

CDM Monitoring Report

*Transalloys Manganese Alloy Smelter Energy
Efficiency Project*

Project CDM ID:1027

Project registration date: 19 October 2007

Monitoring period No 3: 01/07/2009 - 28/02/2010

Date monitoring report and version nr. 29/03/2010 V1

1. Project background

Transalloys Manganese Alloy Smelter Energy Efficiency Project has been registered as CDM project by the UNFCCC on 19 October 2007 under reference 1027.

Further background on this project can be found in the PDD and associated documents, which are available on the UNFCCC website: <http://cdm.unfccc.int/Projects/DB/DNV-CUK1174913531.12/view>

Parties involved are Republic of South Africa (Host Country) and the United Kingdom of Great Britain and Northern Ireland as well as Switzerland (other Parties). The project participants are Transalloys PTY LTD [South Africa] formerly Highveld Steel and Vanadium Corporation Limited and EcoSecurities Group Plc [UK].

2. Project implementation in relation to registered PDD

The project is implemented and operated as per registered PDD.

2.1. Implementation status

Furnaces 3, 5 and 7 have been retrofitted as described in the PDD section.

Furnaces 1 and 6 have not yet been implemented due to poor market conditions.

2.2. Operation of the project

The project started operating on 01/10/2004, with the commissioning of furnace 7 after the retrofit. "Operational" in this context includes downtime due to maintenance or technical issues.

2.3. Forecasted emission reductions versus actual emission reductions

The forecasted emission reduction in the PDD for the period 2009-2010 is 66,553 tCO₂/year. When this is reduced to the current length of monitoring period of 8 months the forecast comes to 44,369tCO₂. During this monitoring period the emission reductions amount to 82,849tCO₂, which exceeds the forecast by 87%. The reasons for this difference are detailed below.

1. **On-site emission reductions.** On-site emission reductions (due to consumption of coal, coke and paste) are 13,616 tCO₂¹, due to a specific emission factor of 2.65 tCO₂/tSiMn in the project, which is lower than the 2.93 tCO₂/SiMn factor in the baseline. The methodology requires including on-site emissions in the project boundary although it was assumed in the PDD that they would not be affected. This methodology requirement reduces the difference from 87% to 40%.
2. **Higher electricity savings during the monitoring period than 0.4 MWh/tSiMn originally forecasted in the PDD estimates.**

¹ 14,963 tCO₂ minus 9% discount for uncertainty

- a. **Methodology effect on baseline electricity consumption.** PDD estimates of reductions in specific electricity consumption assumed a value of 0.4 MWh/tSiMn. The methodology established a baseline consumption of 5.4 MWh/tSiMn (based on data from 1997-2003) however when the electricity saving of 0.4 MWh/tSiMn was estimated at time of decision making (2003) by the project developer the specific consumption was 4.91 MWh/tSiMn. When validation started in November 2006 it was appropriate to keep the 0.4 MWh/tSiMn savings compared to the 7 years baseline level of 5.4 MWh/tSiMn in view of the monitoring data available at the time. If the estimated saving of 0.4 MWh/tSiMn had been increased by the difference between the specific consumption level of 2003 alone (4.91 MWh/tSiMn) and the one obtained by the methodology required longer baseline of 7 years (5.4 MWh/tSiMn) the saving would have been estimated at $0.4 + 0.49 = 0.89$ MWh/tSiMn. Or, seen from the other end, if the baseline used for this monitoring period was based on the 2003 specific electricity consumption of 4.91 MWh/tSiMn instead of the 7 years baseline the difference between emission reductions claimed and PDD estimates would change from 40% to -18% as shown in the table below.
 - b. **Higher electricity savings during the monitoring period.** Compared to PDD estimates of 0.4MWh/t electricity savings, the project achieved 0.59MWh/t (compared to the 2003 baseline). This effect changes the difference from -18% to -38% as shown in the table below.
3. **Delay of Furnace 1 & 6 retrofit.** In the PDD we expected furnace 6 to be retrofitted early 2008 & Furnace 1 in 2009. Due to poor market conditions, the retrofitting works have not started yet. Hence the PDD estimates are adjusted in order to only cover the emission reduction generated by furnaces 3, 5 and 7 (the ones retrofitted to date). This narrows the gap between the estimated and reported emission reductions from -38% to -13%.
 4. **Lower SiMn production during the monitoring period.** The PDD estimates are based on an annual SiMn production of 96,488 t which corresponds to 64,326tSiMn over a period equal to the length of this monitoring period. However, only 61,304 tSiMn have been produced during this monitoring period, hence reducing CERs and bringing the difference from -13% to 0%.

	All furnaces			
	PDD forecast	Monitoring report value	Difference	%
Start assumptions	44,369	82,849	38,480	87%
After adjustment for on-site emissions	44,369	62,232	17,863	40%
After adjustment for baseline electricity consumption factor	44,369	36,319	- 8,050	-18%
After adjustment for project electrical efficiency	44,369	27,467	- 16,902	-38%
After adjustment for furnace 1 & 6 retrofit being delayed	31,417	27,467	- 3,950	-13%
After adjustment for difference in production	31,417	31,417	0	0.0%

3. Compliance of the monitoring plan with the monitoring methodology

This project has been registered under methodology AM0038 V1. A Revised Monitoring Plan was accepted by the UNFCCC on 25 October 2009 and is available on the UNFCCC website (<http://cdm.unfccc.int/Projects/DB/DNV-CUK1174913531.12/view>).

4. Compliance of monitoring with the monitoring plan

Monitoring has been carried out in accordance with the Revised Monitoring Plan.

4.1. Monitoring period

The monitoring period covers 01/07/2009 – 28/02/2010. The starting date is later than the registration date [19/10/2007] and the last day of the last monitoring period [30/06/2009]. The ending date is before the end of the crediting period [30/09/2014].

4.2. Monitoring parameters

Data / Parameter:	QPy,monitored
Data unit:	Tonnes of SiMn
Description:	Quantity of SiMn production
Source of data used:	Measured
Value for this monitoring period:	F3 = 15,670 F5 = 25,646 F7 = 19,989
Description of measurement methods and procedures applied:	The ladles filled at each tapping of the project furnaces are weighed on two weighing platforms before and after being filled with SiMn. The resulting amount of metal produced within the project boundaries is aggregated daily.
QA/QC procedures applied:	The weighing platforms are calibrated daily following the internal procedure SOP:SiMn161 The measured data correlates satisfactorily with the product sales record during this Monitoring Period.
Any comment:	

Data / Parameter:	ECy
Data unit:	MWh
Description:	Grid electricity consumption by the submerged electric arc furnace

Source of data used:	Measured
Value for this monitoring period:	F3 = 65,711 F5 = 117,976 F7 = 83,350
Description of measurement methods and procedures applied:	An electricity meter per project furnace measures continuously the electricity consumed. The value is recorded daily.
QA/QC procedures applied:	The electricity meters are calibrated every 5 years to ensure optimal accuracy. Values reported are cross-checked with electricity metered monthly by the grid company ESKOM. The two values correlate satisfactorily during this Monitoring Period.
Any comment:	

Data / Parameter:	Qpcoal,y
Data unit:	Tonnes of coal
Description:	Consumption of coal used as reductant in the submerged electric arc furnace
Source of data used:	Measured
Value for this monitoring period:	F3 = 11,922 F5 = 19,950 F7 = 15,688
Description of measurement methods and procedures applied:	The amount of coal used in the project furnaces is metered by weigh hoppers and is automatically summed and recorded daily per furnace.
QA/QC procedures applied:	The weigh hoppers are maintained regularly and tested weekly for accuracy according to internal procedure TAOP230.
Any comment:	

Data / Parameter:	Qpcoke,y
Data unit:	Tonnes of coke
Description:	Consumption of coke used as reductant in the submerged electric arc furnace
Source of data used:	Measured
Value for this	F3 = 78

monitoring period:	F5 = 1,206 F7 = 986
Description of measurement methods and procedures to be applied:	The amount of coal used in the project furnaces is metered by weigh hoppers and is automatically summed and recorded daily per furnace.
QA/QC procedures applied:	The weigh hoppers are maintained regularly and tested weekly for accuracy according to internal procedure TAOP230.
Any comment:	

Data / Parameter:	Qppaste,y
Data unit:	Tonnes of paste
Description:	Consumption of electrode paste used as electrode in the submerged electric arc furnace
Source of data used:	Measured and calculated
Value for this monitoring period:	F3 = 515 F5 = 1,053 F7 = 822
Description of measurement methods and procedures applied:	<p>The number of paste cylinders put into the electrode is logged each time a new cylinder is used.</p> <p>The weight of the cylinders is obtained by on weighing paste trucks (arriving at the facility) on a weighbridge and dividing on a monthly basis the total weight by number of cylinders delivered to the facility.</p> <p>The annual figure is obtained by summing the daily product of number of cylinders used and monthly average weight.</p>
QA/QC procedures applied:	Average weight of each cylinder is compared to indications of the supplier. The figures match the supplier's indications within 0.12% for the 700mm cylinders used in furnaces 7 and 5 and 0.08% for the 500mm cylinders used in furnace 3. The result of this cross check is satisfactory as measurements are made by two different weighbridges once the paste has been loaded onto the delivery truck.
Any comment:	

Data / Parameter:	EFpcoal,y
Data unit:	tCO2/t coal
Description:	Emission factor applied for the coal consumed as reductant in year y

Source of data used:	IPCC (2006) – Vol3, Ch4, section 4.3.3.2, table 4.6 page 4.37
Value for this monitoring period:	3.1 See preliminary note above.
Description of measurement methods and procedures applied:	The 2006 IPCC value of 3.1tCO ₂ /t coal will be used in the project. If new IPCC guidelines are released, this value may be updated according to latest relevant EB guidance.
QA/QC procedures applied:	
Any comment:	IPCC data is used to ensure consistency with the emission factor used in the baseline.

Data / Parameter:	EF_{pcoke,y}		
Data unit:	tCO ₂ /t coke		
Description:	Emission factor applied for the coke consumed as reductant in year y		
Source of data used:	Calculated based on: <ul style="list-style-type: none"> - Carbon content and volatiles proportion sourced from laboratory analyses. - Carbon content of volatiles from IPCC (2006). 		
Value for this monitoring period:	2009 3.01	2010 2.97	
Description of measurement methods and procedures applied:	<p>Coke samples are prepared at Transalloys and sent to the laboratory for analysis of volatile and fix carbon content. Monthly averages of carbon contents are used for the calculation of a monthly emission factor.</p> <p>This emission factor is calculated using equation 4.19, p4.33 of IPCC (2006):</p> <div style="border: 1px solid black; padding: 10px; text-align: center;"> <p>EQUATION 4.19 CARBON CONTENT OF FERROALLOY REDUCING AGENTS Total C-content in reducing agent i = Fix C in i + Content of volatiles in i • Cv</p> </div> <p>Where: Cv = Carbon content in volatiles. Unless other information is available, Cv = 0.65 is used for coal and 0.80 for coke.</p> <p>The annual emission factor is calculated as the average of monthly emission factors and used for emission calculations.</p>		
QA/QC procedures applied:	Lab analyses are done according to national SABS standards. When values are missing or inconsistent for some months, the average of		

	previous and next 3 months are used.
Any comment:	

Data / Parameter:	EF_{ppaste,y}		
Data unit:	tCO ₂ /t of carbon paste		
Description:	Emission factor applied for the electrode paste consumed as electrode in year y		
Source of data used:	Calculated from supplier's analyses and/or IPCC.		
Value for this monitoring period:	2009	2010	
	3.33	3.35	
Description of measurement methods and procedures applied:	<p>This emission factor is calculated using equation 4.19, p4.33 of IPCC (2006):</p> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;">EQUATION 4.19 CARBON CONTENT OF FERROALLOY REDUCING AGENTS Total C-content in reducing agent i = Fix C in i + Content of volatiles in i • Cv</p> </div> <p>Where: Cv = Carbon content in volatiles. Unless other information is available, Cv = 0.65 is used for coal and 0.80 for coke.</p> <p>Fix carbon and volatiles content analyses are obtained from the supplier. Carbon content in the volatiles (Cv) is not available in these analyses hence in accordance with the monitoring plan the same value as for the coke of 80% is used.</p> <p>For the months when supplier analysis reports are not available, the conservative value of 3.67 tCO₂/t suggested by the methodology AM0038 is used.</p>		
QA/QC procedures applied:	The annual emission factor obtained is compared to EF _{bpaste,y} (3.32 tCO ₂ /t) and the maximum between the two values is taken for EF _{ppaste,y} .		
Any comment:	An analysis on the paste used is carried out monthly hence this parameter is updated monthly. In case a monthly analysis is not available the conservative value 3.67 tCO ₂ /t is used for that month.		

Data / Parameter:	Quality of coalp
Data unit:	Mass fraction of each component (%m/m)
Description:	Quality of coal based on elementary analysis and other relevant properties
Source of data used:	Analysis report from internal laboratory
Value for this	N/A

monitoring period:	
Description of measurement methods and procedures applied:	Laboratory analyses are carried out at least monthly and fixed carbon, volatiles, S and P contents are reported.
QA/QC procedures applied:	Lab analyses are done according to national SABS standards.
Any comment:	

Data / Parameter:	Quality of coke
Data unit:	Mass fraction of each component (% m/m)
Description:	Quality of coke based on elementary analysis and other relevant properties
Source of data used:	Analysis report from internal laboratory
Value for this monitoring period:	N/A
Description of measurement methods and procedures applied:	Laboratory analyses are carried out at least monthly and fixed carbon, volatiles, S and P contents are reported.
QA/QC procedures applied:	Lab analyses are done according to national SABS standards.
Any comment:	

Data / Parameter:	Quality of electrode pastep
Data unit:	Mass fraction of each component (% m/m)
Description:	Quality of electrode paste based on elementary analyses and other relevant properties
Source of data used:	Supplier
Value for this monitoring period:	Not applicable
Description of measurement methods and procedures applied:	This is based on supplier's laboratory analyses reports.
QA/QC procedures applied:	The IPCC 2006 Volume 3 p.4.38 Table 4.6 "CO2 Emission Factors for Ferroalloy Production" gives a typical emission factor of 3.4tCO ₂ /t _{paste} . When new paste analyses are received it is checked that the characteristics measured correspond reasonably to this value. As a result it was found over this monitoring period that the paste analysis corresponds within 2.1%(2009 value, 0.9% for 2010) to this IPCC value. This is reasonable as

	these are project specific measurements and any measurement uncertainty is covered conservatively by the 9% reduction on overall onsite emission reduction.
Any comment:	

Data / Parameter:	EF_{y,offsite}
Data unit:	tCO ₂ /MWh
Description:	Grid emission factor
Source of data used:	Registered PDD
Value for this monitoring period:	The factor of 1.221tCO ₂ /MWh is used during the whole crediting period.
Description of measurement methods and procedures applied:	The Grid electricity emission factor (EF _{y,offsite} in tCO ₂ e/MWh) for South Africa is established ex ante according to ACM0002.
QA/QC procedures applied:	
Any comment:	

Data / Parameter:	Quality of SiMnp
Data unit:	Mass fraction of each component (%m/m)
Description:	Quality of SiMn produced during the project activity
Source of data used:	Analysis report from internal laboratory
Value for this monitoring period:	N/A
Description of measurement methods and procedures applied:	A sample is lab analysed daily to ensure that the quality remains between pre-determined specifications for Mn, C, Si, P and S.
QA/QC procedures applied:	Lab analyses are undertaken to national SABS standards to ensure accuracy. Results are reviewed and anomalous results investigated.
Any comment:	

Data / Parameter:	Quality of ore
Data unit:	Mass fraction of each component (%m/m)
Description:	Quality of ore
Source of data used:	Analysis report from internal laboratory

Value for this monitoring period:	N/A
Description of measurement methods and procedures applied:	A sample is lab analysed monthly to determine the composition of the ore (e.g. contents in Mn, Fe, SiO ₂ , CaO)
QA/QC procedures applied:	Lab analyses are undertaken to national SABS standards to ensure accuracy. Results are reviewed and anomalous results investigated.
Any comment:	

Data / Parameter:	Quality of fluxes
Data unit:	Mass fraction of each component (%m/m)
Description:	Quality of fluxes
Source of data used:	Analysis report from internal laboratory
Value for this monitoring period:	N/A
Description of measurement methods and procedures applied:	A sample of each type of flux is lab analysed at least monthly when new batches are used. During this monitoring period only pellets are considered as flux, slag not being re-introduced in the furnace any more during this monitoring period.
QA/QC procedures applied:	Lab analyses are undertaken to national SABS standards to ensure accuracy. Results are reviewed and anomalous results investigated.
Any comment:	

4.3. Management and operational system

The responsibilities and authorities for monitoring and reporting are in accordance with the responsibilities and authorities stated in page 9-10 of the revised monitoring plan (This is the same as in the registered PDD).

4.4. Quality assurance and quality control

The monitoring system implemented during this monitoring period is in conformity with the calibration requirements, recording frequency and quality assurance/quality control procedures stated in the revised monitoring plan.

4.4.1. Calibration of monitoring equipment

The metering equipment used for the calculation of emission reduction was duly calibrated according to a pre-set schedule as follows:

Meter	Serial Nr	Calibration date	Location	Calibrated by	Next Calibration Due
Electricity Meter	00061498	25/04/2008	Furnace 3 (33kV)	Strike Technologies	25/04/2013
Electricity meter	06470035	24/11/2006	Furnace 3 (22kV)	Strike Technologies	24/11/2011
Electricity Meter	06460054	22/11/2006	Furnace 5	Strike Technologies	22/11/2011
Electricity Meter	06390018	28/09/2006	Furnace 7	Strike Technologies	28/09/2011
Weighbridge	991019	20/01/2009 28/01/2010	Entrance	JCS Scales	28/01/2012
Batch weigh cluster	N/A	Daily	Furnace 3	Instrumentation Department	Weekly
Batch weigh cluster	N/A	Daily	Furnace 5	Instrumentation Department	Weekly
Batch weigh cluster	N/A	Daily	Furnace 7	Instrumentation Department	Weekly
Platform scale 2	N/A	Daily		Instrumentation Department	Daily
Platform scale 3	N/A	Daily		Instrumentation Department	Daily

4.4.2. Monitoring frequency

The parameters to be monitored were read with the frequency indicated in section 4.2 of this document. This corresponds with the requirements from the approved methodology and the revised monitoring plan (which is also in line with the registered PDD).

4.4.3. Monitoring system

Monitoring organisation

Monitoring organization has been maintained during this monitoring period.

CDM staff training took place and training records are available on site. Procedures for data collection, archiving and data quality assurance and quality control are described in a monitoring manual when they were not already covered by the site's previously existing procedures. These procedures and monitoring manual have been signed off by the plant manager and incorporated into the plant's Integrated Management System (IMS). They are available on site.

Monitoring equipment and installation

The meters were installed by qualified technicians and the proper functioning thereof has been proven during calibration [see section 4.4.1 above].

During the monitoring period no failure of meters occurred. The procedure in case of meter failures and need for replacements is in the Monitoring Manual.

Data records and management

Data records are filed electronically each month and kept for 2 years until the end of the crediting period. The procedures for data management are described in the monitoring manual.

Internal audits

The implementation of the monitoring system is checked regularly by EcoSecurities during field visits and/or the consistency and plausibility of the data which are processed each month.

4.4.4. Forward Action Requests

The following FARs arisen from the previous verification.

Forward Action Request No. 1:

There is a need to archive all equipment printouts for both equipment calibration and for monitoring project parameters for the entire project crediting period.

This has been implemented and can be verified on site.

Forward Action Request No. 2:

There is a need to make all monthly Excel logsheets password protected at the end of the month when they are saved on the server in order to prevent any 'editing' of these logsheets taking place.

This has been implemented and can be verified on site.

Forward Action Request No. 3:

There is a need to protect all 'calculation cells' in the daily Excel logsheets in order to prevent the entering of raw data into these cells.

This has been implemented and can be verified on site.

Forward Action Request No. 4:

There is a need for a procedure for the QA/QC of logsheet data to be developed and for this procedure to include processes for the changing of data in logsheets.

This has been implemented and can be verified on site.

Forward Action Request No. 5:

There is a need to update the current load cell (weigh hopper) calibration procedure to include the process in place to calibrate the mass pieces used for the calibration of the weighhoppers' load cells.

The site has implemented two separate procedures for these two processes since calibration of the test weights is an annual activity and calibration of the load cells in the

batchweigh system using these test weights is a weekly activity. These procedures are available on site.

Forward Action Request No. 6:

There is a need to file the documentation (letters and emails) relating to the manufacturers requirements for the maintenance and calibration of scale platforms (QPy, monitored), electricity meters (ECy), and load cells in weigh hoppers (Qpcoal,y and Qpcoke,y) on site with the monitoring plan.

This has been implemented and can be verified on site where these emails and letters are included in the CDM Monitoring Manual.

5. Calculation of emission reductions

Calculation of emission reductions took place on the basis of a complete set of cross checked data, applying the approved methodology. Calculations are summarized in Annex A.

5.1. Data completeness

A complete set of data was used in the calculation of emission reductions. Where data were unavailable conservative assumptions were made and documented according to the methodology and revised monitoring plan.

5.2. Cross checks of monitoring data

All cross check and quality assurance procedures are documented in the monitoring manual referred to in section 4.4.3. Implementation of the monitoring procedures is regularly checked by EcoSecurities.

The cross checks listed in the Monitoring Plan concern SiMn produced, electricity consumed, paste emission factor and Quality of electrode paste. Detail of these checks has been included in the corresponding parameter's tables in section 4.2. Cross checks applied during this period showed that the data used in the calculation of emission reductions are reliable.

5.3. Calculation of emission reductions

Emission reductions have been calculated on the basis of the formulas provided by the validated PDD and the approved methodology. The calculations are shown in Annex A of this document.

5.4. Assumptions in emission calculations

No assumptions were required when calculating the emission reductions over the monitoring period.

5.5. Application of emission factors, IPCC default values and other reference values

The emission factor used in the calculation of the off-site emission reductions is the combined margin grid emission factor. This has been calculated in the PDD and validated. The value is shown in Annex A and it is valid throughout the crediting period.

The onsite emission factor ($EF_{on-site}$) is determined on a mass weighted basis from the emission factors for coal, coke and paste. Each of these is calculated following the methodology and the monitoring plan. When required data is missing conservative default values specified in the PDD are taken.

6. Summary

The CDM project activity Transalloys Manganese Alloy Smelter Energy Efficiency Project, CDM reference 1027 has reduced **82,849 tCO₂eq** in the period 01/07/2009 - 28/02/2010. The emission reduction has been calculated as set out in the validated PDD, revised Monitoring Plan and the approved methodology. The project activity is implemented as set out in the validated PDD. The validated revised monitoring plan is in accordance with the approved methodology. Monitoring has been carried out as per revised monitoring plan.

7. ANNEX A

Presentation of monitoring results – spreadsheet

All monitoring data has been included in an Excel. There are 3 furnaces in the project. The workbook includes:

1. Overview: Provides project details.
2. CER Summary – which summaries project and baseline emissions and emission reductions per furnace. The final adjusted CER figure is presented in this tab.
3. F# (furnace ref number: 3, 5 or 7) - Historic & Baseline: Outlines the historic data inputs and baseline emissions calculation.
4. F# (furnace ref number: 3, 5 or 7) – Project Emissions & ER: Outlines the project emissions calculation with raw data inputs and references to data sources. Also states the non adjusted emission reduction for the particular furnace.
5. F# (furnace ref number: 3, 5 or 7) – Daily Furnace Data: Contains monitored data used to calculate emission reductions.
6. F# (furnace ref number: 3, 5 or 7) – SiMn Composition Data: Contains composition data for metal produced by this particular furnace
7. Paste Emission Factor Data – Data from the paste suppliers used to calculate the paste emission factor
8. Paste Deliveries – Contains data on monthly paste deliveries used to calculate the monthly average mass per cylinder of paste
9. Coke Emission Factor Data – Contains data used to calculate the Coke Emission Factor
10. Ore Quality – Contains ore quality data
11. Coal Quality Data – Contains coal quality data
12. Flux Quality Data – Contains flux quality data

Calculation methodology

The calculation methodology of emission reductions for this project is summarised below. Please note that data and calculations are cross-checked in order to assure quality.

Calculation was carried out as detailed in the following steps for the data generated:

A) Worksheet *F# (furnace ref number: 3, 5 or 7) - Historic & Baseline*:

1. All monitored data from 1997 to 2003 (7 years) is copied into a table. The data is tons of SiMn produced per year, electricity, coal, coke, paste consumed per year, coke fixed carbon and coke percent volatiles;
2. QP_{historic} is calculated as the average SiMn produced per year over the period 1997 to 2003;
3. sec_b is calculated as the ratio of the electrical consumption to SiMn consumption over 1997 to 2003;
4. $EF_{b, \text{coal}}$ is the baseline emission factor for coal and is taken as a fixed value from IPCC;
5. $EF_{b, \text{coke}}$ (baseline emission factor for coke) is determined by summing the monitored coke fixed carbon content and the product of the monitored volatiles % in coke and the IPCC value of carbon % in volatiles per year; this value is then multiplied by the weight ratio of a mole of CO₂ over a mole of C, and averaged over the 1997 to 2003 period;
6. $EF_{b, \text{paste}}$ (baseline emission factor for paste) is calculated by adding the paste fixed carbon (from supplier specifications) and the product of the volatiles % (from supplier

- specifications) with carbon % in volatiles (from IPCC for coke as paste has a very similar composition to coke);
7. $EF_{y, \text{offset}}$ is the grid CEF and has been established on the basis of ACM0002 v6 and is stated in the PDD;
 8. $QP_{y, \text{max}}$ is the SiMn produced at year y and is selected as the smaller figure (i.e. more conservative) between year y SiMn production and $QPhistoric$ (see step 2). If at year y the furnace has functioned less than 12 months, a factor is introduced to $QPhistoric$ to correspond to the activity period within year y;
 9. $BE_{y, \text{offsite}}$ (offsite baseline emissions) are the product of $QP_{y, \text{max}}$ (step 8), $EF_{y, \text{offset}}$ (step 7) and $secb$ (step 3);
 10. $EF_{b, \text{onsite}}$ (onsite baseline emission factor) is the sum of the products of the emission factors for coal, coke and paste and their respective consumptions, divided by the overall SiMn production over the period 1997 to 2003;
 11. $BE_{y, \text{onsite}}$ (onsite baseline emissions) in year y are the product of $EF_{b, \text{onsite}}$ (step 10) and
 12. $QP_{y, \text{max}}$ (step 8);
 13. BE_y (overall baseline emissions) are the sum of $BE_{y, \text{onsite}}$ (step 11) and $BE_{y, \text{offsite}}$ (step 9);

B) Worksheet $F\#$ (furnace ref number: 3, 5 or 7) – Project Emissions & ER:

1. All monitored data for the monitoring period is entered into a table. The data depicts SiMn produced per year [$QP_{y, \text{monitored}}$], electricity [EC_y] (which has been corrected for drift where applicable), coal [$QP_{\text{coal}, y}$], coke [$QP_{\text{coke}, y}$], paste [$QP_{\text{paste}, y}$] consumed per year, coke fixed carbon and coke percent volatiles. This data is taken from the daily measurements in worksheet $F\#$ (furnace ref number: 3, 5, or 7)- *Daily Furnace Data*;
2. $sec_{p, y}$ is calculated as the ratio of the electrical consumption to SiMn consumption at year y;
3. $EF_{p, \text{coal}, y}$ is the project emission factor for coal and is taken as a fixed value from IPCC. It is equivalent to $EF_{b, \text{coal}}$;
4. $EF_{p, \text{coke}, y}$ (project emission factor for coke) is calculated by summing from each lab analysis report in a year (see worksheet $F\#$ (furnace ref number: 3, 5, or 7)- *Daily Furnace Data*) the monitored coke fixed carbon and the product of the monitored volatiles % in coke (same source as for the fixed carbon) and the IPCC value of carbon % in volatiles; this value is then multiplied by the weight ratio of a mole of CO_2 over a mole of C;
5. $EF_{p, \text{paste}, y}$ (project emission factor for paste) is calculated by adding the paste fixed carbon (from supplier specifications) and the product of the volatiles % (from supplier specifications) with carbon % in volatiles (from IPCC for coke as paste has a very similar composition to coke). This approach is equivalent to the one taken for $EF_{b, \text{paste}}$. The value used in the calculations is the maximum between the baseline value and the monitored value.
6. $EF_{y, \text{offset}}$ is the grid CEF and has been established on the basis of ACM0002 v6 and is stated in the PDD (same as in the baseline);
7. $QP_{y, \text{max}}$ is the SiMn produced at year y and is selected as the smaller figure (i.e. more conservative) between year y SiMn production and QP_{historic} (see baseline, step 2). If at year y the furnace has functioned less than 12 months, a factor is introduced to QP_{historic} to correspond to the activity period within year y;
8. $PE_{y, \text{offsite}}$ (offsite project emissions) are the product of $QP_{y, \text{max}}$ (step 7), $EF_{y, \text{offset}}$ (step 6), and $sec_{p, y}$ (step 2);
9. $EF_{p, y, \text{onsite}}$ (onsite project emission factor) is the sum of the products of the emission factors for coal, coke and paste and their respective consumptions, divided by $QP_{y, \text{monitored}}$ i.e. the amount of SiMn production at year y;

10. $PE_{y, onsite}$ (onsite project emissions) in year y are the product of $EF_{p, y, onsite}$ (step 9) and $QP_{y, max}$ (step 7);
11. PE_y (overall project emissions) are the sum of $PE_{y, onsite}$ (step 10) and $PE_{y, offsite}$ (step 8);
12. ER_y (non adjusted emission reductions) at year y are the difference between BE_y and PE_y ;

In the Summary tab the overall furnaces figures are presented. If for a specific year the on-site emission reductions are positive, only 91% of these on-site emission reductions will taken for the calculation of the emission reductions reported in order to compensate for uncertainty of measurement as detailed in the registered PDD section B.6.3.4.b) p.40. The final (adjusted) emission reductions are obtained.

Project Summary				
Overall Emission Reductions (all furnaces)				
Monitoring Period 3	UNIT	2009	2010	TOTAL
Furnace 3				
Baseline emissions	tCO ₂ e	84,386	28,129	112,514
Project emissions	tCO ₂ e	72,491	25,616	98,108
Leakage	tCO ₂ e	0	0	0
Emission reduction	tCO₂e	11,894	2,512	14,407
Onsite Emission reduction (for uncertainty)	tCO ₂ e	1,471	310	1,781
Furnace 5				
Baseline emissions	tCO ₂ e	180,002	60,905	240,907
Project emissions	tCO ₂ e	153,133	53,554	206,688
Leakage	tCO ₂ e	0	0	0
Emission reduction	tCO₂e	26,869	7,351	34,219
Onsite Emission reduction (for uncertainty)	tCO ₂ e	7,558	1,604	9,162
Furnace 7				
Baseline emissions	tCO ₂ e	116,163	64,141	180,304
Project emissions	tCO ₂ e	95,877	48,858	144,735
Leakage	tCO ₂ e	0	0	0
Emission reduction	tCO₂e	20,286	15,284	35,569
Onsite Emission reduction (for uncertainty)	tCO ₂ e	1018	3002	4,020
TOTAL				
Baseline Emissions	tCO ₂	380,550	153,175	533,725
Project Emissions	tCO ₂	321,502	128,028	449,530
Leakage	tCO ₂	0	0	0
Emission Reductions	tCO₂	59,049	25,147	84,195
Onsite Emission reduction (for uncertainty) ER _{Onsite,y}	tCO ₂	10,047	4,916	14,963
Emissions to be deducted for uncertainty if ER _{onsite,y} >0	tCO ₂	904	442	1,347
Emission Reductions (adjusted for uncertainty)	tCO₂	58,144	24,704	82,849

Baseline and Project Emissions for Furnace 3

Baseline Emissions

$$QP_{y, \max} = \text{minimum of } (QP_{y, \text{monitored}}, QP_{\text{historic}}) \quad \text{Equation (3)}$$

Name	Symbol	Unit	2009	2010
SiMn in year during project activity	$QP_{y, \text{monitored}}$	t SiMn/year	12,137	3,533
SiMn production for estimating baseline	$QP_{y, \max}$	t SiMn/year	9,663	3,221

$$BE_{y, \text{offsite}} = QP_{y, \max} \times \text{sec}_b \times EF_{y, \text{offsite}} \quad \text{Equation (2)}$$

Name	Symbol	Unit	2009	2010
Offsite baseline emissions	$BE_{y, \text{offsite}}$	tCO ₂ e	59,038	19,679

$$EF_{b, \text{onsite}} = \{ \sum Q_{b, \text{coal}, i} \times EF_{b, \text{coal}, i} + \sum Q_{b, \text{coke}, i} \times EF_{b, \text{coke}, i} + \sum Q_{b, \text{paste}, i} \times EF_{b, \text{paste}, i} \} / \sum QP_i$$

Name	Symbol	Unit	All years
Baseline emission factor (onsite)	$EF_{b, \text{onsite}}$	t CO ₂ e/t SiMn	2.62

$$BE_{y, \text{onsite}} = QP_{y, \max} \times EF_{b, \text{onsite}} \quad \text{Equation (6)}$$

Name	Symbol	Unit	2009	2010
Onsite baseline emissions	$BE_{y, \text{onsite}}$	tCO ₂ e	25,348	8,449

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

Name	Symbol	Unit	2009	2010
Baseline emissions	BE_y	tCO ₂ e	84,386	28,129

Project Emissions

$$PE_{y, \text{offsite}} = QP_{y, \max} \times \text{sec}_p \times EF_{y, \text{offsite}} \quad \text{Equation (9)}$$

Name	Symbol	Unit	2009	2010
SiMn from Equation 3	$QP_{y, \max}$	t SiMn/year	9,663	3,221
Offsite project grid emissions	$PE_{y, \text{offsite}}$	tCO ₂ e	48,614	17,477

$$EF_{p, \text{onsite}} = \{ \sum Q_{p, \text{coal}, i} \times EF_{p, \text{coal}, i} + \sum Q_{p, \text{coke}, i} \times EF_{p, \text{coke}, i} + \sum Q_{p, \text{paste}, i} \times EF_{p, \text{paste}, i} \} / \sum QP_y$$

Name	Symbol	Unit	2009	2010
Project emission factor (onsite)	$EF_{p, \text{onsite}}$	t CO ₂ e/t SiMn	2.47	2.53

$$PE_{y, \text{onsite}} = QP_{y, \max} \times EF_{p, \text{onsite}} \quad \text{Equation (11)}$$

Name	Symbol	Unit	2009	2010
SiMn from Equation 3	$QP_{y, \max}$	t SiMn/year	9,663	3,221
Onsite project emissions	$PE_{y, \text{onsite}}$	tCO ₂ e	23,877	8,139

$$PE_y = PE_{y, \text{offsite}} + PE_{y, \text{onsite}} \quad \text{Equation (8)}$$

Name	Symbol	Unit	2009	2010
Project emissions	PE_y	tCO ₂ e	72,491	25,616

Baseline and Project Emissions for Furnace 5

Baseline Emissions

QPy, max $QPy, max = \text{minimum of } (QPy, \text{monitored}, QF \text{ Equation } (3))$

Name	Symbol	Unit	2009	2010
SiMn in year during project activity	QPy monitored	t SiMn/year	18,603	7,042
SiMn production for estimating baseline	QPy max	t SiMn/year	18,603	6,294

BEy, offsite $BEy, offsite = QPy, max \times secb \times EFy, offsite \text{ Equation } (2)$

Name	Symbol	Unit	2009	2010
Offsite baseline emissions	BEy, offsite	tCO2e	123,165	41,674

EFb, onsite $EFb, onsite = \{S Qb \text{ coal}, i \times EFb \text{ coal} + S Qb \text{ coke}, i \times EFb \text{ coke} + S Qb \text{ paste}, i \times EFb \text{ paste}\}$

Name	Symbol	Unit	All years
Baseline emission factor (onsite)	EFb, onsite	CO2e/t SiMn	3.06

BEy, onsite $BEy, onsite = QPy, max \times EFb, c \text{ Equation } (6)$

Name	Symbol	Unit	2009	2010
Onsite baseline emissions	BEy, onsite	tCO2e	56,837	19,231

BEy $BEy = BEy, offsite + BEy, onsite \text{ Equation } (1)$

Name	Symbol	Unit	2009	2010
Baseline emissions	BEy	tCO2e	180,002	60,905

Project Emissions

PEy, offsite $PEy, offsite = QPy, max \times secp \times EFy, offsite \text{ Equation } (9)$

Name	Symbol	Unit	2009	2010
SiMn from Equation 3	QPy max	t SiMn/year	18,603	6,294
Offsite project grid emissions	PEy, offsite	tCO2e	103,855	35,927

EFp, onsite $EFp, onsite = \{S Qp \text{ coal}, i \times EFp \text{ coal} + S Qp \text{ coke}, i \times EFp \text{ coke} + S Qp \text{ paste}, i \times EFp \text{ paste}\}$

Name	Symbol	Unit	2009	2010
Project emission factor (onsite)	EFp, onsite	t CO2e/t SiMn	2.65	2.80

PEy, onsite $PEy, onsite = QPy, max \times EFp, y, onsite \text{ Equation } (11)$

Name	Symbol	Unit	2009	2010
SiMn from Equation 3	QPy max	t SiMn/year	18,603	6,294
Onsite project emissions	PEy, onsite	tCO2e	49,279	17,627

PEy $PEy = PEy (offsite) + PEy (onsite) \text{ Equation } (8)$

Name	Symbol	Unit	2009	2010
Project emissions	PEy	tCO2e	153,133	53,554

Baseline and Project Emissions for Furnace 7

Baseline Emissions

QPy, max $QPy, \max = \text{minimum of } (QPy, \text{monitored}, QP) \text{ Equation (3)}$

Name	Symbol	Unit	2009	2010
SiMn in year during project activity	QPy monitored	t SiMn/year	11,891	8,098
SiMn production for estimating baseline	QPy max	t SiMn/year	11,891	6,566

BEy, offsite $BEy, \text{offsite} = QPy, \max \times \text{secb} \times EFy, \text{offsite} \text{ Equation (2)}$

Name	Symbol	Unit	2009	2010
Offsite baseline emissions	BEy, offsite	tCO2e	81,015	44,734

EFb, onsite $EFb, \text{onsite} = \{S Qb \text{ coal}, i \times EFb \text{ coal} + S Qb \text{ coke}, i \times EFb \text{ coke} + S Qb \text{ paste}, i$

Name	Symbol	Unit	All years
Baseline emission factor (onsite)	EFb, onsite	t CO2e/t SiMn	2.96

BEy, onsite $BEy, \text{onsite} = QPy, \max \times EFb, \text{onsite} \text{ Equation (6)}$

Name	Symbol	Unit	2009	2010
Onsite baseline emissions	BEy, onsite	tCO2e	35,148	19,408

BEy $BEy = BEy, \text{offsite} + BEy, \text{onsite} \text{ Equation (1)}$

Name	Symbol	Unit	2009	2010
Baseline emissions	BEy	tCO2e	116,163	64,141

Project Emissions

PEy, offsite $PEy, \text{offsite} = QPy, \max \times \text{secp} \times EFy, \text{offsite} \text{ Equation (9)}$

Name	Symbol	Unit	2009	2010
SiMn from Equation 3	QPy max	t SiMn/year	11,891	6,566
Offsite project grid emissions	PEy, offsite	tCO2e	61,747	32,452

EFp, onsite $EFp, \text{onsite} = \{S Qp \text{ coal}, i \times EFp \text{ coal} + S Qp \text{ coke}, i \times EFp \text{ coke} + S Qp \text{ paste}, i \times EFp \text{ paste}$

Name	Symbol	Unit	2009	2010
Project emission factor (onsite)	EFp, onsite	t CO2e/t SiMn	2.87	2.50

PEy, onsite $PEy, \text{onsite} = QPy, \max \times EFp, \text{onsite} \text{ Equation (11)}$

Name	Symbol	Unit	2009	2010
SiMn from Equation 3	QPy max	t SiMn/year	11,891	6,566
Onsite project emissions	PEy, onsite	tCO2e	34,130	16,406

PEy $PEy = PEy (\text{offsite}) + PEy (\text{onsite}) \text{ Equation (8)}$

Name	Symbol	Unit	2009	2010
Project emissions	PEy	tCO2e	95,877	48,858

Emissions Reductions

Furnace 3

Emission Reduction

$$ER_y = BE_y - PE_y \quad ER_y = BE_y - PE_y \quad \text{Equation (13)}$$

Name	Symbol	Unit	2009	2010
Baseline emissions	BE _y	tCO ₂ e	84,386	28,129
Project emissions	PE _y	tCO ₂ e	72,491	25,616
Emission Reduction onsite	ER _{y, onsite}	tCO ₂ e	1,471	310
Emission reduction before adjustment	ER_y	tCO₂e	11,894	2,512

TOTAL ER Furnace #3 before adjustment	14,407
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Furnace 5

Emission Reduction

$$ER_y = BE_y - PE_y \quad ER_y = BE_y - PE_y \quad \text{Equation (13)}$$

Name	Symbol	Unit	2009	2010
Baseline emissions	BE _y	tCO ₂ e	180,002	60,905
Project emissions	PE _y	tCO ₂ e	153,133	53,554
Emission Reduction onsite	ER _{y, onsite}	tCO ₂ e	7,558	1,604
Emission reduction before adjustment	ER_y	tCO₂e	26,869	7,351

TOTAL ER Furnace #5 before adjustment	34,219
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Furnace 7

Emission Reduction

$$ER_y = BE_y - PE_y \quad ER_y = BE_y - PE_y \quad \text{Equation (13)}$$

Name	Symbol	Unit	2009	2010
Baseline emissions	BE _y	tCO ₂ e	116,163	64,141
Project emissions	PE _y	tCO ₂ e	95,877	48,858
Emission Reduction onsite	ER _{y, onsite}	tCO ₂ e	1,018	3,002
Emission reduction before adjustment	ER_y	tCO₂e	20,286	15,284

TOTAL ER Furnace #7 before adjustment	35,569
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