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:

Avoiding flaring of waste gases from steel manufacturing operations and its utilization for substituting GHG intensive fuel in power generating units and/ or generating power to supply to grid.

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:

- the methodology is applicable to steel production plants (existing, newly constructed or both) using basic oxygen furnace (BOF) route where part of the waste gases in the facility is normally[1] used (or would have been used) for internal heating requirements, and the remaining waste gases were being (or would have been) flared;
- project activity does not induce diversion of waste gases required for internal usage;
- proposed project activity does not result in integrated process change, except for possible associated changes due to use of waste gases for electricity generation~~rs~~;
- there are neither local regulations~~/ programmes~~ to constrain use of GHG intensive fuels (like coal) nor restrict flaring ~~any regulation making use~~ of waste gases ~~mandatory~~;
- waste gas is supplied to partially replace existing/ planned fuel use in existing/ new power plant or a new power plant facility solely based on use of waste gas or a combination of all the above; and
- there are only two possible alternatives: continued flaring of excess waste gases over and above the internal consumption, or its use for power generation~~;~~
- ~~project activity results in supply of electricity to local grids that do not have surplus power, unless cost of generation and supply makes exports to other grids attractive~~.

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.

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[1] A project activity considered for CDM applicability to identify and define areas where waste gases are and will be used for meeting internal requirements as standard practice in the steel industry following similar BOF route.

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. Cannot calculate leakage emissions due to use of fuel displaced by the project activity, if the use of the same is not directly attributable to the project activity.
6. There could be lack of adequate data for similar waste gas generating projects.

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 as mentioned under the corresponding proposed baseline methodology called "Avoiding flaring of waste gases from steel manufacturing operations and its utilization for generating thermal power thereby substituting fuel and supplying to grid". 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:

- Amount of existing GHG intensive fuel consumed by a power plant in the project activity,
- Actual quantity of waste gas available for use in power generation,
- 'Gross Calorific Value' for waste gas used for power generation,
- 'Heat Rate' for power plant using waste gases,
- Percent auxiliary consumption at power plant.

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

- Actual electricity generation by plants in the operating margin,
- Representative plant load factors for plants in the operating margin,
- Installed capacity of plants in the operating margin,
- Net electricity generated/ delivered by any power plant that uses waste gases in the project activity,

- Electricity delivered to the grid by power plants in the connected grid in operating and build margins, and
- Amount of existing GHG intensive fuel consumed by the above power plants in the grid.

Data for Project Emission calculation:

- Quantity of waste gases that were generated in the steel manufacturing operations considered in the project activity during the last 3 years or any other smaller duration in case of recently stabilized manufacturing operations,
- Quantity of waste gases that were flared in the steel manufacturing operations considered in the project activity during the last 3 years or any other smaller duration in case of recently stabilized manufacturing operations, and
- Average amount of waste gases that were used for meeting the internal requirements in the steel manufacturing operations considered in the project activity during the last 3 years or any other smaller duration in case of recently stabilized manufacturing operations.

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
$W_{p,y}$	Annual quantity of waste gas available/ provided for use in power generation at power plant 'p' during year 'y'	Records from power plant generator and waste gas generator	SCM	m	Annual	Daily	Electronic or paper	No comments.

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

The project activity results in combustion of a quantity of excess waste gases in one or more power plants (existing and/or greenfield) instead of flaring. This means that the project activity does not normally cause any additional GHG emissions than those were already occurring in its absence, but causes a physical relocation of the emitting point(s).

Hence, the project emission **PEy** (in tCO2equ) during any year 'y' is zero.

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
$F_{x,p}$	Amount of existing GHG intensive fuel 'x' consumed by power plant 'p'	Existing Project records at power generator using waste gases	tonnes	m	Annual	Daily	Electronic or paper	No comments.
GCV	'Gross Calorific Value' for waste gas based on average daily values	Existing Project records of power generator using waste gases	kCal/ SCM	e	Annual	Monthly	Electronic or paper	No comments.
$HR_{p,y}$	'Heat Rate' for waste gas based on average daily values	Existing Project records at power generator using waste gases	kCal/ MWh	e	Annual	Monthly	Electronic or paper	No comments.
AUX	Auxiliary consumption at power plant	Existing Project records at power generator using waste gases	Percent	m	Annual	Annual	Electronic or paper	No comments.
AG	Actual generation of plants in the operating margin	Published government level official data	GWh	e	Annual	Annual	Electronic or paper	No comments.
IC	Installed capacity of plants in the operating margin	Published government level official data	MW	e	Annual	Annual	Electronic or paper	No comments.
PLF	Representative plant load factors for plants in the operating margin	Published government level official data	%	e	Annual	Annual	Electronic or paper	Previous 3 years data to be used.

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
$F_{i,j}$	Amount of existing GHG intensive fuel 'i' consumed by power plant 'j' in the grid	Existing Project records at power generator using waste gases	tonnes	m	Annual	Annual	Electronic or paper	No comments.
GEN_j	Electricity delivered to the grid by power plant 'j'	Published data from Electricity Boards or Control Authorities	GWh	e/ c	Annual	Annual	electronic	No comments.
GEN_m	Installed capacity addition to the grid by each project/ fuel type[2] 'm' added to the grid	Published data from Electricity Boards or Control Authorities	MW	e	Annual	Annual	electronic	5 years data
PLF_m	Typical plant load factors or electricity generation efficiency for each project/ fuel type 'm'	As per local country based publicly available data	%	e	Annual	Annual	electronic	5 years data

[2] 'm' types could be coal, natural gas, diesel, lignite, hydro, nuclear, etc., based capacity additions to the grid.

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
$NPO_{p,y}$	'Net electricity generated by waste gases' at power plant 'p' during year 'y'.	Existing Project records at power generator using waste gases or Receiver of power delivered by power plant	GWh	m/ e	Monthly	Annual	Electronic or paper	No comments.
$W_{p1,y}$	Quantity of waste gas available from/ provided by waste gas generator '1' during year 'y', to power generator 'p'	Existing Project records of power generator using waste gases or waste gas generator	SCM	m	Annual	Daily	Electronic or paper	No comments.
GCV_{p1}	Average 'Gross Calorific Value' for waste gas provided by waste gas generator '1'.	Existing Project records of power generator using waste gases or waste gas generator	kCal/ SCM	m	Annual	Daily	Electronic or paper	No comments.
$NPO_{p,y}$ (2)	Net electricity exported to grid by power plant in the project activity	Existing records of power plant or power purchasing grid	GWh	m	Daily	Annual	Electronic or paper	Lower among $NPO_{p,y}$ and $NPO_{p,y}$ (2) to be used in applying equation (11).

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 Emissions: Replacing GHG intensive fuel with waste gases

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

$Baseline\ I = \Sigma (BL\_IPCC_p)$……………………………………………………………………(1)

where, BL_IPCC_p is calculated as follows:

$BL\_IPCC_p = (F_{x,p} * COEF_x)$ ……………………………………………………….………...(2)

$COEF_x = NCV_x * CEF_x * OXID_x * (44/12)$ …………………………………………………(3)

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

The baseline emissions are calculated using combined margin methodology as per procedures provided in the baseline methodology. The rational for the same is that substitution of coal with excess BOF waste gases have not yet started in the project activity, and hence there is no data available to estimate/ monitor the extent of coal substitution with available excess BOF waste gases to generate equivalent quantity of heat. In the absence of the same, a conservative baseline emission rate is calculated with the combined margin component of the baseline only.

Least 'Merit Order' Operating Margin calculations (based on performance ratio)

The OM emission factor ($EF_{OM,y}$) is calculated as per the following procedure. The OM emission factor will be dynamic, i.e., can change annually for every crediting year. All the generating units contributing to the selected grid will be identified and data on their installed capacities, actual annual generation/ delivery to the grid and representative plant load factors (PLF) (average for previous 3 years prior to the project activity) will be obtained from published available data sources. Utilizing these data, the performance ratio of each plant will be calculated by applying following formula:

*Performance Ratio (PR) = AG / (IC * PLF)……(4)*

The PRs for all plants in the operating margin are analyzed to select the worst performers[3] (low performance ratio) who contributed about 10% of the total power generated in the grid in the operating year. The total power contributed by these plants will be ΣGEN_j (in GWh).

[3] Ranked in order (0 – 1, including fractional values).

To calculate CO_2 emission factor from each of these power plants, their annual power dispatch (GEN_j) is multiplied by the individual emission factor(s). The summation of CO_2 contributed by all plants provides the total CO_2 contributed by all the plants in the operating margin given as following, from which the operating margin is calculated.

$EF_{OM,y} = \Sigma (F_{i,j} * COEF_i) / \Sigma GEN_j$ ………………………………………………(5)

and

$COEF_i = NCV_i * CEF_i * OXID_i * (44/12)$ ……………………………………….………(6)

Build Margin calculations
This is calculated as the capacity addition-weighted average emission factor (tCO_2/GWh) of a sample of power plants recently added to the grid, as per the following algorithm:

$EF_{BM,,y} = \Sigma (3.6 * GEN_{m\%} * EF_m / PLF_m)$ …………………………………………………………(7)

$EF_m = CEF_m * OXID_m * (44/12)$ ………………………………………………………………………(8)

$GEM_{m\%} = GEN_m * 100 / \Sigma GEN_m$ ……………………………………………………………………(9)

The baseline emission factor in CM ($EF\_BL_{CM,y}$) during any year y, is calculated as,

$EF\_BL_{CM,y} = (w_{OM}*EF_{OM,,y} + w_{BM}*EF_{BM,,y}) / (w_{OM} + w_{BM})$………………………………(10)

where, w_{OM} and w_{BM} are the weightages in the operating and build margins, and $w_{OM} + w_{BM} = 1$.

A straight average[4] of the OM and BM has been taken to develop the CM.

Baseline II (in tCO_{2equ}) = $EF\_BL_{CM,y}$ * *Annual net electricity* (NPO_y) *generated by project activity* ……………………(11)

NPO_y value to be considered for calculating Baseline II in equation (2) will be lower of the following:

[4] Equal weightage have been provided to OM and BM, as default, in line with approved methodology ACM0002. Alternative weights can also be used, with appropriate justification.

(i) monitored value at the power plant(s); and

(ii) calculated value as per equations (3.3) and (3) below.

Calculation of Annual Net Electricity generated by Project Activity

The annual measure of net electricity generated at any power plant using excess waste gases will be calculated as per the following algorithm.

$MPO_{p,y} = W_{p,y} * GCV / HR_{p,y}$ ……………………………………………………………………(12)

$W = \Sigma W_{p,y}$ ……………………………………………………………………………….…………(13)

$NPO_{p,y} = MPO_{p,y} * (1 – AUX/100)$ ……………………………………………………….………(14)

$NPO_y = \Sigma NPO_{p,y}$ ……………………………………………………………………….…………(15)

In case there are more than one contributing sources of excess waste gases to a power generator, then the contribution of scenarios I and II components to the ‘baseline estimation’ relevant to each of such waste gas source would be computed using the following algorithm:

$BEC_1 = (W_{p1,y} * GCV_{p1}) / \Sigma (W_{p1,y} * GCV_{p1})$ ………………………………………………(16)

where:

Heat supplied by individual waste gas generator to any power plant ‘p’ = $(W_{p1,y} * GCV_{p1})$ …(17)

BEC_1 value will be 1 in case there is only one waste gas source to the power generator.

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
Not Applicable	Not Applicabl e	Not Applicable	Not Applicabl e	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

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:

>> Potential leakages could occur from use of any GHG intensive fuel(s) instead of waste gases for normal internal requirements, whereby the alternate GHG intensive fuel(s) is(are) used could emit CO_2. The leakage emissions (**LE_y**) due to such practices will be calculated as per algorithm provided under section B.4.2.

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
RM (if applicable to the steel manufacturing unit)	Annual quantity of GHG intensive raw material used in the steel manufacturin	Project data of steel manufacturin g operations	tonnes	m	Annual	Daily	Electronic/ paper	No comments.

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
	g operations							
PROD	Annual quantity of metal produced	Project data of steel manufacturing operations	tonnes	m	Annual	Daily	Electronic/ paper	No comments.
$Q_{ALT,y}$	Amount of alternate GHG intensive fuel(s) used for internal requirements in steel manufacturing operation in place of waste gases	Project data of steel manufacturing operations	tonnes	m	Annual	Daily	Electronic/ paper	No comments.

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

>> The potential leakage mentioned under section B.4 is calculated using the following formula:

$$LE_y = Q_{ALT,y} * NCV_{ALT} * CEF_{ALT} * OXID_{ALT} * (44/12) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (18)$$

The areas where waste gases are used for meeting internal heating requirements will be identified and checked for use of any other alternate fuel to divert waste gases to project activity. If any alternate fuel are used, then emissions due to use of such fuels will be included under lekage emission calculations, using equation (18).

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 total annual emission reductions would constitute one or more of the three components, as applicable to a project activity per details below.

Based on the usage pattern of the available excess waste gases, the total annual emission reductions would constitute one or more of the three components, as applicable to a project activity per details below.

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

$ER_y(1) = Baseline\ I * BEC_1 - PE_y - LE_y$…………………………………………………………….(19)

Component 2: Emission reduction in existing power plant during any year 'y' where fuel substitution occurs alongwith additional power generation

$ER_y(2) = (Baseline\ I + Baseline\ II) * BEC_1 - PE_y - LE_y$ ……………………………………………….(20)

Component 3: 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 substitution has not yet started (i.e., tentative emission calculations prior to start of project activity)

$ER_y(3) = Baseline\ II * BEC_1 - PE_y - LE_y$ …………………………………………………………..(21)

In the event that the project activity results in more than one of the above components occurring, by distributing the available excess waste gases to multiple power plants during any year 'y', the total emission reductions will be summation of appropriate components as described above

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

The power generators having opted for using waste gases will continue to use the same as fuel during the entire crediting period;
The steel industry in the project activity continues with same production technology over the crediting period;
All 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 operations 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.
$W_{p,y}$ *(Table B.2.1)*	Low	If the monitoring needs to be regularly checked as part of existing ISO 9001: 2000 or other quality management system (QMS) of the industry undertaking the project activity, QC/QA for the measurement would be part of the existing QMS; hence, separate QC/QA procedures may not be necessary. However, if such systems do not exist at a site where the project activity is undertaken, steps need to be taken to ensure that regular calibration of monitoring meters are conducted and all data maintained as per requirements of Table B.2.1.
$F_{x,p}$ *(Table B.2.3)*	Low	If the monitoring needs to be regularly checked as part of existing ISO 9001: 2000 or other quality management system (QMS) of the industry undertaking the project activity, QC/QA for the measurement would be part of the existing QMS; hence, separate QC/QA procedures may not be necessary. However, if such systems do not exist at a site where the project activity is undertaken, steps need to be taken to ensure that regular calibration of monitoring meters are conducted and all data maintained as per requirements of Table B.2.3.
GCV *(Table B.2.3)*	Low	Same as above.
$HR_{p,y}$ *(Table B.2.3)*	Low	Same as above.
$W_{p1,y}$ *(Table B.2.3)*	Low	Same as above.
GCV_{p1} *(Table B.2.3)*	Low	Same as above.
RM *(Table B.4.1)*	Low	If the monitoring needs to be regularly checked as part of existing ISO 9001: 2000 or other quality management system (QMS) of the industry undertaking the project activity, QC/QA for the measurement would be part of the existing QMS; hence, separate QC/QA procedures may not be necessary. However, if such systems do not exist at a site where the project activity is undertaken, steps need to be taken to ensure that regular calibration of monitoring meters are conducted and all data maintained as per requirements of Table B.4.1.
PROD *(Table B.4.1)*	Low	Same as above.
$F_{i,j}$ *(Table B.2.3)*	Low	These data are from available public reports obtained from regulatory authorities or energy boards; hence QA/QC procedures would not be necessary.
GEN_i *(Table B.2.3)*	Low	Same as above.
GEN_m *(Table B.2.3)*	Low	Same as above.
$NPO_{p,y}$(2)*(Table B.2.3)*	Low	Same as above.
AG *(Table B.2.3)*	Low	Same as above.
IC *(Table B.2.3)*	Low	Same as above.
PLF *(Table B.2.3)*	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 using BOF route and generating waste gases that may be utilized to generate thermal power. It has been applied to a project activity on waste gas from BOF route of steel manufacturing unit of Jindal Vijayanagar Steel Limited to generate electricity.

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