example, if the regulation requires the power factor to be equal or greater than 0.9, the current practice is to keep the power factor on the minimal required level (i.e. 0.9). However, if as a consequence of installed reactive power compensation technologies prior to project implementation, the power factor at industrial facilities is higher than that required by the regulation, the former shall represent the current situation. In cases where the current situation cannot be the baseline due to wide-spread non-compliance, adequate justification needs to be provided to use a value lower than the regulation;

(c) S3: Implementation of the other technologies to improve the power factor, which are different from project reactive power compensation facilities.

16. The methodology is only applicable if the outcome of this section resulted in the baseline scenario S2.

5.3. Additionality

17. The investment barrier analysis shall be used to demonstrate additionality of the project activity using the latest approved version of the “Demonstration of additionality of small-scale project activities”. The investment analysis shall take into account the avoided losses/penalties and the revenues from electricity savings due to the implementation of the project activity.

18. The project activity under the proposed methodology is not eligible to apply the provisions for automatic additionality specified under the tools “Demonstration of additionality of small-scale project activities” and “Demonstration of additionality of microscale project activities”.

5.4. Baseline emissions

19. The baseline emissions shall be calculated as follows:

$$BE_y = W_{BL,y} \times \frac{1}{(1 - TD_y)} \times EF_{EL,y} \qquad \text{Equation (1)}$$

With

$$W_{BL,y} = \sum_n \left(\frac{P_{p,n,H,y}}{U_{p,n,H,y}}\right)^2 \times R_{P,n} \times \frac{1}{\cos \alpha_{H,n}^2} \times H_n \qquad \text{Equation (2)}$$

Where:

BE_y	=	Baseline Emissions in year *y* (t CO_2/yr)
$W_{BL,y}$	=	Line losses in the baseline scenario in year *y* (MWh/yr)
$EF_{EL,y}$	=	Combined margin CO_2 emission factor for grid connected project activity in year *y* (t CO_2/MWh)
$P_{p,n,H,y}$	=	Active power delivered to the receiving end of the distribution network of the project activity unit *n* in hour H in the project scenario in year *y* (kW)
$U_{p,n,H,y}$	=	Voltage of the project activity unit *n* in hour H in the project scenario in year *y* (kV)
$R_{P,n}$	=	Resistance of the input lines of the project activity unit *n* in the project scenario (Ω)
$\cos \alpha_{H,n}$	=	Power factor of project activity unit *n* in hour H in the baseline scenario
H_n	=	Operating hours of project activity unit *n* in the project scenario (h)
TD_y	=	Average annual technical grid losses (transmission and distribution) during year *y* for the grid serving the locations where the devices are installed, expressed as a fraction. This value shall not include non-technical losses such as commercial losses (e.g. theft/pilferage). The average annual technical grid losses shall be determined using recent, accurate and reliable data available for the host country. This value can be determined from recent data published either by a national utility or an official governmental body. Reliability of the data used (e.g. appropriateness, accuracy/uncertainty, especially exclusion of non-technical grid losses) shall be established and documented by the project participant. A default value of 10 per cent shall be used for average annual technical grid losses, if no recent data are available or the data cannot be regarded accurate and reliable

20. Resistance of input lines of the project activity unit in the project scenario shall be calculated as follows:

$$R_{P,n} = x \times R_{cond,n} \times L_{P,n} \qquad \text{Equation (3)}$$

Where:

x	=	Number of 3 phase lines/feeders (3 conductors, no neutral line considered) or one phase line/feeder of the project activity unit in the project scenario for which the losses reduction can be claimed
$R_{cond,n}$	=	Resistance per kilometre of the lines/feeders of the project activity unit n in the project scenario (Ω/km)[1]
$L_{P,n}$	=	Length of the lines/feeders of the project activity unit n in the project scenario (km)

5.5. Project activity emissions

21. The project activity emissions shall be calculated as follows:

$$PE_y = W_{P,y} \times \frac{1}{(1 - TD_y)} \times EF_{EL,y}$$ Equation (4)

With

$$W_{P,y} = \sum_n \left(\frac{P_{p,n,H,y}}{U_{p,n,H,y}}\right)^2 \times R_{P,n} \times \frac{1}{\cos \beta_{H,n}^2} \times H_n$$ Equation (5)

Where:

PE_y	=	Project Emissions in year *y* (t CO_2/yr)
$W_{P,y}$	=	Line losses in the project scenario in year *y* (MWh/yr)
$\cos \beta_{H,n}$	=	Power factor of project activity unit *n* in hour H in the project scenario

5.6. Leakage

22. No other leakage emissions are considered.

5.7. Emission reductions

23. The emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$ Equation (6)

Where:

ER_y	=	Emission reductions in year y (t CO_2/yr)
BE_y	=	Baseline Emissions in year *y* (t CO_2/yr)
PE_y	=	Project Emissions in year *y* (t CO_2/yr)

[1] For example, if the line loss calculation involves 3 phase feeder, resistance of a conductor is 0.05 Ω/km and length of the each feeder is 2 km then $R_{p,n}$ = 3* 0.05 *2 =0.3 Ω.

5.8. Changes required for methodology implementation in 2nd and 3rd crediting periods

24. Refer to the tool “Assessment of the validity of the original/current baseline and to update of the baseline at the renewal of the crediting period”.

5.9. Data and parameters not monitored

25. In addition to the parameters listed here, the provisions on data and parameters not monitored in the tools referred to in this methodology apply.

Data / Parameter table 1.

Data / Parameter:	x
Data unit:	-
Description:	Number of 3 phase lines/feeders (3 conductors, no neutral line considered) or one phase line/feeder of the project activity unit in the project scenario for which the losses reduction can be claimed
Source of data:	Project Feasibility Study Report submitted for its approval for example to government agencies or financial institutions
Measurement procedures (if any):	N/A
Any comment:	N/A

Data / Parameter table 2.

Data / Parameter:	$R_{cond,n}$
Data unit:	Ω/km
Description:	Resistance per meter of the lines/feeders of the project activity unit n in the project scenario
Source of data:	One of the following sources shall be used as source of data (in preferential order): (a) Measured according to IEC 60468 (Method of measurement of resistivity of metallic materials); (b) Test report issued by the third-party testing institutions; or (c) Product Specification provided by the manufacturer or calculated by relevant parameters; or (d) Project feasibility study report (FSR); or (e) Project documents submitted to the government authorities for applications for approval; or (f) Project documents submitted to financial institutions for appraisal
Measurement procedures (if any):	N/A
Any comment:	N/A

Data / Parameter table 3.

Data / Parameter:	$L_{P,n}$
Data unit:	km
Description:	Length of the lines/feeders of the project activity unit n in the project scenario
Source of data:	Project Feasibility Study Report submitted for its approval for example to government agencies or financial institutions
Measurement procedures (if any):	N/A
Any comment:	N/A

Data / Parameter table 4.

Data / Parameter:	n
Data unit:	N/A
Description:	The number of the project activity unit in the project scenario
Source of data:	N/A
Measurement procedures (if any):	N/A
Any comment:	N/A

6. Monitoring methodology

26. All data collected as part of monitoring should be archived electronically and be kept at least for two years after the end of the last crediting period. One hundred per cent of the data should be monitored if not indicated otherwise in the tables below.

27. The monitoring provisions in the tools referred to in this methodology apply.

Data / Parameter table 5.

Data / Parameter:	$P_{p,n,H,y}$
Data unit:	kW
Description:	Average active power delivered to the receiving end of the distribution network unit *n* in H hours in the project scenario in year *y*
Source of data:	Measured by the project participant
Measurement procedures (if any):	Power measurement instrument or measurement equipment integrated in reactive compensation facilities in accordance with applicable national or international standards
Monitoring frequency:	Continuously
QA/QC procedures:	Shall be calibrated periodically for accuracy as per national/regional standard
Any comment:	N/A

Data / Parameter table 6.

Data / Parameter:	$U_{p,n,H,y}$
Data unit:	kV
Description:	Average voltage of the project activity unit *n* in H hours in the project scenario in year *y*
Source of data:	Measured by the project participant
Measurement procedures (if any):	Power measurement instrument or measurement equipment integrated in reactive compensation facilities
Monitoring frequency:	Continuously
QA/QC procedures:	Measurement equipment shall be calibrated periodically for accuracy as per international/national/regional standard
Any comment:	N/A

Data / Parameter table 7.

Data / Parameter:	$EF_{EL,y}$
Data unit:	t CO_2/MWh
Description:	Combined margin CO_2 emission factor for grid connected project activity in year *y*
Source of data:	The value of the combined margin CO_2 emission factor can be calculated by the project participant or derived from the DNA or the Standardized Baseline website <https://cdm.unfccc.int/methodologies/standard_base/2015/sb4.html>
Measurement procedures (if any):	Calculated using the latest version of the “Tool to calculate the emission factor for an electricity system”
Monitoring frequency:	As per the “Tool to calculate the emission factor for an electricity system”
QA/QC procedures:	As per the “Tool to calculate the emission factor for an electricity system”
Any comment:	N/A

Data / Parameter table 8.

Data / Parameter:	$\cos \beta_{H,n}$
Data unit:	-
Description:	Power factor of project activity unit *n* in hour H in the project scenario
Source of data:	Measured by the project participant
Measurement procedures (if any):	Power Factor Meter or measurement equipment integrated in RCF equipment
Monitoring frequency:	Continuously
QA/QC procedures:	Shall be calibrated periodically for accuracy as per international/national/regional standard
Any comment:	N/A

Data / Parameter table 9.

Data / parameter:	$\cos \alpha_{H,n}$
Data unit:	N/A
Description:	Power factor of project activity unit n in hour H in the baseline scenario
Source of data:	1. For project activity involving retrofitting/modification, i.e. project activity corresponding to para 3 (a) (ii) and (iii), baseline power factor shall be determined as a maximum value between: (a) The average of the full one-year historic data immediately prior to the implementation of the project (If historical information is not available, it shall be determined through baseline measurement campaign covering the period sufficient to capture the normal operating conditions. The measurement campaign shall be carried out by the accredited third party before project implementation) and (b) The minimal target value required by the current regulations (e.g., value specified by electric utility). In case regulation does not exist (or wide spread non-compliance of the regulation is evidenced), baseline power factor shall be determined solely using the historic data or measurement campaign as mentioned above. 2. For project activity involving new installations, i.e. project activity corresponding to para 3 (a) (i), baseline power factor shall be the latest available minimal value required by the local regulation. The value shall be updated annually with the latest regulation, as available. In case where regulation is not available, baseline power factor shall be determined using the ex post monitoring, i.e. by monitoring the power factor demanded by the load in the baseline scenario
Measurement procedures (if any):	Power Factor Meter or measurement equipment integrated in RCF equipment applicable to the cases where power factor is determined based on measurement)
Monitoring frequency:	N/A
QA/QC procedures:	RCF equipment shall be calibrated periodically for accuracy as per international/national/regional standard.
Any comment:	Where baseline power factor is determined using ex-post measurement, it is possible that integrated RFC equipment monitors power factor supplied by the power utility and demanded by the electric motor at the same time and continuously. That is, it is possible to determine baseline power factor while operating the RCF equipment using such integrated meter

Data / Parameter table 10.

Data / Parameter:	H_n
Data unit:	hour
Description:	Operating hours of project activity unit *n* in the project scenario
Source of data:	Measured by the project participant

Measurement procedures (if any):	Recorded continuously, aggregated monthly
Monitoring frequency:	N/A
QA/QC procedures:	N/A
Any comment:	N/A

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Document information

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