CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: MONITORING (CDM-NMM)
Version 01 - in effect as of: 1 July 2004

CONTENTS

SECTION A. Identification of methodology

A.1. Title of the proposed methodology:

Monitoring generation, storage and stabilization, and supply of waste gases from steel manufacturing operations to generate thermal power plant(s).

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

✓ The project activity is applicable to 'Category 9, metal production', as per sectoral scope. In the absence of an appropriate project category definition, a new project category may be considered titled *"Process waste gas recovery and combustion for electricity generation in grid connected power plants"*.

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

- Waste gases would have been flared in the absence of the project activity;
- Waste gas composition and heat containing characteristics are measurable;
- Part of the waste gases generated during the steel manufacturing operations are used for meeting internal heating requirements within the steel manufacturing industry; and
- Project activity will not induce diversion of waste gases required for internal usage for generation of power and replacing the shortfall with other energy sources.

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

Potential Strengths

1. Availability of data from project based on the methodology adopted is very high.
2. Cost effective.
3. Potential to demonstrate conservativeness is high.
4. Consistency is high.
5. Reproducibility is high.

Potential Weakness

1. Not applicable to grids with surplus power, unless cost of generation and supply is favourable for inter-grid transfers.
2. Potential for bias in decision taking process pertaining to inclusion/ exclusion of units in the Operating Margin Method.
3. Conservativeness of the methodology shall have to be assessed on a grid-to-grid basis.
4. Representative character of the Build Margin component is uncertain since future developments need not always follow the historical trend based on policy decisions at government level, and the Build Margin do not capture such uncertainties.

5. There could be lack of adequate data for similar waste gas generating projects[1].

SECTION B. Proposed new monitoring methodology

B.1. Brief description of the new methodology:

The new monitoring methodology includes the monitoring and verification (M&V) protocol for actual GHG reductions as per a fixed project baseline. Therefore, the implementation of the monitoring methodology includes developing appropriate methods for data collection and interpretation, with specific focus on technical / efficiency / performance parameters. The baseline and project data that the monitoring methodology will verify are mentioned below.

Data for 'fuel replacement' component of Baseline Emission calculation:

1. Monthly 'Waste Gas Consumption' of during year 'y' (in SCM),
2. Monthly 'Gross Calorific Value' for waste gas (in kCal/ SCM), based on average daily values,
3. Monthly 'Heat Rate' for waste gas (in kCal/kWH), based on average daily values, and
4. Emission Factor of GHG intensive fuel to be replaced by use of waste gases as per IPCC (in tCO_2 / GWh).

Data for 'electricity supplied to grid' component of Baseline Emission calculation:

1. Electricity (GWh) delivered to the grid by source j, and
2. Emission Factor as per IPCC for CO_2 from fuel i (tCO_2 / GWh) at power sources j.

Data for Project Emission calculation:

1. Actual quantity of waste gas available for use in power generation,
2. Minimum quantity of waste gases that were generated in the steel manufacturing industry during the last 3 years or any other smaller duration in case of recently stabilized manufacturing operations,
3. Minimum quantity of waste gases that were flared in the steel manufacturing industry during the last 3 years or any other smaller duration in case of recently stabilized manufacturing operations, and
4. Average amount of waste gases that were used for meeting the internal requirements of all waste gas generators (in similar steel manufacturing sector) in the region or country during the last 3 years or any other smaller duration in case of recently stabilized manufacturing operations.

[1] There are only three COREX process based steel manufacturing units in the world.

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:

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
W	Actual quantity of waste gas available for use in power generation	Records from power plant generator and waste gas generator	SCM	m	Annual	Daily	Electronic or paper	--
X	Minimum quantity of waste gases that were generated in the steel manufacturing industry	To be estimated as per monitored project data	SCM	e	Annual	Last 3 years or any other smaller duration in case of recently stabilized manufacturing operations	Electronic or paper	--
Y	Minimum quantity of waste gases that were flared in the steel manufacturing industry	To be estimated as per monitored project data	SCM	e	Annual	Last 3 years or any other smaller duration in case of recently stabilized manufacturing operations	Electronic or paper	--
Z	Average amount of waste gases that were used for meeting the internal equirements of all waste gas generators in	To be estimated as per monitored project data	SCM	e	Annual	Last 3 years or any other smaller duration in case of recently stabilized manufacturing operations	Electronic or paper	--

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:

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
	similar steel manufacturing sector) in the region or country							

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

<u>Calculation of Correction Factor for eligible gas quantity in emission reduction</u>

Let the project activity result in availability of waste gas quantity 'W' for use in power generation. The following steps need to be followed to compute emission reduction.

Let 'X' be the minimum quantity of waste gases that were generated in the steel manufacturing industry during the last 3 years or any other smaller duration in case of recently stabilized manufacturing operations.

Let 'Y' be the minimum quantity of waste gases that were flared in the steel manufacturing industry during the last 3 years or any other smaller duration in case of recently stabilized manufacturing operations.

Let 'Z' be the average amount of waste gases that were used for meeting the internal requirements of all waste gas generators (in similar steel manufacturing sector) in the region or country during the last 3 years or any other smaller duration in case of recently stabilized manufacturing operations.

Quantity of excess waste gas available for (i) flaring or (ii) flaring and delivery to power plants = (X – Z).

Correction Factor (CF) for gas quantity eligible for emission reduction = Minimum[(X-Z), Y, W] / W…………(1)

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
$Q_{i,y}$	Monthly 'Waste Gas Consumption' during year 'y'	Existing Project records at power generator using waste gases	SCM	m	Annual	3 years data	Electronic or paper	If 3 years data is not available then consider a smaller period not less than 1 year.
GCV_i	Monthly 'Gross Calorific Value' for waste gas based on average daily values	Existing Project records of power generator using waste gases	kCal/ SCM	e	Monthly	3 years (36 months) data	Electronic or paper	If 3 years data is not available then consider a smaller period not less than 1 year. Based on 95% confidence level of average available monthly values.
HR_i	Monthly 'Heat Rate' for waste gas (in), based on average daily values	Existing Project records at power generator using waste gases	kCal/kWH	e	Monthly	3 years (36 months) data	Electronic or paper	If 3 years data is not available then consider a smaller period not less than 1 year. Based on 95% confidence level of average available monthly values.

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
$GEN_{j,y}$	Electricity delivered to the grid by source j	Published data from Electricity Boards or Control Authorities	GWh	c	Annual	Annual	electronic	--
$GEN_{m,y}$	Monitored installed capacity of power plants connected to the grid to which power generator will be contributing	Published data from Electricity Boards or Control Authorities	GWh	c	Annual	Annual	electronic	--

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

Baseline I: Replacing GHG intensive fuel with waste gases

The baseline emission will depend on quantities of waste gases combusted at the power plant(s) as replacement of GHG intensive fuel. The methodology for calculation of baseline for fuel replacement scenario will be as per the following algorithm.

$MPO_{i,y} = Q_{i,y} * GCV_i / HR_i$……………………………………………………………………….(2.1)

$TPO_y = S\ MPO_{i,y}$………………………………………………………………………………….(2.2)

$Baseline\ I = EF\_IPCC * TPO_y$…………………………………………………………………….(2)

Baseline II: Replace/ avoid/ delay equivalent amount of electricity supplied to the grid

'Average Operation Margin' calculations

The average OM emission factor ($EF_{OM,Average,y}$) is to be calculated as the average emission rate of all power plants, including low-operating cost and must-run power plants, using equation (2.1) below. A 3-year average data vintage, based on the most recent statistics available at the time of PDD submission, is to be considered.

$EF_{OM,Average,y} = S\ (GEN_{j,y} * EF\_IPCC_{i,j}) / S\ GEN_{j,y}$…………………………………………………………...(3)

Build Margin calculations

This is calculated as the generation-weighted average emission factor (tCO_2/GWH) of a sample of power plants, as per the following algorithm:

$EF_{BM,,y} = S\ (GEN_{m,\ y} * EF\_IPCC_m) / S\ GEN_{m,y}$……………………………………………………………...(4.1)

where, EF_IPCC_m and $GEN_{m,y}$ are analogous to the variables described for the average OM method earlier for plants *m.* The sample group *m* consists of either:

- five power plants that have been built most recently [including plants under construction], or
- power plants capacity additions in the electricity system that comprise 20% of the system generation (in *GWH*) and that have been built most recently [including plants under construction].

Considering equal weightage for both OB and BM, the baseline emission factor by average CM in any year y, is calculated as,

$EF\_BL_{CM,y} = EF_{OM,Average,y} + EF_{BM,,y}$……………………………………………………...………...(4.2)

Baseline II (in tCO_{2equ})
$= EF\_BL_{CM,y}$ * *Average annual power generated (GWh) during last 3 years operation*…………..…(4)

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

Not applicable

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.):

>> Not applicable.

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

The potential leakages are built into the monitoring plan for project emissions as mentioned in B.5.

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:

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.):

The potential leakages are built into the monitoring plan for project emissions as mentioned in B.5.

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.):

Step 1: Emission reduction during any year 'y' in existing power plant where only fuel replacement occurs

*$ER_y(1)$ = Baseline I * CF - PE_y*……………………………………………………………………..(5)

Step 3: Emission reduction in existing power plant during any year 'y' where only fuel replacement occurs alongwith additional power generation

$ER_y(2)$ = (Baseline I + Baseline II) CF - PE_y*…………………………………………………..(6)

Step 4: Emission reduction in a greenfield power plant during any year 'y' connected to the grid or approximate emission reduction in an existing power plant where fuel replacement has not yet started (i.e., tentative emission calculations prior to start of project activity)

$ER_y(3)$ = Baseline II CF - PE_y*…………………………………………………………………...(7)

Step 5: If more than one of steps 2, 3 or 4 occurs by distributing the available waste gas during any year 'y' connected to the grid

*$ER_y(4)$ = S ($Baseline_i$ * CF_i) - PE_y*,…………………………………………………………….(8)

where, the monitored gas volumes to individual plants will be used for calculating CF_i.

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

- Emission Factor of fuel replaced will be as per IPCC recommended values;
- All other data required for baseline emission calculation will be from available published data from Public sources in the Host Country; and
- Vintage of project data is last 36 months of operation of the steel manufacturing project or less if the plant has not stabilized.

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.
W	Low	The monitoring needs to be regularly checked as part of ISO 9001: 2000 or other quality management system of the industry undertaking the project activity. Thus, QC/QA for the measurement is part of the existing system. Hence, separate QC/QA procedures may not be necessary.
X	Low	Same as above.
Y	Low	Same as above.
Z	Low	Same as above.
$Q_{i,y}$	Low	Same as above.
GCV_i	Low	Same as above.
HR_i	Low	Same as above.
$GEN_{j,y}$	Low	These data are from available public reports obtained from regulatory authorities.
$GEN_{m,y}$	Low	Same as above.

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

This is a new monitoring methodology proposed for steel manufacturing units generating waste gases that may be utilized to generate thermal power. It has been applied to two representative cases: (1) waste gas from steel manufacturing unit using COREX process of Jindal Vijayanagar Steel Limited in India, and (2) waste gases from BOF process for the same industry.

- - - - -