**CLEAN DEVELOPMENT MECHANISM**
**PROJECT DESIGN DOCUMENT FORM (CDM-PDD)**
**Version 03 - in effect as of: 28 July 2006**

**CONTENTS**



**Annexes**



Deleted: analysis

## SECTION A. General description of project activity

### A.1 Title of the project activity:

Transalloys Manganese Alloy Smelter Energy Efficiency Project
PDD Version Number 6
02 March 2007

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### A.2. Description of the project activity:

The Transalloys Manganese Alloy Smelter Energy Efficiency Project (hereafter, the "Project"), developed by Transalloys division of Highveld Steel and Vanadium Corportation Ltd (hereafter referred to as the "Project Developer"), is an industrial energy efficiency project that will reduce the electricity consumption in the production of silicomanganese (SiMn) alloy (a key component in steel making) at its Witbank facility in South Africa (hereafter referred to as the "Host Country").

The production of each tonne of manganese alloy produced in the current submerged electric arc furnaces requires approximately 5MWh of grid-fed electricity. The project is to retrofit current furnaces with new design of electric arc furnaces, electrode assemblies, and control and peripheral systems. This will reduce the specific electricity consumption of alloy production by some 10-20% to between 4.5-4MWh per tonne of alloy produced. The aim is to achieve approximately a 0.5MWh reduction in specific electricity consumption, with a belief that up to 1MWh could be achieved under the correct operating conditions, should the retrofitting be successful. The project will therefore displace electricity from the South African grid, which is mostly produced from coal. The amounts of coal and coke used as reductants, and paste (mostly made of carbon) used as electrode in the submerged electric arc furnaces are not expected to be affected by the project.

Five furnaces are covered by the project. The first one (#7) was retrofitted in late 2004, two more (#5 and #3) in 2005 and the last two (#1 and #6) are expected to be retrofitted, although plans have been delayed due to poor market conditions that directly affected the viability of the projects. The project is a prompt start project claiming carbon credits since October 2004 for retrofitting of the five furnaces. These credits, generated from electricity savings, were and are a determining factor in the decision to retrofit all furnaces and were considered in the setup of the project since 2003.

The project is helping the Host Country fulfil its goals of promoting sustainable development. Specifically:

- Makes a significant contribution to maintaining the livelihoods of the workers employed in this and ancillary industries both up and down stream of the facility;
- Reduces directly the amount of electricity needed to produce the silico-manganese alloy and hence reduces the demand placed upon the South African national grid on the demand side;
- Acts as a clean technology demonstration project, encouraging development of modern and more efficient utilisation of electricity throughout the Country;

- Has a more effective capture of fugitive dust from process, allowing better particulate capture and a reduced emission to the local environment.
- Allows Transalloys to maintain and increase its competitive advantage in what is a competitive, global, export focussed market. Transalloys currently contributes $130m(+) to the national balance of payments through export sales. Recently, export focussed sectors have seen an increased risk of facilities going out of business as a result of the strong Rand, this project will contribute to mitigating some of this currency risk.

## A.3. Project participants:

Table 1 - Project participants

| Name of party involved (*) ((host) indicates a host party) | Private and/or public entity(ies) Project participants (*) (as applicable) | Kindly indicate if the party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| South Africa(host) | Highveld Steel and Vanadium Corporation Limited | No |
| United Kingdom of Great Britain and Northern Ireland | EcoSecurities Group Plc | No |

(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time requesting registration, the approval by the Party(ies) involved is required.

## A.4. Technical description of the project activity:

### A.4.1. Location of the project activity:

#### A.4.1.1. Host Party(ies):

South Africa (the “Host Country”)

#### A.4.1.2. Region/State/Province etc.:

Gauteng Province

#### A.4.1.3. City/Town/Community etc:

Witbank

**A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):**

Clewer Road, Witbank, 1035, Mpumalanga, RSA

**A.4.2. Category(ies) of project activity:**

According to Annex A of the Kyoto Protocol, this project fits in Sectoral Category 9, Metal production

**A.4.3. Technology to be employed by the project activity:**

The Transalloys facility currently uses 5 submerged electric arc furnaces for silicomanganese alloy production (see figure 1). Furnaces 1, 3 and 5 are Elkem design, while #6 is a self-built furnace based on that design. Furnace 7 is a Demag design. The electric capacities of the furnaces are 48MVA (#7 and #5), 22MVA (#6) and 21MVA (#1 and #3).

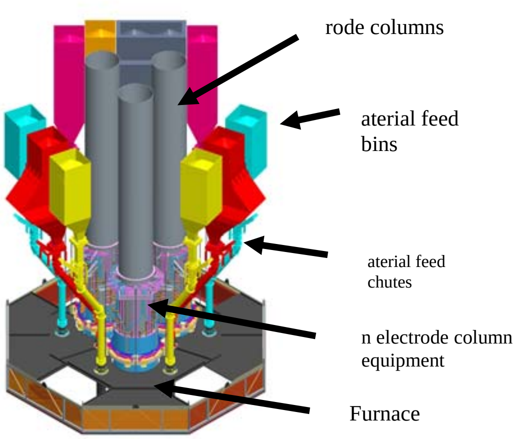
The approach of the project, for all furnaces, is to retrofit new technology into the existing furnace infrastructure, which is designed for a different technology. Under normal circumstances such technology would not be installed into old furnaces, but repairs would be done regularly to maintain the furnace at acceptable level.

More specifically, the central elements that are changed in the project are the following:

- Furnaces 7 and 5: the PCD (pitch centre diameter), which measures the distance between the three electrodes (see figure 3), is optimized in order to reduce electricity consumption. If the PCD is too big, then the furnace requires a higher current density; if the PCD is too small, the outside of the furnaces cools excessively, resulting in operational difficulties. The decision to change this PCD was based on assumptions and mathematical models that still need actual confirmation in practice, as such innovative changes have an important element of uncertainty. Changing this PCD means in particular that all 3 electrode column assemblies as well as the material inlets have to be changed and the existing roofing structure adapted to this new dimensions. For furnace 5, the investment cost is higher as offtake systems (stacks) also have to be changed and new lining and foundations have to be given to the furnace. Pyromet provides the technology for these furnaces, and it is the first time such technology is used for a brownfield project.

- The same principles are applied for furnaces 1, 3, and 6. These units being smaller, the design is a bit different and the elements needed to be changed for the project are not all the same. For instance, #3 is converted from a rotating (around its vertical axle) to a stationary furnace and the old pneumatic slipping system (to let the electrode paste down the electrode) is changed – both elements make the scope of this retrofitting unique and challenging. Bateman provide the technology for these furnaces.

Figure 1: Current furnace electrodes



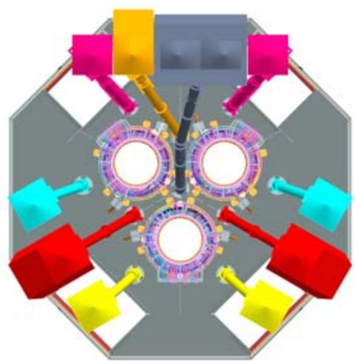



Figure 3 (above): View of the electrodes and raw material inlet from the top

Figure 2 (left): Plan view of electrodes and material feed bin (from the top)

The project involves taking furnaces out of production for several weeks to install the new system. The original and actual retrofitting schedule of the five furnaces is given in table 2. Retrofitting of furnaces 6 and 1 have been postponed to 2008 and 2009 if market conditions allow for it.

Table 2: Furnace Retrofitting Timetable

| Furnace | Size | Commissioning date (age of the furnace) | Original retrofitting Schedule | Actual retrofitting schedule |
|---|---|---|---|---|
| 7 | 48MVA | 1990 | July – September 2004 | 12July – 06 September 2004 |

| | | | | |
|---|---|---|---|---|
| 5 | 48MVA | 1979 | March – May 2005 | 30May – 04 December 2005 |
| 6 | 22MVA | 1980 | July – September 2005 | Expected 2008 |
| 1 | 21MVA | 1964 | March – May 2006 | Expected 2009 |
| 3 | 21MVA | 1964 | July – September 2006 | 28May – 18 October 2005 |

### A.4.4 Estimated amount of emission reductions over the chosen crediting period:

Assuming savings of 0.4MWh per tonne of SiMn produced once the furnaces are retrofitted, the following emission reductions can be expected from the project:

Table 3: Estimated emissions reductions from the project

| **Estimated emission reductions from the project** | |
|---|---|
| **Years** | **Annual estimation of emission reductions in tonnes of CO2e** |
| 2004-05 | 19,241 |
| 2005-06 | 47,125 |
| 2006-07 | 47,125 |
| 2007-08 | 47,125 |
| 2008-09 | 57,058 |
| 2009-10 | 66,553 |
| 2010-11 | 66,553 |
| 2011-12 | 66,553 |
| 2112-13 | 66,553 |
| 2013-14 | 66,553 |
| **Total estimated reductions (tonnes of CO2e)** | 550,438 |
| **Total number of crediting years** | 10 |
| **Annual average over the crediting period of estimated reductions** (tonnes of $CO_2$e) | 55,044 |

### A.4.5. Public funding of the project activity:

The project will not receive any public funding from Parties included in Annex I of the UNFCCC.

## SECTION B. Application of a baseline and monitoring methodology

### B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

The project uses approved methodology AM0038 ("Methodology for improved electrical energy efficiency of an existing submerged electric arc furnace used for the production of SiMn"), version 01, dated 29.09.06.

To calculate the grid emission factor, the project uses approved methodology ACM0002 ("Consolidated baseline methodology for grid-connected electricity generation from renewable sources"), version 06, dated 19.05.06.

To select the baseline and demonstrate additionality, the project uses the step-wise approach defined in AM0038, which refers to the latest version of the "Tool for the demonstration and assessment of additionality". Version 03 of this Tool, adopted at EB29, is used.

### B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

The project meets all the applicability criteria as set out in the methodology AM0038:

a) Submerged electrical arc furnaces are used for production of silicomanganese (SiMn) both in the project case and baseline.
   - This is indeed the case in the baseline and there are no plans to change this in the future.

b) 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 onsite generation.
   - All the electricity is bought from national utility Eskom.

c) The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available
   - There is only one national grid for South Africa, and therefore the geographic and system boundaries can be clearly identified. Information on the characteristics of the grid (mostly electricity generation and fuel consumption of all the plants) has been gathered in order to determine the grid emission factor according to ACM0002.

d) The quality of the raw material and SiMn produced is not affected by the project activity and remains unchanged;
   - This quality will indeed be unchanged and this will be monitored in the project and compared against the baseline. In particular, the production has to meet certain specifications and it is shown that these specifications are still met in the project.

e) The local regulations/programs do not cap the level of grid electricity that can be procured by the SiMn production facility where the project activity is implemented;
   - South African and local regulations/programs do not constrain the facility from using electricity from the grid. This has been confirmed by Eskom (see annex 6).

f) Data for at least three years preceding the implementing the project activity is available to estimate the baseline emission.
   - Data for seven years is available (1997-2003) and will be used to estimate the baseline emissions.

g) Emission reduction credits shall be claimed only until the end of the lifetime of the equipment;
   - There is no specified lifetime of the equipment by the manufacturer. For the user (the project developer), the equipment can be kept as long as its availability and/or efficiency is sufficient to make it economically viable to run the furnace. This is ensured by performing regular maintenance and refurbishment operations, which is the current situation and which is what would continue to happen during the whole crediting period in the absence of the project activity (see also section B.4). We can see from table 1 that the furnaces of the project are between 16 and 42 years old, and the schedule of retrofitting is independent of that age.

h) The project activity does not result in increase in production capacity of the SiMn production facility, where the project is implemented, during the crediting period.
   - The production capacity of each furnace (determined by its electric capacity (MVA) indicated in table 2) remains constant. Actual production can fluctuate as a result of operational requirements, market conditions and demand. No significant increase is expected in the project, but if the production in a given year is higher than the historic average, no emission reductions will be claimed for the extra-production (see equation 3 in section B.6.1).

All the above conditions being met, the methodology is applicable to the project.

## B.3. Description of the sources and gases included in the project boundary

*Spatial boundaries*

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 ACM0002; in this case, it is all the plants connected to the South African grid, owned and operated by Eskom.
- The physical structure of the submerged electric arc furnace, as described in figure 4 below. The project includes furnaces #1, 3, 5, 6 and 7 at Transalloys facility. Each furnace will be included in the project boundary only once it is retrofitted, as the retrofitting is scheduled over several years (see table 2).

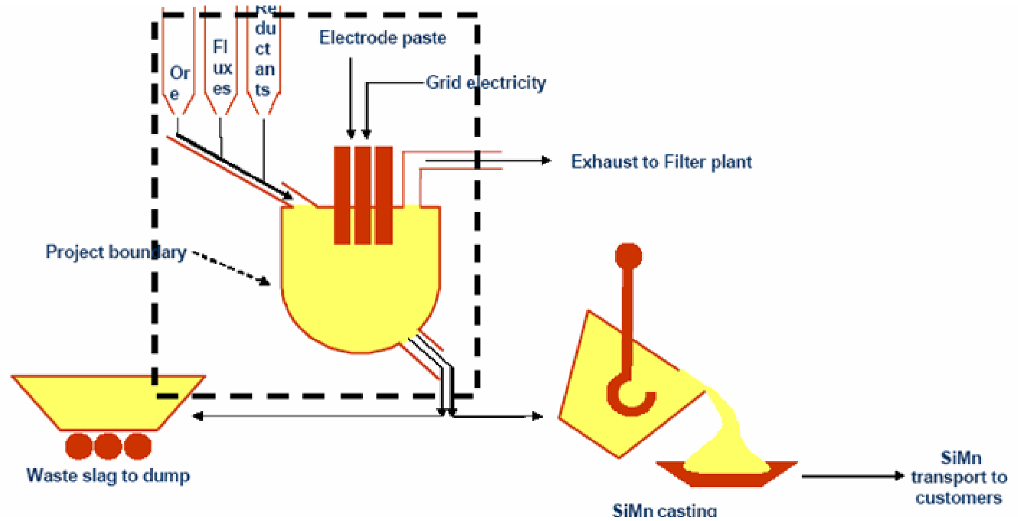



Figure 4: Spatial extent of the project boundary
(excluding the grid generation capacity according to ACM0002)

*Emissions sources*
The emissions sources included in the project boundary are defined in table 3 below.

Table 4: Emissions sources included in or excluded from the project boundary

| | Source | Gas | Included? | Justification / Explanation |
|---|---|---|---|---|
| **Baseline** | Grid electricity generation | $CO_2$ | Included | ▪ Only CO2 emissions associated with the electricity consumption of the Submerged arc electric furnace will be counted, according to ACM0002. |
| | | $CH_4$ | 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 measured on 7 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 7 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 CO2 emissions associated with the electricity consumption of the Submerged arc electric furnace will be counted, according to ACM0002. |
| | | $CH_4$ | 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. Reductant 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

**B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:**

The determination of the baseline scenario is done according to the step-wise approach defined in AM0038. The project involves the implementation of energy efficient, new design technology in five furnaces. As required by the methodology, baseline and additionality shall be determined per individual furnace – the approach here is to highlight the main elements that come into play for all furnaces and for each of these elements see how/if they apply to each furnace separately.

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

For each furnace, the same following alternatives are considered:

a) Continued use of installed furnace technology
   - Under this scenario, current submerged electric arc furnace will continue to be used, producing silicomanganese alloy at a specific energy consumption of about 5 MWh per tonne of alloy produced. Normal repair and refurbishing operations (i.e. replacing existing equipment as it is) will be carried out occasionally to maintain the availability of the furnace at an acceptable level, but electrical efficiency cannot be increased significantly because the design of the furnace is still the same.

b) The project activity, installation of a new-build design, not implemented as a CDM project
   - Under this scenario, current furnace is retrofitted in-situ with technology designed for new furnace, reducing specific electricity consumption to about 4-4.5 MWh per tonne of alloy owing to this new design. Core elements of the furnace (e.g. electrode columns) are rebuilt with a new design.

c) Complete replacement of the installation
   - Under this scenario, current furnace as well as ancillary equipment are entirely replaced by a new installation.

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
   - Although several different technology providers where considered (in addition to Pyromet and Bateman) by the project proponents, no additional alternative project activities were identified.

Table 4 below outlines some key differences between the three technically feasible options a), b) and c) identified. Only the change of the design can deliver consistent electricity savings – any normal repair/refurbishment (or new build with same design) could not decrease electricity consumption, or only marginally by improving overall furnace use (e.g. by decreasing the number of switch on/off during which electricity consumption is not efficient).

Table 5: Typical characteristics of the three alternative scenarios identified in step 1

| *All elements per furnace and prices in Rands* | a) Continued use - refurbish | b) Project activity – retrofit/rebuild | c) Complete new installation |
|---|---|---|---|
| Costs of short-term repairs | ca. R9mn/yr | ca. R5mn/yr | R3mn/yr (?) |
| Investment cost | 0 (0.5 – 3mn for each repair) | R17-45mn depending on the furnace (see table 6) | R200mn (?) |
| Time offline | 1-11 weeks | 8-27 weeks depending on | Depends on whether |

| | | | |
|---|---|---|---|
| | | the furnace (see table 2) | new installation replaces an existing one |
| Typical increase in availability* | 5% | 10% | n/a |
| Electricity savings | 0 | 0.5-1 MWh/tSiMn | Depends on design |

*The increase in availability of a furnace depends on so many factors that it is difficult to estimate the increase in availability through any of the alternatives. A brand new furnace could start off with poor availability due to "teething problems" – so can a repair or rebuild.

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

For each furnace, all the alternatives comply with the laws and regulatory requirements for SiMn production in the project location; there are no government policies to impose energy efficiency improvements to the metal sector. Therefore, no alternatives shall be eliminated at this stage.

**Step 3. Eliminate baseline alternatives that face prohibitive barriers:**

This step is carried out by identifying a common set of barriers that can apply to at least one of the three alternatives remaining after steps 1 and 2. The description of each barrier is combined with an assessment of how this barrier affects the various alternatives considered for each furnace.

*1. Low electricity price*

South Africa is very rich in coal resources and almost 90% of the country's electricity is generated in coal-fired power plants, mostly owned by state-owned utility Eskom. As a result, South Africa is "one of the four cheapest electricity producers in the world"[1]. This situation provides no incentive for electrical efficiency projects, and there is no important energy efficiency culture in South Africa, as highlighted for instance in South Africa energy efficiency strategy[2]. Project developers going beyond this usual culture in order to reduce their electricity consumption (alternatives b and c) will reduce electricity costs, but this is highly dependent on the actual electrical performance of the furnace (see point 5. below), and requires up-front investment in new equipment (see point 2. below).

*2. High investment cost*

Implementing a complete replacement of a furnace and ancillary equipments would require extremely high levels of investment. Even if CDM was considered to alleviate some of this financial pressure, this option

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[1] *South Africa 2005/2006 Yearbook,* Chapter 16: Minerals, energy and geology, p469 (available at http://www.gcis.gov.za/docs/publications/yearbook/minerals_energy.pdf). See also http://www.dme.gov.za/energy/electricity.stm

[2] "http://www.dme.gov.za/energy/electricity.stm.

[2] "The second reason for the high energy intensity is that South Africa is sometimes wasteful in the use of energy. Low energy costs have not encouraged industry, commerce, transport and households to adopt energy efficiency measures." (Department of Minerals and Energy (2005) Energy Efficiency Strategy of the Republic of South Africa, section 3.1 page 8

does not present an economically feasible alternative; therefore, alternative c is eliminated from the rest of the analysis.

The project activity (alternative b) also incurs significant investment costs, which need to be recouped through electricity savings, increased availability, and decreased cost of repairs. These revenues are highly dependent on the price of SiMn, the exchange rate of the Rand and the technical performance of the project.

This applies to each furnace, although figures are different depending on the size of each furnace and the magnitude of the retrofit. Furnace 7 is big (48MVA – approximately 40,000tSiMn produced per year) but needs only replacement of the core elements. Furnace 5 is big and also needs some peripheral elements to be changed (especially offtake system), making the retrofit much more expensive. Furnaces 1,6 and 7 are smaller but need significant changes and therefore incur a similar cost to furnace 7. Figures per individual furnace are given in the table below.

Table 6: Investment cost of the project activity, furnace by furnace

| **Furnace** | **Size** | **Investment cost (mn Rand)** |
|---|---|---|
| 7 | 48MVA | 17 |
| 5 | 48MVA | 45 |
| 6 | 22MVA | ca. 20 |
| 1 | 21MVA | ca. 20 |
| 3 | 21MVA | ca. 18 |

3. *Increased competition - uncertainty of silicomanganese and raw material prices*
In the project activity (alternative b), the new improved furnace has an increased fixed cost (as opposed to variable costs from electricity and raw materials use) per unit of silicomanganese produced. One objective of the project is to compensate this increased fixed cost by an increased availability of the furnace compared to the availability with the continued operation of the existing furnace (alternative a). The balance between the two effects ("net profit/loss") is highly dependent on:

- the actual technical performance of the project (increased availability);
- the global price of SiMn (in $);
- the exchange rate of the $ (in Rand/$).

The uncertainty associated with the technical performance of the project will be discussed in point 5. and the exchange rate in point 4. The global price of SiMn itself is affected by highly increased competition from China, which puts pressure on both SiMn price (downwards because of increased production) and raw material prices (upwards because of increased consumption). Between 2003 and 2004, when the decision to go ahead with the first furnace was made, production of SiMn from Asia and Oceania increased by 22% (2.63 to 3.21mn tSiMn)[3] while production at each furnace of Transalloys remained the same.

[3] See International Manganese Institute (August 2006) – World Overview Q2 2005 (available from: http://www.manganese.org/marketresearch.php)

Therefore, expected increased revenues from increased availability in the project activity (alternative b) were and still are very uncertain and threatened by changes in market conditions. Alternative a (continued use of current furnaces) is less affected by such changes. These external changes apply equally to all furnaces (they all produce SiMn) but increased availability will depend on the actual performance of each furnace.

4. *Uncertainty of exchange rate*
The project developer's business is focused on exports of SiMn to a global market. The price of SiMn is fixed in dollars while most operating costs are mostly expressed in Rands on the South African market; therefore, the project is highly dependent on the exchange rate of the dollar. The Rand was becoming increasingly strong when the decision to embark on the programme and go ahead with the first 3 furnaces was made (2004), as a result of the attractiveness of the South African economy following a successful transition from apartheid to an internationally attractive market economy.

Although this effect has been decreased to a certain extent in 2005-2006, overall market conditions (taking into account points 3 and 4 above) have deteriorated since 2004 and the retrofitting of the last two furnaces has been put on hold (see section B.5, step 3), which demonstrates the importance of barriers 3 and 4 to the viability of the project activity.

5. *Technology risks*
The attractiveness of the project is crucially dependent on its ability to deliver the expected savings from electricity use, lower repair costs, and to a lower extent increased availability. This represents a very high risk in the project activity due to its innovative character (see point 6. below) and the fact that metal production is to a large extent an art of craftsman.

Two years of operation of the new furnaces have confirmed these risks as a number of components have failed: "jumper pipes", dust covers, pressure rings, bellows, locking pipes, downpipes, slipping devices, rubber hoses and feed chutes). These 'design problems' as well as other unrelated operational problems have largely deteriorated the financial viability of the projects (see illustration below).

6. *Lack of prevailing practice*
As highlighted above in section A.4.3 and below in section B.5 (Step 3), the technology used in the project is not common practice. This causes extra-technical complications and increases the uncertainty of the performance of the project as it is even more difficult to assess how the features of the new design will fit in the existing infrastructure; the only advantage compared to a complete new build is the limited investment cost.

In conclusion of step 3, it can be seen that the alternative b, i.e. the project activity (installation of new-build design) not implemented as a CDM project, is facing a number of barriers which make it highly unlikely as the baseline scenario. However, to discard completely this alternative, an investment analysis is carried out as per step 4 of AM0038.

**Step 4. Compare economic attractiveness of the remaining alternatives:**

This section compares the net present value of the two remaining alternatives:

a) Continued use of installed furnace technology
b) The project activity, installation of a new-build design, not implemented as a CDM project

As alternative a) doesn't entail any investment cost, its NPV cannot be calculated; instead, the NPV of alternative b) compared to alternative a) is calculated.

*Parameters used and assumptions*

The analysis uses the following parameters, which are also summarised on tables 7a below:

- Investment requirements: this takes into account all costs including equipment purchase, construction and installation. However, it does not include the opportunity cost of taking the furnace off-line during the retrofitting period (this is conservative as it would increase the investment cost). Investment cost for each furnace is indicated on table 7a (source: Transalloys – see also PDD table 6)
- Discount rate: The 2year average interest rate on loans provided by The Development Bank of Southern Africa was 12.2% in 2003-04[4]. Based on this, we use 12% as the discount rate, which is an extremely conservative assumption given that the project is funded by Highveld's own funds and therefore requires a higher return because of the risks involved (risks highlighted in step 3 above).
- Price of energy, raw materials and products. According to the methodology, as a default assumption the current prices[5] have been assumed as the future prices:
    i. Electricity: the cost of electricity depends on the season (winter/summer) as well as the tariff band (peak/standard/off-peak), and therefore varies every month. The average price weighed by the average proportion of the various tariff bands and seasons is calculated at 113R/MWh (see annex 8)[6].
    ii. Raw material: the cost of ore is based on historic prices paid by Transalloys. It is integrated with other costs of production (including electricity) to calculate the total cost of production. Added to the cost of transport, it gives an overall "cost of sale" of 2,735 R/t (see details in annex 8)
    iii. Products: each furnace has several products (e.g. lump, fines) with different values, and a weighed average of the sale of the various products is used to calculate the total "revenue from sale" of 2,835 R/t (see annex 8). This is relatively low because of the market conditions and exchange rate in 2004, and the sensitivity analysis will include a 10% increase of this parameter to see its effect on the financial indicators.
- Operation and maintenance costs: Costs of operation are integrated in the overall "cost of sale" (see ii) above). Costs of maintenance (or of "short-term repairs") in the baseline are based on Transalloys 2004 data. Costs of maintenance in the project are lower due to the fact that the newly retrofitted furnace needs less repair than the old one – an expected

[4] Average of the value in 2002/03 (13.5%) and in 2003/04 (11.0%). Source: Development Bank of Southern Africa Ltd, Annual report 2003/2004, page 8. Available from http://www.dbsa.org/Research/Pages/AnnualReports.aspx

[5] i.e. as of 2004, when decision to go ahead with the project was made

[6] Note: 1USD is approximately equivalent to 7 Rands.

savings rate is used, which differs between the furnaces (see table 7a and explanation below).

- Production rate: the level of production of each furnace is affected by the project due to the use of a new furnace with new design. In theory, it can be higher in the project. However, this is very difficult to achieve due to the technical difficulties associated with operating the new design. The project has indeed failed to achieve this in the first two years of operation (see details of failing components in paragraph 5 of step 3 above), where the production level has only been between 93% (for furnace 7) and 97% (for furnace 5) of the production level in the baseline – however, we conservatively assume that the production level is maintained in the project. In the sensitivity analysis, we also consider the case where this production level would go 10% above the baseline level.
- Electricity savings: Savings of 0.1MWh/t are expected. This is lower than the target potential of the project, but is actually higher than the savings that have been realised so far. Nevertheless, it is hoped that project performance (electrical efficiency) will increase, and savings of 0.3MWh/t (i.e. an additional 0.2MWh/t) are taken in the sensitivity analysis to see how this would affect project financial indicators.

All furnaces have some similar parameters, such as the cost of electricity, raw material and products. There are however some important differences between the furnaces regarding investment costs, production rates, and savings on short-term repairs. Furnace 5 is one of the two big ones (together with furnace 7) and had high repair costs in the baseline; therefore, the project allows to make significant savings on this (almost 50%), but at a high investment cost (45,000,000R). In comparison, furnace 7 is also big but needed fewer modifications (and lower investment cost) due to its relatively good conditions before retrofitting; therefore, it has similar absolute savings and investment cost to the other 3 smaller furnaces (i.e. about 17-20mn R investment cost and 2.4mn R/yr savings on short-term repairs).

*Financial results*

Table 7a below summarises the assumptions for each furnace and indicates the resulting financial indicators. It shows that the net present value of the retrofitting is negative for all furnaces. This can be explained by analysing the three main components of the project and varying them with a sensitivity analysis.

## Table 7a: Financial analysis

| | | | | a. Fce #7 | b. Fce #5 | c. Fce #6 | d. Fce #1 | e. Fce #3 | | SOURCE |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Furnace > | | | | | | | | |
| 0. | Investment cost | | R | **17,238,000** | **45,000,000** | **20,000,000** | **20,000,000** | **18,000,000** | A | PDD table 6 (investment costs) |
| 1. | Increased availability | Production in the baseline | tSiMn/yr | 39,396 | 37,767 | 20,337 | 19,441 | 19,326 | B | PDD table 9 (Qp historic) |
| | | Production in project vs baseline | % | 100% | 100% | 100% | 100% | 100% | C | Production level expected to be equal in bsl and project (see PDD step 4) |
| | | => Additional production in project | tSiMn | - | - | - | - | - | D | D=B*(C-1) |
| | | Cost of sale* | R/tSiMn | 2,735 | 2,735 | 2,735 | 2,735 | 2,735 | E1 | PDD annex 8 |
| | | Revenues from sale** | R/tSiMn | 2,835 | 2,835 | 2,835 | 2,835 | 2,835 | E2 | PDD annex 8 |
| | | => Additional profit per year*** | R/yr | **-** | **-** | **-** | **-** | **-** | F | F=D*(E2-E1) |
| 2. | Electricity savings | Production in the project | tSiMn/yr | 39,396 | 37,767 | 20,337 | 19,441 | 19,326 | G | G=B*C |
| | | Electricity savings per tonne produced | MWh/t SiMn | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | H | Optimistic expectation (see PDD step 4) |
| | | => Electricity savings | MWh/yr | 3,940 | 3,777 | 2,034 | 1,944 | 1,933 | I | I=G*H |
| | | Cost of electricity | R/MWh | 113 | 113 | 113 | 113 | 113 | J | PDD annex 8 |
| | | => Revenues from electricity savings | R/yr | **446,253** | **427,801** | **230,365** | **220,215** | **218,913** | K | K=I*J |
| 3. | Savings on short term repair costs | Cost in baseline | R/yr | 9,600,000 | 13,690,114 | 6,000,000 | 6,000,000 | 6,000,000 | L | Transalloys historic data |
| | | Savings on repair costs in project | % | 24% | 48% | 40% | 40% | 40% | M | Realistic expectation (see PDD step 4) |
| | | => Cost savings per year | R/yr | **2,329,270** | **6,540,748** | **2,400,000** | **2,400,000** | **2,400,000** | N | N=L*M |
| 1+2+3 | Total revenues | | R/yr | **2,775,523** | **6,968,549** | **2,630,365** | **2,620,215** | **2,618,913** | O | O=F+K+N |
| => | Financial indicators | Net present value (NPV) | R | **(2,186,891)** | **(7,026,632)** | **(5,343,535)** | **(5,391,819)** | **(3,612,302)** | P | P=NPV(12%,A,O) |
| | | Internal rate of return (IRR) | % | **8.1%** | **7.2%** | **3.5%** | **3.4%** | **5.8%** | Q | Q=IRR(A,O) |

* Cost of sale = Cost of ore + other production costs + transport costs incurred by Transalloys

** Revenue from sale = Cost of delivered product

*** Additional profit per year is zero in the base case. However, it will be changed in the sensitivity analysis scnarios 1a and 1b

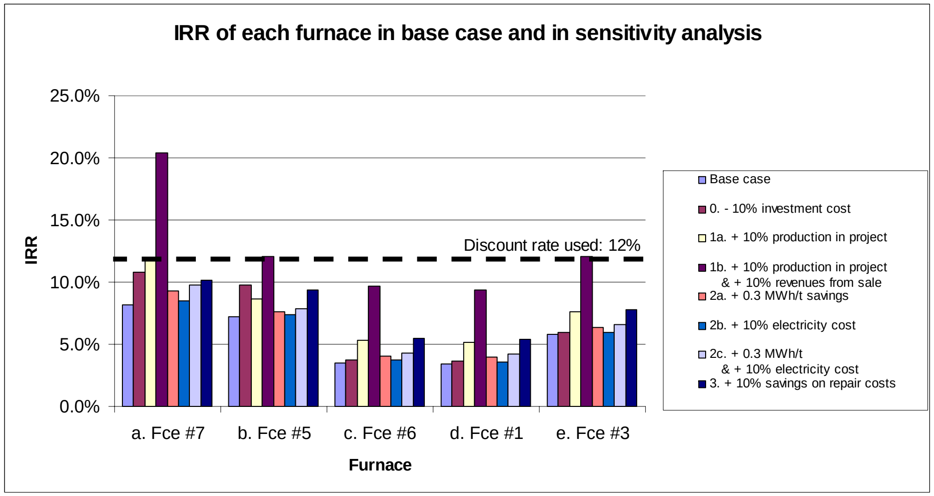
Note: Parameters highlighted in grey are those which are being changed in the sensitivity analysis

## Table 7b: Sensitivity analysis – Example of results for scenario 1a (+10% production in project)

| | | | | a. Fce #7 | b. Fce #5 | c. Fce #6 | d. Fce #1 | e. Fce #3 | | SOURCE |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Furnace > | | | | | | | | |
| 0. | Investment cost | | R | **17,238,000** | **45,000,000** | **20,000,000** | **20,000,000** | **18,000,000** | A | PDD table 6 (investment costs) |
| 1. | Increased availability | Production in the baseline | tSiMn/yr | 39,396 | 37,767 | 20,337 | 19,441 | 19,326 | B | PDD table 9 (Qp historic) |
| | | Production in project vs baseline | % | 110% | 110% | 110% | 110% | 110% | C | Production level 10% higher in project than baseline |
| | | => Additional production in project | tSiMn | 3,940 | 3,777 | 2,034 | 1,944 | 1,933 | D | D=B*(C-1) |
| | | Cost of sale* | R/tSiMn | 2,735 | 2,735 | 2,735 | 2,735 | 2,735 | E1 | PDD annex 8 |
| | | Revenues from sale** | R/tSiMn | 2,835 | 2,835 | 2,835 | 2,835 | 2,835 | E2 | PDD annex 8 |
| | | => Additional profit per year*** | R/yr | **396,033** | **379,657** | **204,440** | **195,433** | **194,277** | F | F=D*(E2-E1) |
| 2. | Electricity savings | Production in the project | tSiMn/yr | 43,336 | 41,544 | 22,371 | 21,385 | 21,259 | G | G=B*C |
| | | Electricity savings per tonne produced | MWh/t SiMn | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | H | Optimistic expectation (see PDD step 4) |
| | | => Electricity savings | MWh/yr | 4,334 | 4,154 | 2,237 | 2,139 | 2,126 | I | I=G*H |
| | | Cost of electricity | R/MWh | 113 | 113 | 113 | 113 | 113 | J | PDD annex 8 |
| | | => Revenues from electricity savings | R/yr | **490,879** | **470,581** | **253,401** | **242,237** | **240,804** | K | K=I*J |
| 3. | Savings on short term repair costs | Cost in baseline | R/yr | 9,600,000 | 13,690,114 | 6,000,000 | 6,000,000 | 6,000,000 | L | Transalloys historic data |
| | | Savings on repair costs in project | % | 24% | 48% | 40% | 40% | 40% | M | Realistic expectation (see PDD step 4) |
| | | => Cost savings per year | R/yr | **2,329,270** | **6,540,748** | **2,400,000** | **2,400,000** | **2,400,000** | N | N=L*M |
| 1+2+3 | Total revenues | | R/yr | **3,216,182** | **7,390,987** | **2,857,842** | **2,837,670** | **2,835,081** | O | O=F+K+N |
| => | Financial indicators | Net present value (NPV) | R | **(90,517)** | **(5,016,942)** | **(4,261,345)** | **(4,357,308)** | **(2,583,910)** | P | P=NPV(12%,A,O) |
| | | Internal rate of return (IRR) | % | **11.8%** | **8.6%** | **5.4%** | **5.2%** | **7.6%** | Q | Q=IRR(A,O) |

Table 7c: Sensitivity analysis – Summary of results

| Parameter changed | | Change scneario | Financial indicator | Unit | a. Fce #7 | b. Fce #5 | c. Fce #6 | d. Fce #1 | e. Fce #3 | |
|---|---|---|---|---|---|---|---|---|---|---|
| x | | Base case | NPV | R | (2,186,891) | (7,026,632) | (5,343,535) | (5,391,819) | (3,612,302) | No change |
| | | | IRR | % | 8.1% | 7.2% | 3.5% | 3.4% | 5.8% | |
| 0. | Invesment cost | 0. - 10% investment cost | NPV | R | (647,784) | (3,008,775) | (4,699,588) | (4,747,873) | (3,146,927) | A => A * 0.9 |
| | | | IRR | % | 10.8% | 9.8% | 3.7% | 3.6% | 6.0% | |
| 1. | Increased availability | 1a. + 10% production in project | NPV | R | (90,517) | (5,016,942) | (4,261,345) | (4,357,308) | (2,583,910) | C => C * 1.1 |
| | | | IRR | % | 11.8% | 8.6% | 5.4% | 5.2% | 7.6% | |
| | | 1b. + 10% production in project & + 10% revenues from sale | NPV | R | 5,223,075 | 76,936 | (1,518,363) | (1,735,175) | 22,712 | C => C * 1.1 |
| | | | IRR | % | 20.4% | 12.1% | 9.7% | 9.4% | 12.0% | & E2 => E2 * 1.1 |
| 2. | Electricity savings | 2a. + 0.3 MWh/t savings | NPV | R | (1,549,994) | (6,416,070) | (5,014,756) | (5,077,525) | (3,299,867) | H => H + 0.3 |
| | | | IRR | % | 9.3% | 7.6% | 4.1% | 4.0% | 6.3% | |
| | | 2b. + 10% electricity cost | NPV | R | (1,974,592) | (6,823,112) | (5,233,942) | (5,287,054) | (3,508,157) | J => J * 1.1 |
| | | | IRR | % | 8.5% | 7.4% | 3.7% | 3.6% | 6.0% | |
| | | 2c. + 0.3 MWh/t & + 10% electricity cost | NPV | R | (1,274,005) | (6,151,494) | (4,872,285) | (4,941,331) | (3,164,479) | H => H + 0.3 |
| | | | IRR | % | 9.8% | 7.8% | 4.3% | 4.2% | 6.6% | & J => J * 1.1 |
| 3. | Savings on short term repair costs | 3. + 10% savings on repair costs | NPV | R | (1,078,772) | (3,914,959) | (4,201,767) | (4,250,051) | (2,470,534) | M => M * 0.9 |
| | | | IRR | % | 10.1% | 9.4% | 5.4% | 5.4% | 7.8% | |



*Sensitivity analysis*

All main parameters of the project, regarding its 3 components (increase in availability, electricity savings, savings on short term repairs), have been varied to see their impact on the project's financial indicators. An example of the results obtained is presented in table 7b, and all results are summarised in table 7c.

1. Difference in availability
   In theory, the use of the newly retrofitted furnace can allow a higher production level, and therefore higher profits from sales. However, it also brings difficulties, and a lot of elements can fail (see detail in paragraph 5 of step 3). Therefore, in the base case, we assume that furnaces produce as much in the project as in the baseline (which has not even been the case so far). This is however sensitive to two main parameters:
   - The actual production level of the new furnaces. If it increases and goes above the baseline level, then the project generates extra-profits from the additional production. In sensitivity analysis scenario 1a, we assume a 10% increase in the production level in the project; the resulting NPV is still negative for all furnaces.
   - The profit per tonne produced. If it increases, then an increase in production has a more positive impact on the project performance.

   If the project manages to combine an increase in production level and with favourable market conditions (increase in revenue from sale), then the project can have a positive NPV (see scenario 1b for furnace 7). However, this scenario is unlikely and very uncertain; for instance, what happened in the first two years of operation is that the profits have been high but production level has been between 3 and 7% below the baseline production level, resulting in big losses of profits caused by the project[7].

2. Electricity savings
   In the base case, we assume savings of 0.1MWh/t produced. This is below the target potential of each retrofitting, however it is a more realistic assumption – in the first years of operation, the project has not even been able to reach this level. If improvements are made to the electrical efficiency in order to harness better the potential of the new furnaces and save an additional 0.3MWh/t (thus reaching the 0.4MWh/t target), then the revenues from electricity savings would increase importantly and can bring the IRR up to 9%. Combined with a 10% increase in electricity prices (sensitivity scenario 2c), the project IRR could reach almost 10% (for furnace 7). This still gives a negative NPV; furthermore, this scenario would depend on high savings being maintained long-term and electricity prices actually rising significantly, which has not been the case between 2004 and 2006 (for instance, electricity price in the last four months of 2006 were between 106 and 117R/MWh, i.e. still approximately the same as in 2004 where they were 113R/MWh in average).

3. Savings on short-term repair costs

[7] Losses were -6.41mnR from this decreased production component only for furnace 7 in its first 27months of operation, and -8.06mnR in the first 14months of operation of furnace 5.

The newly retrofitted furnaces have lower repair costs than the old ones, and this component generates important savings. A further 10% savings in those repair costs would increase again the profitability of the project, especially for furnaces 7 and 5, although there would still be a negative NPV, therefore the project would remain economically unattractive.

*Discussion of the results of the sensitivity analysis:*

The technical performance of the project and in particular the availability (production rate) will certainly increase in future years due to better handling of the new design – metal production has an important craftsmanship aspect to it, with a lot of learning by doing when it comes to adjusting operating parameters to a new furnace design.

However, the sensitivity analysis above shows that, even with a combination of favourable scenarios, the NPV of the project activity remains relatively low and, perhaps more importantly, highly uncertain – due to the variation of both internal parameters (saving rates, production rate, etc) and external parameters (exchange rate, selling price). Consequently, any additional, secure and diversified revenue from carbon credits contributes importantly to the project viability and has been an important element in the decision to go ahead with the project in the first place. See step 3 of section B.5 for more details on the impact and importance of registration.

**Conclusion of section B.4**

This section demonstrates that for each furnace, the project activity (installation of new-build design) not implemented as a CDM project (alternative b), is not the most realistic alternative because it faces a number of barriers and its economic attractiveness is low. The project undertaken as a CDM project still faces some of these barriers but they are alleviated and diminished to an acceptable level (see step 3 of section B.5). Therefore, the only realistic baseline alternative is alternative a) continued use of current furnace technology.

**B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):**

**Step 0. Preliminary screening based on the starting date of the project activity:**

This step is not mandated by AM0038 and has been deleted from version 03 of the Tool for the demonstration and assessment of additionality; however, it is still used here to demonstrate that CDM was considered before the starting date of the project activity.

**Deleted:** ¶
*Illustration based on financial results*¶
¶
To illustrate points 3 to 6 above and put some figures on the qualitative arguments advanced, below are the financial results to date (as of December 2006) from the retrofitting of furnaces 7 and 5:¶
¶
Table 7: Financial results of the first two retrofittings covered by the project activity, as of December 2006.¶
... [1]

**Deleted:** Nevertheless, the payback of the project activity is relatively long and, maybe more importantly, very uncertain (as illustrated by the difference between expected and actual paybacks).

**Deleted:** very uncertain

**Deleted:** , and there is no need to perform Step 4: Compare economic attractiveness of the remaining alternatives (this step has in fact partly been performed in table 7, but it is very difficult to conclude on the attractiveness of the project based on such a purely financial analysis – see for instance the extremely high or low NPV and IRR values).

The project began construction prior to the registration of the first CDM project, commencing construction in July 2004 (and operation in September 2004), which falls between 1 January 2000 and the date of the registration of a first CDM project activity (18 November 2004).

The project developer started engaging with EcoSecurities and Standard Bank for the CDM component of the project in 2003. Highveld's financial director attended a workshop held at Standard Bank (Johannesburg) in July 2003[10] and confirmed in August 2003 Highveld's interest to go ahead with the CDM project[11]. Subsequent follow-up was made between the companies to determine how the proposed project could benefit from carbon credits and a first outline of CDM proposal was given by EcoSecurities and Standard Bank to Highveld in February 2004[12].

This was a key element in the decision to embark on the programme of retrofitting all furnaces, which matured at the end of 2003 and beginning of 2004. Decision to go ahead with the first retrofitting (furnace 7) was voted in January 2004. After a successful trial period at the end of 2004 for furnace 7, it was decided to pursue with furnace 3 and 5 (approved in January 2005).

In terms of formal CDM milestones, final CDM contract was signed in August 2004[13] after several proposals were made. This accelerated the process of developing a new methodology, which was finally approved on 30 September 2006 after 3 submissions (NM0092 rated B, NM0092-rev rated C, NM0146 rated A and approved as AM0038). The prospect of CDM revenues has been and continues to be a central element in the decision to pursue the programme and retrofit each furnace. Retrofitting of furnaces 1 and 6 has been delayed due in particular to the market conditions.

**Step 1. Investment and sensitivity analysis:**

It has been demonstrated in section B.4 that the project activity undertaken without the CDM (alternative b) is economically less attractive than the most plausible baseline scenario (alternative a) continued use of existing furnace technology). An investment analysis based on the NPV/IRR was performed and consistently supports this fact for a range of realistic assumptions. This is illustrated in table 7b: the NPV of the project is still negative (i.e. IRR below 12%) in almost all sensitivity scenarios.

**Deleted:** because of the perceived, but also real risks and uncertainties associated with the project activity

**Deleted:** The argument was illustrated by an investment analysis and included a NPV/IRR calculation and a description of the sensitivity of various parameters to the financial attractiveness of the project activity.

**Step 2. Common practice analysis**

To date there has been no identifiable example of a similar project in South Africa, or the wider region, of a project approach that retrofits new technology into an infrastructure designed for a completely different technology. The adjustment of PCD of a furnace would normally only take place when the product is

[10] See PDD attachment A – Documents 1 and 2

[11] See PDD attachment A – Document 3

[12] See PDD attachment A – Document 4

[13] See PDD attachment A – Document 5

changed (for instance: chrome, manganese and silicon alloys can be made in the same furnace) as the optimal PCD differs. Project developers are not aware of anyone who has made PCD adjustments for optimisation purposes, as it was done in furnaces 7 and 5, or changed the slipping device type of an existing electrode to the type now used in furnace #3 or the nature of the furnace (from rotating to stationary). It is the first brownfield project of this sort for technology providers Bateman and Pyromet.

Therefore, the project is not common practice in the manganese alloy, or wider metals production industry. Standard practice is to continue running existing stock, refurbishing as appropriate (typically every 3-5 years). Refurbishing would maintain the levels of consumption at about 5MWh per tonne of manganese alloy produced – the only way to change that efficiency is through a change in design. In some cases, facilities may build completely new furnaces but this would be very costly.

**Step 3. Impact of CDM registration**

Although this step has been deleted in version 03 of the Tool for the demonstration and assessment of additionality, it is mandated by AM0038 and is therefore carried out according to version 02 of the Additionality Tool.

The financial benefit from the revenues obtained by selling the certified emissions reductions has been one of the key issues encouraging investment in the proposed project activity. The CDM has been considered from an early stage (see step 0) and it is an integral part of the decision to go ahead with each retrofitting.

Revenues from carbon credits make a significant contribution to the overall profitability of the retrofitting project in themselves. For instance, at 12$/CER, CDM revenues are approximately equivalent to 100R/MWh[14], which is almost as high as the cost of electricity itself – i.e. CDM double the revenue stream from electricity savings.

**Deleted:** As shown in table 7 (in the examples of furnaces 7 and 5), revenues

**Deleted:** s

Furthermore, they diversify the sources of revenues in an industry under pressure from competition in its core business. In this sense, it is a more secure source of revenues than other principal sources of revenues of the project (savings from reduced repair costs and electricity use, and increased availability), although it is still subject to a certain extent to the technical performance of the furnaces.

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It is also important to highlight the fact that the retrofitting of the last two furnaces of the project (#1 and #6) has been put on hold temporarily because of the difficult market conditions, technical challenges and other barriers faced by the project (see section B.4, step 3). The perspective of CDM is an important element in the overall attractiveness of those retrofittings, and the registration of the project will certainly encourage project developers to pursue the project activity.

[14] 1.221tCO2/MWh * 12$/tCO2 * 7R/$ = 102R/MWh, compared to an electricity price in the base case (2004 prices) of 113R/MWh (in the last four months of 2006, the price paid by Transalloys was still approximately the same, between 106 and 117R/MWh).

## B.6 Emission reductions

### B.6.1. Explanation of methodological choices:

**1. Baseline emissions**

Emissions associated with SiMn production in the baseline are determined as follows:

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

where:

$BE_y$ Baseline emissions ($tCO_2$ in year y)

$BE_{y,offsite}$ Offsite baseline (grid) electricity emissions associated with the electricity consumption of the submerged arc furnace ($tCO_2e$ in year y)

$BE_{y,onsite}$ Onsite baseline emissions associated with the consumption of Reductant (Coal and Coke) and electrode paste during the production of SiMn ($tCO_2e$ in year y)

- The vintage period used for the determination of baseline emissions is 1997-2003 (7 years preceding the start of the project activity).

1.1. Offsite baseline emissions

Offsite baseline emissions are calculated according to:

$$BE_{y,offsite} = QP_{y,\,max} \text{ x } sec_b \text{ x } EF_{y,offsite} \qquad (2)$$

where:

$BE_{y,offsite}$ Offsite baseline (grid) electricity emissions associated with the electricity consumption of the submerged arc furnace ($tCO_2e$ in year y)

$QP_{y,\,max}$ Quantity of SiMn production in year y (tSiMn/y) maximised at historic average via 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 electricity consumption per tonne of SiMn produced (MWh/tSiMn)

$EF_{y,offsite}$ Grid electricity emissions factor ($tCO_2e$/MWh), estimated using ACM0002.

1.1.1. Determination of $QP_{y,\,max}$

The SiMn production is limited to the historic level as follows:

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

where:

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

The historic average production of SiMn is calculated according to:

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

where:
$QP_{historic}$ Historic (at least a three year vintage period) average annual production of SiMn (tSiMn/y)
$QP_{i,}$ Annual SiMn production for the $i^{th}$ year preceding the project activity (tSiMn)

1.1.2. Determination of $sec_b$

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

$$\sec_b = \frac{\sum_{i=1}^{n} EC_i}{\sum_{i=1}^{n} QP_i} \qquad (5)$$

where:
$sec_b$ Historic (at least a three year vintage period) average grid electricity consumption per tonne of SiMn produced (MWh/tSiMn)
$QP_{i,}$ Annual SiMn production for the $i^{th}$ year preceding the project activity (tSiMn produced in year i)
$EC_{i,}$ Annual grid electricity consumption by the submerged electric arc furnace for the $i^{th}$ year preceding the project activity (MWh consumed in year i)

1.1.3. Determination of $EF_{y,offsite}$

AM0038 states that $EF_{y,offsite}$ should be estimated using the latest version of ACM0002; version 06 is used. $EF_{y,offsite}$ is calculating by estimating the Operating Margin and Build Margin emission factors of the South African grid

- STEP 1: Calculate the Operating Margin emission factor ($EF_{OM}$):

Four options are available to determine $EF_{OM}$:

a) Simple OM
b) Simple adjusted OM
c) Dispatch Data Analysis OM
d) Average OM.

Although ACM0002's preferred option is c), this is not an option here due to the lack of data and the prohibitive cost of processing it if it was available. As low-cost and must-run resources (hydro, bagasse and nuclear in the South African grid) has always represented less than 50% of the electricity generation on the grid, option a) can be used and is used to determine $EF_{OM}$. The following equation is used:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} \quad (6)$$

where:

$F_{i,j,y}$ Amount of fuel *i* (in mass or volume unit) consumed by relevant power sources *j* in year(s) *y*

$j$ Refers to the power sources delivering electricity to the grid, not including low-cost and must-run power plants

$COEF_{i,j}$ CO2 emission coefficient of fuel *i* ($tCO_2$/mass or volume unit of fuel) taking into account the carbon content of fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*

$GEN_{j,y}$ Electricity (MWh) delivered to the grid by source *j*

$EF_{OM,y}$ is determined ex ante for years 2002, 2003 and 2004 as this is the most recent period for which information is available (2004 figures are only just in the process of being published by the National Energy Regulator). The value taken for $EF_{OM}$ is the full generation weighed average of $EF_{OM,y}$. The values and sources of all data used are given in Annex 3. For some power sources, a default efficiency or specific fuel consumption have been used due to the lack of publicly available information (all assumptions made are conservative and explained in Annex 3). Coal emission factor is based on specific IPCC value for South Africa.

- STEP 2: Calculate the Build Margin emission factor ($EF_{BM}$)

$EF_{BM}$ is determined ex ante by using the same equation as above, except that the sample of plants used is not *i* (all power sources excluding low-cost and must-run) but *m* and only the latest available year is used (2004). Plants in sample group *m* are constituted by the 5 most recent plants, as they represented a higher electricity generation than the generation of the 20% (in terms of generation) more recent. The dates of commissioning of power plants are indicated in annex 3 when they are available.

Note: Using 2004 data to estimate the build margin underestimates the actual Build Margin emission factor, as the trend is to put back into use old, inefficient coal-fired power plants that had been shut down decades ago (Eskom 2006)[15]. This is due to "a sharp increase in the demand for electricity"; any effort to reduce this demand, such as the one undertaken in the project, could therefore directly avoid the production of electricity from these marginal plants (both in terms of operating margin and build margin), whose electricity production is more carbon intensive than any other plant on the grid.

- STEP 3: Calculate the Combined Margin (i.e baseline emission factor $EF_{y,offsite}$)
  A weighed-average of $EF_{OM}$ and $EF_{BM}$ is used to calculate $EF_{y,offsite}$ (which is determined ex ante and will be constant through the crediting period). Default weights of ½ for OM, ½ for BM are used:

$$EF_{y,offsite} = \frac{EF_{OM} + EF_{BM}}{2} \quad (7)$$

The results of the calculations of $EF_{OM}$, $EF_{BM}$ and $E_{y,offiste}$ ("Combined margin" – CM) are given in section B.6.3.

1.2. Onsite baseline emissions

Onsite baseline emissions are calculated using the following equations:

$$BE_{y,onsite} = QP_{y,\,max} \text{ x } EF_{b,onsite} \qquad (8)$$

where:

| | |
|---|---|
| $BE_{y,onsite}$ | Onsite baseline emissions associated with the consumption of Reductant (Coal and Coke) and electrode paste during the production of SiMn (tCO2e in year y) |
| $QP_{y,\,max}$ | Value of SiMn production used for estimating baseline and project emissions for the year y (tSiMn/y) |
| $EF_{b,onsite}$ | Baseline emission factor associated with the (onsite) consumption of reductant (Coal and Coke) and electrode paste per tonne of SiMn produced ($tCO_2e$/tSiMn). The average onsite emissions are based on historic (at least a three year vintage period) average annual consumption as calculated in equation 7 |

[15] See http://www.eskom.co.za/live/content.php?Item_ID=162M:

"th http://www.eskom.co.za/live/content.php?Item_ID=162M:

"the Eskom Board of Directors took a final decision in 2003 for the Return to Service (RTS) of the three power stations, Camden, Grootvlei and Komati, that were mothballed in the late 1980's and early 1990's. Unit 6 at Camden Power Station was then identified as the first unit to be commissioned. Another 2 units will be commissioned in 2006, 3 units in 2007 and the last of the 8 units in 2008. Unit 6 […] went on commercial load on 16 July 2005.

The onsite emission factor is determined as follows:

$$EF_{b,onsite} = \frac{\sum_{i=1}^{n} Q_{boal,i} * EF_{bcoal,i} + \sum_{i=1}^{n} Q_{boke,i} * EF_{bcoke,i} + \sum_{i=1}^{n} Q_{bpaste,i} * EF_{bpaste}}{\sum_{i=1}^{n} QP_i} \quad (9)$$

where:

$EF_{b,onsite}$ Baseline emission factor associated with the (onsite) consumption of reductant (Coal and Coke) and electrode paste per tonne of SiMn produced ($tCO_2e/tSiMn$).

$Q_{bcoal,\ i}$ Historic (at least a three year vintage period) annual consumption of coal used as reductant in the submerged electric arc furnace in tonnes of coal per year (tCoal consumed in year i).

$EF_{bcoal,i}$ Emissions factor applied for the coal consumed as reductant.

$Q_{bcoke,\ i}$ Historic (at least a three year vintage period) annual consumption of coke used as reductant in the submerged electric arc furnace in tonnes of coke per year (tCoke consumed in year i).

$EF_{bcoke,i}$ Emissions factor applied for the coke consumed as reductant.

$Q_{bpaste,\ i}$ Historic (at least a three year vintage period) 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).

$EF_{bpaste}$ Emissions factor applied for the electrode paste consumed as electrode

$QP_{i,}$ Annual SiMn production for the $i^{th}$ year preceding the project activity (tSiMn)

- According to the preferred method of AM0038 and owing to the project’s good monitoring practice of this factor, the emission factor of coke is based on ex ante monitoring of the carbon content of the coke used in the facility rather than IPCC values. Carbon content is recorded monthly and annual averages are taken for $EF_{bcoke,i}$ ; if some monthly values are missing, average from previous and next months are used. Emission factors for the coal and the electrode paste are taken from IPCC (2006) (see section B.6.2).
- See section B.6.3 for the calculation of overall uncertainty of onsite emissions and an explanation of how this has been taken into account in the calculations.

**2. Project emissions**

Emissions associated with SiMn production in the project are determined as follows:

$$PE_y = PE_{y,offsite} + PE_{y,onsite} \quad (10)$$

where:

$PE_y$ Project emissions ($tCO_2$ in year y)

$PE_{y,offsite}$ Offsite project (grid) electricity emissions associated with the electricity consumption of the submerged arc furnace ($tCO_2e$ in year y)

$PE_{y,onsite}$ Onsite project emissions associated with the consumption of Reductant (Coal and Coke) and electrode paste during the production of SiMn ($tCO_2e$ in year y)

2.1. Offsite project emissions

Offsite project emissions are calculated according to:

$$PE_{y,offsite} = QP_{y,\,max} \times sec_{p,y} \times EF_{y,offsite} \qquad (11)$$

where:

$PE_{y,offsite}$ Offsite project (grid) electricity emissions associated with the electricity consumption of the submerged arc furnace ($tCO_2e$ in year y)

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

$sec_{p,y}$ Grid specific electricity consumption per tonne of SiMn produced in the project situation (MWh/tSiMn) in year y

$EF_{y,offsite}$ Grid electricity emissions factor ($tCO_2e$/MWh), estimated according to ACM0002 (see 1.1.3 above)

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

$$\sec_{p,y} = \frac{EC_y}{QP_{y,monitored}} \qquad (12)$$

where:

$sec_{p,y}$ Grid specific electricity consumption per tonne of SiMn produced in the project situation (MWh/tSiMn) in year y

$EC_{y,}$ Annual grid electricity consumption by the submerged electric arc furnace in year y (MWh)

$QP_{y,monitored,}$ Monitored production of SiMn in year y during the project activity (tSiMn/y)

2.2. Onsite project emissions

Onsite project emissions are calculated using the following equations:

$$PE_{y,onsite} = QP_{y,\,max} \times EF_{p,y,onsite} \qquad (13)$$

where:

$PE_{y,onsite}$ Onsite project emissions associated with the consumption of Reductant (Coal and Coke) and electrode paste during the production of SiMn (tCO2e in year y)

$QP_{y,\ max}$ Value of SiMn production used for estimating baseline and project emissions for the year y (tSiMn/y)

$EF_{p,y,onsite}$ Project emission factor associated with the (onsite) average consumption of reductant (Coal and Coke) and electrode paste per tonne of SiMn in year y ($tCO_2e/tSiMn$) as calculated in equation 12.

The onsite emission factor is determined as follows:

$$EF_{p,y,onsite} = \frac{Q_{poal,y} *EF_{pcoal,y} + Q_{poke,y} *EF_{pcoke,y} + Q_{ppaste,y} *EF_{ppaste,y}}{QP_{y,monitored}} \quad (14)$$

where:

$EF_{p,y,onsite}$ Project emission factor associated with the (onsite) average consumption of reductant (Coal and Coke) and electrode paste per tonne of SiMn produced ($tCO_2e/tSiMn$) in year y.

$Q_{pcoal,\ y}$ Consumption of coal used as reductant in the submerged electric arc furnace in tonnes of coal per year (tCoal/y).

$EF_{pcoal,y}$ Emissions factor applied for the coal consumed as reductant.

$Q_{pcoke,\ y}$ Consumption of coke used as reductant in the submerged electric arc furnace in tonnes of coke per year (tCoke/y).

$EF_{pcoke.y}$ Emissions factor applied for the coke consumed as reductant.

$Q_{ppaste,\ y}$ Consumption of electrode paste used as electrode in the submerged electric arc furnace in tonnes of electrode paste per year (tpaste/y).

$EF_{ppaste,y}$ Emissions factor applied for the electrode paste consumed as electrode, using the relevant emissions factor (tCO2) for the carbon paste as specified by the manufacturer for the vintage period.

$QP_{y,monitored,}$ Monitored production of SiMn in year y during the project activity (tSiMn/y)

- According to the preferred method of AM0038, project-specific measurement of the emission factor for the coke will be based on ex post monitoring of the carbon content of the coke used in the facility rather than IPCC values. Carbon content will be recorded monthly and annual averages are taken for $EF_{bcoal,i}$ and $EF_{bcoke,i}$. If some monthly values are missing, average from previous and next months will be used. Emission factor for the coal will be taken from IPCC (2006) and emission factor for the paste will be based on the supplier's specifications with possible use of IPCC or other literature references for the determination of the carbon content of volatiles in the paste.
- See section B.6.3 for the calculation of overall uncertainty of onsite emissions and an explanation of how this has been taken into account in the calculations..

**3. Leakage**

There is no leakage associated with the project activity, whether under AM0038 or ACM0002.

**4. 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 formula below:

$$ER_y = BE_y – PE_y – L_y \quad (15)$$

where :
$ER_y$ Emissions Reductions (t $CO_2$e) in year y
$BE_y$ Emissions in the baseline scenario (t $CO_2$e) in year y
$EP_y$ Emissions in the project scenario (t $CO_2$e) in year y
$L_y$ Leakage (t $CO_2$e) in year y

### B.6.2. Data and parameters that are available at validation:

| **Data / Parameter:** | **QPi** |
|---|---|
| Data unit: | Tonnes of SiMn/year |
| Description: | Annual SiMn production for 7 years preceding the project activity |
| Source of data used: | Project proponent |
| Value applied: | (see table below) |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Measurement methods are the same as the ones that will be used for QPy,monitored (see section B.7.2) |
| Any comment: | |

| **QPi (tSiMn/y)** | | | | | |
|---|---|---|---|---|---|
| **Furnace** | **1** | **3** | **5** | **6** | **7** |
| 1997 | 21,685 | 21,930 | 38,847 | 22,571 | 40,685 |
| 1998 | 7,506 | 9,518 | 42,005 | 24,188 | 42,399 |
| 1999 | 21,779 | 17,680 | 35,788 | 8,238 | 44,477 |
| 2000 | 18,641 | 19,731 | 35,877 | 21,269 | 34,862 |
| 2001 | 21,809 | 22,660 | 34,843 | 21,846 | 31,933 |
| 2002 | 23,349 | 22,159 | 41,898 | 22,618 | 43,700 |
| 2003 | 21,321 | 21,601 | 35,108 | 21,632 | 37,717 |
| Total 97-03 | 136,090 | 135,279 | 264,366 | 142,362 | 275,773 |

| **Data / Parameter:** | **ECi** |
|---|---|
| Data unit: | MWh/year |
| Description: | Annual grid electricity consumption by the submerged electric arc furnace for 7 years preceding the project activity |
| Source of data used: | Project proponent |
| Value applied: | |

| ECi (MWh/y) | | | | | |
|---|---|---|---|---|---|
| **Furnace** | **1** | **3** | **5** | **6** | **7** |
| 1997 | 115,511 | 115,381 | 224,774 | 130,113 | 231,635 |
| 1998 | 41,735 | 51,814 | 248,046 | 136,458 | 256,158 |
| 1999 | 111,837 | 93,474 | 205,295 | 44,755 | 260,410 |
| 2000 | 97,656 | 100,458 | 214,388 | 120,804 | 208,377 |
| 2001 | 107,293 | 111,287 | 168,826 | 107,474 | 173,106 |
| 2002 | 109,409 | 104,833 | 200,136 | 119,525 | 216,880 |
| 2003 | 99,142 | 99,678 | 172,039 | 110,109 | 192,187 |
| Total 97-03 | 682,583 | 676,925 | 1,433,504 | 769,238 | 1,538,753 |

| | |
|---|---|
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Measurement methods are the same as the ones that will be used for ECy (see section B.7.2) |
| Any comment: | |

| **Data / Parameter:** | **Qboal,i** |
|---|---|
| Data unit: | Tonnes of coal/year |
| Description: | Annual consumption of coal used as reductant in the submerged electric arc furnace for 7 years preceding the project activity |
| Source of data used: | Project proponent |
| Value applied: | (see table below) |

| Qbcoal,i (tcoal/y) | | | | | |
|---|---|---|---|---|---|
| **Furnace** | **1** | **3** | **5** | **6** | **7** |
| 1997 | 14,538 | 15,064 | 28,939 | 17,345 | 31,098 |
| 1998 | 4,494 | 5,862 | 33,313 | 16,586 | 31,741 |
| 1999 | 13,005 | 11,529 | 31,738 | 5,764 | 37,165 |
| 2000 | 13,426 | 13,055 | 33,574 | 17,146 | 31,216 |
| 2001 | 16,304 | 17,863 | 31,619 | 19,936 | 26,698 |
| 2002 | 16,704 | 16,871 | 35,932 | 20,993 | 37,788 |
| 2003 | 18,501 | 19,475 | 32,739 | 20,195 | 33,883 |
| Total 97-03 | 96,972 | 99,719 | 227,854 | 117,965 | 229,589 |

| | |
|---|---|
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Measurement methods are the same as the ones that will be used for Qpcoal,y (see section B.7.2) |
| Any comment: | |

| **Data / Parameter:** | **Qbcoke,i** |
|---|---|
| Data unit: | Tonnes of coke/year |
| Description: | Annual consumption of coke used as reductant in the submerged electric arc furnace for 7 years preceding the project activity |
| Source of data used: | Project proponent |
| Value applied: | |

| | |
|---|---|
| | **Qbcoke,i (tcoke/y)** |

| Furnace | 1 | 3 | 5 | 6 | 7 |
|---|---|---|---|---|---|
| 1997 | 1,480 | 1,718 | 3,644 | 1,734 | 3,702 |
| 1998 | 554 | 803 | 3,361 | 2,245 | 4,172 |
| 1999 | 1,652 | 1,479 | 2,986 | 788 | 3,517 |
| 2000 | 1,234 | 1,409 | 2,656 | 1,687 | 2,085 |
| 2001 | 1,163 | 1,234 | 1,151 | 1,002 | 1,964 |
| 2002 | 563 | 836 | 2,247 | 823 | 1,880 |
| 2003 | 1,011 | 973 | 1,507 | 1,118 | 1,689 |
| Total 97-03 | 7,657 | 8,452 | 17,552 | 9,397 | 19,009 |

| | |
|---|---|
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Measurement methods are the same as the ones that will be used for Qpcoke,y (see section B.7.2) |
| Any comment: | |

| | |
|---|---|
| **Data / Parameter:** | **Qbpaste,i** |
| Data unit: | Tonnes of paste/year |
| Description: | Annual consumption of electrode paste used as electrode in the submerged electric arc furnace for 7 years preceding the project activity |
| Source of data used: | Project proponent |
| Value applied: | |

| Qbpaste,i (tpaste/y) | | | | | |
|---|---|---|---|---|---|
| **Furnace** | **1** | **3** | **5** | **6** | **7** |
| 1997 | 1,127 | 1,136 | 2,123 | 1,175 | 2,023 |
| 1998 | 350 | 487 | 2,344 | 1,275 | 2,045 |
| 1999 | 1,086 | 946 | 1,763 | 417 | 2,123 |
| 2000 | 1,032 | 104 | 2,045 | 1,143 | 2,009 |
| 2001 | 1,141 | 1,147 | 2,031 | 958 | 1,543 |
| 2002 | 1,029 | 1,025 | 1,968 | 975 | 1,739 |
| 2003 | 1,097 | 956 | 1,690 | 1,028 | 1,721 |
| Total 97-03 | 6,862 | 5,801 | 13,964 | 6,971 | 13,203 |

| | |
|---|---|
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Measurement methods are the same as the ones that will be used for Qppaste,y (see section B.7.2) |
| Any comment: | |

| | |
|---|---|
| **Data / Parameter:** | **EFbcoal,i** |
| Data unit: | tCO2/tcoal |
| Description: | Emission factor applied for the coal consumed as reductant based on carbon content |
| Source of data used: | IPCC (2006) – Vol3, Ch4, section 4.3.3.2, table 4.6 page 4.37 |
| Value applied: | |

| | |
|---|---|
| | **EFbcoal,i (tCO2/tcoal)**<br>3.1 \| tCO2/tcoal<br>*Source: IPCC (2006) Vol3, Ch4, p4.37, Table 4.6* |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | The IPCC table gives specific values for coal used as reductant in ferroalloy production. The value for Si-metal is taken in the IPCC table. |
| Any comment: | Project specific values cannot be used because previous coal carbon contents monitoring didn't enable a calculation of EFbcoal (several coal types have been used and no weighed average can be done). |

| **Data / Parameter:** | **EFbcoke,i** |
|---|---|
| Data unit: | tCO2/tcoke |
| Description: | Emission factor applied for the coke consumed as reductant based on carbon content |
| Source of data used: | Project proponent |
| Value applied: | see table below |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Measurement methods are the same as the ones that will be used for EFpcoke,y (see section B.7.2) |
| Any comment: | A measured project-specific value for 7 years preceding the project activity has been preferred to IPCC values. |

**EFbcoke,i (tCO2/tcoke)**

| Year | EF |
|---|---|
| 1997 | 3.09 |
| 1998 | 3.13 |
| 1999 | 3.10 |
| 2000 | 3.12 |
| 2001 | 3.15 |
| 2002 | 3.17 |
| 2003 | 3.19 |
| Average 97-03 | 3.13 |

| **Data / Parameter:** | **EFbpaste,i** |
|---|---|
| Data unit: | tCO2/t of carbon paste |
| Description: | Emission factor applied for the electrode paste consumed as electrode based on carbon content |
| Source of data used: | Paste supplier |
| Value applied: | 3.32 |

<table>
<tr><td></td><td></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually applied :</td><td>The paste supplier supplied the following information on the composition of the paste:
<table>
<tr><th>PROPERTY</th><th>UNIT</th><th>STANDARD</th><th>TYPICAL</th></tr>
<tr><td>Ash Content</td><td>%</td><td><6 - 7</td><td>6.4</td></tr>
<tr><td>Volatile Matter</td><td>%</td><td>13 - 15</td><td>13.6</td></tr>
<tr><td>Fixed Carbon Content</td><td>%</td><td>> 79</td><td>79.8</td></tr>
</table>
<br>
The emission factor is then calculated using equation 4.19, p4.33 of IPCC (2006):<br>
<br>
EQUATION 4.19<br>
CARBON CONTENT OF FERROALLOY REDUCING AGENTS<br>
Total C-content in reducing agent i = Fix C in i + Content of volatiles in i • Cv<br>
Where:<br>
Cv = Carbon content in volatiles. Unless other information is available, Cv = 0.65 is used for coal and 0.80 for coke.<br>
<br>
We take for Cv the same value as for coke (0.80), given that the characteristics of the paste are similar to that of the coke:<br>
- 78.5% of the paste is anthracite, which is a form of coal with high calorific value and carbon content (like coke)<br>
- 21.5% or the paste is the binder, which itself is composed of a minimum of 45% of coking-value.<br>
<br>
Therefore the total carbon content of the paste is 79.8 + 13.6 * 0.80 = 90.68tC/tpaste, and EFbpaste=3.32tCO2/tpaste. This value is still lower than the IPCC value of 3.4.</td></tr>
</table>

<table>
<tr><td>Data / Parameter:</td><td>Quality of coalb</td></tr>
<tr><td>Data unit:</td><td>Mass fraction of each component (%m/m)</td></tr>
<tr><td>Description:</td><td>Quality of coal based on elementary analysis and other relevant properties</td></tr>
<tr><td>Source of data used:</td><td>Project proponent</td></tr>
<tr><td>Value applied:</td><td>
<table>
<tr><th colspan="5">Quality of coalb</th></tr>
<tr><td>Composition (%)</td><td>Fixed C</td><td>Volatiles</td><td>S</td><td>P</td></tr>
<tr><td>Average 2003</td><td>52.9</td><td>30.4</td><td>0.74</td><td>0.22</td></tr>
</table>
</td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually applied :</td><td>Measurement methods are the same as the ones that will be used for the Quality of coalp (see section B.7.2). The value for 2003 is used to facilitate the comparison with the quality of coal at the beginning of the project activity.</td></tr>
<tr><td>Any comment:</td><td>Project proponent’s lab analyses are preferred to supplier’s data and are</td></tr>
</table>

| | |
|---|---|
| | used to determine the emission factor of the coal EFbcoal,i. |

| **Data / Parameter:** | **Quality of cokeb** |
|---|---|
| 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: | Project proponent |
| Value applied: | (see table below) |

| **Quality of cokeb** | | | | |
|---|---|---|---|---|
| Composition (%) | Fixed C | Volatiles | S | P |
| Average 2003 | 85.6 | 1.7 | 0.93 | 0.35 |

| | |
|---|---|
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Measurement methods are the same as the ones that will be used for the Quality of coalp (see section B.7.2). The value for 2003 is used to facilitate the comparison with the quality of coal at the beginning of the project activity. |
| Any comment: | Project proponent's lab analyses are preferred to supplier's data and are used to determine the emission factor of the coke EFbcoke,i. |

| **Data / Parameter:** | **Quality of electrode pasteb** |
|---|---|
| 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 applied: | (see table below) |

| **GREEN PASTE** | | | |
|---|---|---|---|
| **Property** | **Unit** | **Standard** | **Typical** |
| Ash Content | % | <6 - 7 | 6.4 |
| Volatile Matter | % | 13 - 15 | 13.6 |
| Fixed Carbon Content | % | > 79 | 79.8 |
| Apparent Density | $g/cm^3$ | > 1.56 | 1.6 |
| Plasticity Range | % | 15 - 55 | 24 |
| Specific Heat | J/g°C | > 0.8 | 0.88 |
| Softening Point | °C | 55 – 59 | Per customer |
| | | 68 – 73 | |
| Size (Cylinders) | mm | Diameter: 400 x Length: 550 | Per customer |
| | | Diameter: 500 x Length: 550 | |
| | | Diameter: 500 x Length: 1000 | |
| | | Diameter: 600 x Length: 1000 | |
| | | Diameter: 700 x Length: 1000 | |
| Extruder Block Size | mm | 100 x 100 x 80 | |

| PASTE BAKED @ 1000 °C | | | |
|---|---|---|---|
| Property | Unit | Standard | Typical |
| Ash Content | % | < 8 | 7.3 |
| Fixed Carbon Content | % | > 90 | 93 |
| Apparent Density | g/cm$^3$ | > 1.35 | 1.4 |
| Relative Density | g/cm$^3$ | > 1.8 | 1.87 |
| Total Porosity | % | > 23 | 24.9 |
| Specific Electrical Resistivity | Ohm.mm$^2$/m | < 80 | 65.7 |
| Thermal Shock Resistance | kW | > 12 | 12.5 |
| Thermal Conductivity | W/mK | 8.0 - 9.0 | 8.8 |
| Specific Heat | J/g°C | > 0.7 | 0.75 |
| Cold Crushing Strength | kg/cm$^2$ | > 50 | 54 |
| Bending Strength | kg/cm$^2$ | 30 - 50 | 46.4 |
| Elasticity Modulus | kg/cm$^2$ x 10$^4$ | 3.0 - 5.0 | 4.4 |
| Linear Coeff. of Thermal Expansion | 20 - 950 °C | | Nil |

| | |
|---|---|
| Justification of the choice of data or description of measurement methods and procedures actually applied : | |
| Any comment: | Green paste is bought from the supplier and put into the electrodes. As the heat increases when it goes down the electrodes, it is baked before it reaches the core of the furnace. The quality of green paste should be used for the comparison between the composition of the paste before and after the project activity, and for the calculation of emission factors. |

| **Data / Parameter:** | **Quality of SiMnb** |
|---|---|
| Data unit: | Text |
| Description: | Quality of SiMnb, based on elementary analysis and other relevant properties |
| Source of data used: | Project proponent |
| Value applied: | |

| **Quality of SiMnb** | | | | |
|---|---|---|---|---|
| SiMn Specifications (Contractual elements with customer): | | | | |
| Element | | Max (%) | Min (%) | Typical (%) |
| Mn | Manganese | 68* | 65.0 | 66.7 |
| Si | Silicon | 18.0 | 16.0 | 17.1 |
| C | Carbon | 2.0 | - | 1.6 |
| P | Phosphorus | 0.150 | - | 0.100 |
| S | Sulphur | 0.015 | - | 0.010 |

* Mn content of SiMn produced by furnaces 1 and 3 don't have a maximum Mn content allowed (because it is used for different applications)

| | |
|---|---|
| Justification of the choice of data or description of measurement methods and procedures actually applied : | The specifications of the SiMn produced will be used to compare the quality of the SiMn produced before and after the project activity. |
| Any comment: | |

| **Data / Parameter:** | **Quality of ore** |
|---|---|
| Data unit: | Text |
| Description: | Quality of ore, based on elementary analysis and other relevant properties |
| Source of data used: | Project proponent |
| Value applied: | (see table below) |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Measurement methods are the same as the ones that will be used for the Quality of ore in the project (see section B.7.2). The value for 2003 is used to facilitate the comparison with the quality of coal at the beginning of the project activity. |
| Any comment: | |

**Quality of ore**

| Composition (%) | Mn | Fe | SiO2 | CaO | MgO | P |
|---|---|---|---|---|---|---|
| Average 2003 | 38.2 | 4.4 | 5.0 | 15.1 | 3.6 | 0.017 |

| **Data / Parameter:** | **Quality of fluxes** |
|---|---|
| Data unit: | Text |
| Description: | Quality of fluxes, based on elementary analysis and other relevant properties |
| Source of data used: | Project proponent |
| Value applied: | (see table below) |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Measurement methods are the same as the ones that will be used for the Quality of fluxes in the project (see section B.7.2). The value for 2003 is used to facilitate the comparison with the quality of coal at the beginning of the project activity. |
| Any comment: | |

**Quality of fluxes**

| *Composition of Metal rich slag:* | | | | | | |
|---|---|---|---|---|---|---|
| Composition (%) | Mn | C | Si | Fe | CaO | MgO |
| Average 2003 | 11.7 | 0.6 | 19.8 | 0.9 | 24.3 | 4.7 |
| *Composition of pellets:* | | | | | | |
| Composition (%) | MnO | SiO2 | CaO | MgO | FeO | C |
| Average 2003 | 30.8 | 28.3 | 6.0 | 8.5 | 1.9 | 7.2 |

### B.6.3 Ex-ante calculation of emission reductions:

**1. Grid electricity emission factor**

The Grid electricity emission factor ($EF_{y,offsite}$ in tCO2e/MWh) for South Africa is estimated according to ACM0002, following the procedure described in section B.6.1. Detail of data and sources used is provided in Annex 3. The following table gives the results of the calculation of Operating margin, Build margin and Combined margin (i.e. $EF_{y,offiste}$):

Table 8: Grid electricity emission factor calculations

| Results | |
|---|---|
| **EF** | **tCO2/MWh** |
| OM | 1.195 |
| BM | 1.248 |
| CM | 1.221 |

**2. Onsite and offsite emission factors; baseline emissions and emission reductions per furnace**

If we apply equations provided in section B.6.1 with values provided in section B.6.2 we can obtain baseline emission factors $EF_{b,onsite}$ and $EF_{b,offsite}$. To calculate project emissions (and emission reductions), we assume the following:

- $QP_{y,monitored} = QP_{historic}$
- $EF_{y,onsite} = EF_{b,onsite}$ (tCO2e/SiMn)
- $EF_{y,offiste} = EF_{b,offiste}$ (tCO2/MWh)
- $sec_{p,y} = sec_b$ – 0.4 (MWh/tSiMn) i.e. savings of 0.4MWh/tSiMn in the project.

The results per furnace are provided in the table below:

Table 9: Baseline emissions and emission reductions per furnace

| RESULTS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Furnace** | **QPhistoric (tSiMn/y)** | **secb (MWh/tSiMn)** | **EFb offiste (tCO2/tSiMn)** | **EFb onsite (tCO2/tSiMn)** | **EFb total (tCO2/tSiMn)** | **Average emissions at QPhistoric (tCO2/y)** | **ERs from elec savings at QPhistoric (tCO2/y)** |
| 1 | 19,441 | 5.02 | 6.12 | 2.55 | 8.68 | 168,687 | 9,495 |
| 3 | 19,326 | 5.00 | 6.11 | 2.62 | 8.73 | 168,768 | 9,439 |
| 5 | 37,767 | 5.42 | 6.62 | 3.05 | 9.68 | 365,421 | 18,445 |
| 6 | 20,337 | 5.40 | 6.60 | 2.94 | 9.54 | 193,931 | 9,933 |
| 7 | 39,396 | 5.58 | 6.81 | 2.96 | 9.77 | 384,838 | 19,241 |

**3. Overall emissions**

To compile the overall project emissions (PE) and emission reductions (ER) of the project, we sum in each year PE and ER for the furnaces that have been retrofitted in that year. As mentioned in section B.3, each furnace enters into the project boundary only once it is retrofitted. The following retrofitting schedule is used:

Table 10: Furnace retrofitting schedule

| Furnace retrofitting schedule | | | | | | |
|---|---|---|---|---|---|---|
| Furnace # | | 1 | 3 | 5 | 6 | 7 |
| Date retrofit | | 2009 | 2005 | 2005 | 2008 | 2004 |
| Year | | *Retrofitted furnace operational?* | | | | |
| 1 | 2004-05 | 0 | 0 | 0 | 0 | 1 |
| 2 | 2005-06 | 0 | 1 | 1 | 0 | 1 |
| 3 | 2006-07 | 0 | 1 | 1 | 0 | 1 |
| 4 | 2007-08 | 0 | 1 | 1 | 0 | 1 |
| 5 | 2008-09 | 0 | 1 | 1 | 1 | 1 |
| 6 | 2009-10 | 1 | 1 | 1 | 1 | 1 |
| 7 | 2010-11 | 1 | 1 | 1 | 1 | 1 |
| 8 | 2011-12 | 1 | 1 | 1 | 1 | 1 |
| 9 | 2112-13 | 1 | 1 | 1 | 1 | 1 |
| 10 | 2013-14 | 1 | 1 | 1 | 1 | 1 |

The overall results are given in section B.6.4

## 4. Uncertainty

AM0038 states that :

> "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 onsite emissions".

The interpretation of the project participants, who wrote the methodology, is that uncertainty should be taken into account according to the monitoring and reporting guidelines that are used in the EU Emissions Trading Scheme (ETS) (further referred to as "EC monitoring guidelines"). This analysis has been done and is presented in annex 7. The main conclusion is that the monitoring system used in the project meets most of the requirements imposed by the monitoring tier that would apply to the project's plant, should it be covered by the EU ETS (see explanation of these tiers in paragraph a) below). These requirements could be met through the implementation of a rigorous monitoring system and efforts have been made on specific parameters with a higher uncertainty, such as the coke emission factor which has been determined on a project-specific basis.

However the project participants have been requested to clarify the uncertainty estimate and also to clarify how uncertainties have been incorporated in the emission reduction calculations. Using uncertainty in the calculations has the following issues:

*a) EU ETS does not use uncertainty to correct calculated emissions*

The EC monitoring guidelines contain different approaches for determining activity data, emission factors, oxidation and conversion factors. These approaches are referred to as tiers. The tier level depends on the type of activity and the production level. The resulting tier level sets the approach that the participants must follow to determine activity data, emission factors, oxidation and emission factors, unless the required level of accuracy is not technically feasible or would lead to unreasonable high costs.

The sequence is therefore: activity and production → tier level [= monitoring method + maximum allowable uncertainty level] → calculate uncertainties → compare with required tier level[16].

"Taken into account" means therefore that the tier approach proposed in the EU ETS will be followed in order to determine emissions. This leads to the selection of a tier level, which in turn gives guidance for the monitoring methodology. The applied monitoring methodology results in an emission estimate that reflects the required tier level, thus taking uncertainty into account (i.e. in the EU ETS taking uncertainty into account does not require corrections to calculated emissions to be made).

*b) Reducing emissions for uncertainty levels is not statistically accurate*

Both the EU ETS and the IPCC require that uncertainties are taken into account. In the EU ETS, monitoring systems must comply with a maximum allowable uncertainty. This uncertainty depends on type of activity and production level [see above]. The EU ETS does not require that emissions are "corrected" for uncertainty. Under the IPCC, Parties are required to improve the quality of their emission inventories, which includes the reduction of uncertainty, but does not require "correction" of emissions.

In statistics, "uncertainty" refers to the envelope around the "true" value of the measured parameter. The 95% confidence interval around the measured average states that 19 out of 20 measurements will fall into this interval. The uncertainty can be + or -. Working with the lowest value in the confidence range means therefore that you minimize the probability of working with the correct value. This is the reason that both the IPCC and the EU ETS use uncertainty only as a *qualitative* concept in order to improve the quality of emission estimates. Applying quantitative "corrections" in CDM means that emission reduction efforts in this instrument would be valued systematically lower than in other Kyoto instruments where this approach is not seen as statistically accurate. In other words, it creates a *bias*.

For the reasons above, making corrections to calculated emissions to take uncertainty into account is viewed as a statistically inaccurate approach. However, the project participants have been required to make these corrections and therefore will **discount *onsite emission reductions* by the uncertainty of overall onsite emissions**, which has been calculated at **9.0%** (see tables 11 and 12).

Notes:

- The project is an electricity saving project (affecting offsite emissions) and onsite emissions should not be affected significantly by the project. If onsite emissions increase, project participants will be penalised as these emissions count as project emissions. If onsite emissions decrease, project participants will also be penalised through the 9.0% discount factor on the emission reductions.
- The uncertainty that will be used for the calculations during the whole crediting period should be this 9.0% figure, determined *ex ante*. Table 12 illustrates the calculations for furnace 7 (the first one that was retrofitted), but results would be the same for other furnaces.

[16] See EC monitoring guidelines, section 4.2.2.1.4 p12 (for the determination of the tiers) and section 4.3 pp19-21 (for the use of uncertainty).

Table 11: Determination of the uncertainty of activity data and emission factors for parameters used in the calculation of onsite emissions

| Parameters uncertainties | | |
|---|---|---|
| **Reductant** | **Uncertainty** | **Source** |
| *Activity data* | | |
| Coal | 2.5% | Based on 2% rated accuracy of load cells (which measure the tonnes of each raw material in each batch). Other possible sources of uncertainty (associated to procedures/way instruments are used) will be minimised by calibrating load cells inline with manufacturer's requirements and using appropriate QA and QC procedures which will be integrated into the plant's ISO 14001 management system |
| Coke | 2.5% | |
| Paste | 2.0% | - Number of paste cylinders put in the electrodes is recorded accurately (each time a cylinder is put in)<br>- Weight of each cylinder is based on weighing trucks on the weighbridge and dividing total weight by number of cylinders. While a daily average of paste cylinders' weight would have a relatively high uncertainty (because only a few cylinders are used every day and the weight of an individual cylinder may vary by a few %), a monthly average should give a measurement of monthly paste consumption with an uncertainty below 2%. The weighbridge is calibrated regularly (every 2 years) by an external company. |
| *Emission factors* | | |
| Coal | 10.0% | IPCC (2006) Vol3, Ch4, section 4.3.3.1 page 4.39 |
| Coke | 4.0% | Based on the maximum variation of monthly measurements of coke fixed carbon (%) in a given year. This is a conservative (high) uncertainty, as the variation of monthly measurements is not only due to uncertainties of measurement but also real variation in coke fixed carbon. |
| Paste | 5.0% | Emission factor of the paste is provided by the paste supplier without uncertainty range. A high uncertainty has been assumed |

Table 12: Overall uncertainty of onsite emissions – Example for furnace 7. Uncertainties have been calculated by combining uncertainties of each source of onsite emissions according to IPCC[17].

| Overall uncertainty of onsite emissions - Example for furnace 7 | | | | | |
|---|---|---|---|---|---|
| | **Coal use** | **Coke use** | **Paste use** | **Total** | |
| Onsite baseline emissions #7 1997-2003 (tCO2) | 711,726 | 59,421 | 43,899 | 815,046 | A |
| Uncertainty activity data | 2.5% | 2.5% | 2.0% | | B |
| Uncertainty emission factors | 10.0% | 4.0% | 5.0% | | C |
| Combined uncertainty | 10.3% | 4.7% | 5.4% | | D |
| Combined uncertainty as % of total emissions | 9.0% | 0.3% | 0.3% | 9.0% | E |
| | 1 | 2 | 3 | 4 | |

$$Di = \sqrt{Bi^2 + Ci^2}$$

$$Ei = Di * \frac{Ai}{A4}$$

$$E4 = \sqrt{E1^2 + E2^2 + E3^2}$$

## B.6.4 Summary of the ex-ante estimation of emission reductions:

Table 13: Ex ante estimation of overall project annual baseline and project emissions, leakage

[17] See the following documents:

- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Reporting instructions, Annex 1; and
- IPCC, *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, Appendix 6A.1

| Ex ante estimation of annual BE, PE, L and ER for all furnaces | | | | | |
|---|---|---|---|---|---|
| Year | | Estimation of baseline emissions (tonnes of $CO_2$e) | Estimation of project activity emissions (tonnes of CO2e) | Estimation of leakage (tonnes of CO2e) | Estimation of overall emission reductions (tonnes of CO2e) |
| 1 | 2004-05 | 384,838 | 365,596 | 0 | 19,241 |
| 2 | 2005-06 | 919,027 | 871,902 | 0 | 47,125 |
| 3 | 2006-07 | 919,027 | 871,902 | 0 | 47,125 |
| 4 | 2007-08 | 919,027 | 871,902 | 0 | 47,125 |
| 5 | 2008-09 | 1,112,958 | 1,055,900 | 0 | 57,058 |
| 6 | 2009-10 | 1,281,644 | 1,215,091 | 0 | 66,553 |
| 7 | 2010-11 | 1,281,644 | 1,215,091 | 0 | 66,553 |
| 8 | 2011-12 | 1,281,644 | 1,215,091 | 0 | 66,553 |
| 9 | 2112-13 | 1,281,644 | 1,215,091 | 0 | 66,553 |
| 10 | 2013-14 | 1,281,644 | 1,215,091 | 0 | 66,553 |
| **Total (tonnes of CO2e)** | | **10,663,097** | **10,112,659** | **0** | **550,438** |

## B.7 Application of the monitoring methodology and description of the monitoring plan:

### B.7.1. Data and parameters monitored:

Preliminary note:
As mentioned in section B.6.3, expected emission reductions are calculated by assuming the following:

- $QP_{y,monitored} = QP_{historic}$
- $EF_{y,onsite} = EF_{b,onsite}$ (tCO2e/SiMn)
- $EF_{y,offiste} = EF_{b,offiste}$ (tCO2/MWh)
- $sec_{p,y} = sec_b - 0.4$ (MWh/tSiMn) i.e. savings of 0.4MWh/tSiMn in the project.

The value of $QP_{historic}$, $EF_{b,onsite}$, $EF_{b,offiste}$ and $sec_b$ –are given in table 9.

This means that:

- Activity data ($EC_y$, $Q_{pcoal,y}$, $Q_{pcoke}$, $Q_{ppaste}$) are based on the same specific consumptions as in the baseline (except $EC_y$ which is adjusted by the electricity savings of the project) and multiplied by $QP_{historic}$.
- Emission factors ($EF_{pcoal}$, $EF_{pcoke}$, $EF_{ppaste}$) are equal to the average emission factors in the baseline and Grid emission factor ($EF_{y,offsite}$) is the same as in the baseline

| **Data / Parameter:** | **QPy,monitored** |
|---|---|
| **Data unit:** | Tonnes of SiMn/year |
| **Description:** | Quantity of SiMn production in year y during the project activity |
| **Source of data to be used:** | Project proponent |

| | |
|---|---|
| **Value of data applied for the purpose of calculating expected emission reductions in section B.5** | We assume that QPy,monitored = QPhistoric (see preliminary note above). |
| **Description of measurement methods and procedures to be applied:** | Data will be monitored at each tapping of the furnace by weighing metal ladles on a weighing platform. The weighing platform will be maintained and calibrated regularly in line with the manufacturer's requirements. |
| **QA/QC procedures to be applied:** | Measured data will be cross-checked with product sales records. |
| **Any comment:** | |

| | |
|---|---|
| **Data / Parameter:** | **ECy** |
| **Data unit:** | MWh/year |
| **Description:** | Annual grid electricity consumption by the submerged electric arc furnace |
| **Source of data to be used:** | Project proponent |
| **Value of data applied for the purpose of calculating expected emission reductions in section B.5** | See preliminary note above. |
| **Description of measurement methods and procedures to be applied:** | Electricity consumption will be metered continuously on individual furnaces by an electricity meter and recorded monthly. The meters will be maintained and calibrated regularly in line with the manufacturer's requirements. |
| **QA/QC procedures to be applied:** | Consumption of each furnace will be cross-checked monthly with total electricity bills. |
| **Any comment:** | |

| | |
|---|---|
| **Data / Parameter:** | **Qpcoal,y** |
| **Data unit:** | Tonnes of coal/year |
| **Description:** | Annual consumption of coal used as reductant in the submerged electric arc furnace |
| **Source of data to be used:** | Project proponent |
| **Value of data applied for the purpose of calculating expected emission reductions in section B.5** | See preliminary note above. |
| **Description of measurement** | The amount of coal put in each batch is weighed in hoppers with load cells, |

| | |
|---|---|
| **methods and procedures to be applied:** | and recorded daily. The load cells will be maintained and calibrated regularly in line with the manufacturer's requirements. |
| **QA/QC procedures to be applied:** | |
| **Any comment:** | |

| | |
|---|---|
| **Data / Parameter:** | **Qpcoke,y** |
| **Data unit:** | Tonnes of coke/year |
| **Description:** | Annual consumption of coke used as reductant in the submerged electric arc furnace |
| **Source of data to be used:** | Project proponent |
| **Value of data applied for the purpose of calculating expected emission reductions in section B.5** | See preliminary note above. |
| **Description of measurement methods and procedures to be applied:** | The amount of coke put in each batch is weighed in hoppers with load cells, and recorded daily. The load cells will be maintained and calibrated regularly in line with the manufacturer's requirements. |
| **QA/QC procedures to be applied:** | |
| **Any comment:** | |

| | |
|---|---|
| **Data / Parameter:** | **Qppaste,y** |
| **Data unit:** | Tonnes of paste/year |
| **Description:** | Annual consumption of electrode paste used as electrode in the submerged electric arc furnace |
| **Source of data to be used:** | Project proponent |
| **Value of data applied for the purpose of calculating expected emission reductions in section B.5** | See preliminary note above. |
| **Description of measurement methods and procedures to be applied:** | The number of paste cylinders put into the electrode is logged each time a new cylinder is used.<br>The average weight of each cylinder is calculated based on weighing paste trucks (arriving at the facility) on a weighbridge and dividing total weight by number of cylinders. |
| **QA/QC procedures to be applied:** | The weighbridge will be maintained and calibrated regularly in line with the manufacturer's requirements to ensure its accuracy. Average weight of each |

| | |
|---|---|
| | cylinder will be compared to indications of the supplier. |
| **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 to be used:** | IPCC (2006) – Vol3, Ch4, section 4.3.3.2, table 4.6 page 4.37 |
| **Value of data applied for the purpose of calculating expected emission reductions in section B.5** | 3.1<br>See preliminary note above. |
| **Description of measurement methods and procedures to be applied:** | The 2006 IPCC value of 3.1tCO2/t coal will be used in the project. |
| **QA/QC procedures to be applied:** | |
| **Any comment:** | IPCC data will be used to ensure consistency with the emission factor used in the baseline. Note that project-specific values are expected to be lower than IPCC values, and therefore taking project-specific values for EFpcoal,y wouldn't be conservative. |

| | |
|---|---|
| **Data / Parameter:** | **EFpcoke,y** |
| **Data unit:** | tCO2/t coke |
| **Description:** | Emission factor applied for the coke consumed as reductant in year y |
| **Source of data to be used:** | Carbon content provided by laboratory analyses<br>Carbon content of volatiles from IPCC (2006) |
| **Value of data applied for the purpose of calculating expected emission reductions in section B.5** | See preliminary note above. |
| **Description of measurement methods and procedures to be applied:** | Coke samples are prepared at Transalloys and sent to the laboratory (at the moment from neighbouring facility at Highveld) for analysis of volatile and fix carbon content. Monthly running averages of carbon contents are used for the calculation of a monthly emission factor.<br><br>This emission factor is calculated using equation 4.19, p4.33 of IPCC (2006): |

| | |
|---|---|
| | EQUATION 4.19<br>CARBON CONTENT OF FERROALLOY REDUCING AGENTS<br>Total C-content in reducing agent i = Fix C in i + Content of volatiles in i • Cv<br>Where:<br>Cv = Carbon content in volatiles. Unless other information is available, Cv = 0.65 is used for coal and 0.80 for coke.<br><br>The annual emission factor is calculated as the average of monthly emission factors and used for emission calculations. |
| **QA/QC procedures to be applied:** | Lab analyses are done according to applicable national and international standards.<br>If values are missing or inconsistent for some months, the average of previous and next 3 months will be used. |
| **Any comment:** | This project-specific approach is preferred to IPCC values |

| | |
|---|---|
| **Data / Parameter:** | **EFppaste,y** |
| **Data unit:** | tCO2/t of carbon paste |
| **Description:** | Emission factor applied for the electrode paste consumed as electrode in year y |
| **Source of data to be used:** | Supplier (and IPCC/external literature reference) |
| **Value of data applied for the purpose of calculating expected emission reductions in section B.5** | 3.32<br>See preliminary note above |
| **Description of measurement methods and procedures to be applied:** | This emission factor will be calculated using equation 4.19, p4.33 of IPCC (2006):<br><br>EQUATION 4.19<br>CARBON CONTENT OF FERROALLOY REDUCING AGENTS<br>Total C-content in reducing agent i = Fix C in i + Content of volatiles in i • Cv<br>Where:<br>Cv = Carbon content in volatiles. Unless other information is available, Cv = 0.65 is used for coal and 0.80 for coke.<br><br>Fix carbon and volatiles content will be taken from the supplier. Carbon content in the volatiles (Cv) will be taken from supplier if available; if not available, the same Cv as for coke will be taken (see the justification in the table of $EF_{bpaste}$). |
| **QA/QC procedures to be applied:** | This project-specific value will be compared to $EF_{bpaste,y}$ and the maximum between the two values will be taken for $EF_{ppaste,y}$. |
| **Any comment:** | |

| | |
|---|---|
| **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 to be used:** | Project proponent |
| **Value of data applied for the purpose of calculating expected emission reductions in section B.5** | Not applicable |
| **Description of measurement methods and procedures to be applied:** | Fixed carbon, volatiles, S and P contents will be monitored at the start of the project activity. This will be done by lab analyses according to applicable national and international standards. |
| **QA/QC procedures to be applied:** | Project proponent's lab analyses are preferred to supplier's data and are used to determine the emission factor of the coal EFpcoal,y. |
| **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 to be used:** | Project proponent |
| **Value of data applied for the purpose of calculating expected emission reductions in section B.5** | Not applicable |
| **Description of measurement methods and procedures to be applied:** | Fixed carbon, volatiles, S and P contents will be monitored at the start of the project activity. This will be done by lab analyses according to applicable national and international standards. |
| **QA/QC procedures to be applied:** | Project proponent's lab analyses are preferred to supplier's data and are used to determine the emission factor of the coal EFpcoal,y. |
| **Any comment:** | |

| **Data / Parameter:** | **Quality of electrode pastep** |
|---|---|
| **Data unit:** | Text |
| **Description:** | Quality of electrode paste based on elementary analyses and other relevant properties |
| **Source of data to be used:** | Supplier |
| **Value of data applied for the purpose of** | Not applicable |

| | |
|---|---|
| **calculating expected emission reductions in section B.5** | |
| **Description of measurement methods and procedures to be applied:** | The quality of the paste will be taken from supplier's data at the time of purchase |
| **QA/QC procedures to be applied:** | Results will be compared to factors supplied by IPCC or other suppliers |
| **Any comment:** | |

| | |
|---|---|
| **Data / Parameter:** | **EFy,offsite** |
| **Data unit:** | tCO2/MWh |
| **Description:** | Grid emission factor |
| **Source of data to be used:** | |
| **Value of data applied for the purpose of calculating expected emission reductions in section B.5** | The following table gives the results of the calculation of Operating margin, Build margin and Combined margin: <br><br> Table 8: Grid electricity emission factor calculations <br> **Results** <br> **EF** / **tCO2/MWh** <br> OM / 1.195 <br> BM / 1.248 <br> CM / 1.221 <br><br> The factor of 1.221tCO2/MWh will be used during the whole crediting period. |
| **Description of measurement methods and procedures to be applied:** | The Grid electricity emission factor (EFy,offsite in tCO2e/MWh) for South Africa is established ex ante according to ACM0002. Methodological choices are described in section B.6.1 and detail of the data and assumptions used is provided in Annex 3. |
| **QA/QC procedures to be applied:** | Transparent data is available and referenced.<br>For some parameters where no data is available, conservative assumptions are made. |
| **Any comment:** | |

| | |
|---|---|
| **Data / Parameter:** | **Quality of SiMnp** |
| **Data unit:** | Text |
| **Description:** | Quality of SiMn |
| **Source of data to be used:** | Project proponent |
| **Value of data applied** | Not applicable |

| | |
|---|---|
| **for the purpose of calculating expected emission reductions in section B.5** | |
| **Description of measurement methods and procedures to be applied:** | A sample will be lab analysed periodically to ensure that the quality remains between pre-determined specifications for Mn, C, Si, P and S. |
| **QA/QC procedures to be applied:** | Lab analyses will be undertaken to national or international standards to ensure accuracy |
| **Any comment:** | |

| | |
|---|---|
| **Data / Parameter:** | **Quality of ore** |
| **Data unit:** | Text |
| **Description:** | Quality of ore |
| **Source of data to be used:** | Project proponent |
| **Value of data applied for the purpose of calculating expected emission reductions in section B.5** | Not applicable |
| **Description of measurement methods and procedures to be applied:** | A sample will be lab analysed at least monthly to determine the composition of the ore (e.g. contents in Mn, Fe, SiO2, CaO) |
| **QA/QC procedures to be applied:** | Lab analyses will be undertaken to national or international standards to ensure accuracy |
| **Any comment:** | |

| | |
|---|---|
| **Data / Parameter:** | **Quality of fluxes** |
| **Data unit:** | Text |
| **Description:** | Quality of fluxes |
| **Source of data to be used:** | Project proponent |
| **Value of data applied for the purpose of calculating expected emission reductions in section B.5** | Not applicable |
| **Description of measurement methods and procedures to be** | A sample will be lab analysed at least monthly to determine the composition of the ore (e.g. contents in Mn, Fe, SiO2, CaO) |

| | |
|---|---|
| **applied:** | |
| **QA/QC procedures to be applied:** | Lab analyses will be undertaken to national or international standards to ensure accuracy |
| **Any comment:** | |

### B.7.2 Description of the monitoring plan:

The monitoring plan gives the actions necessary to record all the variables and factors required by methodology AM0038, version 1, 30 September 2006 (no monitoring is required for the grid emission factor calculation according to ACM0002.

The plan is based on the detailed information contained in section B.7.1 above. Most of the monitoring requirements of the methodology are in line with the kind of information routinely collected by Transalloys, so internalising the procedures should be simple and straightforward. The ISO 14001 management system implemented by Transalloys and its parent company Highveld will also help ensure that quality procedures are in place.

All data will be archived electronically, and backed up regularly. It will be kept for the full crediting period, plus two years after the end of the crediting period or the last issuance of CERs for this project activity (whichever occurs later).

Project staff will be trained regularly in order to satisfactorily fulfill their monitoring obligations. The authority and responsibility for project management, monitoring, measurement and reporting will be agreed between the project participants and formalised. Detailed procedures for calibration of monitoring equipment, maintenance of monitoring equipment and installations, and for record handling will be established. Specific procedures for CDM monitoring, GHG internal auditing and reporting will be agreed between Transalloys and EcoSecurities and incorporated into the existing Quality assurance system.

The table below indicates the main responsibilities of the persons involved in the monitoring:

Table 14: Overview of persons responsible for implementing the monitoring plan

| Task | On-site technicians | Laboratory | QC manager | CDM Programme Manager | Management (Project Developer) | EcoSecurities |
|---|---|---|---|---|---|---|
| Collect Data and Send samples to lab | E | | R | I | | |
| Perform lab analyses | | E | R | I | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Enter data into Spreadsheet | I | | E | R | | |
| Make monitoring report | | | | R | I | E |
| Archive data & reports | I | | E | R | | |
| Calibration/ Maintenance | E | | R | I | | |

E = responsible for executing data collection
R = responsible for overseeing and assuring quality
I = to be informed

**B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)**

The baseline study and the monitoring methodology were concluded on 02/11/06. The entity determining the baseline study and the monitoring methodology and participating in the project as the Carbon Advisor is EcoSecurities Group Plc, Ireland, listed in Annex 1 of this document (contact: Arnaud Viel, arnaud@ecosecurities.com).

## SECTION C. Duration of the project activity / crediting period

### C.1 Duration of the project activity:

#### C.1.1. Starting date of the project activity:

01 October 2004

#### C.1.2. Expected operational lifetime of the project activity:

More than 20 years

### C.2 Choice of the crediting period and related information:

#### C.2.1. Renewable crediting period

##### C.2.1.1. Starting date of the first crediting period:

Not applicable

##### C.2.1.2. Length of the first crediting period:

Not applicable

#### C.2.2. Fixed crediting period:

##### C.2.2.1. Starting date:

01 October 2004

##### C.2.2.2. Length:

10 years

## SECTION D. Environmental impacts

### D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

The project is not subject in South Africa to requirements for an environmental impact assessment. The project is not expected to have any significant negative environmental impacts.

It will have a positive impact nationally by reducing the need for grid electricity consumption per unit manganese alloy produced. Consequently there will be a reduced demand for predominantly coal fired electricity, and mitigating the need to dedicate/build up to 30MW (+) of additional capacity to continue to supply this process alone. South Africa is projected to require significant new build in the near future. The project will predominantly reduce $CO_2$ emissions from the power sector, but also local pollutants such as dust and SOx.

A benefit not quantified here may be the improved efficiency of manganese extraction from the raw ore. There will also be a reduction in the amount of ore required to produce a unit of alloy product, requiring less mining, processing, transport, and energy use to provide this ore. No emissions reductions are claimed here for this benefit, but there is a positive environmental impact arising as a result.

It is not sure whether the project will lead to a reduction of coal and coke used as reductants. The impact on the environment of this component could therefore go either way.

One significant local environmental improvement will be the ability of the new furnaces to better manage dust emissions from the furnaces off gases that will allow a reduced emission to the local environment of particulates. This is even more important for furnace 5 where a new offtake system has been installed.

### D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

Not applicable

## SECTION E. Stakeholders' comments

### E.1. Brief description how comments by local stakeholders have been invited and compiled:

A stakeholders' Meeting was held in a meeting room at Transalloys plant on the 27th of October 2006, from 11h00 to 16h00. Personal invitations where send to representatives that where selected to represent the different stakeholder groups as part of the periodic open day that was established to provide ongoing information about Transalloys operations.

The stakeholder meeting was integrated in the open day to ensure a large turnout. The program consisted of:

- Presentations by several line managers explaining the different stages of the production process, followed by Q&A sessions;
- A presentation on the Transalloys energy efficiency and how it will be developed under the CDM, followed by a Q&A session;
- A tour of the plant.

Mr L. Jacobs, manager at Transalloys, introduced himself, his company, the managers that would speak and the Ecosecurities consultant that delivered the presentation on the CDM project (5-10 minutes).

After the presentations by the line managers Henk Sa, Ecosecurities local representative, delivered the presentation that took the audience from the global picture down to the project at hand:

- Climate Change, GHGs and consequences;
- Answer by International Community – The Kyoto Protocol;
- The mechanisms of the Protocol;
- The Transalloys CDM project.

The presentation per se was delivered in 20-30 minutes, uninterrupted. Questions and comments were asked from the public and have been recorded in the subsequent section 2. (20-30 minutes).

After the Q&A session L. Jacobs invited the people present to join him on a tour of the plant followed by refreshment in the boardroom.

Evidence of the event is provided in Annex 5.

### E.2. Summary of the comments received:

The stakeholders present (list in Annex 5) were asked to voice any question or comment that they may have about the Transalloys CDM project or the presentation in general:

1. Mr. S. van Niekerk, Managing Director of Transalloys:

Where does the data from the graph you showed on increasing GHG levels and rising temperatures come from?

- Mr Henk Sa for EcoSecurities answered the question: Historic data on the composition of the atmosphere can be collected in several different ways. The most common method is by analyzing ice samples that where deposited thousands of years ago.

2. Mr J. Makena, from the Emahahleni Municipal Council:

   What measures have been taken to prepare countries for the effects of climate change, like flooding?

   - Mr. Makena his question was answered. The Kyoto protocol does not only aim to curb anthropogenic GHG emissions but it also aims to prepare countries for the effects of climate change via a mechanism called 'adaptation'. For example countries that might be effected by raising sea levels are being advised to take this into account when developing their infrastructure.

3. Mr. S Zwane, Clewer Primary School:

   Was the impact of underdeveloped countries taken into consideration when the data on global warming was put to together?

   - Answer provided: Yes, that is why developing countries do not have emission reduction targets under the Kyoto protocol.

**E.3. Report on how due account was taken of any comments received:**

As explained in Section E.2, no comments were received specifically on the project.

## Annex 1

### CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

| | |
|---|---|
| Organization: | Highveld Steel and Vanadium Corporation Limited |
| Street/P.O.Box: | Clewer Road |
| Building: | Transalloys |
| City: | Witbank |
| State/Region: | Mpumalanga |
| Postfix/ZIP: | 1035 |
| Country: | South Africa |
| Telephone: | 013-6935021 |
| FAX: | 013-6938034 |
| E-Mail: | louj@hiveld.co.za |
| URL: | |
| Represented by: | |
| Title: | Manager |
| Salutation: | Mr. |
| Last Name: | Jacob |
| Middle Name: | |
| First Name: | Lou |
| Department: | Transalloys |
| Mobile: | 0827717393 |
| Direct FAX: | 013-6938034 |
| Direct tel: | 013-6935021 |
| Personal E-Mail: | louj@hiveld.co.za |

**Project Annex 1 participant:**

| | |
|---|---|
| Organization: | EcoSecurities Group Plc. |
| Street/P.O.Box: | 40 Dawson Street |
| Building: | |
| City: | Dublin |
| State/Region: | |
| Postfix/ZIP: | 02 |
| Country: | Ireland |
| Telephone: | +353 1613 9814 |
| FAX: | +353 1672 4716 |
| E-Mail: | info@ecosecurities.com |
| URL: | www.ecosecurities.com |
| Represented by: | |
| Title: | COO & President |
| Salutation: | Dr. |
| Last Name: | Moura Costa |

| | |
|---|---|
| Middle Name: | |
| First Name: | Pedro |
| Mobile: | |
| Direct FAX: | |
| Direct tel: | +44 1865 202 635 |
| Personal E-Mail: | cdm@ecosecurities.com |

## Annex 2

### INFORMATION REGARDING PUBLIC FUNDING

This project will not receive any public funding from Annex 1 parties.

# Annex 3

## BASELINE INFORMATION

1. Data and sources used to calculate the **grid emission factor** are given below:

| Plant and type of fuel | OM plant? (1=y, 0=n) | BM plant? | Year of commission | Licensed capacity (MW) | Net energy sent out (MWh) | | | Fuel consumption | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2002 | 2003 | 2004 | 2002 | 2003 | 2004 | *Unit* |
| **Grand Total** | | | | 43 034 | 204,511,108 | 219,198,686 | 226,393,919 | | | | |
| | | | | | | | | | | | |
| **Eskom generation** | | | | 39 810 | 196,067,796 | 210,218,785 | 217,919,213 | | | | |
| **Coal fired stations** | 1 | | | 35 607 | 181,749,299 | 194,046,490 | 203,564,592 | 96,460 | 104,370 | 109,508 | *kt* |
| Arnot | 1 | | 1975 (June) | 1 980 | 11,974,764 | 14,135,237 | 13,032,188 | | | | *kt* |
| Camden | 1 | | 1967 (April) | 1 520 | | | | | | | *kt* |
| Duvha | 1 | | 1980 | 3 450 | 23,320,444 | 21,384,335 | 25,450,613 | | | | *kt* |
| Grootvlei | 1 | | 1969 | 1 130 | | | | | | | *kt* |
| Hendrina | 1 | | 1970 | 1 895 | 12,752,987 | 12,329,325 | 12,037,179 | | | | *kt* |
| Kendal | 1 | | 1982 (July) | 3 840 | 26,006,905 | 27,820,202 | 27,005,053 | | | | *kt* |
| Komati | 1 | | 1961 | 891 | | | | | | | *kt* |
| Kriel | 1 | | 1979 | 2 850 | 19,165,265 | 18,347,304 | 19,866,814 | | | | *kt* |
| Lethabo | 1 | 1 | 1990 (Dec) | 3 558 | 22,019,627 | 23,505,543 | 22,807,524 | | | 12,269 | *kt* |
| Majuba | 1 | 1 | 1996 (April) | 3 843 | 4,600,976 | 10,015,560 | 12,539,663 | | | 6,746 | *kt* |
| Matimba | 1 | 1 | 1987 | 3 690 | 25,145,393 | 26,510,802 | 26,894,454 | | | 14,468 | *kt* |
| Matla | 1 | | 1983 (July) | 3 450 | 25,577,292 | 25,802,219 | 25,673,648 | | | | *kt* |
| Tutuka | 1 | 1 | 1985 (June) | 3 510 | 11,185,646 | 14,195,963 | 18,257,456 | | | 9,822 | *kt* |
| **Gas turbine stations** | 1 | | | 342 | 0 | 341 | 350 | | | | |
| Acacia | 1 | | 1976 | 171 | 0 | 299 | 305 | 0.00 | 3.55 | 3.62 | *TJ* |
| PortRex | 1 | | 1976 | 171 | 0 | 42 | 45 | 0.00 | 0.50 | 0.53 | *TJ* |
| **Hydro power stations** | | | | 661 | 2,356,753 | 777,041 | 777,041 | | | | |
| Gariep | | | 1971 | 360 | 1,164,640 | 383,991 | 383,991 | - | - | - | |
| Vanderkloof | | | 1977 (March) | 240 | 1,192,113 | 393,050 | 393,050 | - | - | - | |
| Colleywobbles(Mbashe) | | | | 42 | | | | | | | |
| First Falls | | | | 6 | | | | | | | |
| Second Falls | | | | 11 | | | | | | | |
| Ncora | | | | 2 | | | | | | | |
| **Nuclear stations** | | | | 1 800 | 11,961,744 | 12,662,591 | 13,365,123 | | | | |
| Koeberg | | | 1984 (April) | 1 800 | 11,961,744 | 12,662,591 | 13,365,123 | - | - | - | |
| **Pumped-storage stations** | 1 | | | 1 400 | 0 | 2,732,322 | 212,107 | | | | |
| Drakensberg | 1 | | 1981 | 1 000 | 0 | 1,787,554 | 0 | - | - | - | |
| Palmiet | 1 | 1 | 1988 | 400 | 0 | 944,768 | 212,107 | - | - | - | |
| | | | | | | | | | | | |
| **Municipal generation** | | | | 1 837 | 1,218,826 | 1,326,122 | 1,040,945 | | | | |
| **Coal fired stations** | 1 | | | 1 323 | 1,201,006 | 1,038,433 | 1,027,337 | | | | |
| Athlone | 1 | | n/a | 180 | 76,596 | 76,596 | 10,230 | 38 | 38 | 5 | *kt* |
| Kroonstad | 1 | | | 30 | | | | | | | *kt* |
| Swartkops | 1 | | | 240 | | | | | | | *kt* |
| Bloemfontein | 1 | | n/a | 103 | 8,233 | 19,444 | 5,931 | 4 | 10 | 3 | *kt* |
| Orlando | 1 | | | 300 | | | | | | | *kt* |
| Rooiwal | 1 | | n/a | 300 | 949,078 | 826,217 | 895,000 | 475 | 413 | 448 | *kt* |
| Pretoria West | 1 | | n/a | 170 | 167,099 | 116,176 | 116,176 | 84 | 58 | 58 | *kt* |
| **Gas turbine stations** | 1 | | | 330 | 7,189 | 3,654 | 2,976 | | | | |
| Roggebaai | 1 | | n/a | 50 | 2,787 | 2,787 | 1,141 | 31.35 | 31.35 | 12.84 | *TJ* |
| Athlone | 1 | | n/a | 40 | 867 | 867 | 1,827 | 9.75 | 9.75 | 20.55 | *TJ* |
| Port Elizabeth | 1 | | n/a | 40 | | | 8 | | | 0.09 | *TJ* |
| Johannesburg | 1 | | n/a | 176 | 3,535 | | | 39.77 | | | *TJ* |
| Pretoria West | 1 | | | 24 | | | | | | | *TJ* |
| **Hydro power stations** | | | | 4 | 10,632 | 10,632 | 10,632 | | | | |
| Lydenburg | | | n/a | 2 | 6,000 | 6,000 | 6,000 | - | - | - | |
| Ceres | | | n/a | 1 | 1,082 | 1,082 | 1,082 | - | - | - | |
| Piet Retief | | | n/a | 1 | 3,550 | 3,550 | 3,550 | - | - | - | |
| **Pumped-storage stations** | 1 | | | 180 | 0 | 273,403 | 0 | | | | |
| Steenbras | 1 | | n/a | 180 | 0 | 273,403 | 0 | - | - | - | |
| | | | | | | | | | | | |
| **Private generation** | | | | 1 387 | 7,224,486 | 7,653,779 | 7,433,761 | | | | |
| **Bagasse / coal fired stations** | | | | 105 | 259,317 | 259,317 | 192,337 | *(assumed pure bagasse)* | | | |
| Tongaat-Hulett Amatikulu | | | n/a | 12 | 26,781 | 26,781 | 26,781 | - | - | - | |
| Tongaat Hulett - Darnall | | | n/a | 12 | 21,704 | 21,704 | 21,704 | - | - | - | |
| Tongaat Hulett - Felixton | | | n/a | 32 | 66,510 | 66,510 | 66,510 | - | - | - | |
| Tongaat Hulett - Maidstone Mill | | | n/a | 29 | 67,397 | 67,397 | 67,397 | - | - | - | |
| Transvaal Suiker Ltd | | | n/a | 20 | 76,925 | 76,925 | 9,945 | - | - | - | |
| **Coal fired stations** | 1 | | | 1 279 | 6,950,506 | 7,379,448 | 7,226,761 | | | | |
| Kelvin | 1 | | n/a | 540 | 1,721,353 | 1,721,353 | 1,568,666 | 861 | 861 | 784 | *kt* |
| Sasol Synth Fuels | 1 | | n/a | 600 | 4,421,074 | 4,738,677 | 4,738,677 | 2,211 | 2,369 | 2,369 | *kt* |
| Sasol Chem Ind | 1 | | n/a | 139 | 808,079 | 919,418 | 919,418 | 404 | 460 | 460 | *kt* |
| **Hydro power stations** | | | | 3 | 14,663 | 15,014 | 14,663 | | | | |
| Friedenheim | | | n/a | 3 | 14,663 | 15,014 | 14,663 | - | - | - | |

| Sources | | |
|---|---|---|
| NER supply side statistics (1) | | |
| Areas shaded: where net electricity sent out is negative, we set it to zero | | |
| Eskom annual report 2005 | | |
| NER pers.comm 2005 (2) | | |
| Using rated efficiencies on www.eskom.co.za (conservative): | % | *i.e Mwhprod /TJcons* |
| Acacia | 30.30% | 84.2 |
| Port Rex | 30.30% | 84.2 |
| Assuming conservative (high) efficiency: | 32.00% | 88.9 |
| We calculate 2004 Eksom average specific coal consumption from | | |
| i) Eskom aggregate coal consumption (ktcoal) | | |
| ii) NER net electricity sent (MWh) | | |
| 2004 | 0.000537952 | ktcoal/MWhcoal |
| and assume it to be the same as Actual Eskom build margin spec. coal consumption (because actual marginal plants = old inefficient coal) | | |
| Assuming conservative (low) specific coal | 0.000500000 | ktcoal/MWhcoal |

| Calculation of fuel emission factors | | | | | |
|---|---|---|---|---|---|
| | NCV | EF | OX | => EF | |
| | TJ/t fuel | tC/TJ | % | Value | *Unit* |
| Coal | 0.02509 | 25.8 | 98.0% | 2.326 | *tCO2/t coal* |
| Gas | | 15.3 | 99.5% | 55.8 | *tCO2/TJ* |
| *Source:* | *1* | *2* | | *Calculated* | |

List of sources:

1 IPCC (1996) Table 1-2 (Value for South Africa)

2 IPCC (1996) Table 1-1

Conversion factor 277.7778 MWh/TJ

**Detail of sources and assumptions used**

All sources and assumptions used are indicated at the bottom of the previous page, with one color for each source of information. The text below explains this further.

*Data available*

Emission factors (tCO2/t fuel) are country-specific IPCC values for coal and gas in South Africa. Detailed data is available on electricity generation but not on fossil fuel consumption. The table below summarises the information available.

| Type of plant | Electricity generation | Fossil fuel consumption | Commissioning dates |
|---|---|---|---|
| Eskom plants | Detailed information (plant by plant) available from NER Electricity Supply statistics for 2002-2003-2004[18] | Detailed information not publicly available. Other information available:<br>• Coal: Aggregate consumption figure available from Eskom's annual reports.<br>• Gas: Rated efficiency available from Eskom's website[19] | Obtained from NER (personal communication) |
| Municipal and private | | No compilation of data available. Obtaining data from every individual plant would be excessively costly and may not be made publicly available. | |

Given the lack of data on fossil fuel consumption and commissioning dates, some assumptions have to be made for the calculations of both operating and build margin emission factors.

[18] National Electricity Regulator, *Electricity Supply Statistics for South Africa*. Available in brochures from NER for years 2002 (p14-15), 2003 (p15-16) (p14-15) and 2004

[19] www.eskom.co.za

*Assumptions for operating margin*

<table>
<tr><th>Plant owner</th><th>Plant type</th><th>Assumption on fuel consumption</th><th>Conservativeness</th><th>Materiality</th></tr>
<tr><td rowspan="2">Eskom</td><td>Coal</td><td>Aggregate data is available and used (no need for assumptions)</td><td>(No assumptions need to be made made)</td><td>Key parameter (these plants represent 90% of South African generation)</td></tr>
<tr><td>Gas</td><td>We assume the actual efficiency to be equal to the rated efficiency</td><td>This is an extremely conservative approach as actual efficiency is well below rated efficiency</td><td>These plants represent less than 0.0002% of South African generation</td></tr>
<tr><td rowspan="3">Municipal and private</td><td rowspan="2">Coal</td><td>We assume the efficiency to be a bit higher than the average efficiency of Eskom plants (0.50 tcoal/MWh compared to 0.53 to 0.54 tcoal/MWh for Eskom plants)</td><td>This is a conservative assumption as there is no evidence that municipal and private plants would be more efficient than Eskom plants (as they are smaller, they might in fact be less efficient)</td><td rowspan="3">These plants represent altogether only 4% of South African generation</td></tr>
<tr><td>We assume bagasse-coal plants to be pure bagasse</td><td>Conservative</td></tr>
<tr><td>Gas</td><td>We assume the efficiency to be a bit higher than the rated efficiency of Eskom plants (32.00% compared to 30.30% for Eskom plants)</td><td>This is an extremely conservative approach as actual efficiency is well below rated efficiency + there is no evidence that municipal and private plants would be more efficient than Eskom plants</td></tr>
</table>

*Assumptions for build margin*

<table>
<tr><th>Parameter</th><th>Assumption</th><th>Conservativeness and materiality</th></tr>
<tr><td>Selection of build margin plants</td><td>Only Eskom plants are taken for the build margin (last 5, as it represents more generation than the last 20%) because the commissioning date of other plants is not available. This includes 4 coal plants and 1 (small) pumped hydro.</td><td>- Eksom plants represent 96% of South African generation<br>- Out of the remaining 4% generation (by municipal and private), 94 to 97% is coal-based<br>=> Taking Eskom plants can be considered representative of the overall South African grid (essentially, the grid is almost pure coal, both in Eskom plants and others)</td></tr>
<tr><td>Coal consumptio n</td><td>We assume Eskom build margin coal plants to be as efficient as 2004 average Eskom coal plants</td><td>Build margin plants would usually be more efficient than average plants because they are more recent. However, the situation in South Africa is particular as build margin plants are in fact big, old, inefficient coal-fired power plants that had been shut down decades ago and are being put back online (see PDD section B.6 > 1.1.3 > STEP 2). This process started in 2005 and therefore the 2004 average figure (which has been used and does not include those old plants) is very likely to be below the actual 2005 build margin figure (which is not available), thus ensuring the conservativeness of the $EF_{BM}$ used.</td></tr>
</table>

2. **<u>Historic production data and emissions factors</u>** used to calculate baseline emissions are given in the next two pages.

**TRANSALLOYS PROJECT - BASELINE EMISSIONS CALCULATIONS**

| ASSUMPTIONS | | | | |
|---|---|---|---|---|
| | Reductant EF (tCO2/t reductant) | | | CEF (tCO2/MWh) |
| | Coal | Coke | Paste | Electricity |
| 1997 | 3.1 | 3.09 | 3.32 | 1.221 |
| 1998 | 3.1 | 3.13 | 3.32 | 1.221 |
| 1999 | 3.1 | 3.10 | 3.32 | 1.221 |
| 2000 | 3.1 | 3.12 | 3.32 | 1.221 |
| 2001 | 3.1 | 3.15 | 3.32 | 1.221 |
| 2002 | 3.1 | 3.17 | 3.32 | 1.221 |
| 2003 | 3.1 | 3.19 | 3.32 | 1.221 |
| Electricity savings | | 0.40 | MWh/tSiMn | |
| i.e. | | 0.49 | tCO2/tSiMn | |

| RESULTS | | | | | | | |
|---|---|---|---|---|---|---|---|
| Furnace | QPhistoric (tSiMn/y) | secb (MWh/tSiMn) | EFb offiste (tCO2/tSiMn) | EFb onsite (tCO2/tSiMn) | EFb total (tCO2/tSiMn) | Average emissions at QPhistoric (tCO2/y) | ERs from elec savings at QPhistoric (tCO2/y) |
| 1 | 19,441 | 5.02 | 6.12 | 2.55 | 8.68 | 168,687 | 9,495 |
| 3 | 19,326 | 5.00 | 6.11 | 2.62 | 8.73 | 168,768 | 9,439 |
| 5 | 37,767 | 5.42 | 6.62 | 3.05 | 9.68 | 365,421 | 18,445 |
| 6 | 20,337 | 5.40 | 6.60 | 2.94 | 9.54 | 193,931 | 9,933 |
| 7 | 39,396 | 5.58 | 6.81 | 2.96 | 9.77 | 384,838 | 19,241 |

| Furnace | Year | Production (tSiMn/y) | Total reductant consumption (t/y) | | | Total elec. cons. (MWh/y) | Total CO2 from reductant (tCO2/y) | | | | Total CO2 from elec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Coal | Coke | Paste | | Coal | Coke | Paste | TOTAL | |
| 1 | 1997 | 21,685 | 14,538 | 1,480 | 1,127 | 115,511 | 45,068 | 4,573 | 3,747 | 53,388 | 141,039 |
| | 1998 | 7,506 | 4,494 | 554 | 350 | 41,735 | 13,931 | 1,733 | 1,164 | 16,828 | 50,958 |
| | 1999 | 21,779 | 13,005 | 1,652 | 1,086 | 111,837 | 40,316 | 5,123 | 3,611 | 49,049 | 136,553 |
| | 2000 | 18,641 | 13,426 | 1,234 | 1,032 | 97,656 | 41,621 | 3,846 | 3,431 | 48,898 | 119,238 |
| | 2001 | 21,809 | 16,304 | 1,163 | 1,141 | 107,293 | 50,542 | 3,662 | 3,794 | 57,998 | 131,005 |
| | 2002 | 23,349 | 16,704 | 563 | 1,029 | 109,409 | 51,782 | 1,785 | 3,421 | 56,988 | 133,588 |
| | 2003 | 21,321 | 18,501 | 1,011 | 1,097 | 99,142 | 57,353 | 3,224 | 3,647 | 64,224 | 121,052 |
| | Total | 136,090 | 96,972 | 7,657 | 6,862 | 682,583 | 300,613 | 23,944 | 22,816 | 347,373 | 833,434 |

| Furnace | Year | Production (tSiMn/y) | Total reductant consumption (t/y) | | | Total elec. cons. (MWh/y) | Total CO2 from reductant (tCO2/y) | | | | Total CO2 from elec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Coal | Coke | Paste | | Coal | Coke | Paste | TOTAL | |
| 3 | 1997 | 21,930 | 15,064 | 1,718 | 1,136 | 115,381 | 46,698 | 5,308 | 3,777 | 55,784 | 140,880 |
| | 1998 | 9,518 | 5,862 | 803 | 487 | 51,814 | 18,172 | 2,512 | 1,619 | 22,303 | 63,265 |
| | 1999 | 17,680 | 11,529 | 1,479 | 946 | 93,474 | 35,740 | 4,586 | 3,145 | 43,472 | 114,132 |
| | 2000 | 19,731 | 13,055 | 1,409 | 104 | 100,458 | 40,471 | 4,391 | 346 | 45,207 | 122,659 |
| | 2001 | 22,660 | 17,863 | 1,234 | 1,147 | 111,287 | 55,375 | 3,885 | 3,814 | 63,074 | 135,881 |
| | 2002 | 22,159 | 16,871 | 836 | 1,025 | 104,833 | 52,300 | 2,650 | 3,408 | 58,358 | 128,001 |
| | 2003 | 21,601 | 19,475 | 973 | 956 | 99,678 | 60,373 | 3,103 | 3,179 | 66,654 | 121,707 |
| | Total | 135,279 | 99,719 | 8,452 | 5,801 | 676,925 | 309,129 | 26,435 | 19,288 | 354,852 | 826,525 |

| Furnace | Year | Production (tSiMn/y) | Total reductant consumption (t/y) | | | Total elec. cons. (MWh/y) | Total CO2 from reductant (tCO2/y) | | | | Total CO2 from elec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Coal | Coke | Paste | | Coal | Coke | Paste | TOTAL | |
| 5 | 1997 | 38,847 | 28,939 | 3,644 | 2,123 | 224,774 | 89,711 | 11,259 | 7,059 | 108,029 | 274,449 |
| | 1998 | 42,005 | 33,313 | 3,361 | 2,344 | 248,046 | 103,270 | 10,513 | 7,794 | 121,577 | 302,864 |
| | 1999 | 35,788 | 31,738 | 2,986 | 1,763 | 205,295 | 98,388 | 9,260 | 5,862 | 113,509 | 250,665 |
| | 2000 | 35,877 | 33,574 | 2,656 | 2,045 | 214,388 | 104,079 | 8,277 | 6,799 | 119,156 | 261,768 |
| | 2001 | 34,843 | 31,619 | 1,151 | 2,031 | 168,826 | 98,019 | 3,624 | 6,753 | 108,396 | 206,137 |
| | 2002 | 41,898 | 35,932 | 2,247 | 1,968 | 200,136 | 111,389 | 7,123 | 6,543 | 125,055 | 244,366 |
| | 2003 | 35,108 | 32,739 | 1,507 | 1,690 | 172,039 | 101,491 | 4,805 | 5,619 | 111,915 | 210,060 |
| | Total | 264,366 | 227,854 | 17,552 | 13,964 | 1,433,504 | 706,347 | 54,861 | 46,429 | 807,638 | 1,750,308 |

| Furnace | Year | Production (tSiMn/y) | Total reductant consumption (t/y) | | | Total elec. cons. (MWh/y) | Total CO2 from reductant (tCO2/y) | | | | Total CO2 from elec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Coal | Coke | Paste | | Coal | Coke | Paste | TOTAL | |
| 6 | 1997 | 22,571 | 17,345 | 1,734 | 1,175 | 130,113 | 53,770 | 5,358 | 3,907 | 63,034 | 158,868 |
| | 1998 | 24,188 | 16,586 | 2,245 | 1,275 | 136,458 | 51,417 | 7,022 | 4,239 | 62,678 | 166,615 |
| | 1999 | 8,238 | 5,764 | 788 | 417 | 44,755 | 17,868 | 2,444 | 1,386 | 21,698 | 54,646 |
| | 2000 | 21,269 | 17,146 | 1,687 | 1,143 | 120,804 | 53,151 | 5,257 | 3,800 | 62,209 | 147,502 |
| | 2001 | 21,846 | 19,936 | 1,002 | 958 | 107,474 | 61,802 | 3,155 | 3,185 | 68,142 | 131,226 |
| | 2002 | 22,618 | 20,993 | 823 | 975 | 119,525 | 65,078 | 2,609 | 3,242 | 70,929 | 145,940 |
| | 2003 | 21,632 | 20,195 | 1,118 | 1,028 | 110,109 | 62,605 | 3,565 | 3,418 | 69,587 | 134,443 |
| | Total | 142,362 | 117,965 | 9,397 | 6,971 | 769,238 | 365,690 | 29,409 | 23,178 | 418,277 | 939,240 |

| Furnace | Year | Production (tSiMn/y) | Total reductant consumption (t/y) | | | Total elec. cons. (MWh/y) | Total CO2 from reductant (tCO2/y) | | | | Total CO2 from elec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Coal | Coke | Paste | | Coal | Coke | Paste | TOTAL | |
| 7 | 1997 | 40,685 | 31,098 | 3,702 | 2,023 | 231,635 | 96,404 | 11,438 | 6,726 | 114,568 | 282,826 |
| | 1998 | 42,399 | 31,741 | 4,172 | 2,045 | 256,158 | 98,397 | 13,050 | 6,799 | 118,247 | 312,769 |
| | 1999 | 44,477 | 37,165 | 3,517 | 2,123 | 260,410 | 115,212 | 10,906 | 7,059 | 133,176 | 317,961 |
| | 2000 | 34,862 | 31,216 | 2,085 | 2,009 | 208,377 | 96,770 | 6,498 | 6,680 | 109,947 | 254,428 |
| | 2001 | 31,933 | 26,698 | 1,964 | 1,543 | 173,106 | 82,764 | 6,184 | 5,130 | 94,078 | 211,362 |
| | 2002 | 43,700 | 37,788 | 1,880 | 1,739 | 216,880 | 117,143 | 5,959 | 5,782 | 128,884 | 264,810 |
| | 2003 | 37,717 | 33,883 | 1,689 | 1,721 | 192,187 | 105,037 | 5,386 | 5,722 | 116,145 | 234,660 |
| | Total | 275,773 | 229,589 | 19,009 | 13,203 | 1,538,753 | 711,726 | 59,421 | 43,899 | 815,046 | 1,878,817 |

| |
|---|
| Project annual measured value |
| Default value (copied from input) |
| Project fixed value (copied from input) |
| Calculated value (copied from other sheet) |
| Results |

## Annex 4

### MONITORING INFORMATION

This information is contained in section B.7.

## Annex 5

## STAKEHOLDER CONSULTATION

Personal invitations were sent to representatives who were selected to represent the different stakeholder groups, as part of the periodic open day that was established to provide ongoing information about Transalloys operations.

A copy of the ad to publicise the event, the list of persons invited, the actual attendance list and a photo taken during the meeting are provided in this annex.

30. OCT. 2006 49 TRANSALLOYS NO. 385

Transalloys

**TRANSALLOYS**

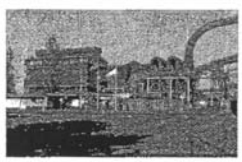
*(A Division of Highveld Steel and Vanadium Corporation Limited)*

Cordially invites you to attend our

Open Day

**To be Held on Friday, 27 October 2006**
**at 11:00**
**in the**
**Transalloys Administration Building**

*Kindly confirm your attendance on, or before the 9th October 2006 to*
*Mike Watson*
*Tel: 013 693 8119, or fax 013 659 7411, or email mikew@hiveld.co.za*
*Bulelwa*
*Tel: 013 693 8158/9 or Fax: 013 659 7411*



*Programme*

| | |
|---|---|
| 11:00 Welcome | - L. C. Jacobs, Manager, Transalloys |
| 11:10 Raw Materials | - L. Maseko, Unit Manager |
| 11:20 Silica Manganese Process | - D. Q. Beck, Unit Manager |
| 11:30 Ferromanganese Process | - L. S. Kubheka, Unit Manager |
| 11:40 Finished Products | - E. Banardo Jnr, Unit Manager |
| 12:00 Baghouses | - M. S. Mamakoko, Electrical Engineer |
| 12:10 Environmental Issues | - D. Nell, Engineering Manager |
| 12:20 Questions & Answers | - L. C. Jacobs, Manager, Transalloys |
| 12:30 – 13:15 | - Plant Tour |
| 13:15 – 13:45 | - Light Finger Lunch |

**OPEN DAY 27 October 2006**
**INVITATIONS**

| Organisation | Name | Contact No | Fax No | e-mail | PPE Needs | Confirmed |
|---|---|---|---|---|---|---|
| APOLCOM | Ms C Venter | | | | | |
| | Mr W du Pisanie | 017 | | | | |
| | Mr P Ncanazo | 017 | | | | |
| Buhle Bemvelo Environmental Group | Mr M Ngobeni | 072 | | | | |
| | Mr Mzwakali | 013 | | | | |
| | Mr J Bembe | | | | | |
| Canon Eng | Mr E Smit | | | | | |
| | Mr. K du Plessis | | | | | |
| Clewer Primary School | Mr S Zwane | 013 | | | | |
| DEAT | Mr J van Graan | 011 | | | | |
| | Mr C du Plooy | 011 | | | | |
| Eskom Customer Service | Mr D Madike<br>Ravas Nades<br>Alleta Nkuna | 013<br>082 | | | | |
| Emalahleni Municipal Council | Ms L Strydom | 013 | | | | |
| | Mr Mbuke | 013 | | | | |
| | Mr M Matlejoane | 072 | | | | |
| | Mr J Makena | 013 | | | | |
| | Mrs A Simelane | 013 | | | | |
| Environmental Justice Networking Forum | Mr I Mamapane | 072 | | | | |
| | Mr H Mashifane | 013 | | | | |
| | Mr K Bashele | 013 | | | | |
| | Mr W Mamapane | 013 | | | | |
| | Mr E Mkhwanazi | 013 | | | | |
| | Mr T Fakude | 072 | | | | |
| J & I Recycling | Mr A. Maseko | 082 | | | | |
| Mpumalanga Aids Environmental Forum | Mr C Markham | 013<br>972 | | | | |
| | Ms Y Masilela | | | | | |
| Witbank News | Ms M Boshoff | 013 | | | | |
| Wildlife & Environment Society of SA | Mr M Suttill | 013<br>083 | | | | |
| | Mr M Ngobeni | 013 | | | | |
| Highveld Steel | Mr A. de Nysschen | 013 | | | | |
| | Dr J. Pienaar | 013 | | | | |
| | Mr J. Theiss | 013 | | | | |
| | Mr L.A. Aggenbach | 013 | | | | |
| | Mr S. Mafoane | 013 | | | | |
| | Ms A Diener | 013 | | | | |
| | Dr D Brooderyk | | | | | |

## OPEN DAY 27 October 2006
## Attendance

| Organisation | Name | Contact No | Fax No | Signature |
|---|---|---|---|---|
| Buhle Bemvelo Environmental Group | Mr M Ngobeni | 072 383 6871 | 013 656 3264 | |
| Canon Eng | Mr E Smit | 0824603534 | 013659 7112 | |
| | Mr. K du Plessis | 0836601586 | 0136597112 | |
| Clewer Primary School | Mr S Zwane | 013 659 7537 | 013 659 7124 | |
| Eco Securities | Mr H Sa | | | |
| Eskom Customer Service | Mr D Madike<br>Ravas Nades<br>Alleta Nkuna | 013 693 3423<br>082 788 1498 | 013 693 3719 | |
| Emahahleni Municipal Council | Mr J Makena<br>Mrs A Simelane | 013 690 6428<br>013 690 6234 | 013 690 6459<br>013 696 2350 | |
| Environmental Justice Networking Forum | Mr I Mamapane | 072 741 2682 | 013 656 2894 | |
| J & I Recycling | Mr A. Maseko | 082 445 0019 | | |
| Witbank News | Ms M Boshoff | 013 656 2490 | Chanel Pringle | |
| EMALAHLENI COUNCIL | FANIE SITHOLE | 0826347551 | | |
| HIGVELD STEEL | Ms P.N. NDLOVU | 0136908880 | | |
| TRANSALLOYS | P.J. FOURIE | 0827315916 | | |
| Highveld. | Erik Muller | 0833002183 | | |

Above: Henk Sa (EcoSecurities) presenting Climate Change

## Annex 6

### CONFIRMATION OF NO CAP ON ELECTRICITY USE

-----Original Message-----
**From:** Daniel Madike [mailto:Daniel.Madike@eskom.co.za]
**Sent:** 26 January 2007 08:45 AM
**To:** ALL Lou Jacobs
**Cc:** ALL Steve Van Niekerk
**Subject:** Re: National Power Supplier - No Limitation since 2003

NB: This email and its contents are subject to the Eskom Holdings Limited EMAIL LEGAL NOTICE which can be viewed at http://www.eskom.co.za/email_legalnotice

Eskom does not put any ristriction on the energy usage by customers. There was no restrictions on the purchase of energy by Transalloys from Eskom. Transalloys is allowed to use all the energy available from the Eskom installation & as per the agreement

Regards,

Daniel Madike
Key Sales and Customer Service
Key Customer Executive
Tel: (013) 693-3423
Fax: (013) 6933719
Cell: 082 788 1498

>>> "ALL Lou Jacobs" <Lou@hiveld.co.za> 26/01/2007 07:54:25 >>>
Hi, Daniel

As discussed telephonically, could you please confirm by return e-mail that **from 2003 onwards, there has been no "cap" on the purchase / use of electricity by Transalloys.** I think the purpose is to prove that we (Transalloys) did not initiate the project to improve efficiency on Furnaces as a result of a restriction placed (By Eskom) on the amount of electricity that can be procured from the National Grid.

Regards,

Lou Jacobs

(013) 693 8021
082 771 7393
********************************************************************************

HIGHVELD STEEL AND VANADIUM CORPORATION LIMITED Registration No. 1960/001900/06

DIRECTORS: G G Gomwe (Chairman) (Zimbabwean), A J de Nysschen (Chief Executive Officer), D D Barber, E Barnardo,

I Botha, L Boyd, C B Brayshaw, J W Campbell, C J Colebank, A V Frolov (Russian), A Harris, L Matteucci, N B Mbazima

(Zambian), Ms D R Motsepe, Dr A J Pienaar, B J T Shongwe, A Sorokin (Russian).

ALTERNATE DIRECTOR: GF Young

COMPANY SECRETARY: A Diener

## Annex 7

### UNCERTAINTY ANALYSIS

Project participants have used the EC monitoring guidelines to take into account the uncertainty in the calculation of onsite emissions. The way EU ETS deal with uncertainty and how it is applied to the project is the following:

1. Look at the monitoring tier imposed to the project given its size and its sector. This tier gives guidelines on the method of measurement or estimation, and the maximum permissible uncertainty for measured parameters.

   - In the iron and steel sector, the tiers imposed to a plant are the following (table 1 p13, method 'Fuel as process input'):

| | Activity Data | | | Net Calorific Value | | | Emission Factor | | |
|---|---|---|---|---|---|---|---|---|---|
| Size of the plant | A | B | C | A | B | C | A | B | C |
| Tier | 2 | 2 | 3 | 2 | 2 | 3 | 1 | 2 | 2 |

Column A: total annual emissions<=50 ktonnes
Column B: 50 ktonnes<total annual emissions<=500 ktonnes
Column C: total annual emissions>500 ktonnes

If the project plant was covered by the EU ETS, it would fall under column C and the following tiers would therefore apply (annex II – "CO2 emissions from combustion installations and processes"):

- Activity data (t reductant)
  Tier 3a: "Fuel consumption is metered without intermediate storage before combustion in the installation applying metering devices resulting in a maximum permissible uncertainty of less than ±2.5 % for the metering process."
  or Tier 3b: "Fuel purchase metered applying metering devices resulting in a maximum permissible uncertainty of less than ±2.0% for the metering process."
- Net calorific value (GJ/t reductant):
  Tier 3: "The net calorific value representative for each batch of fuel in an installation is measured by the operator, a contracted laboratory or the fuel supplier in accordance with the provisions of section 10 of Annex I."
- Emission factor (tC/GJ):
  Tier 2a: "The operator applies country specific emission factors for the respective fuel as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change."
  or Tier 2b: "The operator derives emission factors for each batch of fuel based on one of the following established proxies:
    - density measurement of specific oils or gases common e.g. to the refinery or steel industry, and
    - net calorific value for specific coals types,

  in combination with an empirical correlation as determined by an external laboratory
  according to the provisions of section 10 of Annex I. The operator shall ensure that the correlation satisfies the requirements of good engineering practice and that it is applied only to values of the proxy which fall into the range for which it was established."

2. Use the method prescribed by the monitoring tier to monitor emissions (e.g. IPCC values; default national value; project-specific value measured with such or such instrument)

- Activity data:
  - Tier 3a is used for coal and coke consumption (these consumptions are metered in the load cells, and there is no intermediate storage thereafter before it reaches the furnace).
  - Tier 3b is used for paste consumption (paste purchases are metered on a weighbridge)

- Net calorific value (GJ/t reductant) and emission factor (tC/GJ) :
  In the project, these two parameters are combined in an overall carbon content per ton of reductant (tC/t reductant).
  Project participants have made all efforts possible to retrieve data enabling the use of the highest tier possible (NCV tier 3, EF tier 2b), which was possible for:
  - the coke, for which seven years of volatile and fix carbon contents have been compiled to calculate the coke emission factor (monthly running average are used, as data per batch is not available) ;
  - the paste, for which reliable information is available from the supplier

  However, project specific carbon content for the coal could not be calculated because there is no accurate records of the proportions of various types of coal that were used in the baseline (these proportions are needed to calculate the weighed average coal carbon content). Therefore, tier 2b has been used; as there is national factor communicated by South Africa to the UNFCCC[20], IPCC 2006 emission factor for coal consumed as a reductant has been used.

and :

*For estimated values:*

3. Take the estimated value from the relevant reference (no uncertainty should be assigned to that value)

- The only estimated parameters are:
  - **Coal emission factor**: 3.1t$CO_2$/t coal (from IPCC 2006)
  - **Paste emission factor**: 3.32 t$CO_2$/t paste (from manufacturer)

  Note that although no uncertainty should be assigned to estimated values in the EU ETS, the IPCC uncertainty range has been used here to stay inline with AM0038's requirements. This is extremely conservative and contrary to the EU ETS approach.

*For measured values:*

3. Measure the parameter according to the prescribed method

- For all parameters except coal emission factor: see point 2 above for the method, and tables in section B.6.2 for the results in the baseline.

4. Calculate the uncertainty of the measurement.

- The uncertainties have been calculated and are indicated in table 11.

5. Make sure that the uncertainty is below the maximum permissible uncertainty under the tier imposed. If it is not: improve the monitoring system until the uncertainty of the measurement falls below the maximum permissible uncertainty

[20] South Africa (2000) *Initial national communication under the United Nations Framework Convention on Climate Change*, section 2.4.2 p26: "Emission factors determined by the industry for the South African situation were used for calculating the emissions from the production of aluminium and ammonia. For all other process emissions, IPCC default values were used."

- The uncertainties of each parameter have been calculated and are indicated in table 11.
  - To make sure the uncertainty of **coal and coke consumptions** stay below the 2.5% permissible uncertainty, load cells (which have a rated uncertainty of 2%) will be calibrated in line with manufacturer's specifications and measurements will be made using appropriate QA and QC procedures and integrated into the plant's ISO 14001 management system.
  - For **paste consumption**, average weights of paste cylinders were initially made per day but have been changed to monthly to ensure that the overall uncertainty of monthly paste consumption stays below 2.5% (however, the daily consumption may be above +/- 2.5% because the weight of one individual cylinder may differ by more than 2.5% from the average monthly weight).
  - The uncertainty of **coke emission factor** is slightly higher than that of other parameters due to the fact that this is done through sampling and a calculation of a monthly running average.

In conclusion, eforts have been made to follow the tiers imposed by the EC, successfully for all parameters, with the following exceptions:

- the determination of the coal emission factor, which couldn't be determined on a project-specific basis; and
- the determination of the coke emission factor, which is determined on a project specific basis but might not follow all the provisions of section 10 of Annex I of the EC monitoring guidelines.

It is important to note that retroactively applying a monitoring tier to a baseline factor which is based on historical data (as required in the CDM) is much more delicate that imposing a monitoring tier to a project factor that will be measured (as in the EU ETS).

As a result of this comprehensive analysis and rigorous monitoring plan, project participants estimate that they have assessed uncertainty "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 onsite emissions".

# Annex 8

## FINANCIAL ASSUMPTIONS

Deleted: ANALYSIS

| | | | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| | **Revenue from sale** | | | | | |
| A | Lump | R/t | 3,209 | | | |
| B | 12*3mm | R/t | 2,680 | *Source: Price obtained by Transalloys in 2004 per product* | | |
| C | Fines | R/t | 1,506 | | | |
| | **Cost of sale** | | | | | |
| D | Ore | R/t | 936 | *Source: Prices paid by Transalloys in 2004* | | |
| E | Other prodution cost | R/t | 1,448 | *Note: Cost of transport has to be paid only for Lump and 12*3mm* | | |
| F | Transport (for FOB contracts - Lump and 12*3mm) | R/t | 350 | *products (FOB contracts). Fines are sold locally* | | |
| | **Breakdown of production** | | | | | |
| G | Lump | % | 75.0% | | | |
| H | 12*3mm | % | 13.0% | *Source: Proportions of each product in the final tSiMn produced (in all years).* | | |
| I | Fines | % | 5.3% | | | |
| J | Non saleable products | % | 6.7% | *J=K=(G+H+I)* | | |
| K | Total product | % | 100.0% | | | |
| | **=> Weighed average cost/revenues per t of total product** | | Total | Lump | 12*3mm | Fines |
| L | Production of each product | t | 1.00 | 0.75 | 0.13 | 0.05 |
| M | Additional cost of sale | | | | | |
| N | Ore | R/t | 936 | | | |
| O | Other production cost | R/t | 1,448 | | | |
| P | Cost of transport | R/t | 350 | | | |
| Q | => Total cost of sale | | **2,735** | | | |
| R | Additional revenue from sale | R/t | **2,835** | 2,407 | 348 | 80 |
| | | | R1=R2+R3+R4 | R2= A*L2 | R3= B*L3 | R4= C*L4 |

Table 1: Calculation of cost and revenue from sales.
Assumptions are highlighted in yellow with an indication of the source.

| Tariff band | % of the time | Rates (R/MWh) Winter | Summer | |
|---|---|---|---|---|
| Peak | 15% | 494 | 151 | *Source:* |
| Standard | 35% | 143 | 100 | *Price paid by Transalloys in* |
| Off peak | 50% | 85 | 76 | *2004 per band and season* |
| => Average cost per season | | 166 | 96 | |
| Number of months per season | | 3 | 9 | |
| ==> Average cost per year | | **113** | | |

Table 2: Calculation of the average cost of electricity weighed by tariff band and season.
Assumptions are highlighted in yellow with an indication of the source.

TRANSALLOYS
2006 CAPITAL PAYBAC

C57013 - No. 7 Furnace
Increased Furnace Availal
Savings on MWh
Savings on Short Term Re
*Payback not achieved*
*expected availability n*

C57029 - No 5 Furnace F
Increased Furnace Availal
Savings on MWh
Savings on Short Term Re
*Payback not achieved*
*expected availability n*

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Deleted: Capital Payback Evaluation Schedule (as of December 2006). Source: Highveld financial department

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Deleted: Assumptions are highlighted in pink, and inputs from the Capital Payback Evaluation Schedule in bright blue. Cells in white are calculated values

## Annex 9

### LIST OF PDD ATTACHMENTS

The following documents are attached to the PDD:

A. Consideration of CDM

| Page 20: [1] Deleted | Arnaud Viel | 6/21/2007 11:32:00 AM |
|---|---|---|

*Illustration based on financial results*

To illustrate points 3 to 6 above and put some figures on the qualitative arguments advanced, below are the financial results to date (as of December 2006) from the retrofitting of furnaces 7 and 5:

Table 7: Financial results of the first two retrofittings covered by the project activity, as of December 2006.

| *All figures in Rands* | **Without carbon credits** | | **With carbon credits** | |
|---|---|---|---|---|
| | **Expected** | **Actual** | **Expected** | **Actual** |
| **FURNACE 7** | | | | |
| ***Cost*** | | | | |
| TOTAL Investment cost | 17,238,000 | | | |
| ***Revenues to date (Oct04-Dec06)*** | | | | |
| Increased furnace availability | 4,530,486 | -6,415,075 | | |
| Savings on MWh | 6,433,134 | -1,415,088 | | |
| Savings on short term repairs | 10,157,400 | 5,240,858 | | |
| TOTAL revenues to date | 21,121,020 | -2,589,305 | 25,190,507 | 1,480,183 |
| ***Financial analysis (over 10 years)*** | | | | |
| NPV | 34,374,905 | -21,492,068 | 43,963,553 | -11,903,420 |
| IRR | 54.0% | #DIV/0! | 64.7% | -12.2% |
| **FURNACE 5** | | | | |
| ***Cost*** | | | | |
| TOTAL Investment cost | 45,000,000 | | | |
| ***Revenues to date (Nov05-Dec06)*** | | | | |
| Increased furnace availability | 17,420,666 | -8,058,870 | | |
| Savings on MWh | 3,381,602 | -2,328,290 | | |
| Savings on short term repairs | 9,583,079 | 10,220,278 | | |
| TOTAL revenues to date | 30,385,347 | -166,883 | 32,408,170 | 1,855,940 |
| ***Financial analysis (over 10 years)*** | | | | |
| NPV | 97,897,232 | -12,045,385 | 107,089,258 | -2,853,359 |
| IRR | 57.5% | -12.7% | 61.4% | 7.6% |

Note: This table includes only investment cost. However, a finer analysis would also include the opportunity cost from lost production during the months of retrofitting – such a cost would add significantly to the investment cost.
Source: Highveld, Payback evaluation schedule

The financial analysis presented in table 7 is based on the Payback evaluation schedule made by Transalloys for both projects as of December 2006[1]. It shows that:

[1] Included in annex 8.

On the one hand, NPVs and IRRs based on ‘expected’ results are extremely high because these calculations were based on excessively optimistic forecasts for the project.

On the other hand, NPVs and IRRs based on actual results are negative[2], because of the technical difficulties that the project has faced, which make it financially very risky. Payback is far from being reached after 1 to 2 years of actual operation because of project underperformance.

This underperformance is due to both technical elements (see point 5 and 6 above) and market conditions (see points 3 and 4 above). On the technical side, some problems are independent of the project (change in raw material supplies, planned shutdown which had to be reversed, etc) but a lot of them are directly linked to the installation of the newly design furnaces (see the design problems described in point 5. above).

**Page 73: [2] Deleted** **Arnaud Viel** **6/22/2007 7:56:00 AM**

---

[2]Note that negative financial results on electricity savings are based on low figures for the baseline consumption of electricity (as set by Transalloys in their Payback evaluation schedule). Compared to the baseline electricity consumption as calculated per AM0038, electricity savings are actually positive and a 0.4MWh/tSiMn savings (lower than the 0.5-1MWh/tSiMn initially expected) is assumed for emission reduction forecasts (see section B.7).

Page Break

| Financial assumptions | | |
|---|---|---|
| CER price | 10 | €/tCO2e |
| Exchange rate | 9.4 | R/€ |
| Discount rate | 12.0% | |

| Revenues from carbon credits | | |
|---|---|---|
| Furnace 7 | 1,808,661 | Rands per annum |
| | 4,069,488 | Rands to date (Oct04-Dec06 |
| Furnace 5 | 1,733,848 | Rands per annum |
| | 2,022,823 | Rands to date (Nov05-Dec0 |

| *Total revenues of the projects to date (as of December 2006) (Rands)* | Furnace 7 Cumulated savings (Oct04 - Dec06) | | Furnace 5 Cumulative savings (Nov05-Dec06) | |
|---|---|---|---|---|
| | Expected | Actual | Expected | Actual |
| **Increased furnace availability** | 4,530,486 | -6,415,075 | 17,420,666 | -8,058,870 |
| **Savings on MWh** | 6,433,134 | -1,415,088 | 3,381,602 | -2,328,290 |
| **Savings on short term repairs** | 10,157,400 | 5,240,858 | 9,583,079 | 10,220,278 |
| **TOTAL** | 21,121,020 | -2,589,305 | 30,385,347 | -166,883 |

*Source: Payback Eval Schedule Dec 2006*

| *Monthly revenues of the projects (Rands)* | Furnace 7 | | Furnace 5 | |
|---|---|---|---|---|
| | Expected | Actual (avg 27mths) | Expected | Actual (avg 14mths) |
| **Increased furnace availability** | 167,796 | -237,595 | 1,244,333 | -575,634 |
| **Savings on MWh** | 238,264 | -52,411 | 241,543 | -101,796 |
| **Savings on short term repairs** | 376,200 | 194,106 | 684,506 | 730,020 |
| **TOTAL** | 782,260 | -95,900 | 2,170,382 | 52,590 |

*Source: Payback Eval Schedule Dec 2006*

| *All figures in Rands* | Without carbon credits | | With carbon credits | |
|---|---|---|---|---|
| | Expected | Actual | Expected | Actual |
| **FURNACE 7** | | | | |
| *Cost* | | | | |
| TOTAL Investment cost | 17,238,000 | | | |
| *Revenues to date (Oct04-Dec06)* | | | | |
| Increased furnace availability | 4,530,486 | -6,415,075 | | |
| Savings on MWh | 6,433,134 | -1,415,088 | | |
| Savings on short term repairs | 10,157,400 | 5,240,858 | | |
| TOTAL revenues to date | 21,121,020 | -2,589,305 | 25,190,507 | 1,480,183 |
| *Financial analysis (over 20 years)* | | | | |
| NPV | 34,374,905 | -21,492,068 | 43,963,553 | -11,903,420 |
| IRR | 54.0% | #DIV/0! | 64.7% | -12.2% |
| **FURNACE 5** | | | | |
| *Cost* | | | | |
| TOTAL Investment cost | 45,000,000 | | | |
| *Revenues to date (Nov05-Dec06)* | | | | |
| Increased furnace availability | 17,420,666 | -8,058,870 | | |
| Savings on MWh | 3,381,602 | -2,328,290 | | |
| Savings on short term repairs | 9,583,079 | 10,220,278 | | |
| TOTAL revenues to date | 30,385,347 | -166,883 | 32,408,170 | 1,855,940 |
| *Financial analysis (over 20 years)* | | | | |
| NPV | 97,897,232 | -12,045,385 | 107,089,258 | -2,853,359 |
| IRR | 57.5% | -12.7% | 61.4% | 7.6% |

| Furnace | Size | Investment cost (mn Rand) | Number of months of operation | |
|---|---|---|---|---|
| 7 | 48MVA | 17 | 27 | Oct04-Dec06 |
| 5 | 48MVA | 45 | 14 | Nov05-Dec06 |

| Year | | | | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Furnace 7 | Without carbon | Expected | Cash flow | -17,238,000 | 9,387,120 | 9,387,120 | 9,387,120 | 9,387,120 | 9,387,120 | 9,387,120 | 9,387,120 | 9,387 |
| | | | NPV | 34,374,905 | | | | | | | | |
| | | | IRR | 54.0% | | | | | | | | |
| | | Actual | Cash flow | -17,238,000 | -1,150,802 | -1,150,802 | -1,150,802 | -1,150,802 | -1,150,802 | -1,150,802 | -1,150,802 | -1,15 |
| | | | NPV | -21,492,068 | | | | | | | | |
| | | | IRR | #DIV/0! | | | | | | | | |
| | With carbon | Expected | Cash flow | -17,238,000 | 11,195,781 | 11,195,781 | 11,195,781 | 11,195,781 | 11,195,781 | 11,195,781 | 11,195,781 | 11,19 |
| | | | NPV | 43,963,553 | | | | | | | | |
| | | | IRR | 65% | | | | | | | | |
| | | Actual | Cash flow | -17,238,000 | 657,859 | 657,859 | 657,859 | 657,859 | 657,859 | 657,859 | 657,859 | 657, |
| | | | NPV | -11,903,420 | | | | | | | | |
| | | | IRR | -12.2% | | | | | | | | |
| Furnace 5 | Without carbon | Expected | Cash flow | -45,000,000 | 26,044,583 | 26,044,583 | 26,044,583 | 26,044,583 | 26,044,583 | 26,044,583 | 26,044,583 | 26,04 |
| | | | NPV | 97,897,232 | | | | | | | | |
| | | | IRR | 57% | | | | | | | | |
| | | Actual | Cash flow | -17,238,000 | 631,081 | 631,081 | 631,081 | 631,081 | 631,081 | 631,081 | 631,081 | 631, |
| | | | NPV | -12,045,385 | | | | | | | | |
| | | | IRR | -12.7% | | | | | | | | |
| | With carbon | Expected | Cash flow | -45,000,000 | 27,778,432 | 27,778,432 | 27,778,432 | 27,778,432 | 27,778,432 | 27,778,432 | 27,778,432 | 27,77 |
| | | | NPV | 107,089,258 | | | | | | | | |
| | | | IRR | 61% | | | | | | | | |
| | | Actual | Cash flow | -17,238,000 | 2,364,929 | 2,364,929 | 2,364,929 | 2,364,929 | 2,364,929 | 2,364,929 | 2,364,929 | 2,364 |
| | | | NPV | -2,853,359 | | | | | | | | |
| | | | IRR | 7.6% | | | | | | | | |