Approved baseline and monitoring methodology AM0038

“Methodology for improved electrical energy efficiency of an existing submerged electric arc furnace used for the production of silicon and ferro alloys”

I. SOURCE AND APPLICABILITY

Source

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

- NM0146 “Baseline methodology for improved electrical energy efficiency of an existing submerged electric arc furnace used for the production of Alloy” submitted by Transalloys Division of the Highveld Steel and Vanadium Corporation Ltd.

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

- “Tool to calculate the emission factor for an electricity system”, to calculate the grid emission factor;
- “Tool to determine the remaining lifetime of equipment”.

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

Baseline Approach Selected from Paragraph 48 of the CDM Modalities and Procedures

“Existing actual or historical emissions, as applicable”.

Applicability

This methodology is applicable if the following conditions are met:

- Submerged electrical arc furnaces are used for production of the same type of product both in the project case and baseline;
- The alloy(s) produced in the electric arc furnace is ferrosilicon, ferromanganese, silicomanganese, silicon metal or ferrochrome;
- The electricity consumed both in the project case and the baseline, by the submerged electric arc furnace is sourced from the grid and not by on-site generation.
- The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available;
- The quality[1] of the raw material and products produced is not affected by the project activity and remains unchanged;
- The local regulations/programs do not cap the level of grid electricity that can be procured by the production facility where the project activity is implemented;
- Data for the most recent three years preceding the implementation of the project activity is available to estimate the baseline emissions.

[1] Quality is defined as remaining the same if the composition (elementary analysis) remains in the same range.

- Emission reduction credits shall be claimed only until the end of the lifetime of the equipment, as determined using the “Tool to determine the remaining lifetime of equipment”;
- The project activity does not result in an increase in the production capacity of the production facility, where the project is implemented, during the crediting period.

If the project activity is implemented in a number of electric arc furnaces, which produce the alloy, as part of a program, the methodology is applicable to the program as a whole. However all of the requirements (baseline determination, additionality, etc.) shall be applied to and should be fulfilled by each individual electric arc furnace covered under the program.

II. BASELINE METHODOLOGY

Project Boundary

The project boundary comprises of the following two components:

- The electricity grid from which the electricity used in the project activity is purchased, as defined in the latest version of “Tool to calculate emission factor for an electricity system”;
- The physical structure of the submerged electric arc furnace, as described in figure below (Figure 1).

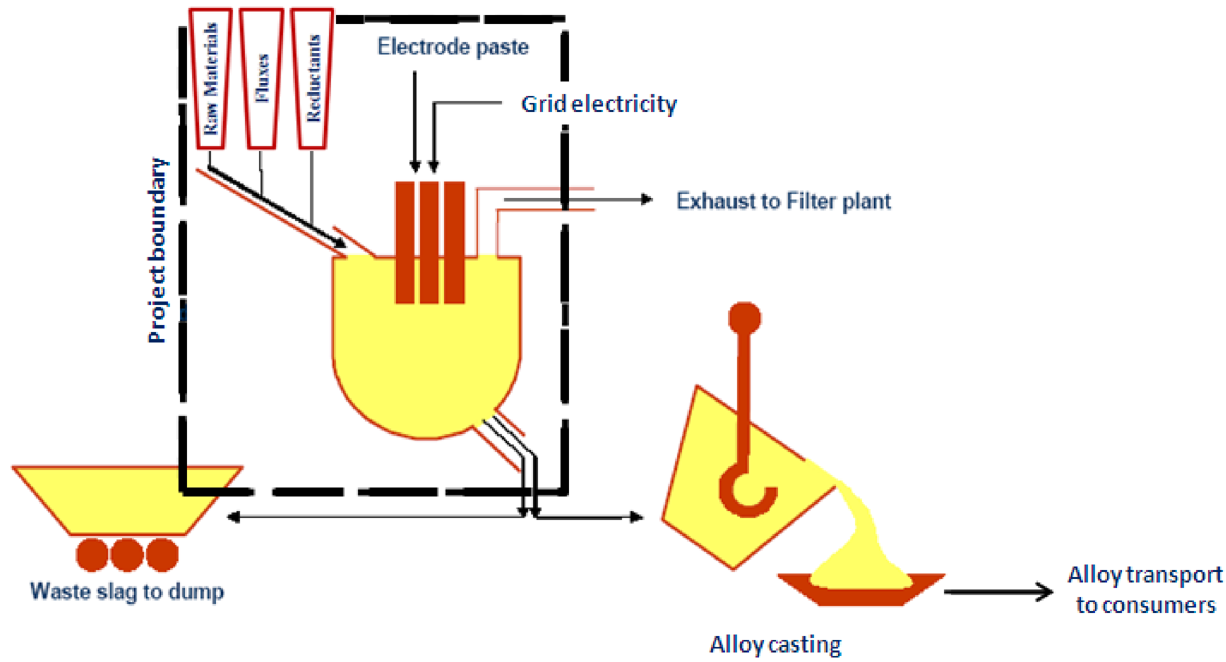

Figure 1: Spatial extent of the project boundary
(excluding the grid generation capacity according to the latest version of “Tool to calculate emission factor for an electricity system”)

Emissions sources

The emissions sources included in the project boundary are defined in table 1 below.

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

	Source	Gas	Included?	Justification / Explanation
Baseline	Grid electricity generation	CO_2	Included	▪ Only CO_2 emissions associated with the electricity consumption of the submerged arc electric furnace; based on most recent 3 year historic data
		CH_4	Excluded	
		N_2O	Excluded	
	Emissions from the consumption of reductants	CO_2	Included	▪ Although some part of the carbon will end up in the end product it is assumed that 100% will be emitted to the air via the exhaust gases. Carbon content is based on the most recent 3 year historic average reductant consumption
		CH_4	Excluded	▪ No CH_4 emissions
		N_2O	Excluded	▪ N_2O emissions are excluded for simplification[a]
	Emissions from the consumption of electrode paste	CO_2	Included	▪ Based on the most recent 3 year historic average electrode paste consumption
		CH_4	Excluded	▪ No CH_4 emissions
		N_2O	Excluded	▪ N_2O emissions are excluded for simplification[a]
Project Activity	Grid electricity generation	CO_2	Included	▪ Only CO_2 emissions associated with the utilisation of the submerged arc electric furnace will be counted; ▪ The combined margin method as described in the latest version of “Tool to calculate emission factor for an electricity system” should be used
		CH_4	Excluded	
		N_2O	Excluded	
	Emissions from the consumption of reductants	CO_2	Included	▪ Although some part of the carbon will end up in the end product it is assumed that 100% will be emitted to the air via the exhaust gases. Reduction consumption is monitored during project
		CH_4	Excluded	▪ No CH_4 emissions
		N_2O	Excluded	▪ N_2O emissions are excluded for simplification[a]
	Emissions from the consumption of electrode paste	CO_2	Included	▪ Electrode paste consumption is monitored during the project
		CH_4	Excluded	▪ No CH_4 emissions
		N_2O	Excluded	▪ N_2O emissions are excluded for simplification[a]

Note [a]: N_2O emissions are excluded for simplification.

Identification of baseline scenario

The baseline scenario shall be determined using the following steps:

Step 1: Identify technically feasible options to increase energy efficiency within the project boundary

The project proponent shall consider at least the following baseline alternatives:

(a) Complete replacement of furnace;

(b) Continued use of installed furnace technology;

(c) The project activity, installation of new-build design, not implemented as a CDM project;

(d) All other plausible and credible alternatives to the project activity that provide energy efficiency improvement to the furnace which are technically feasible to implement with comparable quality, properties and application areas.

Step 2: Identify baseline alternatives that do not comply with legal or regulatory requirements

The project proponent shall consider the following:

- Identify all the legal or regulatory requirements that may influence the choice of baseline options and evidence should be provided that all such requirements have been documented;
- The baseline alternative should also be evaluated in the context of sector trends, and incorporate the effects of any legislation and government policies that may affect this trend. For example, if energy efficiency standards are being introduced by the national government, they should be incorporated in the available baseline alternative.

If a baseline alternative does not comply with all 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 baseline alternative from further consideration.

Step 3: Eliminate baseline alternatives that face prohibitive barriers

Scenarios that face prohibitive barriers should be eliminated by applying step 3 of the latest version of
the “Tool for demonstration and assessment of additionality” agreed by the CDM Executive Board.

Establish a complete list of barriers that would prevent baseline alternatives to occur in the absence of the CDM. Since the “proposed project activity not being registered as a CDM project activity” shall be one of the considered baseline alternatives, any barrier that may prevent the project activity to occur shall be included in that list. Show which baseline alternatives are prevented by at least one of the barriers previously identified and eliminate those alternatives from further consideration. All alternatives shall be evaluated for a common set of barriers.

If there is only one baseline alternative that is not prevented by any barrier then this alternative is identified as the baseline scenario. Where more than one baseline alternative remains, project participants shall, as a conservative assumption, use the alternative baseline scenario that results in the lowest baseline emissions as the most likely baseline scenario, or conduct an investment analysis (Step 4).

Step 4: Compare economic attractiveness of the remaining alternatives

The net present value (NPV) analysis shall be used to compare the economic attractiveness, without revenues from CERs, for all baseline alternatives that are remaining after step 3. Explicitly state the following parameters:

- Investment requirements (incl. break-up into major equipment cost, required construction work, installation);
- A discount rate appropriate to the country and sector
(Use government bond rates, increased by a suitable risk premium to reflect private investment in the specific project type, as substantiated by an independent (financial) expert);
- Current price and expected future price (variable costs) of energy, raw materials and other products (Note: As a default assumption the current prices may be assumed as future prices. Where project participants intend to use future prices that are different from current prices, the future prices have to be substantiated by a public and official publication from a governmental body or an intergovernmental institution);
- Other operating costs for each alternative;
- Lifetime of the project, equal to the remaining lifetime of the existing facility; and
- Other operation and maintenance costs.

The NPV calculation should take into account the residual value of the new equipment at the end of the lifetime of the project activity.[2] The information on all the above factors as well as assumptions shall be explicitly stated in the CDM-PDD.

Compare the NPV of the different baseline alternatives and select the most cost-effective alternative (i.e. with the highest NPV) as the baseline scenario. Include a sensitivity analysis applying Sub-step 2d of the latest version of the "Tool for demonstration assessment and of additionality" agreed by the CDM Executive Board. The most cost-effective scenario is the baseline scenario if the sensitivity analysis consistently supports (for a realistic range of assumptions) this conclusion. In case the sensitivity analysis is not fully conclusive, select the baseline scenario alternative with least emissions among the alternatives that are the most economically attractive according to the investment analysis and the sensitivity analysis.

This methodology is only applicable if the continuation of use of installed furnace technology throughout the crediting period is the most plausible baseline scenario.

Additionality

The assessment of additionality comprises of three steps:

Step 1: Investment & sensitivity analysis

Demonstrate that the project activity undertaken without the CDM is economically less attractive than the most plausible baseline scenario, by following the instructions given in step 4 of the chapter "Identification of the baseline scenario" above. Include a sensitivity analysis applying Sub-step 2d of the latest version of the "Tool for demonstration assessment and of additionality" as agreed by the CDM Executive Board. The investment analysis provides a valid argument in favour of additionality

[2] Note that NPV values may be negative.

only if it consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be the most financially attractive.

Step 2: Common practice analysis

Demonstrate that the project activity is not a common practice in the country and sector by applying Step 4 of the latest version of the "Tool for demonstration assessment and of additionality" as agreed by the CDM Executive Board.

Step 3: Impact of CDM registration

Describe the impact of the registration of the project activity by applying Step 5 of the latest version of the "Tool for demonstration assessment and of additionality" as agreed by the CDM Executive Board.

If all 3 steps are satisfied, then the project is considered additional.

Baseline Emissions

Emissions associated with alloy production in the baseline scenario are determined as follows:[3]

Note: Subscript y indicates years during the crediting period and subscript i is used for years preceding the start of the project activity.

$$BE_y = BE_{y,offsite} + BE_{y,onsite} \quad (1)$$

Where:

BE_y	=	Baseline emissions (tCO_2e in year y)
$BE_{y,off\text{-}site}$	=	Off-site baseline (grid) electricity emissions associated with the electricity consumption of the submerged arc furnace (tCO_2e in year y)
$BE_{y,\ on\text{-}site}$	=	On-site baseline emissions associated with the consumption of Reductant and electrode paste during the production of the alloy (tCO_2e in year *y*)

Off-site baseline emissions are calculated according to:

$$BE_{y,\ offsite} = QP_{y,\ max} * sec_b * EF_{y,offsite} \quad (2)$$

Where:

$BE_{y,\ off\text{-}site}$	=	Off-site baseline (grid) electricity emissions associated with the electricity consumption of the submerged arc furnace (tCO_2e in year y)
$QP_{y,\ max}$	=	Value of alloy production in year *y* (t alloy/y) as estimated using equation 3. This value is used in both the baseline and the project emission calculations
sec_b	=	Historic (at least a three year vintage period) average grid specific electricity consumption per tonne of alloy produced in the baseline situation (MWh/t alloy)
$EF_{y,\ off\text{-}site}$	=	Grid electricity emissions factor, estimated using the latest version of the "Tool to calculate emission factor for an electricity system" (tCO_2e/MWh)

The alloy production is limited to a historic average level as follows:

$$QP_{y,max} = min^{m} \text{ of } (QP_{y,monitored}, QP_{historic}) \quad \textbf{(3)}$$

Where:

$QP_{y,max}$	=	Value of alloy production used for estimating baseline and project emissions for year y (t alloy/y)
$QP_{y,monitored}$	=	Monitored production of alloy in year y during the project activity (t alloy /y)
$QP_{historic}$	=	Historic (at least a three year vintage period) average annual production of alloy (t alloy /y)

The historic average production of alloy is calculated according to:

$$QP_{historic} = \frac{\sum_{i=1}^{n} QP_i}{n} \quad \textbf{(4)}$$

Where:

$QP_{historic}$	=	Historic (at least a three year vintage period) average annual quantity of alloy production (t alloy /y)
QP_i	=	Annual alloy production for the i^{th} years preceding the project activity (t alloy)
n	=	Number, at least three years, of historic year data used for estimating historic annual average production

The average electricity consumption per tonne of alloy produced in the baseline situation is calculated as follows:

$$sec_{historic} = \frac{\sum_{i=1}^{n} EC_i}{\sum_{i=1}^{n} QP_i} \quad \textbf{(5)}$$

Where:

$Sec_{historic}$	=	Historic (at least a three year vintage period) average grid specific electricity consumption per tonne of alloy produced in the baseline situation (MWh/t alloy)
QP_i	=	Annual alloy production for the at least three years preceding the project activity (t alloy produced in year i)
EC_i	=	Annual grid electricity consumption by the submerged electric arc furnace for the at least three years preceding the project activity (MWh consumed in year i)

The on-site emissions are calculated using the following equations:

$$BE_{y,onsite} = QP_{y,max} * EF_{b,onsite} \quad \textbf{(6)}$$

Where:

$BE_{y, on-site}$ = On-site baseline emissions associated with the consumption of reductant (Coal and Coke) and electrode paste in the production of alloy (tCO_2e in year y)

$QP_{y, max}$ = Value of alloy production used for estimating baseline and project emissions for year y (t alloy /y)

$EF_{b, on-site}$ = Baseline emission factor associated with the (on-site) consumption of reductant and electrode paste in the production of per tonne of alloy (tCO_2e/t alloy). The average on-site emissions are based on historic (at least a three year vintage period) average annual consumption as calculated in equation 7

The on-site emission factor is determined as follows:

$$EF_{b,onsite} = \frac{\sum_{i=1}^{n} Q_{bcoal,i} * EF_{bcoal} + \sum_{i=1}^{n} Q_{bcoke,i} * EF_{bcoke} + \sum_{i=1}^{n} Q_{bpaste,i} * EF_{bpaste} + \sum_{i=1}^{n} Q_{breductother,i} * EF_{breductother}}{\sum_{i=1}^{n} QP_i} \quad (7)$$

Where:

$EF_{b, on-site}$ = Baseline emission factor associated with the (on-site) consumption of reductant and electrode paste in the production of per tonne of alloy (tCO_2e/t alloy). The average on-site emissions are based on historic (at least a three year vintage period)

$Q_{bcoal, i}$ = Average historic (most recent three years) annual consumption of coal used as reductant in the submerged electric arc furnace in tonnes of coal per year (tCoal consumed in year i). This value shall be taken into account when assessing the overall uncertainty for on-site emissions using project specific values

EF_{bcoal} = Emissions factor applied for the coal consumed as reductant. This factor can be calculated on a project specific basis or a default IPCC value can be applied. If project specific values are used this factor shall be taken into account when assessing the overall uncertainty for on-site emissions. If IPCC values are used the conservative end of the uncertainty range shall be applied

$Q_{bcoke, i}$ = Average historic (most recent three years) annual consumption of coke used as reductant in the submerged electric arc furnace in tonnes of coke per year (tCoke consumed in year i). This value shall be taken into account when assessing the overall uncertainty for on-site emissions using project specific values

EF_{bcoke} = Emissions factor applied for the coke consumed as reductant. This factor can be calculated on a project specific basis or a default IPCC value can be applied. If project specific values are used this factor shall be taken into account when assessing the overall uncertainty for on-site emissions. If IPCC values are used, the conservative end of the uncertainty range shall be applied

$Q_{bpaste, i}$ = Average historic (most recent three years) annual consumption of electrode paste used as Electrode in the submerged electric arc furnace in tonnes of electrode paste per year (t paste consumed in year i). This value shall be taken into account when assessing the overall uncertainty for on-site emissions using project specific values

EF_{bpaste} = Emissions factor applied for the electrode paste consumed as electrode, using the relevant emissions factor (tCO_2) for the carbon paste as specified by the manufacturer applicable for the vintage period. If manufacturer's specifications are used, the lower value of the uncertainty range provided by the manufacturer will have to be adopted. Alternatively, a conservative but not real default factor of 0 tCO_2 /t of Carbon paste can be used (based on the assumption that the paste is 0% carbon)

$Q_{breductother, i}$ = Average historic (most recent three years) annual consumption of other materials used as reductant in the submerged electric arc furnace in tonnes of reductant per year ($t_{Other\ Reductant}$ consumed in year i). This value shall be taken into account when assessing the overall uncertainty for on-site emissions using project specific values

$EF_{breductother}$ = Emissions factor applied for the other materials consumed as reductants. This factor can be calculated on a project specific basis or a default IPCC value can be applied. If project specific values are used, this factor shall be taken into account when assessing the overall uncertainty for on-site emissions. If IPCC values are used the conservative end of the uncertainty range shall be applied

When IPCC values are used to determine the emission factors for calculating on-site emissions, an uncertainty coefficient shall be defined based on the most recent version of the IPCC guidelines on National Greenhouse Gas Inventories and the most recent country specific information reported on the basis thereof.[4] Where project specific values are used, the overall uncertainty of the on-site emissions will be assessed based on the measurements of activity data and emission factors. The uncertainty will be assessed in line with the European Commission guidelines on monitoring and reporting of GHG emissions in iron and steel production and taken into account when calculating the on-site emissions.[5]

If charcoal is used as a reductant instead of coal, only the on-site emissions of the charcoal will be taken into account. Any offset of emissions due to replacing coal by renewable reductants will not be taken into account under this methodology as it concerns a change of fossil to renewable consumables which does not fit into the scope of improved electrical efficiency.

Project Emissions

Estimates of the emissions associated with alloy production in the project scenario are determined as follows:

$$PE_y = PE_y(offsite) + PE_y(onsite) \quad \textbf{(8)}$$

Where:

PE_y = Project emissions in year y

PE_y (off-site) = Off-site project (grid) electricity emissions associated with the electricity consumption of the submerged arc furnace (tCO_2e in year y)

PE_y (on-site) = On-site project emissions associated with the consumption of reductant and electrode paste during the production of alloy (tCO_2e in year y)

Off-site emissions in the project scenario are determined according to:

$$PE_y(\text{off-site}) = QP_{y,\max} * sec_{p,y} * EF_y(\text{off-site}) \quad \textbf{(9)}$$

Where:

$QP_{y, max}$ = Value of alloy production used for estimating baseline and project emissions for year y (t alloy /y), estimated using equation 3 in the baseline emission section

PE_y (off-site) = Off-site project (grid) electricity emissions associated with the electricity consumption of the submerged arc furnace (tCO_2e in year y)

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[4] Latest version of IPCC Guidelines for National Greenhouse Gas Inventories: Reporting Instructions.

[5] Commission Decision of 29 January 2004 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council.

$sec_{p,y}$ = Grid specific electricity consumption per tonne of alloy produced in the project situation (MWh/t alloy) in year y
EF_y (off-site) = Grid electricity emissions factor (tCO_2e/MWh) estimated by using the latest version of "Tool to calculate emission factor for an electricity system"

The average electricity consumption per tonne of alloy produced in the project situation is calculated as follows:

$$sec_{p,y} = EC_y \;/\; QP_{y,monitored} \qquad \textbf{(10)}$$

Where:
$sec_{p,y}$ = Grid specific electricity consumption per tonne of alloy produced in the project situation (MWh/t alloy) in year y
EC_y = Annual grid electricity consumption by the submerged electric arc furnace in year y (MWh/y)

The on-site emissions for the project scenario are calculated using the following equations:

$$PE_y(\text{on-site}) = QP_{y,max} \times EF_{p,y}(\text{on-site}) \qquad \textbf{(11)}$$

Where:
PE_y (on-site) = On-site project emissions associated with the consumption of reductant and electrode paste during the production of alloy (tCO_2e in year y)
$QP_{y,max}$ = Value of alloy production used for estimating baseline and project emissions for year y (t alloy /y)
$EF_{p,y}$(on-site) = Project emission factor associated with the (on-site) average consumption of reductant and electrode paste during the production per ton alloy in year y (tCO_2e/t alloy) as calculated in equation 12

The on-site emission factor in the project scenario are calculated as follows:

$$EF_{p,y,onsite} = \frac{Q_{pcoal,y} * EF_{pcoal,y} + Q_{pcoke,y} * EF_{pcoke,y} + Q_{ppaste,y} * EF_{ppaste,y} + \sum_{i=1}^{n} Q_{breductother,i,y} * EF_{breductother,i,y}}{QP_y} \qquad \textbf{(12)}$$

Where:
$EF_{p,y(on\text{-}site)}$ = Project emission factor associated with the (on-site) average consumption of reductant (Coal and Coke) and electrode paste in the production per ton alloy in year y (tCO_2e/t alloy) as calculated in equation 12
$Q_{pcoal,y}$ = Consumption of coal used as reductant in the submerged electric arc furnace in tonnes of coal per year (tCoal/y). This value shall be taken into account when assessing the overall uncertainty for on-site emissions using project specific values
$EF_{pcoal,y}$ = Emissions factor applied for the coal consumed as reductant. This factor can be calculated on a project specific basis or a default IPCC value can be applied. If project specific values are used this factor shall be taken into account when assessing the overall uncertainty for on-site emissions. If IPCC values are used the conservative end of the uncertainty range shall be applied

$Q_{pcoke, y}$	=	Consumption of coke used as reductant in the submerged electric arc furnace in tonnes of coke per year (tCoke/y). This value shall be taken into account when assessing the overall uncertainty for on-site emissions using project specific values
$EF_{pcoke,y}$	=	Emissions factor applied for the coke consumed as reductant. This factor can be calculated on a project specific basis or a default IPCC value can be applied. If project specific values are used this factor shall be taken into account when assessing the overall uncertainty for on-site emissions. If IPCC values are used the conservative end of the uncertainty range shall be applied
$Q_{ppaste, y}$	=	Consumption of electrode paste used as electrode in the submerged electric arc furnace in tonnes of electrode paste per year (tpaste/y). This value shall be taken into account when assessing the overall uncertainty for on-site emissions using project specific values
$EF_{ppaste,y}$	=	Emissions factor applied for the electrode paste consumed as electrode, using the relevant emissions factor (tCO_2) for the carbon paste as specified by the manufacturer in year y. If manufacturer's specifications are used, the lower value of the uncertainty range provided by the manufacturer will have to be adopted. Alternatively, a default factor of 3.67 tCO_2 /t of carbon paste can be taken (based on the assumption that the paste is 100% carbon which is the same as 44/12 tCO_2eq)
QP_y	=	Quantity of alloy production in year y during the project activity (t alloy /y)
$Q_{breductother,y}$	=	Consumption of other materials used as a reductant in the submerged electric arc furnace in tonnes of reductant per year. This value shall be taken into account when assessing the overall uncertainty for on-site emissions using project specific values
$EF_{breductother,y}$	=	Emission factor applied for the other materials consumed as reductants. This factor can be calculated on a project specific basis or a default IPCC value can be applied. If project specific values are used this factor shall be taken into account when assessing the overall uncertainty for on-site emissions. If IPCC values are used the conservative end of the uncertainty range shall be applied

When IPCC values are used to determine the emission factors for calculating on-site emissions an uncertainty coefficient shall be defined based on the most recent version of the IPCC guidelines on National Greenhouse Gas Inventories and the most recent country specific information reported on the basis thereof.[6] Where project specific values are used the overall uncertainty of the on-site emissions will be assessed based on the measurements of activity data and emission factors. The uncertainty will be assessed in line with the EC guidelines on monitoring and reporting of GHG emissions in iron and steel production and taken into account when calculating the on-site emissions.[7]

Leakage

The methodology does not anticipate any other measurable forms of leakage attributable to the project activity. This assumption should be verified when a project is developed. The leakages mentioned in the "Tool to calculate the emission factor for an electricity system" too shall be assessed.

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6 Latest version of IPCC Guidelines for National Greenhouse Gas Inventories: Reporting Instructions

7 Commission Decision of 29 January 2004 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council

A project activity is likely to result in a decrease in emissions outside the project boundary, which will not be taken into account in the calculation. The decrease may occur due to following reasons:

The project activity will improve the efficiency of alloy production from the relevant raw materials and consequently reduce the rate of depletion of these non-renewable resources. Consequently this reduces the anthropogenic GHG emissions associated with the activities 'upstream' of the alloy production process. The emissions associated with a reduction in the extraction of raw materials and the reduced transport of materials to the alloy plant occur outside the project boundary and therefore, it cannot be considered as a component of emissions reduction.

In addition the above-mentioned increase in the efficiency of alloy production, the project will result in the production of less slag in relation to the same amount of alloy produced.[8] The 'downstream' anthropogenic GHG emissions associated with the handling of this slag (e.g. crushing and transportation to the dump) will be reduced as a result. These emissions occur outside the boundary and hence, cannot be considered as a component of emissions reduction.

Emission reductions

The emission reductions (ER_y) of the project activity during a given year y is the difference between the baseline, project emissions and emissions due to leakage, as expressed in the equation below:

$$ER_y = BE_y - PE_y - L_y \quad \textbf{(13)}$$

Where :

ER_y	=	Emissions Reductions (t CO_2e) in year y
BE_y	=	Emissions in the baseline scenario (t CO_2e) in year y
PE_y	=	Emissions in the project scenario (t CO_2e) in year y
L_y	=	Leakage (t CO_2e) in year y

Data and Parameters not monitored

Data / Parameter:	QP_i
Data unit:	Tonnes of alloy /year
Description:	Annual alloy production for years preceding the project activity, at least three years
Source of data:	Project proponent
Measurement procedures (if any):	The annual alloy production for years preceding the project activity will be recorded at the start of the project activity and is used to calculate $QP_{historic}$
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	Historic calibration and maintenance reports may serve to demonstrate QA/QC procedures and access uncertainties
Any comment:	

[8] These reductions may not occur in processes that do not produce slag as a by-product.

Data / Parameter:	EC_i
Data unit:	MWh/year
Description:	Annual grid electricity consumption by the submerged electric arc furnace for years preceding the project implementation, at least three years data should be used.
Source of data:	Project proponent
Measurement procedures (if any):	The annual electricity consumption for at least three years preceding the project activity will be recorded at the start of the project activity
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	This data will be double checked with bills from grid operator to ensure consistency. Electricity meter historic calibration and maintenance reports may serve to demonstrate QA/QC procedures and access uncertainties
Any comment:	

Data / Parameter:	$Q_{bcoal, I}$
Data unit:	Tonnes of coal/year
Description:	Historic annual consumption of coal used as reductant in the submerged electric arc furnace
Source of data:	Project proponent
Measurement procedures (if any):	The annual coal consumption for at least three years preceding the project activity will be recorded at the start of the project activity
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	Load cells historic calibration and maintenance reports may serve to demonstrate QA/QC procedures and access uncertainties
Any comment:	

Data / Parameter:	$Q_{bcoke, I}$
Data unit:	Tonnes of coke/year
Description:	Historic annual consumption of coke used as reductant in the submerged electric arc furnace
Source of data:	Project proponent
Measurement procedures (if any):	The annual coke consumption for at least three years preceding the project activity will be recorded at the start of the project activity
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	Load cells historic calibration and maintenance reports may serve to demonstrate QA/QC procedures and access uncertainties
Any comment:	

Data / Parameter:	$Q_{bpaste, I}$
Data unit:	Tonnes of paste/year
Description:	Historic annual consumption of electrode paste used as electrode in the submerged electric arc furnace
Source of data:	Project proponent
Measurement procedures (if any):	The annual paste consumption for at least three years preceding the project activity will be recorded at the start of the project activity
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	Load cells historic calibration and maintenance reports may serve to demonstrate QA/QC procedures and access uncertainties
Any comment:	

Data / Parameter:	$Q_{breductother, I}$
Data unit:	Tonnes of reductant/year
Description:	Historic annual consumption of other materials used as reductant in the submerged electric arc furnace
Source of data:	Project proponent
Measurement procedures (if any):	The annual other reductant consumption for most recent three years preceding the project activity will be recorded at the start of the project activity
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	Load cells historic calibration and maintenance reports may serve to demonstrate QA/QC procedures and access uncertainties
Any comment:	

Data / Parameter:	EF_{bcoal}
Data unit:	tCO_2/ t coal
Description:	Emission factor applied for the coal consumed as reductant based on carbon content
Source of data:	Carbon content furnished by the supplier or independent laboratory or IPCC values
Measurement procedures (if any):	
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	Historic laboratory reports
Any comment:	An estimated project-specific value for three years preceding the project activity is preferred to IPCC value.

Data / Parameter:	EF_{bcoke}
Data unit:	tCO_2/ t coke
Description:	Emission factor applied for the coke consumed as reductant based on carbon content
Source of data:	Carbon content furnished by the supplier or independent laboratory or IPCC values
Measurement procedures (if any):	
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	
Any comment:	An estimated project-specific value for three years preceding the project activity is preferred to IPCC value

Data / Parameter:	EF_{bpaste}
Data unit:	tCO_2/ t of carbon paste
Description:	Emission factor applied for the electrode paste consumed as electrode based on carbon content
Source of data:	Carbon content furnished by the supplier or independent laboratory or IPCC values
Measurement procedures (if any):	
Monitoring frequency:	At the start of the project activity

QA/QC procedures:	
Any comment:	Based on the manufacturer's specifications for the paste used in the three years preceding the project activity, a value will be determined. Alternatively, a factor of 0 tCO_2/ t of carbon paste can be applied only for the baseline

Data / Parameter:	$EF_{breductother}$
Data unit:	tCO_2/ $t_{Other\ Material}$
Description:	Emission factor applied for the other material consumed as reductant based on carbon content
Source of data:	Carbon content furnished by the supplier or independent laboratory or IPCC values
Measurement procedures (if any):	
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	
Any comment:	An estimated project-specific value for three years preceding the project activity is preferred to IPCC value

Data / Parameter:	Quality of $Coal_b$
Data unit:	Mass fraction of each component (%m/m)
Description:	Quality of Coal based on relevant properties
Source of data:	Supplier
Measurement procedures (if any):	To ensure consistency and, if applicable, calculate EF_{coal} The quality shall be monitored. Quality will be established on the basis of historic data for standard grades and carbon content.
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	
Any comment:	

Data / Parameter:	Quality of $Coke_b$
Data unit:	Mass fraction of each component (%m/m)
Description:	Quality of Coke based on relevant properties
Source of data:	Project proponent or a third party laboratory (can be the supplier)
Measurement procedures (if any):	To ensure consistency and, if applicable, calculate EF_{coke} the quality shall be monitored. Quality will be established on the basis of historic data for standard grades and carbon content
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	Historic data obtained from analysis reports to be compared with IPCC range of values
Any comment:	

Data / Parameter:	Quality of electrode paste$_b$ based on relevant properties
Data unit:	Mass fraction of each component (%m/m)
Description:	Quality of electrode paste
Source of data:	Project proponent or a third party laboratory (can be the supplier) or IPCC values
Measurement procedures (if any):	To ensure consistency and, if applicable, calculate EF_{paste} the quality shall be monitored. Quality will be established on the basis of manufacturer's information for the paste used in the past three years
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	Historic data obtained from analysis reports to be compared with IPCC range of values
Any comment:	

Data / Parameter:	Quality of Other Reductant$_b$
Data unit:	Mass fraction of each component (%m/m)
Description:	Quality of other material used as a reductant, based on relevant properties
Source of data:	Project proponent or a third party laboratory (can be the supplier)
Measurement procedures (if any):	To ensure consistency and, if applicable, calculate $EF_{reductother}$ the quality shall be monitored. Quality will be established on the basis of historic data for standard grades and carbon content
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	Historic data obtained from analysis reports to be compared with IPCC range of values
Any comment:	

Data / Parameter:	Quality of alloy$_b$ based on elementary analysis and other relevant properties
Data unit:	Text
Description:	Quality of alloy
Source of data:	Project proponent or a third party laboratory or IPCC values.
Measurement procedures (if any):	The quality of the alloy (defined by certain specifications for Mn, C, Si, P, S as appropriate)[9] for the three years preceding the project activity will be recorded at the start of the project activity based on historic sampling analysis data
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	Historic data obtained from analysis reports to be compared with reference data
Any comment:	

[9] As in Table 4.5 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 4, pg 4.37.

Data / Parameter:	Quality of Raw Materials[10] based on relevant properties
Data unit:	Text
Description:	Quality of Raw Materials
Source of data:	Project proponent or a third party laboratory or IPCC values.
Measurement procedures (if any):	The quality of the Raw Materials (defined by certain specifications for Fe, Mn, C, Si, P, S as appropriate) for the three years preceding the project activity will be recorded at the start of the project activity based on historic sampling analysis data
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	Historic data obtained from analysis reports to be compared with reference data
Any comment:	

Data / Parameter:	Quality of fluxes[11] based on relevant properties
Data unit:	Text
Description:	Quality of fluxes
Source of data:	Project proponent
Measurement procedures (if any):	The quality of the fluxes (defined by relevant properties) for the three years preceding the project activity will be recorded at the start of the project activity based on historic sampling analysis data.
Monitoring frequency:	At the start of the project activity
QA/QC procedures:	
Any comment:	Fluxes are only monitored when the specified alloy production processes requires their use

III. MONITORING METHODOLOGY

Overview of Parameters to be Monitored

The methodology is devised to monitor emissions as a result of both baseline and project activities arising from project implementation. The methodology monitors the on-site and off-site emissions in the baseline and the project scenario. Some of the baseline parameters are defined as constant values since they can no longer be separately measured after implementation of the project. These constant values are based on actual historic measurements and interpreted in a conservative manner.

Data for estimating grid electricity emission factor should be monitored as defined in the latest version of “Tool to calculate emission factor for an electricity system”.

IPCC emission factors are used for coal, coke and other reductants in case local data is not available. Manufacturer’s emission factor is used for electrode paste. The methodology requires monitoring of the consumption of electricity, coal, coke, other reductants and electrode paste, alloy production and project-specific quality and emission factors for coal, coke, other reductants and electrode paste.

[10] Raw materials are defined as those materials which contribute the major components to the final alloy, for instance in SiMn production raw materials are Manganese Ore and Quartz, in FeSi production raw materials are mill scale (or other source of iron) and Quartz.

[11] For the avoidance of doubt, fluxes are defined to be a mineral added to the furnace charge for the purpose of removing impurities (Coal & Steel Report, World Coal Institute, 2009).

Monitoring of baseline and project parameters

Data / Parameter:	QP_y
Data unit:	Tonnes of alloy /year
Description:	Quantity of alloy production in year y during the project activity
Source of data:	Project proponent
Measurement procedures (if any):	The alloy production is weighed on a weighing instrument as it is transferred to the casting machine or casting bed
Monitoring frequency:	Per production run
QA/QC procedures:	Measurement equipment used at the plant site should be subject to a regular maintenance and testing regime (incl. calibration) to ensure accuracy
Any comment:	

Data / Parameter:	EC_y
Data unit:	MWh/year
Description:	Annual grid electricity consumption by the submerged electric arc furnace
Source of data:	Project proponent
Measurement procedures (if any):	The quantity of electricity consumed from a grid will be metered, and double-checked with the bills from the electricity supplier
Monitoring frequency:	Measured continuously, recorded monthly
QA/QC procedures:	This data will be double checked with bills from grid operator to ensure consistency. Electricity meter will be calibrated in line with manufacturer’s recommendations
Any comment:	

Data / Parameter:	$Q_{pcoal, y}$
Data unit:	Tonnes of Coal/year
Description:	Consumption of coal used as reductant in the submerged electric arc furnace
Source of data:	Project proponent
Measurement procedures (if any):	The coal is loaded into dispensers equipped with mass measuring devices to determine the mass fed into the furnace
Monitoring frequency:	Daily
QA/QC procedures:	Measurement equipment used at the plant site should be subject to a regular maintenance and testing regime (including calibration) to ensure accuracy
Any comment:	

Data / Parameter:	$Q_{pcoke, y}$
Data unit:	Tonnes of Coke/year
Description:	Consumption of coke used as reductant in the submerged electric arc furnace in tonnes of coke per year
Source of data:	Project proponent
Measurement procedures (if any):	The coke is loaded into dispensers equipped with mass measuring devices to determine the mass fed into the furnace
Monitoring frequency:	Daily

QA/QC procedures:	Measurement equipment used at the plant site should be subject to a regular maintenance and testing regime (including calibration) to ensure accuracy
Any comment:	

Data / Parameter:	$Q_{ppaste, y}$
Data unit:	Tonne of paste/year
Description:	Consumption of electrode paste used as electrode in the submerged electric arc furnace in tonnes of electrode paste per year
Source of data:	Project proponent
Measurement procedures (if any):	Based on the inventory of paste cylinders at the facilities and the mass per cylinder as measured upon arrival at the plant
Monitoring frequency:	Monthly
QA/QC procedures:	Measurement equipment (load cells) used at the plant site should be subject to a regular maintenance and testing regime (including calibration) to ensure accuracy
Any comment:	

Data / Parameter:	$Q_{preductother, y}$
Data unit:	Tonnes of Reductant/year
Description:	Consumption of other material used as reductant in the submerged electric arc furnace in tonnes of reductant per year
Source of data:	Project proponent
Measurement procedures (if any):	The material is loaded into dispensers equipped with mass measuring devices to determine the mass fed into the furnace
Monitoring frequency:	Daily
QA/QC procedures:	Measurement equipment used at the plant site should be subject to a regular maintenance and testing regime (including calibration) to ensure accuracy
Any comment:	

Data / Parameter:	$EF_{pcoal, y}$
Data unit:	tCO_2/ t coal
Description:	Emission factor applied for the coal consumed as reductant
Source of data:	Carbon content furnished by the supplier or laboratory.
Measurement procedures (if any):	Laboratory analysis
Monitoring frequency:	Monthly
QA/QC procedures:	Compare any measurement results with the range of default emission factors
Any comment:	Calculated project-specific value is preferred to IPCC value

Data / Parameter:	$EF_{pcoke, y}$
Data unit:	tCO_2/ t coke
Description:	Emission factor applied for the coke consumed as reductant
Source of data:	Carbon content furnished by the supplier or laboratory
Measurement procedures (if any):	Laboratory analysis
Monitoring frequency:	Monthly
QA/QC procedures:	Compare any measurement results with the range of default emission factors.
Any comment:	Calculated project-specific value is preferred to IPCC value

Data / Parameter:	$EF_{ppaste, y}$
Data unit:	tCO_2/ t of carbon paste
Description:	Emission factor applied for the electrode paste consumed as reductant
Source of data:	Carbon content furnished by the supplier or laboratory
Measurement procedures (if any):	Laboratory analysis
Monitoring frequency:	Monthly
QA/QC procedures:	Compare manufacturer's information with alternative conservative factor.
Any comment:	Specified by the manufacturer. Alternatively, a conservative factor of 3.67 tCO_2/ t of carbon paste can be applied for the project activity scenario

Data / Parameter:	$EF_{preductother, y}$
Data unit:	tCO_2/ t Reductant
Description:	Emission factor applied for the other materials consumed as reductant
Source of data:	Carbon content furnished by the supplier or laboratory
Measurement procedures (if any):	Laboratory analysis
Monitoring frequency:	Monthly
QA/QC procedures:	Compare any measurement results with the range of default emission factors
Any comment:	Calculated project-specific value is preferred to IPCC value

Data / Parameter:	Quality of $Coal_p$
Data unit:	Mass fraction of each component (%m/m)
Description:	Quality of Coal based on relevant properties
Source of data:	Project proponent or a third party laboratory (can be the supplier)
Measurement procedures (if any):	Laboratory analysis
Monitoring frequency:	Monthly
QA/QC procedures:	Lab analyses will be undertaken to national or international standard to ensure accuracy and consistency.
Any comment:	To ensure consistency and, if applicable, calculate EF_{coal} The quality shall be monitored. Quality will be established on the basis of standard grades and carbon content.

Data / Parameter:	Quality of $Coke_p$
Data unit:	Mass fraction of each component (%m/m)
Description:	Quality of Coke based on relevant properties
Source of data:	Project proponent or a third party laboratory (can be the supplier)
Measurement procedures (if any):	Laboratory analysis
Monitoring frequency:	Monthly
QA/QC procedures:	Lab analyses will be undertaken to national or international standard to ensure accuracy and consistency
Any comment:	To ensure consistency and, if applicable, calculate EF_{coke} , the quality shall be monitored. Quality will be established on the basis of standard grades and carbon content

Data / Parameter:	Quality of electrode $paste_p$
Data unit:	Mass fraction of each component (%m/m)
Description:	Quality of Paste based on relevant properties
Source of data:	Project proponent or a third party laboratory (can be the supplier)
Measurement procedures (if any):	Laboratory analysis
Monitoring frequency:	At the time of purchase
QA/QC procedures:	Compare any measurement results with a range of factors supplied by other suppliers or IPCC
Any comment:	To ensure consistency and, if applicable, calculate EF_{paste} the quality shall be monitored. Quality will be established on the basis of manufacturer's information

Data / Parameter:	Quality of Other $Reductant_p$
Data unit:	Mass fraction of each component (%m/m)
Description:	Quality of Other Reductant based on relevant properties
Source of data:	Project proponent or a third party laboratory (can be the supplier)
Measurement procedures (if any):	Laboratory analysis
Monitoring frequency:	Monthly
QA/QC procedures:	Lab analyses will be undertaken to national or international standard to ensure accuracy and consistency
Any comment:	To ensure consistency and, if applicable, calculate $EF_{reductother}$ The quality shall be monitored. Quality will be established on the basis of standard grades and carbon content

Data / Parameter:	$EF_{y\ (off\text{-}site)}$
Data unit:	tCO_2/MWh
Description:	Grid emissions factor
Source of data:	
Measurement procedures (if any):	Established according to the latest version of "Tool to calculate emission factor for an electricity system".
Monitoring frequency:	According to the latest version of "Tool to calculate emission factor for an electricity system"

QA/QC procedures:	QA/QC procedures specified in the latest version of "Tool to calculate emission factor for an electricity system" will be followed
Any comment:	As resulting from the latest version of "Tool to calculate emission factor for an electricity system"

Data / Parameter:	Quality of $Alloy_p$
Data unit:	Text
Description:	Quality of Alloy
Source of data:	Project proponent or a third party laboratory
Measurement procedures (if any):	A sample will be lab analysed periodically to ensure that the quality remains between pre-determined specifications
Monitoring frequency:	Daily
QA/QC procedures:	Lab analyses will be undertaken to national or international standard to ensure accuracy and consistency
Any comment:	

Data / Parameter:	Quality of Raw Materials based on relevant properties
Data unit:	Text
Description:	Quality of Raw Materials
Source of data:	Project proponent or a third party laboratory (can be the supplier)
Measurement procedures (if any):	The quality of the Raw Materials (defined by certain specifications for Fe, Mn, C, Si, P, S etc as appropriate) will be lab analysed periodically
Monitoring frequency:	Monthly
QA/QC procedures:	Historic data obtained from analysis reports to be compared with reference data
Any comment:	

Data / Parameter:	Quality of fluxes based on relevant properties
Data unit:	Text
Description:	Quality of fluxes
Source of data:	Project proponent
Measurement procedures (if any):	The quality of the fluxes (defined by relevant properties) for the three years preceding the project activity will be recorded at the start of the project activity based on historic sampling analysis data
Monitoring frequency:	Monthly
QA/QC procedures:	Lab analyses will be undertaken to national or international standard to ensure accuracy and consistency
Any comment:	Fluxes are only monitored when the specified alloy production processes requires their use

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History of the document

Version	Date	Nature of revision(s)
03.0.0	EB 61, Annex 6 3 June 2011	Revision to: • Expand the applicability to projects which improve the efficiency of the production of various alloys; • Take into account the contents of various reductants that may be used in alloy production, in the calculation of the project and baseline emissions; • Add reference to the "Tool to determine the remaining lifetime of equipment.
02	EB 35, Para 24, 19 October 2007	Revision to incorporate the use of the "Tool to calculate emission factor for an electricity system".
01	EB 26, Annex 5, 29 September 2006	Initial adoption.
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