EcoSecurities International Ltd.

CDM Monitoring Report

Transalloys Manganese Alloy Smelter Energy Efficiency Project

Project CDM ID:1027

Project registration date: 19 October 2007

Monitoring period No 2: 01/04/2008 - 30/06/2009

Date monitoring report and version nr. 02/10/2009 V2

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 Ltd 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 2008-2009 is 57,058 tCO2/year. When this is expanded to the current length of monitoring period of 15 months the forecast comes to 71,323 tCO2. During this monitoring period the emission reductions amount to 112,292 tCO2, which exceeds the forecast by 57%. 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 19,411 tCO2[1], due to a specific emission factor of 2.59 tCO2/tSiMn in the project, which is lower than the 2.93 tCO2/SiMn factor in the baseline. The methodology requires to include 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 57% to 30%.

[1] 21,331 tCO2 minus 9% discount for uncertainty

2. **Higher electricity savings during the monitoring period than 0.4 MWh/tSiMn originally forecasted in the PDD estimates.**

    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 30% to -29% 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 -29% to -49% as shown in the table below.

3. **Delay of Furnace 6 retrofit**. In the PDD we expected furnace 6 to be retrofitted early 2008. 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 -49% to -38%.

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 120,610tSiMn over a period equal to the length of this monitoring period. However, only 79,635 tSiMn have been produced during this monitoring period, hence reducing CERs and bringing the difference from -38% to 0%.

	All furnaces			
	PDD forecast	Monitoring report value	Difference	%
Start assumptions	71,323	112,292	40,969	57%
After adjustment for on-site emissions	71,323	92,881	21,558	30%
After adjustment for baseline electricity consumption factor	71,323	50,475	- 20,848	-29%
After adjustment for project electrical efficiency	71,323	36,306	- 35,017	-49%
After adjustment for furnace 6 retrofit being delayed	58,906	36,306	- 22,600	-38%
After adjustment for difference in production	58,906	58,906	- 0	0%

3. Compliance of the monitoring plan with the monitoring methodology

This project has been registered under methodology AM0038 V1. The project has sought revision to the monitoring plan in the current monitoring period. The new monitoring plan was validated by DNV and has been submitted to the UNFCCC.

4. Compliance of monitoring with the monitoring plan

Monitoring has been carried out in accordance with the monitoring plan contained in the registered PDD and revised Monitoring Plan.

4.1. Monitoring period

The monitoring period covers 01/04/2008 00:00 - 30/06/2009 24:00. The starting date is later than the registration date [19/10/2007] and the last day of the last monitoring period [31/07/2008]. 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 = 24,573 F5 = 22,452

	F7 = 32,608
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 Production figures are compared to the sum of sales, internal consumption and stock level difference between start and end of monitoring period. The results correlate within 9%, which is satisfactory knowing that the level of accuracy of this check comprises: - a maximum of 15% product wastage in the crushing/screening process (not all the alloy can be re-melted in the furnaces) ; - a maximum of 20% inaccuracy of stock opening survey in April 2008 as it was done on a visualized volume basis (in June 2009 on the contrary the practice had improved with systematic weighing so the inaccuracy on this side is negligible). Hence the maximum difference allowed between the two values is 22,531 tonnes of SiMn, or 20% of the total production, which is satisfied 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 = 101,600 F5 = 106,631 F7 = 136,065
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 with an error of 8%. The reason for this difference is a metering issue on the grid company's side that was acknowledged and rectified by ESKOM in October 2008. After that month (from October 2008 until June 2009) the difference between the two metering systems is only 2.1%. This difference is acceptable knowing that the site adds the values of 13 meters to correlate their

	readings with the ESKOM bill (less than 0.2% error for each meter).
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 = 17,237 F5 = 17,863 F7 = 23,838
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 monitoring period:	F3 = 1,203 F5 = 1,730 F7 = 1,399
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 = 879 F5 = 935 F7 =1,189
Description of measurement methods and procedures applied:	The number of paste cylinders put into the electrode is logged each time a new cylinder is used. 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. The annual figure is obtained by summing the daily product of number of cylinders used and monthly average weight.
QA/QC procedures applied:	Average weight of each cylinder is compared to indications of the supplier. The figures match the supplier's indications within 4.4% for the 700mm cylinders used in furnaces 7 and 5 and 2.1% for the 500mm cylinders used in furnace 3. The result of this cross check is satisfactory as the paste making process is not tightly controlled.
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 3.1tCO2/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:	**EFpcoke,y**

<table>
<tr><td>Data unit:</td><td>tCO2/t coke</td></tr>
<tr><td>Description:</td><td>Emission factor applied for the coke consumed as reductant in year y</td></tr>
<tr><td>Source of data used:</td><td>Calculated based on:
- Carbon content and volatiles proportion sourced from laboratory analyses.
- Carbon content of volatiles from IPCC (2006).</td></tr>
<tr><td>Value for this monitoring period:</td><td><table><tr><th></th><th>2008</th><th>2009</th></tr><tr><td>F3</td><td>3.04</td><td>3.01</td></tr><tr><td>F5</td><td>3.01</td><td>N/A</td></tr><tr><td>F7</td><td>3.04</td><td>N/A</td></tr></table></td></tr>
<tr><td>Description of measurement methods and procedures applied:</td><td>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.

This emission factor is calculated using equation 4.19, p4.33 of IPCC (2006):

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
Where:
Cv = Carbon content in volatiles. Unless other information is available, Cv = 0.65 is used for coal and 0.80 for coke.

The annual emission factor is calculated as the average of monthly emission factors and used for emission calculations.</td></tr>
<tr><td>QA/QC procedures applied:</td><td>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.</td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

<table>
<tr><td>Data / Parameter:</td><td>EFppaste,y</td></tr>
<tr><td>Data unit:</td><td>tCO2/t of carbon paste</td></tr>
<tr><td>Description:</td><td>Emission factor applied for the electrode paste consumed as electrode in year y</td></tr>
<tr><td>Source of data used:</td><td>Calculated from supplier’s analyses and/or IPCC.</td></tr>
<tr><td>Value for this monitoring period:</td><td><table><tr><th></th><th>2008</th><th>2009</th></tr><tr><td>F3</td><td>3.46</td><td>3.61</td></tr></table></td></tr>
</table>

	F5 3.50 N/A F7 3.46 N/A
Description of measurement methods and procedures applied:	This emission factor is calculated using equation 4.19, p4.33 of IPCC (2006): EQUATION 4.19 CARBON CONTENT OF FERROALLOY REDUCTING AGENTS Total C-content in reducing agent i = Fix C in i + Content of volatiles in i • Cv Where: Cv = Carbon content in volatiles. Unless other information is available, Cv = 0.65 is used for coal and 0.80 for coke. 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. 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.
QA/QC procedures applied:	The annual emission factor obtained is compared to $EF_{bpaste,y}$ (3.32 tCO2/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 tCO2/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 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 cokep**

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 $3.4tCO2/t_{paste}$. 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 2.57% 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:	**EFy,offsite**
Data unit:	tCO2/MWh
Description:	Grid emission factor
Source of data used:	Registered PDD
Value for this	The factor of 1.221tCO2/MWh is used during the whole crediting period.

monitoring period:	
Description of measurement methods and procedures applied:	The Grid electricity emission factor (EFy,offsite in tCO2e/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, SiO2, 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	24/04/2013
Electricity meter	06470035	24/11/2006	Furnace 3 (22kV)	Strike Technologies	23/11/2011
Electricity Meter	06460054	22/11/2006	Furnace 5	Strike Technologies	21/11/2011
Electricity Meter	06390018	28/09/2006	Furnace 7	Strike Technologies	27/09/2011
Weighbridge	060102100	25/01/2008 20/01/2009	Entrance	JCS Scales	 19/01/2010

Batch weigh cluster	N/A	Daily	Furnace 3	Instrumentation Department	Daily
Batch weigh cluster	N/A	Daily	Furnace 5	Instrumentation Department	Daily
Batch weigh cluster	N/A	Daily	Furnace 7	Instrumentation Department	Daily
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:
The available procedures need to be amended in order to cover the roles and responsibilities according to the responsibility matrix in the PDD, for access, revision, modification and authority for data collection, storage, archiving and back up.

Procedures for the roles and responsibilities (i.e. access, revision, modification) for data collection, storage, archiving and back-up are described in the monitoring manual. This is verifiable on site.

Forward Action Request No. 2:
A new procedure to define the calibration of the power meters has to be created and enforced covering all elements requested in FAR 1.

A calibration procedure has been set-up for electricity meters covering roles and responsibilities, this is contained in the monitoring manual and is verifiable on site.

Forward Action Request No. 3:
There is a need to create, communicate and enforce a calibration plan for each monitoring equipment. The calibration plan should be part of the integrated management system SHEQ.

A calibration plan has been set-up for the monitoring equipment and uploaded to the Integrated Management System. This is verifiable on site.

Forward Action Request No. 4:
The responsibilities and authorities have to be described in the integrated management system SHEQ as per the responsibility matrix indicated in the PDD.

The monitoring manual and roles and all relevant procedures have been uploaded to the IMS. This is verifiable on site.

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 ($EF_{on\text{-}site}$) 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 **112,292 tCO2eq** in the period 01/04/2008, 00:00 - 30/06/2009, 24:00. 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 workbook per furnace. There are 3 furnaces in the project with a workbook per furnace. The workbook includes:

1. Overview: Provides project details.
2. F# (furnace ref number: 3, 5 or 7) - Historic & Baseline: Outlines the historic data inputs and baseline emissions calculation.
3. F# (furnace ref number: 3, 5 or 7) – Compositions: Provides details regarding the compositions of various raw materials and finite product.
4. F# (furnace ref number: 3, 5 or 7) – Raw & processed data: Contains monitored data used to calculate emission reductions.
5. 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 net emission reduction for the particular furnace.

In addition there is a **summary workbook** with the calculated values from each furnace and the resultant emission reductions.

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. $EF_{b, coal}$ is the baseline emission factor for coal and is taken as a fixed value from IPCC;
5. $EF_{b, coke}$ (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. $EF_{b, paste}$ (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. $EF_{y, offset}$ is the grid CEF and has been established on the basis of ACM0002 v6 and is stated in the PDD;
8. $QP_{y, max}$ 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. $BE_{y, offsite}$ (offsite baseline emissions) are the product of QPy, max (step 8), EFy, offset (step 7) and secb (step 3);
10. $EF_{b, onsite}$ (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. $BE_{y, onsite}$ (onsite baseline emissions) in year y are the product of EFb, onsite (step 10) and
12. $QP_{y, max}$ (step 8);
13. BE_y (overall baseline emissions) are the sum of BEy, onsite (step 11) and BEy, 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 [$QP_{y\ monitored}$], electricity [EC_y] (which has been corrected for drift where applicable), coal [$Qp_{coal, y}$], coke [$Qp_{coke, y}$], paste [$Qp_{paste, y}$] 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)- Raw & processed data*;
2. $sec_{p, y}$ is calculated as the ratio of the electrical consumption to SiMn consumption at year y;
3. $EF_{p\ coal, y}$ is the project emission factor for coal and is taken as a fixed value from IPCC. It is equivalent to $EF_{b, coal}$;
4. $EF_{p\ coke, y}$ (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)- Raw & processed 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. $EF_{p, paste, y}$ (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 $EF_{b, paste}$. The value used in the calculations is the maximum between the baseline value and the monitored value.
6. $EF_{y, offset}$ 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. $QP_{y, max}$ 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. $PE_{y, offsite}$ (offsite project emissions) are the product of $QP_{y, max}$ (step 7), $EF_{y, offset}$ (step 6), and $sec_{p, y}$ (step 2);
9. $EF_{p, y,}$ 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 $QP_{y\ monitored}$ 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. PEy (overall project emissions) are the sum of $PE_{y, onsite}$ (step 10) and $PE_{y, offsite}$ (step 8);
12. ER_y (net emission reductions) at year y are the difference between BE_y and PE_y;

Once 12. has been determined, the furnace specific figures are entered into the Summary spreadsheet and the overall furnaces figures are obtained. 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.

Project Summary				
Overall Emission Reductions (all furnaces)				
Monitoring Period 2	**UNIT**	**2008 (April - Dec)**	**2009 (Jan-June)**	**TOTAL**
Furnace 3				
Baseline emissions	tCO_2e	126,578	68,497	195,075
Project emissions	tCO_2e	107,700	59,908	167,607
Leakage	tCO_2e	0	0	0
Emission reduction	**tCO_2e**	**18,879**	**8,589**	**27,468**
Onsite Emission reduction (for uncertainty)	tCO_2e	3,218	582	3,801
Furnace 5				
Baseline emissions	tCO_2e	217,244	0	217,244
Project emissions	tCO_2e	194,059	0	194,059
Leakage	tCO_2e	0	0	0
Emission reduction	**tCO_2e**	**23,185**	**0**	**23,185**
Onsite Emission reduction (for uncertainty)	tCO_2e	4,733	0	4,733
Furnace 7				
Baseline emissions	tCO_2e	288,637	0	288,637
Project emissions	tCO_2e	225,077	0	225,077
Leakage	tCO_2e	0	0	0
Emission reduction	**tCO_2e**	**63,559**	**0**	**63,559**
Onsite Emission reduction (for uncertainty)	tCO_2e	12,797	0	12,797
TOTAL				
Baseline Emissions	tCO2	632,459	68,497	**700,956**
Project Emissions	tCO2	526,837	59,908	**586,744**
Leakage	tCO2	0	0	**0**
Emission Reductions	**tCO2**	**105,622**	**8,589**	**114,211**
Onsite Emission reduction (for uncertainty) $ER_{Onsite,y}$	tCO2	20,748	582	**21,331**
Emissions to be deducted for uncertainty if $ER_{onsite,y}<0$	tCO2	1,867	52	**1,920**
Emission Reductions (adjusted for uncertainty)	**tCO2**	**103,755**	**8,537**	**112,292**

Baseline and Project Emissions for Furnace 3

Baseline Emissions

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

Name	Symbol	Unit	2008	2009
SiMn in year during project activity	$QP_{y\ monitored}$	t SiMn/year	16,730	7,843
SiMn production for estimating baseline	$QP_{y\ max}$	t SiMn/year	14,494	7,843

$BE_{y, offiste}$	$BE_{y, offsite} = QP_{y, max} \times sec_b \times EF_{y, offiste}$	Equation (2)

Name	Symbol	Unit	2008	2009
Offsite baseline emissions	$BE_{y, offsite}$	tCO_2e	88,556	47,921

$EF_{b, onsite}$	$EF_{b, onsite} = \{\Sigma Q_{b\ coal,\ i} \times EF_{b\ coal} + \Sigma Q_{b\ coke,\ i} \times EF_{b\ coke} + \Sigma Q_{b\ past}$

Name	Symbol	Unit	All years	
Baseline emission factor (onsite)	$EF_{b, onsite}$	$t\ CO_2e/t$ SiMn	2.62	Calculated using

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

Name	Symbol	Unit	2008	2009
Onsite baseline emissions	$BE_{y, onsite}$	tCO_2e	38,022	20,575

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

Name	Symbol	Unit	2008	2009
Baseline emissions	BE_y	tCO_2e	126,578	68,497

Project Emissions

$PE_{y, offsite}$	$PE_{y, offsite} = QP_{y, max} \times sec_p \times EF_{y, offiste}$	Equation (9)

Name	Symbol	Unit	2008	2009
SiMn from Equation 3	$QP_{y\ max}$	t SiMn/year	14,494	7,843
Offsite project grid emissions	$PE_{y,\ offsite}$	tCO_2e	72,896	39,914

$EF_{p, onsite}$	$EF_{p, onsite} = \{\Sigma\ Q_{p\ coal,\ i} \times EF_{p\ coal} + \Sigma\ Q_{p\ coke,\ i} \times EF_{p\ coke} + \Sigma\ Q_{p\ paste,\ i} \times EF_{p\ paste}\} / \Sigma\ Qpy$

Name	Symbol	Unit	2008	2009
Project emission factor (onsite)	$EF_{p,\ onsite}$	$t\ CO_2e/t$ SiMn	2.40	2.55

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

Name	Symbol	Unit	2008	2009
SiMn from Equation 3	$QP_{y\ max}$	t SiMn/year	14,494	7,843
Onsite project emissions	$PE_{y,\ onsite}$	tCO_2e	34,804	19,993

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

Name	Symbol	Unit	2008	2009
Project emissions	PE_y	tCO_2e	107,700	59,908

Baseline and Project Emissions for Furnace 5

Baseline Emissions

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

Name	Symbol	Unit	2008	2009
SiMn in year during project activity	$QP_{y\ monitored}$	t SiMn/year	22,452	0
SiMn production for estimating baseline	$QP_{y\ max}$	t SiMn/year	22,452	0

$BE_{y, offiste}$	$BE_{y, offsite} = QP_{y, max} \times sec_b \times EF_{y, offiste}$	Equation (2)

Name	Symbol	Unit	2008	2009
Offsite baseline emissions	$BE_{y,\ offsite}$	tCO_2e	148,648	0

$EF_{b, onsite}$	$EF_{b, onsite} = \{\Sigma\ Q_{b\ coal,\ i} \times EF_{b\ coal} + \Sigma\ Q_{b\ coke,\ i} \times EF_{b\ coke} + \Sigma\ Q_{b\ paste}$

Name	Symbol	Unit	All years	
Baseline emission factor (onsite)	$EF_{b,\ onsite}$	$t\ CO_2e/t$ SiMn	3.06	Calculated using

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

Name	Symbol	Unit	2008	2009
Onsite baseline emissions	$BE_{y,\ onsite}$	tCO_2e	68,596	0

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

Name	Symbol	Unit	2008	2009
Baseline emissions	BE_y	tCO_2e	217,244	0

Project Emissions

$PE_{y, offsite}$	$PE_{y, offsite} = QP_{y, max} \times sec_p \times EF_{y, offiste}$	Equation (9)

Name	Symbol	Unit	2008	2009
SiMn from Equation 3	$QP_{y\ max}$	t SiMn/year	22,452	0
Offsite project grid emissions	$PE_{y,\ offsite}$	tCO_2e	130,196	0

$EF_{p, onsite}$	$EF_{p, onsite} = \{\Sigma Q_{p\ coal, i} \times EF_{p\ coal} + \Sigma Q_{p\ coke, i} \times EF_{p\ coke} + \Sigma Q_{p\ paste, i} \times EF_{p\ paste}\} / \Sigma Q$

Name	Symbol	Unit	2008	2009
Project emission factor (onsite)	$EF_{p,\ onsite}$	t CO_2e/t SiMn	2.84	0.00

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

Name	Symbol	Unit	2008	2009
SiMn from Equation 3	$QP_{y\ max}$	t SiMn/year	22,452	0
Onsite project emissions	$PE_{y,\ onsite}$	tCO_2e	63,863	0

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

Name	Symbol	Unit	2008	2009
Project emissions	PE_y	tCO_2e	194,059	0

Baseline and Project Emissions for Furnace 7

Baseline Emissions

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

Name	Symbol	Unit	2008	2009
SiMn in year during project activity	$QP_{y\ monitored}$	t SiMn/year	32,608	0
SiMn production for estimating baseline	$QP_{y\ max}$	t SiMn/year	29,547	0

$BE_{y, offiste}$	$BE_{y, offsite} = QP_{y, max} \times sec_b \times EF_{y, offiste}$	Equation (2)

Name	Symbol	Unit	2008	2009
Offsite baseline emissions	$BE_{y,\ offsite}$	tCO_2e	201,302	0

$EF_{b, onsite}$	$EF_{b, onsite} = \{\Sigma Q_{b\ coal, i} \times EF_{b\ coal} + \Sigma Q_{b\ coke, i} \times EF_{b\ coke} + \Sigma Q_{b\ past}$

Name	Symbol	Unit	All years	
Baseline emission factor (onsite)	$EF_{b,\ onsite}$	t CO_2e/t SiMn	2.96	Calculated using

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

Name	Symbol	Unit	2008	2009
Onsite baseline emissions	$BE_{y,\ onsite}$	tCO_2e	87,335	0

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

Name	Symbol	Unit	2008	2009
Baseline emissions	BE_y	tCO_2e	288,637	0

Project Emissions

$PE_{y, offsite}$	$PE_{y, offsite} = QP_{y, max} \; x \; sec_p \; x \; EF_{y, offiste}$	Equation (9)

Name	Symbol	Unit	2008	2009
SiMn from Equation 3	$QP_{y\ max}$	t SiMn/year	29,547	0
Offsite project grid emissions	$PE_{y,\ offsite}$	tCO_2e	150,540	0

$EF_{p, onsite}$	$EF_{p, onsite} = \{\Sigma \; Q_{p\ coal,\ i} \; x \; EF_{p\ coal} + \Sigma \; Q_{p\ coke,\ i} \; x \; EF_{p\ coke} + \Sigma \; Q_{p\ paste,\ i} \; x \; EF_{p\ paste}\} / \Sigma \; Qpy$	Equation (12)

Name	Symbol	Unit	2008	2009
Project emission factor (onsite)	$EF_{p,\ onsite}$	t CO_2e/t SiMn	2.52	0.00

$PE_{y, onsite}$	$PE_{y, onsite} = QP_{y, max} \; x \; EF_{p, y,onsite}$	Equation (11)

Name	Symbol	Unit	2008	2009
SiMn from Equation 3	$QP_{y\ max}$	t SiMn/year	29,547	0
Onsite project emissions	$PE_{y,\ onsite}$	tCO_2e	74,538	0

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

Name	Symbol	Unit	2008	2009
Project emissions	PE_y	tCO_2e	225,077	0

Emissions Reductions

Furnace 3

Emission Reduction

$ER_y = BE_y - PE_y$	$ER_y = BE_y - PE_y$	Equation (13)

Name	Symbol	Unit	2008	2009
Baseline emissions	BE_y	tCO_2e	126,578	68,497
Project emissions	PE_y	tCO_2e	107,700	59,908
Emission Reduction onsite	$ER_{y,onsite}$	tCO_2e	3,218	582
Emission reduction before adjustment	ER_y	tCO_2e	**18,879**	**8,589**

TOTAL ER Furnace #3 before adjustment	**27,468**

Furnace 5

Emission Reduction

$ER_y = BE_y - PE_y$	$ER_y = BE_y - PE_y$	Equation (13)

Name	Symbol	Unit	2008	2009
Baseline emissions	BE_y	tCO_2e	217,244	0
Project emissions	PE_y	tCO_2e	194,059	0
Emission Reduction onsite	$ER_{y,onsite}$	tCO_2e	4,733	0
Emission reduction before adjustment	$\mathbf{ER_y}$	$\mathbf{tCO_2e}$	**23,185**	**0**

TOTAL ER Furnace #5 before adjustment	**23,185**

Furnace 7

Emission Reduction

$ER_y = BE_y - PE_y$	$ER_y = BE_y - PE_y$	Equation (13)

Name	Symbol	Unit	2008	2009
Baseline emissions	BE_y	tCO_2e	288,637	0
Project emissions	PE_y	tCO_2e	225,077	0
Emission Reduction onsite	$ER_{y,onsite}$	tCO_2e	12,797	0
Emission reduction before adjustment	$\mathbf{ER_y}$	$\mathbf{tCO_2e}$	**63,559**	**0**

TOTAL ER Furnace #7 before adjustment	**63,559**