CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: MONITORING (CDM-NMM)
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SECTION A. Identification of methodology

A.1. Title of the proposed methodology:

Improved Efficiency of Electrical Power System Generation Efficiency through Advanced SCADA Control Systems and Related Energy Management Protocol

A.2. List of category(ies) of project activity to which the methodology may apply:

3- Energy Efficiency

A.3. Conditions under which the methodology is applicable to CDM project activities:

The methodology applies:

- To electrical power systems that lack advanced SCADA and Related Energy Management Software controls on their power distribution network
- To electrical power systems that utilize fossil fuels in at least part of their generation capacity
- Only efficiency improvements in generation units that were online as of the baseline year
- Only to those power generation units that have not undergone upgrades that would significantly change kcal/kWh efficiency levels during the duration of the project.
- Only where accurate data is available to measure the efficiency improvements

A.4. What are the potential strengths and weaknesses of this proposed new methodology?

Strengths

The methodology is simple. It provides a clear transparent overview of the efficiency gains due to improved electrical system operation due to the enhanced data acquisition and controls provided by modern SCADA systems and related energy management protocol. The methodology is set up to ensure any discrepancies in emissions reduction accuracy err on the conservative side. It also has a heavy reliance on monitoring using very accurate data.

Weaknesses

Because of the complexity of electrical power systems, the methodology cannot interpret the likely savings of the SCADA system on new power generation capacity added during the course of the project. There will also be better data after the SCADA system is operational than before, so the monitoring data will typically be of better quality than baseline data.

SECTION B. Proposed new monitoring methodology

B.1. Brief description of the new methodology:

Dispatch systems are responsible for determining how the demand on a given electricity grid is going to be met by the various generation units connected to the grid and how the electricity is moved through the transmission system. Given that most grids operate with a wide variety of plants with different generation methods, capacities and efficiencies, the overall efficiency of operation of the entire system will be determined by how efficient the grid's dispatch system operates. Optimizing the an electricity grid's dispatch system will allow the generating units to operate under closer to optimal conditions thereby increasing their efficiency and reducing input consumption per kWh produced. SCADA systems and associated software also can help reduce technical line losses by better managing the existing transmission system. The reduction of fossil fuel inputs required to deliver the same amount of electricity can be directly translated into fossil fuels saved per kWh produced.

In a very simplistic example with four generating units of equal engineered capacity, if the dispatch system can allow the two most efficient generating units to operate at 100% capacity (close to their optimal operation point) rather than having four generating units operating at 50% capacity the same kWh will likely be produced using significantly less fuel.

Supervisory Control and Data Acquisition systems (SCADA) systems and associated energy management software when utilized in conjunction with a power dispatch system can greatly optimize the operation of the entire system. The data collection and the real time control systems that are typical of modern SCADA systems can allow operators to determine the most efficient combination of generation options at under every operation condition.

The SCADA system will be its own monitoring system. Installing the SCADA in a grid will involve installing and calibrating meters and gathering a year of baseline data. The meters will then be attached to the control system that includes a system optimization module. This will then begin to optimize the system operations and directly track the progress in real time on a generation unit by generation unit basis.

B.2. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario:

B.2.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:

There will be no project emissions from installing a SCADA system.

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

B.2.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

There will be no project emissions from installing a SCADA system.

B.2.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of greenhouse gases (GHG) within the project boundary and how such data will be collected and archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

A-1	*Generation efficiency data given level of kWh delivered through transmission system*	*Measured at each thermal generation unit at each level of kWh delivered*	*Kcal/kWh*	*m*	*hourly*	*100%*	*electronic*	*The SCADA system will gather and archive this data*
A-2	*Total Delivered electricity through the transmission system*	*Measured at each end point of the transmission system and totaled*	*kWh*	*m*	*hourly*	*100%*	*electronic*	*The SCADA system will gather and archive this data*
A-3	*Carbon content of fuel used*	*Measured quantities for each fuel from delivery specifications or IPCCC*	*Kg CO2/Kcal and kg CO2 per liter, m3, etc.*	*m*	*constant*	*100%*	*electronic*	*The project developer will gather and archive this data in cases where better data exists, otherwise IPCC data may be used to determine carbon content for fuels.*
A-4	*Heat content of fuel used*	*Measured or from delivery specifications*	*Kcal/liter of fuel oil, Kcal/m3 of gas, kcal/tonne of coal etc.*	*m*	*Constant*	*100%*	*electronic*	*Each fuel will have a known energy content per unit*
A-5	*Total amount of each fuel type used*	*Measured at each thermal generation unit*	*Liters of fuel oil or m3 of gas, etc.*	*m*	*hourly*	*100%*	*electronic*	
A-6	*Total amount of non-fossil fuel based generation*	*Measured at generation site*	*kWh*	*m*	*hourly*	*100%*	*electronic*	*The SCADA system will gather and archive this data*

A-7	*Total Amount of electricity generated from new or significantly upgraded Fossil Fuel generation*	*Measured at generation site*	*kWh*	*m*	*hourly*	*100%*	*electronic*	*The SCADA system will gather and archive this data*
A-8	*Carbon Emissions Factor*	*Derived from data in A-3,A-4,A-5*	*Kg CO2/kWh*	*c*	*hourly*	*100%*	*electronic*	*The SCADA system will gather and archive this data*

B.2.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

The project is designed to improve the system-wide efficiency of the electricity system by better utilizing the generation capacity and reducing line losses through better management data and tools. The Supervisory Control and Data Acquisition (SCADA) and associated energy management software system will allow the cumulative kcal per unit of electricity generated and delivered through the transmission system up to the distribution system to decrease across the system. This will be the case, because load is being better managed to maximize the efficiency of generation from the given array of generation units and i^2r losses can be minimized by maintaining a better voltage profile in existing transmission system. The efficiency factor of total kWh delivered to metered distribution points per total kcal expended is used because it captures improvements in efficiency at both the generation point and reduction in lines losses resulting from the SCADA system. This efficiency ratio will be measured at each level kWh of delivery in the baseline year so that it can be compared to data in the project year at the same point of delivery.

For example, in the baseline year .3 million kcal/MWh are required to deliver 1000 MWh to the terminal points of the transmission system. If in the post-project year to deliver the same amount of electricity to the end of the transmission system only takes .291million kcal/MWh, it will be clear there has been a three percent efficiency improvement in the system's ability to deliver 1000MWh. This improvement will be from some combination of reduced line losses and increased fossil based generation efficiency due to the SCADA system.

In order to ensure the accuracy of the emission reductions, the baseline will change on an annual basis based on the given CO2 content of the fuel and will be measured on an hourly basis to allow the project developer to compare the thermal system efficiency at a given amount of kWh

delivered to the transmission system from the base line year with the improved efficiency of the system at the same demand point in the project year. Renewable loads and new thermal generation brought on after the initiation of the project will not be included in order to isolate the direct effect of the project and be extremely conservative. That is the delivery amount will equal total delivered minus any non-thermal generation measured at point of generation and any units installed or significantly rehabilitated after the start of the project. The methodology will account for changes in fuel throughout a given year using the kgCO2/kcal figure which will be determined by the average CO2 content per kcal of fuel based on type and relative quantities of fuels used.

The baseline emissions for year x is determined for each hour in year x by multiplying the power supplied to the end of the transmission system for that hour measured in kWh by the average efficiency of the thermal units in the baseline for that same demand point measured in kcal/kWh. The sum of this calculation performed for all the hours in a given year is a measure of the total kilocalories that would have been expended in the project year given the same level of efficiency in the generation as the baseline year. This number is then multiplied by the carbon coefficient for the project year measured in kg CO2/ kcal to get a total carbon emissions in year x for the baseline scenario.

Baseline Emissions in year x equals

$$\sum_{i_x=1}^{8760} (D_{i\ year\ x} * kcal/kWh_{Di\ year\ 0}) * kgCO2/kcal_{i\ year\ x}$$

Where

i = Given hour in a year

Di=Total fossil fuel generated electricity delivered in kWh at given hour i where total fossil-based electricity equals total measured electricity delivered through the transmission system minus the total non-fossil generation measured at the site of generation and total generation from significantly upgraded generation units

$Kcal/kWh_{Di\ year\ 0}$ = an efficiency factor for the fossil fuel based load at the given delivered amount in hour i (Di) as found in the baseline year

Year x= given project year being compared to baseline

Year 0= baseline year

B.3. Option 2: Direct monitoring of emission reductions from the project activity:

N/A

B.3.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

B.3.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

N/A

B.4. Treatment of leakage in the monitoring plan:

There will be no significant leakage form installing meters and control systems. The SCADA installation is not a large, capital-intensive project with substantial environmental impacts (like power plant construction). In terms of dispatch efficiency, the environmental gains should only be positive. In other words it is not expected that dispatch efficiency improvements would lead to greater fossil fuel use or inefficiencies in any other part of the grid.

B.4.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity:

Not applicable

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

B.4.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

NA

B.5. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

The project is designed to improve the system-wide efficiency of the electricity system by better utilizing the generation capacity and reducing line losses through better management data and tools. The Supervisory Control and Data Acquisition (SCADA) system will allow the cumulative kcal per unit of electricity generated and delivered through the transmission system up to the distribution system to decrease across the system. This will be the case, because load is being better managed to maximize the efficiency of generation from the given array of generation units and i^2r losses can be minimized by maintaining a better voltage profile in the existing transmission system. The efficiency factor of total kWh delivered to metered distribution points per total kcal expended is used because it captures improvements in efficiency at both the generation point and reduction in lines losses resulting from the SCADA system.

For example, in the baseline year .3 million kcal/MWh are required to deliver 1000 MWh to the terminal points of the transmission system. If in the post-project year to deliver the same amount of electricity to the end of the transmission system only takes .291million kcal/MWh, it will be clear there has been a three percent efficiency improvement in the system's ability to deliver 1000MWh. This improvement will be from some combination of reduced line losses and increased generation efficiency due to the SCADA system.

In order to ensure the accuracy of the emission reductions, the calculations will be measured on an hourly basis to allow the project developer to compare the thermal system efficiency at a given amount of kWh delivered to the transmission system from the base line year with the improved efficiency of the system at the same demand point in the project year. Renewable loads and new thermal generation brought on after the initiation of the project will not be included in order to isolate the direct effect of the project and be extremely conservative. That is the delivery amount will equal total delivered minus any non-thermal generation measured at point of generation and any units installed or significantly rehabilitated after the start of the project. The methodology will account for changes in fuel throughout a given year using the kgCO2/kcal figure which will be determined by the average CO2 content per kcal of fuel based on type and relative quantities of fuels used.

The actual emissions for year x is determined for each hour in year x by multiplying the power supplied to the end of the transmission system for that hour measured in kWh by the average efficiency of the thermal units for that same demand point measured in kcal/kWh. The sum of this calculation performed for all the hours in a given year is a measure of the total kilocalories expended in the project year. This number is then multiplied by the carbon coefficient for the project year measured in kg CO2/ kcal to get a total carbon emissions in year x. This should equal the combined total of each fossil fuel consumed multiplied by the relevant CO2 emissions factor for that fuel.

Actual Emissions in year x equals

$$\sum_{i_x=1}^{8760} (D_{i\ year\ x} * kcal/kWh_{Di\ year\ x}) * kgCO2/kcal_{i\ yearx}$$

Where
i = Given hour in a year
Di=Total fossil fuel generated electricity delivered in kWh at given hour i where total fossil-based electricity equals total measured electricity delivered through the transmission system minus the total non-fossil generation measured at the site of generation and total generation from significantly upgraded generation units
Kcal/kWh $_{Di\ year\ x}$ = an efficiency factor for the fossil fuel based load at the given delivered amount in hour i (Di) as found in the project year
Year x= given project year being compared to baseline

This should equal

$$\sum_{Fuel_x=1}^{n} \left(\text{total kcal fuel}_x \text{ consumed in year x} * \text{kgCO2/kcal}_{fuelx}\right)$$

Where
$Fuel_x$ = the types of fossil fuel used in year x
Year x = project year
n= number of different fossil fuels consumed

The emissions reductions are simply calculated as the difference between Baseline Emissions calculated for year x and Actual Emissions calculated for year x.

$\text{Baseline Emissions}_x - \text{Actual Emissions}_x = \text{Emissions Reductions}_x$

B.6. Assumptions used in elaborating the new methodology:

In cases where better data does not exist, the carbon content of the fuel will be determined by IPCC data sources.

B.7. Please indicate whether quality control (QC) and quality assurance (QA) procedures are being undertaken for the items monitored:

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
A-1	*L*	*The SCADA system will provide highly accurate data.*
A-2	*L*	*The SCADA system will provide highly accurate data*
A-3	*L*	*Based on sales data that can easily be tested or IPCCC defaults*

A-4	*L*	*Based on specifications at delivery can be easily tested*
A-5	*L*	*Based on delivery and sales data*
A-6	*L*	*The SCADA system will provide highly accurate data*
A-7	*L*	*The SCADA system will provide highly accurate data*
A-8	*L*	*Data will be calculate using highly accurate data from SCADA system and IPCCC defaults as appropriate*

B.8. Has the methodology been applied successfully elsewhere and, if so, in which circumstances?

SCADA systems have been applied in other places and the efficiency benefits from the systems have been quantified. No CDM project has been attempted using this methodology.

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