Draft baseline and monitoring methodology AM0XXX

"Interconnection between electricity systems for energy exchange"

I. SOURCE, DEFINITIONS AND APPLICABILITY

Sources

This baseline and monitoring methodology is based on the following proposed new methodology:

- NM00358 "*Interconnection between electricity systems for international energy exchange*" prepared by Randall Spalding-Fecher, on behalf of the African Development Bank.

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

- "*Tool for the demonstration and assessment of additionality*";
- "*Tool to calculate the emission factor for an electricity system*".

For more information regarding the proposed new methodologies and the tools as well as their consideration by the CDM Executive Board please refer to <http://cdm.unfccc.int/methodologies/PAmethodologies/index.html>.

Selected approach from paragraph 48 of the CDM modalities and procedures

"*Existing actual or historical emissions, as applicable*".

Definitions

For the purpose of this methodology, the following definitions apply:

Transmission line is the physical infrastructure used to deliver electricity at high voltages from one point to another.

Grid is an electricity network, including transmission and distribution lines and power units. The spatial extent of the grid includes the power units that are physically connected through transmission and distribution lines that can be dispatched by a dispatch centre without significant transmission constraints. The spatial extent of the grid shall be determined by following the procedures in the latest version of the "*Tool to calculate the emission factor for an electricity system*".

Power unit is a facility that generates electricity and supplies it to an electricity grid and, if applicable, to specific consumers. Several power units at one site comprise one power plant, whereas a power unit is characterized by the fact that it can operate independently from other power units at the same site. Where several identical power units (i.e. with the same capacity, age and efficiency) are installed at one site, they may be considered as one single power unit.

Interconnection is the connection of two grids through the installation of one or many transmission lines. After implementation of the project activity, the interconnection line is used to deliver electricity primarily from the exporting electricity system to the importing electricity system.

Exporting electricity system is the grid that is being connected to an importing electricity system as a result of the project activity and where the average annual amount of the generated electricity exported to other grid(s) through existing interconnection(s) exceed average annual amount of the electricity imported for the last 3 years.

Importing electricity system is the grid that is being connected to an exporting electricity system as a result of the project activity and where either (a) it has no interconnection with any other grid prior to the implementation of the project activity or (b) the average annual amount of the electricity imported from other grid(s) through existing interconnection(s) exceed average annual amount of the electricity exported for the last 3 years.

Third party electricity system is a grid other than the two grids connected by the project activity.

Applicability

This methodology applies to project activities that involve the establishment of new electrical interconnections between grids to achieve or increase electricity exchange between two grids.

The methodology is applicable under the following conditions:

- The interconnection is through the construction of new transmission lines;
- To ensure that one electricity grid will work mainly as exporting electricity system and the other as importing electricity system, the relation between annual electricity flow from the exporting to the importing electricity system and vice versa shall not fall below 80/20. If the relation between annual amounts of the electricity supplied from the exporting to the importing electricity system and vice versa fall below 80/20 in a particular year, then no CERs shall be issued for this particular year;
- The exporting electricity system has more than 15 per cent of reserve capacity[1] during the most recent year prior to the start of the crediting period. Where significant expansion in generation capacity prior to the commissioning of the interconnection is expected, project participants may estimate the reserve capacity in the first year of the crediting period based on official utility or government plans for capacity expansion and load forecasts. This shall be monitored ex-post, so this estimation will not affect the actual crediting of the project;
- Any other interconnections that the importing and the exporting electricity system have with neighbouring grids prior to the implementation of the project activity should be identified and described in the CDM-PDD;
- The geographic and system boundaries for the relevant country electricity systems can be clearly identified and information on the characteristics and composition of the grids is available;
- The amount of electricity generated in the exporting electricity system by hydropower plants with a power density of the reservoirs below or equal to 4 W/m^2 and that start commercial operation during the crediting period shall be excluded from the calculations of the emission reductions.

[1] For detailed guidance on how reserve capacity should be demonstrated please refer to the leakage section.

In addition, the applicability conditions included in the tools referred to above apply.

Finally, this methodology is only applicable if the application of the procedure to identify the baseline scenario confirms that *"B2. New grid-connected generation capacity using the similar fuel/technology mix as existing power units in the importing electricity system that will provide the same amount of electricity to end users in the importing electricity system (e.g. power plants included in the cohort of plants used to determine the build margin emission factor)"* is the most plausible baseline scenario.

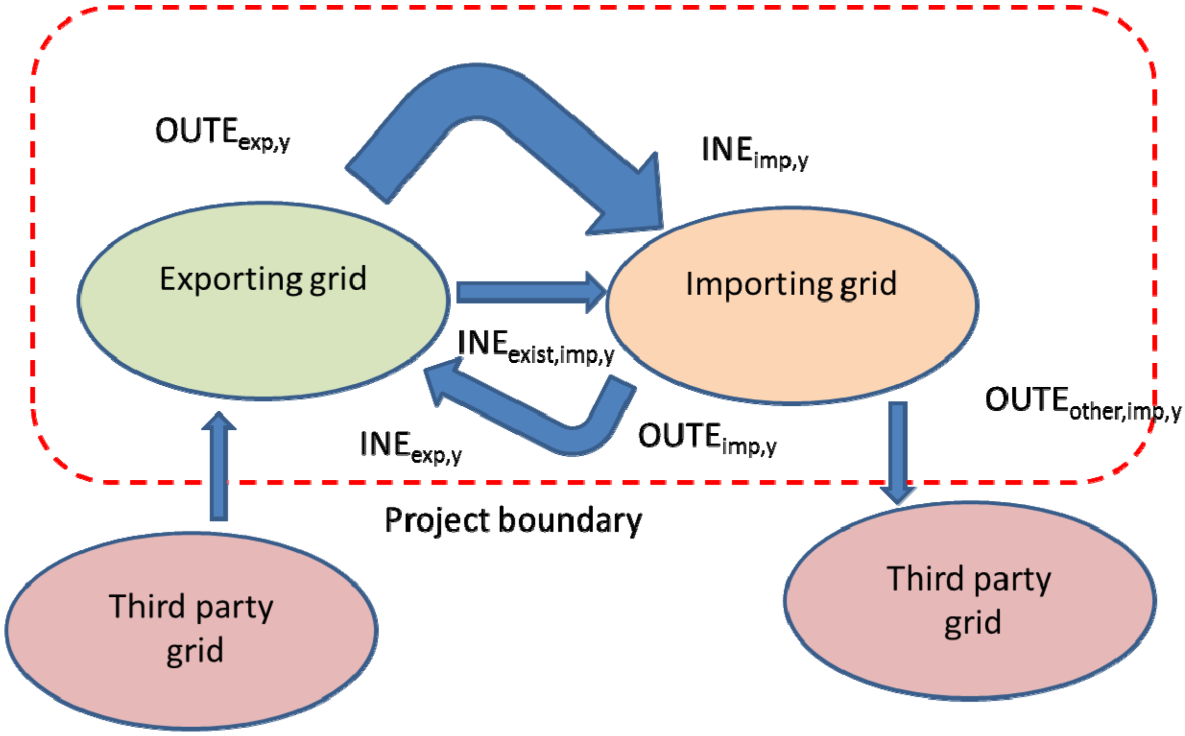
II. BASELINE METHODOLOGY PROCEDURE

Project boundary

The **spatial extent** of the project boundary encompasses all power units connected physically to the exporting and to the importing electricity systems that the CDM project activity transmission line connects. The spatial extent of the grids shall be determined in accordance with the "*Tool to calculate the emission factor for an electricity system*".

Figure 1 below describes both electricity grids with the existing (if applicable) and new interconnections between them. The main objective of the project is to transmit electricity from the exporting to the importing electricity system. However, it is possible that electricity can be transmitted in the opposite direction, i.e. from the importing system to the exporting system. In addition, the figure shows possible connections to third party electricity systems from the importing and from the exporting electricity systems, which fall outside the project boundary.

Figure 1: Project boundary and identification of electricity flows



The greenhouse gases in the project boundary are shown in Table 1

Table 1: Emissions sources included in or excluded from the project boundary

Source		Gas	Included?	Justification / Explanation
Baseline	Emissions from power units connected to the importing electricity system	CO_2	Yes	Main source of emissions
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
	Emissions from power units connected to the exporting electricity system	CO_2	Yes	Main source of emissions
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
Project Activity	Emissions from power plants connected to the importing electricity system	CO_2	Yes	Main source of emissions
		CH_4	No	Excluded for simplification. This is conservative

		N_2O	No	Excluded for simplification. This is conservative
	Emissions from power plants connected to the exporting electricity system	CO_2	Yes	Main source of emissions
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
	Emissions from deforestation due to the transmission line construction	CO_2	Yes	Source of emissions These emissions occurs once
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
	Methane emissions related to new hydropower plants with reservoirs in exporting electricity system	CH_4	Yes	Source of emissions. CH_4 emissions from reservoirs
	Fugitive emissions from new SF_6-containing equipment	SF_6	Yes	Source of emissions. Emissions related to SF_6 used in the new equipment of the project activity

Identification of the baseline scenario

In order to identify the baseline scenario the following steps shall be applied:

Step 1: Identification of alternative scenarios

Identify all alternative scenarios to the proposed CDM project activity that can be identified as the baseline scenario options. This procedure includes baseline scenario alternatives not under the direct control of the project participant. These scenarios shall be evaluated applying the same assumptions and procedures as applied in the project activity implemented without CDM.

Project participants shall identify all alternative scenarios that provide outputs or services with comparable quality, properties and application areas as the proposed CDM project activity (e.g. availability, reliability). Alternative scenarios may include inter alia:

- B1. New transmission line(s) connecting the exporting and importing electricity systems undertaken without CDM (i.e. The proposed project activity undertaken without being registered as a CDM project activity);

- B2. New grid-connected generation capacity using the similar fuel/technology mix as existing power units in the importing electricity system that will provide the same amount of electricity to end users in the importing electricity system (e.g. power plants included in the cohort of plants used to determine the build margin emission factor);

- B3. New grid-connected generation capacity using renewable energy sources in the importing electricity system that will provide the same amount of electricity to end users in the importing electricity system;

- B4. Isolated diesel generators or mini-grids to provide the same amount of electricity to end users in the importing electricity system.

These alternatives need not consist only of power units of the same capacity, load factor and operational characteristics (i.e. several smaller power units, or the share of a larger power unit may be a reasonable alternative to the project activity). However they should deliver similar or equivalent services (e.g. peak vs. base load power) with similar quality. Further, the baseline scenario candidates identified may not be under control of project participants, but could be available to other stakeholders within the project boundary (e.g. other companies investing in power capacity expansion).

A clear description of each baseline scenario alternative, including information on the technology, such as the efficiency and technical lifetime, shall be provided in the CDM-PDD. In addition, if project participants could not implement a baseline scenario alternative, they should indicate which entities would implement it.

Step 2: Compliance with legal and regulatory requirements

The alternative(s) shall be in compliance with all mandatory applicable legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air pollution. (This step does not consider national and local policies that do not have legally-binding status).

If an alternative does not comply with all mandatory applicable legislation and regulations, then show that, based on an examination of current practice in the country or region in which the law or regulation applies, those applicable legal or regulatory requirements are systematically not enforced and that non-compliance with those requirements is widespread in the country. If this cannot be shown, then eliminate the alternative from further consideration.

Step 3: Barrier analysis.

From the remaining alternatives, project participants shall identify those scenarios facing prohibitive barriers preventing their implementation. Such realistic and credible barriers may include inter alia:

- Technology may not be available;

- The establishment of contracts or agreements may be impossible. For example, it could be demonstrated that previous agreements could not be reached for several reasons.

All barriers identified shall be evaluated for all the scenarios proposed to assess how these barriers affect each alternative scenario.

If there is only one alternative scenario that is not prevented by any barrier, then this scenario alternative is the most plausible baseline scenario.

If there are still several baseline scenario alternatives remaining after this step, either go to Step 4 or select the alternative with the lowest emissions (i.e. the most conservative) as the most plausible baseline scenario.

Step 4: Investment analysis

This step serves to determine which of the alternative scenarios in the short list remaining after Step 3 is the most economically or financially attractive. For this purpose, the project participants shall follow the guidelines and procedures of the "*Tool for the demonstration and assessment of additionality*".

The following should be considered as potential economic benefits of interconnection where it is relevant to the project participants:

- Fuel costs avoided in the importing electricity system by the interconnection;
- Costs associated with the construction of new generation capacities in the importing electricity system avoided by the interconnection;
- Operating costs of new generation capacities in the importing electricity system avoided by the interconnection; and
- Avoided costs for the improvements of the transmission lines between exporting and importing electricity systems existing prior to the implementation of the project activity;
- Income from the electricity transfer through the interconnection and/or income from the electricity export.

To exclude any of the potential economic benefits from the consideration project participants shall demonstrate their role in the interconnection project[2].

The methodology is only applicable if the scenario *"B2. New grid-connected generation capacity using the similar fuel/technology mix as existing power units in the importing electricity system that will provide the same amount of electricity to end users in the importing electricity system (e.g. power plants included in the cohort of plants used to determine the build margin emission factor)"* is identified as the most plausible baseline scenario.

Additionality

Additionality of the project activity shall be demonstrated and assessed using the latest version of the "*Tool for the demonstration and assessment of additionality*". The following additional guidance should be used when applying the tool.

The applicable geographical area shall cover (a) countries where the project activity is implemented and (b) all neighbouring countries. In case the project activities involving new electrical interconnection(s) between different countries that are members of the international power market(s) (power pool) all countries-members of that market(s) shall be included in the applicable geographical area.

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[2] For example, if project participants are associated with the importing electricity system, avoided costs should be taken into account, while for the project participants that are operating the interconnection line, income from electricity transmission is only relevant.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

The step 1 of the latest version of the "*Tool for the demonstration and assessment of additionality*" shall be applied. When applying step 1 of the tool, project participants shall use the same set of alternative scenarios identified in Step 1 of the procedure "*Identification of the baseline scenario*".

Step 2: Investment analysis

Step 2 of the latest version of the "*Tool for the demonstration and assessment of additionality*" shall be applied with the following guidance.

Sub-step 2a: Analysis method

The investment analysis should either be an analysis comparing the economic attractiveness of the project activity versus a benchmark rate of return (e.g. project IRR vs. benchmark IRR) or a benchmark analysis comparing the levelized cost of electricity provided by the project activity to the levelized cost of additional power generation in the importing electricity system.

Sub-step 2b: Apply investment analysis

The information used in the investment analysis shall be based on publicly available market prices and information or, in the absence of an open market, published electricity generation costs in the importing electricity system, where appropriate. The tariff for the electricity transfer from the exporting to the importing electricity system and the tariff for the electricity transmission through the interconnection shall be defined for the lifetime of the project activity, and the project proponent shall clearly outline the underlying assumptions.

Assumptions and input data for the investment analysis shall not differ across alternative scenarios, unless differences can be well substantiated.

In addition the guidance on the investment analysis under the baseline scenario identification's section should be applied when the project IRR is determining.

Step 3: Barrier analysis

Sub-step 3a. Identify barriers that would prevent the implementation of alternative baseline scenarios:

To demonstrate that the project activity is the first of its kind the project participants shall refer to the most recent version of "Guidelines on additionality of first-of-its-kind project activities". In the context of this methodology, for the project activities involving new electrical interconnection(s) between different countries, "first of its kind" is defined as no other international interconnection serving either of the two countries before project activity implementation.

Baseline emissions

The procedure to determine baseline emissions considers bidirectional transmission of electricity between the grids. The emissions are estimated based on the amount of electricity received in each electricity system, that otherwise would have been produced in each electricity system, and their respective emission factors.

The equation to calculate baseline emissions is as follows:

$$BE_y = INE_{imp,y} \times EF_{imp,y} + INE_{\exp,y} \times EF_{BSL,\exp,y} \tag{1}$$

Where:

BE_y	=	Baseline emissions in the year y (t CO_2)
$INE_{imp,y}$	=	Net amount of electricity received in the importing electricity system because of the project activity in year y (MWh)
$EF_{imp,y}$	=	CO_2 emission factor for the importing electricity system in the year y (t CO_2/MWh)
$INE_{\exp,y}$	=	Net amount of electricity received in the exporting electricity system because of the project activity in year y (MWh)
$EF_{BSL,\exp,y}$	=	CO_2 baseline emission factor for the exporting electricity system (t CO_2/MWh)

In order to obtain the values to apply the above formula, the following steps are required:

Step 1: Identification of amount of electricity received in each electricity system because of the project activity

The measured amount of electricity coming to the importing electricity system must be adjusted for the amount of electricity that can be supplied over transmission lines exiting prior to the implementation of the project activity.

$$INE_{imp,y} = INE_{imp,measured,y} - PTC_{exist} \times 8760 \tag{2}$$

Where:

$INE_{imp,y}$	=	Net amount of electricity received in the importing electricity system because of the project activity in year y (MWh)
$INE_{imp,measured,y}$	=	Net amount of electricity received in the importing electricity system, measured in the new line in year y (MWh)
PTC_{exist}	=	Power transmission capacity of the existing transmission lines between exporting and importing electricity systems (MW)

The measured amount of electricity coming to the exporting electricity system must be adjusted to compensate for any changes in flows over transmission lines exiting prior to the implementation of the project activity.

$$INE_{\exp,y} = INE_{\exp,measured,y} - \max\left[0;\left(INE_{exist,\exp,hist} - INE_{exist,\exp,measured,y}\right)\right] \tag{3}$$

Where:

$INE_{\exp,y}$	=	Net amount of electricity received in the exporting electricity system because of the project activity in year y (MWh)
$INE_{\exp,measured,y}$	=	Net amount of electricity received in the exporting electricity system, measured in the new line in year y (MWh)
$INE_{exist,\exp,hist}$	=	Historical net amount of electricity received in the exporting electricity system from the importing electricity system in the existing lines (MWh)
$INE_{exist,\exp,measured,y}$	=	Net amount of electricity received in the exporting electricity system from the importing electricity system, measured in the existing lines in year y (MWh)

$INE_{exist,exp,hist}$ shall be the maximum value over the 3 years prior to the implementation of the project activity, based on official records.

Step 2: Grid emission factor for the importing electricity system and baseline grid emission factor for the exporting electricity system

The emission factor for the importing electricity system and the baseline emission factor for the exporting electricity system shall be determined as the combined margin emission factors using the latest version of the "*Tool to calculate the emission factor for an electricity system*".

The emission factors shall be calculated using ex-post data. Ex-ante estimates may only be used for the purposes of estimating emissions reductions from the project activity in the PDD.

Project emissions

Project emissions include those emissions released by power units to generate electricity exchanged between both grids through the new transmission lines, emissions from deforestation, methane emissions from the reservoirs of the hydropower plants and emissions from new SF_6-containing equipment.

Project emissions are calculated in the following steps:

Step 1: Determination of project emissions from incremental electricity generation;

Step 2: Emission from deforestation due to the construction of transmission line;

Step 3: Methane emissions related to new hydropower plants with reservoirs in the exporting electricity system that start commercial operation after the start of the project activity;

Step 4: Determination of project emissions from fugitive SF_6 from new equipment.

Project emissions are shown as follows:

$$PE_y = PE_{elec,y} + PE_{def,1} + PE_{CH4,y} + PE_{SF6,y} \quad \textbf{(4)}$$

Where:

PE_y	=	Project emissions in year y (t CO_2)
$PE_{elec,y}$	=	Project emissions from incremental electricity generation in year y (t CO_2)
$PE_{def,1}$	=	Project emissions from the deforestation during the first year of the crediting period (t CO_2)
$PE_{CH4,y}$	=	Project emissions from new hydropower reservoirs in year *y* (t CO_2)
$PE_{SF6,y}$	=	Project emissions from fugitive SF_6 emissions in year y (t CO_2)

Step 1: Determination of project emissions from incremental electricity generation

$$PE_{elec,y} = OUTE_{\exp,y} \times EF_{\exp,y} + OUTE_{imp,y} \times EF_{imp,y} + \max\left[0;\left(OUTE_{imp-other,y} - OUTE_{imp-other,hist}\right)\right] \times EF_{imp,y} \quad \textbf{(5)}$$

Where:

$PE_{elec,y}$	=	Project emissions from incremental electricity generation in the year y (t CO_2).
$OUTE_{\exp,y}$	=	Amount of electricity generated and sent from the exporting electricity system because of the project activity in year y (MWh)
$EF_{\exp,y}$	=	CO_2 project emission factor for the exporting electricity system (t CO_2/MWh)
$OUTE_{imp,y}$	=	Amount of electricity supplied from the importing electricity system to the exporting electricity system because of the project activity in year y (MWh)
$EF_{imp,y}$	=	CO_2 emission factor for the importing electricity system (t CO_2/MWh)
$OUTE_{imp-other,y}$	=	Amount of electricity sent from the importing electricity system to the third party electricity system in the year y (MWh)
$OUTE_{imp-other,hist}$	=	Historical amount of electricity sent from the importing electricity system to the third party electricity system (MWh)

The emission factor for the importing electricity shall be determined using ex-post data as the combined margin emission factors using the latest version of the *"Tool to calculate the emission factor for an electricity system"*.

The measured amount of electricity coming to the exporting electricity system must be adjusted to compensate for any changes in flows over transmission lines exiting prior to the project.

$$OUTE_{imp,y} = OUTE_{imp,measured,y} + \max\left[0; (OUTE_{exist,imp,measured,y} - OUTE_{exist,imp,hist})\right] \quad \textbf{(6)}$$

Where:

$OUTE_{imp,y}$	=	Amount of electricity supplied from the importing electricity system to the exporting electricity system because of the project activity in year y (MWh)
$OUTE_{imp,measured,y}$	=	Net amount of electricity supplied from the importing electricity system to the exporting electricity system, measured in the new line in year y (MWh)
$OUTE_{exist,imp,hist}$	=	Historical net amount of electricity supplied to the exporting electricity system from the importing electricity system in the existing lines (MWh)
$OUTE_{exist,imp,measured,y}$	=	Net amount of electricity supplied to the exporting electricity system from the importing electricity system, measured in the existing lines in year y (MWh)

$OUTE_{exist,imp,hist}$ shall be the minimum value over the 3 years prior to the implementation of the project activity, based on official records.

<u>Project grid emission factor for the exporting electricity system</u>

The project emission factor for the exporting electricity system shall be determined as the maximum value between the build margin emission factor and the "adapted" simple operating margin emission factor.

$$EF_{\exp,y} = \max\left\{EF_{\exp,OMadapted,y}; EF_{\exp,BM,y}\right\} \quad \textbf{(7)}$$

Where:

$EF_{\exp,y}$	=	CO_2 project emission factor for the exporting electricity system in year y (t CO_2/MWh)
$EF_{exp,OMadapted,y}$	=	"Adapted" simple operating margin CO_2 emission factor for the exporting electricity system in year y (t CO_2/MWh)
$EF_{exp,BM,y}$	=	Build margin CO_2 emission factor for the exporting electricity system in year y (t CO_2/MWh)

The build margin emission factor should be calculated ex post using the latest version of the "*Tool to calculate the emission factor for an electricity system*".

The "adapted" simple OM emission factor is calculated using the following step-wise procedure:

- Rank all power units of the exporting electricity system by emission factors in descending order (t CO_2/MWh);
- Start on the top (i.e. power unit with the highest emission factor) and select the set of units required to cover the amount of electricity sent to the importing electricity system, based on data of generation for the year *y*;
- Use the generation weighted average emission factor corresponding to these units to estimate the operating margin emission factor.

Electricity delivered to the exporting electricity system from a third party grid, i.e. import from another grid/country, shall be accounted for the year y.

If the total electricity delivered is less than 5 per cent of the total electricity generated in the exporting electricity system, then disregard the possible emissions associated with the electricity delivered to the exporting grid.

Otherwise the possible effect on emissions from import should be accounted assuming the electricity was produced by a single power unit and with the emission factor equal to the operating margin emission factor (t CO_2/MWh) for the grid where electricity is generated. If the emission factor is not available, it is assumed that electricity was produced by the most GHG intensive power unit in the exporting electricity system.

The "adapted" simple OM is therefore:

$$EF_{exp,OMadapted,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \quad \textbf{(8)}$$

Where:

$EF_{exp,OMadapted,y}$	=	"Adapted" simple operating margin CO_2emission factor for the exporting electricity system in year y (t CO_2/MWh)
$EG_{m,y}$	=	Net amount of electricity generated and delivered to the grid by power unit *m* in year y (MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year y (t CO_2/MWh)
m	=	Power unit included in the set of units required to cover the amount of electricity sent to the importing electricity system in the year *y* when ranked by emission factors in descending order.
y	=	Applicable year during monitoring

The emissions factors of each power plant *m* can be determined as follows:

Option A

If for a power unit *m* the data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_{i} FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}} \quad \textbf{(9)}$$

Where:

$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year y (t CO_2/MWh)
$FC_{i,m,y}$	=	Amount of fuel type *i* consumed by power unit *m* in year y (mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fuel type *i* in year y (GJ / mass or volume unit)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fuel type *i* in year y (t CO_2/GJ)
$EG_{m,y}$	=	Net amount of electricity generated and delivered to the grid by power unit *m* in year y (MWh)

m	=	Power unit included in the set of units required to cover the amount of electricity sent to the importing electricity system in the year *y*
i	=	Fuel type combusted in power unit *m* in year y
y	=	Applicable year during monitoring

Option B

If for a power unit *m* only the data on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO_2 emission factor of the fuel type used and the efficiency of the power unit, as follows:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}} \tag{10}$$

Where:

$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year y (t CO_2/MWh)
$EF_{CO2,m,i,y}$	=	Average CO_2emission factor of fuel type *i* used in power unit *m* in year y (t CO_2/GJ)
$\eta_{m,y}$	=	Average net energy conversion efficiency of power unit *m* in year y (%)
m	=	Power unit included in the set of units required to cover the amount of electricity sent to the importing electricity system in the year *y*
y	=	Applicable year during monitoring

Where several fuel types are used in the power unit, use the fuel type with the highest CO_2 emission factor for $EF_{CO2,m,i,y}$.

The emission factors should be calculated using ex-post data. Ex-ante estimates may only be used for the purposes of estimating emissions reductions from the project activity in the CDM-PDD.
In particular, where there will be significant expansion in generation capacity prior to the commissioning of the transmission line, project participants may estimate the "adapted" simple OM based on official utility or government plans for capacity expansion.

Project proponents shall exclude from the OM and BM calculations all power generation units that are registered as CDM project activities. This shall be done for the build margin even in cases where the "*Tool to calculate the emission factor for an electricity system*" would require that inclusion of CDM plants in the build margin due to the high age of "recently built plants". This is necessary to avoid double counting of the emissions reductions created by the CDM project power plant.

Step 2: Determination of project emissions from deforestation

Deforestation shall be accounted as one-time emissions and determined using the following procedure:

(a) Divide the transmission line into segments not exceeding 5km, and attribute each segment the type of vegetation (forest land, grassland, cropland, etc.) and location (tropical / temperate, wet / dry), according to classifications cited in IPCC 2006 guideline volume 4;

(b) If the segment can be classified as forest land, then calculate the area of segment deforested on the basis of the length of segment deforested for segment *i* ($L_{DEF,i}$) and average width of segment deforested for segment *i* ($W_{DEF,i}$);

(c) Assign a default value for aboveground biomass for segment *i* ($M_{A,i}$) to be deforested for each segment, on the basis of conservative interpretation of tables 4.7 and 4.8 of IPCC 2006 guideline volume 4 chapter 4;

(d) Calculate the total emissions due to deforestation as follows:

$$PE_{def,1} = \sum_k \left(L_{DEF,k} \times W_{DEF,k} \times M_{A,k} \times 0.5 \times \frac{44}{12} \right) \tag{11}$$

Where:

$PE_{def,1}$	=	Project emissions from the deforestation during the first year of the crediting period (t CO_2)
$L_{DEF,k}$	=	Length deforested for segment *k* (100m).
$W_{DEF,k}$	=	Width deforested for segment *k* (100m).
$M_{A,k}$	=	Aboveground biomass of land to be deforested for segment *k* (tonnes d.m./ha)
0.5	=	Carbon fraction of dry matter (t-C/tonnes d.m.)
k	=	Segment of transmission line

Alternatively, if the information on deforestation is required by the local regulation, it can be also used to determine the total area for each vegetation type and appropriately determine the total aboveground biomass to be deforested for the whole project, instead of performing steps 1-3. In this case the total aboveground biomass to be deforested has to be multiplied by (0.5x44/12) to determine emissions.

Step 3: Determination of project methane emissions from hydropower plants

Methane emissions should be accounted for hydropower plants in the exporting electricity system with power densities higher than 4W/m^2 and below 10W/m^2 that start commercial operation during the crediting period. Based on the approach in ACM0002, the emissions should be calculated as follows:

$$PE_{CH4,y} = \frac{EF_{res} \times \min\left(EG_{z,y}, OUTE_{\exp,y}\right)}{1000} \tag{12}$$

Where:

$PE_{CH4,y}$	=	Project emissions from new hydropower reservoirs in the year *y* (t CO_2)
EF_{res}	=	Default emission factor for emissions from reservoirs of hydro power units with power densities between 4 and 10 W/m^2 (kgCO_2/MWh)
$EG_{z,y}$	=	Electricity generation from hydro power unit z with the power density between 4 and 10 W/m^2 in year y (MWh)
$OUTE_{exp.y}$	=	Amount of electricity generated and sent from the exporting electricity system because of the project activity in year y (MWh)
z	=	Hydropower unit with the power density between 4 and 10 W/m^2 that starts commercial operation during the crediting period

Step 4: Determination of project emissions from fugitive SF_6 emissions

Emissions of SF_6 from new equipment installed under the project activity ($PE_{SF6,y}$), in tonnes of CO_2, are calculated as follows:

$$PE_{SF6,y} = M_{SF6,y} \times GWP_{SF6} \tag{13}$$

Where:

$PE_{SF6,y}$	=	Project emissions of SF_6 from new equipment (e.g. transformers) installed under the project activity in year y (t CO_2)
$M_{SF6,y}$	=	The average quantity of SF_6 emitted from equipment installed under the project activity in year y (t SF_6)
GWP_{SF6}	=	Global warming potential of SF_6 (t CO_2/t SF_6)

Determination of $PE_{SF6,y}$ can be excluded from the ex-ante estimation of emission reductions at the time of validation.

Leakage

Project activities applying this methodology may result in leakage due to an inadequate reserve margin in the exporting electricity system.

Project participants shall calculate the minimal reserve capacity in the exporting electricity system ex-post. The procedure is to divide the sum of the maximum peak load in the exporting electricity system and the additional maximum theoretical load from the new transmission line(s) by the total installed capacity of the exporting electricity system, and subtract this ratio from 1.

$$RC_y = 1 - \frac{\left(LOAD_{\max,y} + CAP_{NL,y}\right)}{CAP_{\exp,y}} \tag{14}$$

Where:

RC_y	=	Minimal reserve capacity in the exporting electricity system in the year y
$LOAD_{\max,y}$	=	Maximum system load in the exporting electricity system (excluding the project exports) in the year y (MW)
$CAP_{NL,y}$	=	Theoretical maximum capacity of the new transmission line in year y (MW)
$CAP_{\exp,y}$	=	Installed power capacity in the exporting electricity system in the year y (MW)

Note that capacity of the new line may vary by year if the transmission line is commissioned in more than one step. In this case, $CAP_{NL,y}$ should be updated.

If the minimal reserve capacity is lower than 15 per cent in any given year, project participants shall calculate leakage emissions due to extra generation from off-grid diesel power generators to satisfy domestic demand in the exporting electricity system.

$$LE_y = 8760 \times \left(0.15 - RC_y\right) \times CAP_{\exp,y} \times EF_d \quad \textbf{(15)}$$

Where:

LE_y	=	Leakage emissions in year y (t CO_2)
RC_y	=	Minimal reserve capacity in the exporting electricity system in year y
$CAP_{\exp,y}$	=	Installed power capacity in the exporting electricity system in year y (MW)
EF_d	=	Emission factor for the electricity generated by diesel power plants (t CO_2/MWh)

Emission reductions

Emission reductions are calculated as follows:

$$\mathrm{ER_y} = \mathrm{BE_y} - \mathrm{PE_y} - \mathrm{LE_y} \quad \textbf{(16)}$$

Where:

ER_y	=	Emission reductions in year y (t CO_2)
BE_y	=	Baseline emissions in year y (t CO_2)
PE_y	=	Project emissions in year y (t CO_2)
LE_y	=	Leakage emissions in year y (t CO_2)

If a project activity temporarily results in "negative emission reductions", i.e. baseline emissions minus project emissions minus leakage effects are negative; any further CERs will only be issued when the emissions increase has been compensated by subsequent emission reductions by the project activity.

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

The use of the procedures included in the methodology to determine baseline emissions may not be adequate to capture the impact of the interconnection on the parameters involved. As an example the decision to build the new plants in the importing electricity system and the operation of plants in the importing electricity system is affected by the interconnection and the combined margin procedures will not capture this impact. Therefore, the methodology conservatively prescribes that for the second and the third crediting period baseline emissions are equal to project emissions and no emission reduction could be claimed[3].

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[3] A different approach based modelling of the importing electricity system's performance could be proposed as a revision of the methodology. The model would be run ex post using as an input the electricity demand level and pattern observed in the grid and would indicate how this respective demand would be met by the power plants in the absence of the transmission line. This output could then be used to estimate the emissions corresponding to the baseline situation. This approach would only be applicable in countries where such kinds of simulation models are available and transparently documented.

Data and parameters not monitored

In addition to the parameters listed in the tables below, the provisions on "*data and parameters not monitored*" in the tools referred to in this methodology also apply.

Data / parameter:	PTC_{exist}
Data unit:	MW
Description:	Power transmission capacity of the existing transmission lines between exporting and importing electricity systems
Source of data:	Company owner of the line
Value to be applied:	Based on design of the transmission line
Any comment:	

Data / parameter:	$OUTE_{imp\text{-}other,hist}$
Data unit:	MWh
Description:	Historical amount of electricity sent from the importing electricity system to the third party electricity system
Source of data:	Official sources
Value to be applied:	Taken from official sources from utility or national government.
Any comment:	

Data / parameter:	$OUTE_{exist,imp,hist}$
Data unit:	MWh
Description:	Historical net amount of electricity supplied to the exporting electricity system from the importing electricity system in the existing lines
Source of data:	Official sources
Value to be applied:	Taken from official sources from utility or national government.
Any comment:	

Data / parameter:	$INE_{exist,exp,hist}$
Data unit:	MWh
Description:	Historical net amount of electricity received in the exporting electricity system from the importing electricity system in the existing lines
Source of data:	Official sources
Value to be applied:	Taken from official sources from utility or national government.
Any comment:	

Data / parameter:	EF_d
Data unit:	t CO_2/MWh
Description:	Emission factor for the electricity generated by diesel power plants
Source of data:	The following data may be used if the relevant conditions apply. **Data source** — **Condition to use the source** Regional or national average default values — If values are reliable and documented in regional/national energy statistics or energy balances AMS I.F default value of 0.8 t CO_2/MWh for generators >200 kW —
Value to be applied:	N/A
Any comment:	

Data/ Parameter:	$L_{DEF,k}$
Data unit:	100m
Description:	Length deforested for segment *k*
Source of data:	-
Value to be applied:	-
Any comment:	-

Data/ Parameter:	$W_{DEF,k}$
Data unit:	100m
Description:	Width deforested for segment *k*
Source of data:	-
Value to be applied:	-
Any comment:	-

Data/ Parameter:	$M_{A,k}$
Data unit:	tonnes d.m./ha
Description:	Aboveground biomass of land to be deforested for segment *k*
Source of data:	
Value to be applied:	
Any comment:	

Data/Parameter:	EF_{res}
Data unit:	kgCO_2/MWh
Description:	Default emission factor for emissions from reservoirs of hydro power units with power densities between 4 and 10 W/m^2
Source of data:	Decision by EB23
Value to be applied:	90
Any comment:	-

Data/ Parameter:	GWP_{SF6}
Data unit:	$t\ CO_2/\ t\ SF_6$
Description:	Global Warming Potential of SF_6
Source of data:	Relevant CMP decisions
Value to be applied:	Project participants shall update GWPs according to any decisions by the CMP. For the first commitment period GWP_{SF6}=23,900
Any comment:	The value applied is valid for the first commitment period

III. MONITORING METHODOLOGY

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. 100 per cent of the data should be monitored if not indicated otherwise in the tables below. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

In addition, the monitoring provisions in the tools referred to in this methodology apply.

Monitoring electricity flows in the new transmission line

The amount of electricity inflow and outflow in both grids through the new transmission line(s) shall be monitored on an hourly basis. Any measurement equipment shall be calibrated according to QA/QC methods required by the national standards to assure its accuracy.

The hourly electricity transmission records through the new transmission line(s) shall be cross-checked with official national records (e.g. from the utility or energy ministry).

Electricity transmitted through the new lines shall be monitored through direct measurement of electricity, through continuous registers in in/out terminals and cross-checked with receipts of electricity purchased and/or compared with official data imports and exports reports. In addition, an extra checking can be done by comparing both grids' official electricity trade reports.

Project participants shall obtain records of failure events registered in the existing lines and their duration from official sources.

All data required for calculation of the grid emission factor according to the tool to calculate the emission factor for an electricity system must be monitored.

Data and parameters monitored

Data / parameter:	$INE_{exp,measured,y}$
Data unit:	MWh
Description:	Net amount of electricity received in the exporting electricity system, measured in the new line in year y
Source of data:	On site electricity meter
Measurement procedures (if any):	Part of the standard monitoring process at interconnection facilities. Shall be measured at substation(s) within the boundary of the exporting electricity system where it connected to the transmission line(s).
Monitoring frequency:	Continuously
QA/QC procedures:	Registered and cross-checked with receipts of electricity purchase or official data.
Any comment:	The beginning (points of connection to the exporting electricity system) and the end (points of connection to the importing electricity system) of the transmission lines shall be identified. Electricity received in the exporting electricity system is measured at the beginning of the transmission line (with losses)

Data / parameter:	$INE_{imp,measured,y}$
Data unit:	MWh
Description:	Net amount of electricity received in the importing electricity system, measured in the new line in year y
Source of data:	On site electricity meter
Measurement procedures (if any):	Part of the standard monitoring process at interconnection facilities. Shall be measured at substation(s) within the boundary of the importing electricity system where it connected to the transmission line(s).
Monitoring frequency:	Continuously
QA/QC procedures:	Registered and cross-checked with receipts of electricity purchase or official data.
Any comment:	The beginning (points of connection to the exporting electricity system) and the end (points of connection to the importing electricity system) of the transmission lines shall be identified. Electricity received in the importing electricity system is measured at the end of the transmission line (with losses)

Data / parameter:	$INE_{exist,exp,measured,y}$
Data unit:	MWh
Description:	Net amount of electricity received in the exporting electricity system from the importing electricity system, measured in the existing lines in year y (MWh)
Source of data:	Official sources
Measurement procedures (if any):	Part of the standard monitoring process at interconnection facilities.
Monitoring frequency:	Continuously
QA/QC procedures:	Checked by comparison of imports and exports reports of both grids
Any comment:	

Data / parameter:	$OUTE_{exp,y}$
Data unit:	MWh
Description:	Amount of electricity generated and sent from the exporting electricity system because of the project activity in year y
Source of data:	On site electricity meter
Measurement procedures (if any):	Part of the standard monitoring process at interconnection facilities. Shall be measured at substation(s) within the boundary of the exporting electricity system where it connected to the transmission line(s).
Monitoring frequency:	Continuously
QA/QC procedures:	Registered and cross-checked with receipts of electricity purchase or official data.
Any comment:	The beginning (points of connection to the exporting electricity system) and the end (points of connection to the importing electricity system) of the transmission lines shall be identified. Electricity received in the importing electricity system is measured at the beginning of the transmission line (without losses)

Data / parameter:	$OUTE_{imp,measured,y}$
Data unit:	MWh
Description:	Net amount of electricity supplied from the importing electricity system to the exporting electricity system, measured in the new line in year y
Source of data:	On site electricity meter
Measurement procedures (if any):	Part of the standard monitoring process at interconnection facilities. Shall be measured at substation(s) within the boundary of the exporting electricity system where it connected to the transmission line(s).
Monitoring frequency:	Continuously
QA/QC procedures:	Registered and checked with receipts of electric energy purchase or official data.
Any comment:	The beginning (points of connection to the exporting electricity system) and the end (points of connection to the importing electricity system) of the transmission lines shall be identified. Electricity received in the exporting electricity system is measured at the end of the transmission line (without losses)

Data / parameter:	$OUTE_{imp-other,y}$
Data unit:	MWh
Description:	Amount of electricity sent from the importing electricity system to the third party electricity system in the year y
Source of data:	Official sources
Measurement procedures (if any):	Part of the standard monitoring process at interconnection facilities.
Monitoring frequency:	Continuously
QA/QC procedures:	Checked by comparison of national imports and exports reports of both grids
Any comment:	

Data / parameter:	$OUTE_{exist,imp,measured,y}$
Data unit:	MWh
Description:	Net amount of electricity supplied to the exporting electricity system from the importing electricity system, measured in the existing lines in year y
Source of data:	Official sources
Measurement procedures (if any):	Part of the standard monitoring process at interconnection facilities.
Monitoring frequency:	Continuously
QA/QC procedures:	Checked by comparison of national imports and exports reports of both grids
Any comment:	

Data / parameter:	$EG_{z,y}$
Data unit:	MWh
Description:	Electricity generation from hydro power unit *z* with the power density between 4 and 10 W/m^2 in year y
Source of data:	Official sources
Measurement procedures (if any):	N/A – taken from reported sources
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$M_{SF6,m}$
Data unit:	-
Description:	The average quantity of SF_6 emitted from equipment installed under the project activity during the monitoring period *m*
Source of data:	Supplier receipts and purchase records
Measurement procedures (if any):	Extra amount of SF_6 injected in the equipments to maintain their operation standards each year
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / parameter:	$CAP_{NL,y}$
Data unit:	MW
Description:	Theoretical maximum capacity of the new transmission line in year y
Source of data:	Company owner of the line
Measurement procedures (if any):	Capacity is net of losses determined in the design of the transmission line
Monitoring frequency:	Annually
QA/QC procedures:	Cross check with invoices or sales receipts
Any comment:	

Data / parameter:	$LOAD_{max,y}$
Data unit:	MW
Description:	Maximum system load in the exporting electricity system (excluding the project exports) in the year y
Source of data:	Official sources
Measurement procedures (if any):	Reported from national utility or government authority.
Monitoring frequency:	Annually
QA/QC procedures:	N/A
Any comment:	Note that this includes exports to any third countries from the exporting electricity system but it excludes the load from the project transmission line.Information to be obtained from official sources

Data / parameter:	$CAP_{exp,y}$
Data unit:	MW
Description:	Installed power capacity in the exporting electricity system in the year y
Source of data:	Official sources
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	N/A
Any comment:	Information to be obtained from official sources

To calculate the Adapted Simple OM for exporting electricity system

Data / parameter:	$EG_{m,y}$
Data unit:	MWh
Description:	Net amount of electricity generated and delivered to the grid by power unit *m* in year y
Source of data:	Official sources
Measurement procedures (if any):	N/A – taken from reported sources
Monitoring frequency:	Annually
QA/QC procedures:	N/A (as per "*Tool to calculate the emission factor for an electricity system*")
Any comment:	Used for calculation of "adapted" simple OM for exporting electricity system

Data / parameter:	$FC_{i,m,y}$
Data unit:	mass or volume unit
Description:	Amount of fuel type *i* consumed by power unit *m* in year y
Source of data:	Official sources
Measurement procedures (if any):	N/A – taken from reported sources
Monitoring frequency:	Annually
QA/QC procedures:	N/A (as per "*Tool to calculate the emission factor for an electricity system*")
Any comment:	Used for calculation of "adapted" simple OM for exporting electricity system

<table>
<tr><td>Data / parameter:</td><td>$NCV_{i,y}$</td></tr>
<tr><td>Data unit:</td><td>GJ / mass or volume unit</td></tr>
<tr><td>Description:</td><td>Net calorific value (energy content) of fuel type i in year y</td></tr>
<tr><td>Source of data:</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><td>Data source</td><td>Conditions for using the data sour</td></tr>
<tr><td>Values provided by the fuel supplier of the power plants in invoices</td><td>If data is collected from power pla operators (e.g. utilities)</td></tr>
<tr><td>Regional or national average default values</td><td>If values are reliable and documented in regional or nationa energy statistics / energy balances</td></tr>
<tr><td>IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td></td></tr>
</table></td></tr>
<tr><td>Measurement procedures (if any):</td><td>N/A – taken from reported sources</td></tr>
<tr><td>Monitoring frequency:</td><td>Annually</td></tr>
<tr><td>QA/QC procedures:</td><td>N/A (as per “Tool to calculate the emission factor for an electricity system”)</td></tr>
<tr><td>Any comment:</td><td>The gross calorific value (GCV) of the fuel can be used, if gross calorific values are provided by the data sources used. Make sure that in such cases also a gross calorific value basis is used for CO2 emission factor</td></tr>
</table>

Data / parameter:	$EF_{CO2,i,y}$ and $EF_{CO2,m,i,y}$
Data unit:	t CO_2/GJ
Description:	CO_2 emission factor of fuel type *i* in year y
Source of data:	The following data sources may be used if the relevant conditions apply: Data source — Conditions for using the data sour Values provided by the fuel supplier of the power plants in invoices — If data is collected from power pla operators (e.g. utilities) Regional or national average default values — If values are reliable and documented in regional or nationa energy statistics / energy balances IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories —
Measurement procedures (if any):	N/A – taken from reported sources
Monitoring frequency:	Once per crediting period
QA/QC procedures:	N/A (as per "*Tool to calculate the emission factor for an electricity system*")
Any comment:	

Data / parameter:	$\eta_{m,y}$
Data unit:	%
Description:	Average net energy conversion efficiency of power unit *m* in year y
Source of data:	Use either: • Documented manufacturer's specifications (if the efficiency of the plant is not significantly increased through retrofits or rehabilitations); or • Data from the utility, the dispatch center or official records if it can be deemed reliable; or • The default values provided in the table in Annex 1 of the "*Tool to calculate the emission factor for an electricity system*" (if available for the type of power plant)
Measurement procedures (if any):	N/A – taken from reported sources
Monitoring frequency:	Once for the crediting period
QA/QC procedures:	If the data obtained from the manufacturer, the utility, the dispatch center of official records is significantly deviate from the default value provided in Annex 1 of the "*Tool to calculate the emission factor for an electricity system*" for the applicable technology, project proponents should assess the reliability of the values, and provide appropriate justification if deemed reliable. Otherwise, the default values shall be used.
Any comment:	

IV. REFERENCES AND ANY OTHER INFORMATION

Not applicable.

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History of the document

<table>
<tr><th>Version</th><th>Date</th><th>Nature of revision(s)</th></tr>
<tr><td>01.0</td><td>21 September 2012</td><td>EB 69, Annex #
To be considered at EB 69.</td></tr>
<tr><td colspan="3">Decision Class: Regulatory
Document Type: Standard
Business Function: Methodology</td></tr>
</table>