CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

Transalloys Manganese Alloy Smelter Upgrade & Energy Efficiency Project in South Africa

Prepared by EcoSecurities Ltd.

January 2005

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Transalloys Manganese Alloy Smelter Upgrade & Energy Efficiency Project

A.2. Description of the project activity:

A.2.1. Purpose of the project activity:

The Transalloys Manganese Alloy Smelter Upgrade & Energy Efficiency Project (the "Project") developed by the Transalloys Division of the Highveld Steel and Vanadium Corporation Ltd (the "Project Developer") is a large-scale project that will reduce the energy consumption (primarily grid electricity) in the production of silico-manganese (Si-Mn) alloy (a key component in steel making) at its Witbank facility in South Africa (the "Host Country").

The production of each tonne of manganese alloy produced in the current electric arc furnaces requires approximately 5MWh of grid-fed electricity. The project will involve the retrofitting of current furnaces with state-of-the-art electric arc furnace, electrode assembly, control and peripheral systems. This will reduce the energy consumption of alloy production by some 10-20% to between 4.5-4MWh. The aim is to achieve around a 0.5MWh reduction in specific energy consumption, with a belief that up to 1MWh could be achieved under the correct operating conditions, should the retrofitting be successful. It will also allow an improvement in the reliability of the furnaces to ensure a smoothing of production through use of a continuous, as opposed to a batch, approach to production. This will allow better and more efficient management of the furnaces ensuring that optimum design loadings are maintained and reduced electricity consumption per tonne of Si-Mn alloy produced is achieved.

One of the five furnaces was retrofitted in late 2004 to run in a pilot mode. This will be thoroughly tested in order to determine the ultimate efficacy of the new furnace design to establish if it is fit for purpose, to optimise design configuration and process control before being rolled out across the remaining furnaces. The total direct investment of this project is estimated at some Rand 83m (USD $12.8m), though total actual cost (including lost production during retrofitting) is expected to be far greater. The opportunity cost of taking furnaces off line is estimated to be in the order of USD $20.5m at the original estimated sale price of manganese alloy of USD $900/t (the current market value of manganese alloy is over USD $1,500 per tonne as a result of demand from the Far East). Thus, total original projected project cost is in the order of USD $33m (+).

Manganese alloys (ferro- manganese and silico-manganese) are important components in the steel making industry, and 80% of the world's recoverable reserves of manganese are found in South Africa. Consequently a significant proportion of the world manganese alloy industry is located in South Africa.

A.2.2. Contribution to Sustainable Development:

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

- Workers will have to be trained in proper management of novel and high-tech equipment. However, the impacts on Transalloys own international competitiveness will make a significant contribution to maintaining the livelihoods of the workers employed in this and ancillary industries both up and down stream of the facility;
- The project will allow 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 facilitates going out of business as a result of the strong Rand, this project will contribute to mitigating some of this currency risk;
- The project directly reduces the amount of electricity needed to produce the silico-manganese alloy and hence reduces the demands placed upon the South African national grid. Thus, directly supporting the drive for industrial demand-side management of energy being pursued by South Africa and Eskom, the national utility;
- The project acts as a clean technology demonstration project, encouraging development of modern and more efficient utilisation of electricity throughout the Country;
- New furnace design will allow a more effective capture of fugitive dust from process, allowing better particulate capture and a reduced emission to the local environment.

The project developers have applied for, and are in the process of receiving a Letter of No Objection from the recently formed South African DNA as an initial step towards receiving Host Nation Approval.

A.3. Project participants:

- Project Developer: Transalloys Division of the Highveld Steel and Vanadium Corporation Ltd (South Africa)

- Annex 1 Participant and Carbon Buyer: EcoSecurities Ltd (UK)

Further contact information of project participants is provided in Annex 1.

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):

Witbank 1035, South Africa.

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

According to the UNFCCC, this project fits in Sectoral Category 9 -Metal Production

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

The Transalloys facility currently utilises 5 DEMAG electric arc furnaces for Silico-Manganese alloy production. These are 2 x 48 MVA furnaces and 3 x 22MVA furnaces. The project will see the retrofitting of these DEMAG designed furnaces with Pyromet technology. This approach to completely rebuild electric arc furnaces in-situ with new furnace technology installed into a configuration that was originally designed for different technology will be a first in South Africa, and in the industry possibly globally. Under normal circumstances such technology would not be installed into old furnaces, rather integrated into a new build design.

Image: Current Furnace Electrodes

Generally, in smelting operations, the electrode assembly is designed first, and the rest of the facility designed around this and the furnace. In this manner the furnace will be developed with an optimal design (e.g. spacing between electrodes- the pitch circle diameter (PCD) etc). The peripheral systems and electrode assembly are then built around the furnace, again to optimise design and performance. Removing and replacing one furnace technology with another is a unique approach to furnace design, as the space and environment the new furnace will be installed into will be completely alien. Thus the process is extremely difficult to predict exactly how the furnace will perform once installed until it is thoroughly tested. There is little information as to likely precedents for its ultimate performance that design engineers can work with to reduce technical risks, unlike building a furnace from new, a tried and tested process. For example, a new Pyromet furnace will be designed to allow for a certain PCD, this is designed in first, with the rest of the furnace designed around this parameter. In this situation a new PCD and electrode assembly design has to be developed to fit the existing space available, not the other way around.

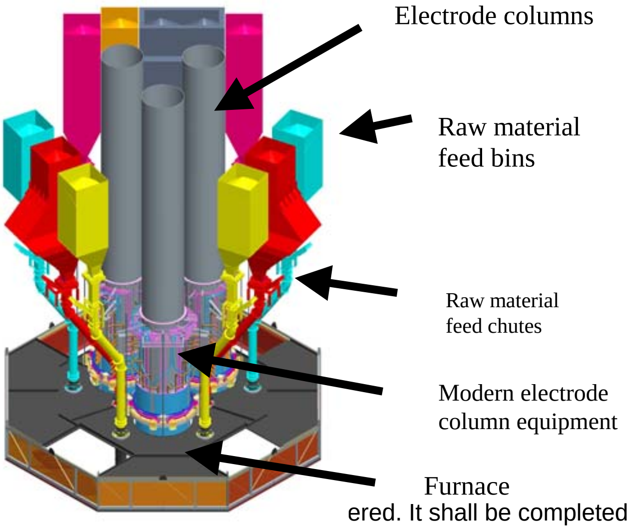


Image: Side View of Electrode Assembly, above the furnace roof level

The project involves taking furnaces out of production for several weeks to install the Pyromet furnaces, while also completely replacing the current furnace electrode assembly. This will involve a number of significant changes that are not limited to (for example) the installation of new contact shoes, protection rings, bus tube risers, mantles and cooling shields.

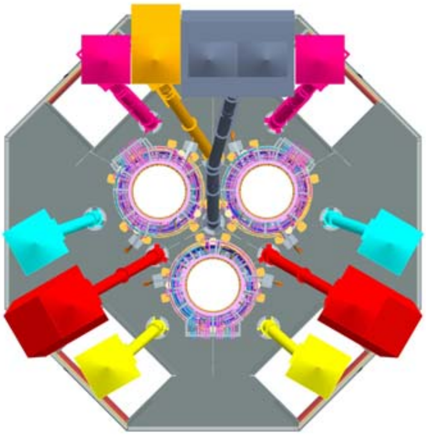
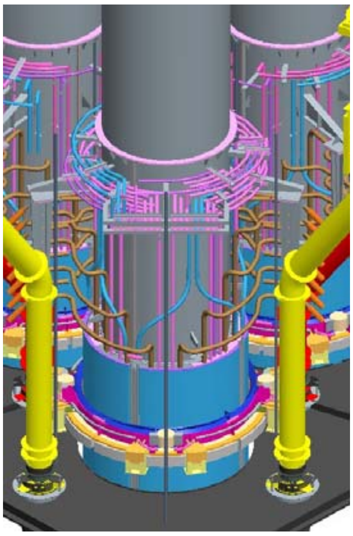


Image (Left): Plan View, of electrodes and material

Image (Right): Cut away and close up of electrode column



The first furnace (furnace 7) was retrofitted in August 2004 on a pilot basis, to test the design of the new furnaces, and optimise this design. During this pilot phase the furnace was thoroughly tested to ensure it performed appropriately, and to smooth out technical glitches that could have arisen. Should this pilot phase be successful, the next four furnaces will be retrofitted over the coming two years according to the schedule outlined in Table 1, below.

Table 1: Furnace Retrofitting Timetable

Furnace	Size	Retrofitting Schedule
Furnace 7	48MVA	July – September 2004
Furnace 5	48MVA	March – May 2005
Furnace 6	22MVA	July – September 2005
Furnace 1	22MVA	March – May 2006
Furnace 3	22MVA	July – September 2006

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

The project activity reduces CO_2 by reducing the amount of carbon-intensive electricity used to produce silico-manganese alloy through retrofitting the current facility furnace stock. In the absence of the proposed project activity electricity consumption would continue at the current rate of consumption per tonne of alloy produced, and continue the current emissions in the Eskom dominated South African national grid. Electricity generation in the South African grid is extremely carbon intensive as a result of

the amount of cheap coal available, and ultimately used. It is unlikely that industrial energy efficiency projects would be developed in the Host Country in the absence of the CDM due to unfavourable market conditions and the existence of significant market barriers for such projects such as the low price of power and the technology barriers and risk that must be overcome in replacing the current furnace stock.

To date there has been limited development of significant industrial energy projects in the Host Country, though a programme of demand side management (DSM) is currently under development. Eskom, the dominant grid supplier (95% of generation in South Africa is Eskom generated) is offering significant grant funding to projects capturing and utilising waste energy onsite for electricity production on an IPP (Independent Power Producer) basis, in order to avoid the need to invest in and build new power plants in South Africa. However, this funding is only available for IPP development, not strictly on site energy-efficiency even though this project directly supports such a DSM process.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

The project will displace electricity from a relatively carbon intensive grid, with a combined margin of 0.977 tCO_2/MWh. This project is expected to conserve in the order of 100,000 MWh per year of grid fed electricity. Thus, the project will avoid in the order of 98,000 tCO_2e per year when all 5 furnaces have been retrofitted, 890,000tCO_2e during the project crediting period of 10 years.

Refer to section E for further details on the quantification of GHG emission reductions associated with the project.

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 methodology

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

The project utilises a new methodology (NM00XX) – "Baseline methodology for energy efficiency through technological improvements in the metals production industry through smelting".

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

Given that the project is a grid-connected energy-efficiency project, this methodology was considered the most appropriate for the quantification of grid emissions. As described in NM00XX, the project here uses ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" at the core of the process to calculate project and baseline emissions.

B.2. Description of how the methodology is applied in the context of the project activity:

The methodology will be applied using Option b of ACM002 (the Consolidated Methodology for Grid Connected Projects), as this is the most complete of the options, with the exception of Option c. Option c (Dispatch Data Analysis) will not be used because data is not available and even if it were available, the costs of processing data would be beyond the amount affordable by the project developer.

The data used for the calculation of the combined margin is shown in Annex 3 of this document. The main source of data for this project are the annual reports of NER- the National Electricity Regulator- and data supplied directly from this agency. The defaults used for the calculation of calorific values for fuel types and fuel oxidization, came from the IPCC GHG Gas Inventory Reference Manual (IPCC 1996). Fuel consumption of the plants in the national grid is not available for all plants, thus, this has been estimated in such cases where data is lacking in this draft CDM PDD using the Standard IPCC Guidelines for National Greenhouse Gas Inventories (1996).

B.3. 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:

The determination of project scenario additionality is carried out using the CDM consolidated tool for demonstration of additionality, which follows the following steps:

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

The project began construction prior to the registration of the first CDM project, commencing construction in mid 2004, while the first CDM project was registered on the 18th of November 2004. The project began operating in a pilot mode after the retrofitting of the first furnace (7) in September 2004. Table 1, above, sets out the implementation profile expected for this project should this pilot phase be successful. It is intended that the Project will be submitted for registration prior to 31st of December 2005.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity:

Alternative 1: The proposed CDM project activity: retrofitting the current furnace stock with new Pyromet technology and producing silico-manganese alloy at a specific energy consumption of 4-4.5 MWh per tonne of alloy produced.

Alternative 2: Continuation of the current situation. The current stock of Demag furnaces will continue to be utilised, producing silico-manganese alloy at a specific energy consumption of 5 MWh per tonne of alloy produced. Under this scenario, even if refurbishments occur in the plant, there have been no planned rehabilitations that would not maintain the specific energy consumption at a level of 5MWh per tonne of alloy produced.

Sub-step 1b. Enforcement of applicable laws and regulations:

All the alternatives comply with the laws and regulatory requirements for Si-Mn production in the project location.

Step 2. Investment Analysis

Sub-step 2a: Determine appropriate analysis method

According to the methodology for determination of additionality, if the CDM project alternatives generate financial or economic benefits other than CDM-related income Options II or III must be used. In this project situation there is no alternative other than the project or business as usual case- therefore a benchmark IRR must be utilised in order to determine additionality. Consequently Option III is applied here.

Sub-step 2b: Option III - Application of benchmark analysis

The likelihood of development of this project, as opposed to the continuation of grid electricity consumption at the current rate (i.e., the baseline), will be determined by comparing the project equity IRR with an appropriate benchmark metric derived from indicators such as bond rates, and country risk premium.

The risk adjusted benchmark equity IRR for projects in the metals sectors in South Africa has been calculated as 15% (source: Standard Bank London Limited).

The Table below shows the financial analysis for the project activity. As shown, the project equity IRR (without carbon) is 12% (data supplied by TransAlloys), lower than the relevant risk adjusted IRR benchmark derived from local bond rates, country risk premiums etc. in the Host Country.

Table: Financial results of the project (Alternative 1) with and without carbon finance. NPV uses a 10.5% discount rate.

	With carbon	**Without C**
Net Present Value (US$)	Rand 78.2m ($12.8)	Rand 63.8m ($10.5m)
IRR	16%	12%
Discount rate	10.5%	10.5%

Summary of results of project analysis. Details to be made available to DOE.

After the completed benchmark analysis, it has been clearly demonstrated that the proposed CDM project activity is unlikely to be the most financially attractive course of action.

Step 4. Common Practice Analysis

Sub-step 4a. Analyse other activities similar to the proposed activity

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. Therefore this is not considered as common practice in the manganese alloy, or wider metals production industry. Standard practice is to continue running existing stock, refurbishing as appropriate. Refurbishing would maintain the levels of consumption at 5MWh per tonne of manganese alloy produced.

Sub-step 4b. Discuss any similar options that are occurring

There are no projects similar to this in South Africa or the wider region that are being implemented.

Step 5. Impact of CDM registration

As shown in Step 2 above, the project is unlikely to move forward without the additional financial support of the CDM. If the developer were able to sell emission reduction credits from the project activity at an assumed price of U$ 4.00 dollars per tonne of CO_2e, the additional revenue generated by carbon sales would be sufficient to make the project go ahead (see Table in Step 2c above). The benefits and incentives brought about by the CDM to the shareholders of the proposed project activity are as follows:

- The financial benefit from the revenue obtained by selling the CO_2e emissions reductions has been one of the key issues that encourage the project developer (and the Highveld parent company) to undertake the proposed project activity. This project was originally looked at some time before, but the investment required ran contrary to the investment culture of the company. Capital allocations were historically made at Transalloys and the Highveld group using very different metrics for analysis of project acceptability than have been applied in this project. In addition there has been a culture of self-sufficiency in utilising in-house expertise to develop projects, as opposed to utilising external contractors and new equipment. Indeed, as previously discussed, the notion of such a large

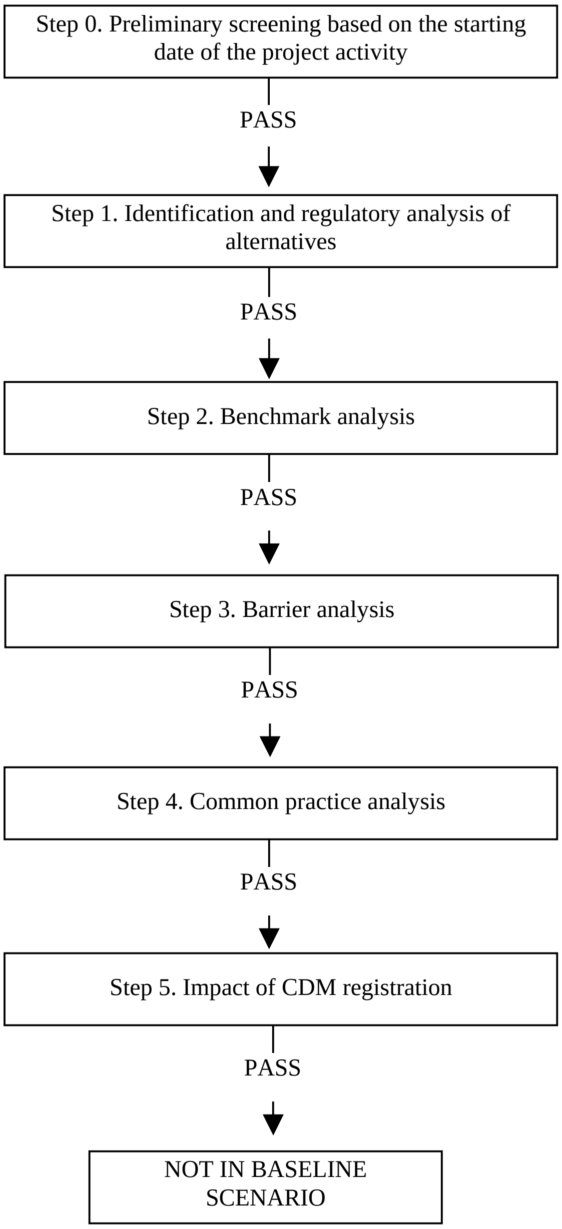
capital investment into old infrastructure is unheard of. Consequently the CDM revenue from this project is one of the factors in encouraging the project developer to undertake this paradigm shift in its internal investment policy in order to enable it to implement the best technological practices possible on this project site.

- A significant risk to this project, over an above the technology risk previously identified, is the exchange rate risk affecting expected revenues and attractiveness for investors. The Rand is increasingly strong in international currency markets as a result of the attractiveness of the South African economy following a successful transition from apartheid to a internationally attractive market economy. The project will allow 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 facilitates going out of business as a result of the strong Rand, this project will contribute to mitigating some of this currency risk. The impact of CDM registration will be to mitigate some of these risks by increasing revenues to the developer to offset some of impacts of currency fluctuations.

- On a macro economic basis, the project brings significant benefits to the host nation, including the maintenance of Transalloys as a significant contributor to the South African economy in a global market, maintaining employment and balance of payments contributions. It also makes a significant contribution to the economy through the reduced need to build new power plants to supply electricity in an environment of growing demand for energy in a buoyant energy. The project will effectively reduce the need for some 30MW of additional capacity implementation in the South African grid system.

Therefore, it has been clearly demonstrated how the approval and registration of the project as a CDM activity, and the attendant benefits and incentives derived from the project activity, will alleviate the technical economic and financial (investment) hurdles showed in Step 2 and thus enable the project to be undertaken. The proposed project activity passes step 5 of the additionality test.

So following all steps of the additionality test, it can be clearly demonstrated that the proposed CDM project activity is not the baseline scenario. This is presented in the following diagram.



Flowchart. Additionality Scheme

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

For the baseline determination, the project will account (in this situation) only for the CO_2 emissions arising as a result of consumption of electricity to produce silico-manganese alloy product. This electricity is generated in fossil fuel power stations operating in the Project grid system, and efficiency takes place that will reduce the amount consumed per tonne of alloy by the Project activity. No material change is envisaged for the consumption of any fossil fuels on site- indeed the project is expected to offer the opportunity to slightly reduce coal consumption per tonne of alloy product. However, these emissions

reductions are not quantified here, and no benefit from such reductions claimed. Coal consumption will be monitored though to ensure no leakage occurs.

The spatial extent of the project boundary is defined as the project site and the plants connected to the grid system to which the project will be connected.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

The baseline study was concluded in February 2005. The entity determining the baseline and participating in the project as the Carbon Advisor is EcoSecurities Ltd., UK, listed in Annex 1 of this document.

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:

01/09/2004 (pilot phase) with an implementation profile as set out in Table 1 above for other furnaces on site, beginning around March 2005.

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

The project is expected to last for more than 25y

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:

01/09/2004

C.2.2.2. Length:

10y-0m

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

NM00XX – “Monitoring methodology for energy efficiency through technological improvements in the metals production industry through smelting”.

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

As discussed in NM00XX, the monitoring methodology is underpinned by principles established in ACM0002 “Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources” and other approved monitoring methodologies, and as set out in the proposed new monitoring methodology. In this project the principles established in ACM002 are to be followed to monitor the project performance. This is appropriate as the core of this methodology acts to monitor grid connected electricity related emissions.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1 $EG_{py/t}$	*Quantity of grid electricity consumed per tonne of metal produced*	*Project Proponent*	*MWh/ tonne metal produced*	*M*	*Constant*	*100%*	*Electronic and Paper*	*The quantity of electricity consumed from a grid will be metered, and this information will be used by the electricity supplier for billing purposes*
2.EF_y	*CO_2 emission factor of the grid*	*Grid operator data*	*tCO_2/MWh*	*C*	*At the beginning of the crediting period*	*100%*	*Electronic*	*Calculated as the weighted sum of OM and BM emission factors. Given the vintage data procedures, it will be recorded just once at the beginning of each crediting period.*
3. OM EF_y	*CO_2 OM emission factor*	*Grid operator data*	*tCO_2/MWh*	*C*	*At the beginning of the crediting period*	*100%*	*Electronic*	*Calculated as indicated in the relevant OM baseline method. Given the vintage data procedures, it will be recorded just once at the beginning of each crediting period.*
4. BM EF_y	*CO_2 BM emission factor*	*Grid operator data*	*tCO_2/MWh*	*C*	*At the beginning of the crediting period*	*100%*	*Electronic*	*Calculated as indicated in the relevant BM baseline method. Given the vintage data procedures, it will be recorded just once at the beginning of each crediting period.*
5. $F_{i\,y}$	*Amount of each fossil fuel*	*Grid operator data*	*Mass*	*M*	*At the beginning of the*	*100%*	*Electronic*	*Given the vintage data procedures, it will be recorded just once at the beginning of each crediting period*

	consumed by each power source / plant				*crediting period*			
6. COEF I (for grid CEF) and EF_{ny-on} (for on site fossil fuel use)	*CO_2 emission coefficient of each fuel type*	*IPCC 1996*	*tCO_2/mass*	*M*	*At the beginning of the crediting period*	*100%*	*Electronic*	*Given the vintage data procedures, it will be recorded just once at the beginning of each crediting period*
7. $GEN_{j/k/n,y}$	*Electricity generation of each power source/plant*	*Grid operator data*	*MWh*	*M*	*At the beginning of the crediting period*	*100%*	*Electronic*	*Given the vintage data procedures, it will be recorded just once at the beginning of each crediting period*
8	*Identification of power source / plant for OM and BM calculation*	*Grid operator data*	*text*	*E*	*At the beginning of the crediting period*	*100%*	*Electronic*	*Given the vintage data procedures, it will be recorded just once at the beginning of each crediting period*
9 QP_y	*Quantity of Si-Mn alloy produced in the facility*	*Project Proponent*	*Tonnes of metal produced*	*M*	*Constant*	*100%*	*Electronic and Paper*	*This information can be evidenced through sales receipts for metal produced*
10 A_{pny}	*Quantity of any fossil fuel utilised per tonne of metal produced (source n)*		*Relevant units for source (n), tonnes (coal), m^3(natural gas), etc*	*M*	*Constant*	*100%*	*Electronic and Paper*	*Where fossil fuel consumption for source (n) is identified as material in the baseline analysis, this information should be monitored. Where it is not, it may be ignored to reduce monitoring transaction costs.* *As with electricity, billing dockets can be used to verify actual fuel use.*

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

$$PE_y = PE_y(offsite) + PE_y(onsite) \qquad \textbf{Equation 1}$$

Where:

PE_y: Project emissions in year y

PE_y(offsite): Offsite electricity emissions associated with the material being produced in year y (tCO_2e) (e.g., emissions associated with the use of grid electricity)

PE_y(onsite): Onsite project emissions associate with the material being produced in year y (such as coal/gas/oil use) (tCO_2e)

$$PE_y(offsite) = EG_{py} \times EF_y(offsite) \qquad \textbf{Equation 2}$$

$$= (EG_{py/t} \times QP_y) \times EF_y(offsite)$$

Where:

EG_{py}: Quantity of project grid electricity utilised in year y (MWh) – calculated through ($EG_{py/t}$ x QP_y)

EF_y(offsite): Grid electricity emissions factor determined in the baseline analysis in year y (tCO_2e/MWh) – see below, from ACM0002

$EG_{py/t}$: Grid electricity consumed per tonne of metal produced in the project scenario in year y

QP_y: Quantity of production in year y (relevant units)

The project boundaries exclude on site fossil fuel use in the baseline analysis as the project is not expected to have a material impact on fossil fuel consumption or emissions. However there exists a risk that consumption may increase, and as such consumption of coke and coal in each furnace will be monitored post retrofitting. Where they increase beyond an annual average consumption per tonne of alloy produced in each furnace as set out in below, associated emissions will be quantified in the monitoring process using equations 3 and 4 below and the monitored data as to actual coal and coke consumption.

Table 2: Average Fossil Fuel Consumption per Tonne Si-Mn

Average Coal and Coke Consumption from Last Three Years	**Coal** T Coal/Si-Mn	**Coke** T Coke/Si-Mn
Furnace 1	0.7978	0.0425
Furnace 3	0.8282	0.0425
Furnace 5	0.8849	0.0578
Furnace 6	0.9301	0.0496
Furnace 7	0.8853	0.0458

$$PE_y(onsite) = QP_y \times EF_{py}(onsite)$$ **Equation 3**

Where:

QP_y: Quantity of production in year y (relevant units)

EF_{py}(onsite): Project emissions factor for onsite emissions in year y (tCO_2e/relevant production unit). EF_{py}(onsite) will be defined as the emission factor associated with production of a single unit of product through on site fossil fuel use in the project scenario

$$EF_y(onsite) = \sum(A_{pny} \times EF_{ny\text{-}on})$$ **Equation 4**

Where:

A_{pny}: Quantity of each individual source (n) of onsite fossil fuel in year y in relevant units (tonnes, m^3) per individual unit of product (in relevant units) in project case - i.e. amount of coal used per tonne of product produced

$EF_{ny\text{-}on}$: Emissions factor applied for that source (n) in year y, using the relevant IPCC emissions factor

As per 2.1.4 in relation to the quantification of a grid electricity factors, and taken from ACM0002

$$\mathbf{EF_y(offsite) = \omega_{om} * EF\_OM_y + \omega_{bm} * EF\_BM_y} \qquad \textbf{Equation 5}$$

Where:

EF(offsite):	Emission factor (tCO_2e / MWh)
ω_{OM}:	Operating Margin weight, which is 0.5 by default
EF_OM:	Operating Margin emission factor (tCO_2e / MWh)
ω_{BM}:	Build Margin weight, which is 0.5 by default
EF_BM:	Build Margin emission factor (tCO_2e / MWh)
y:	A given year

and

$$EF\_OM_y = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y} * COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \frac{\sum_{i,j} F_{i,k,y} * COEF_{i,k}}{\sum_j GEN_{k.y}} \qquad \textbf{Equation 6}$$

Where:

EF_OM:	Operating Margin emission factor (tCO_2e / MWh)
F:	Amount of fuel *i* consumed by relevant power sources *j*
COEF:	CO_2 emission coefficient of fuel (t CO_2/ t)
GEN:	Electricity supplied by the plant to the grid (MWh)
i:	Refers to each fuel type
j:	Refers to operation power sources delivering electricity to the grid, not including low-operating cost and must-run power plants.
k:	Refers to power sources delivering to the grid from low cost/must run sources.
y:	Refers to a given year

$$\lambda_y(\%) = \frac{Number\ of\ hours\ Low Cost / Must\ Run\ Plants\ are\ on\ the\ M\arg in}{Total\ Number\ of\ Hours\ per\ Year} \qquad \textbf{Equation 7}$$

$$EF\_BM_y = \frac{\sum_{i,m} F_{i,m,y} * COEF_{i,m}}{\sum_m GEN_{j,y}}$$

Equation 8

Where:
***EF_BM*:** Build Margin emission factor (tCO_2e / MWh) and
***m*:** Refers to last additions power sources delivering electricity to the grid.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
11. $EG_{by/t}$	*Quantity of grid electricity consumed per tonne of metal produced*	*Project Proponent*	*MWh/ tonne metal produced*	*C*	*N/A*	*N/A*	*N/A*	*Preset as quantified in the baseline analysis* *The quantity of historic electricity consumed from a grid will have been metered, and this information will be used by the electricity supplier for billing purposes*
12.EF_y	*CO_2 emission factor of the grid*	*Grid operator data*	*tCO_2/MWh*	*C*	*At the beginning of the crediting period*	*100%*	*Electronic*	*Calculated as the weighted sum of OM and BM emission factors. Given the vintage data procedures, it will be recorded just once at the beginning of each crediting period.*
13. OM EF_y	*CO_2 OM emission factor*	*Grid operator data*	*tCO_2/MWh*	*C*	*At the beginning of the crediting period*	*100%*	*Electronic*	*Calculated as indicated in the relevant OM baseline method. Given the vintage data procedures, it will be recorded just once at the beginning of each crediting period.*
14. BM EF_y	*CO_2 BM emission factor*	*Grid operator data*	*tCO_2/MWh*	*C*	*At the beginning of the crediting period*	*100%*	*Electronic*	*Calculated as indicated in the relevant BM baseline method. Given the vintage data procedures, it will be recorded just once at the beginning of each crediting period.*
15. $F_{i\,y}$	*Amount of each fossil fuel*	*Grid operator data*	*Mass*	*M*	*At the beginning of the*	*100%*	*Electronic*	*Given the vintage data procedures, it will be recorded just once at the beginning of each crediting period*

	consumed by each power source / plant				*of the crediting period*			
16. COEF I (for grid CEF) and $EF_{ny\text{-}on}$ *(for on site fossil fuel use)*	CO_2 *emission coefficient of each fuel type*	*IPCC 1996*	tCO_2*/mass*	*M*	*At the beginning of the crediting period*	*100%*	*Electronic*	*Given the vintage data procedures, it will be recorded just once at the beginning of each crediting period*
17. $GEN_{j/k/n,y}$	*Electricity generation of each power source/plant*	*Grid operator data*	*MWh*	*M*	*At the beginning of the crediting period*	*100%*	*Electronic*	*Given the vintage data procedures, it will be recorded just once at the beginning of each crediting period*
18	*Identification of power source / plant for OM and BM calculation*	*Grid operator data*	*text*	*E*	*At the beginning of the crediting period*	*100%*	*Electronic*	*Given the vintage data procedures, it will be recorded just once at the beginning of each crediting period*
19 QP_{by}	*Quantity of metal produced in the facility*	*Project Proponent*	*Tonnes of metal produced*	*M*	*Constant*	*100%*	*Electronic and Paper*	*This information can be evidenced through sales receipts for metal produced*
20 A_{bny}	*Quantity of any fossil fuel utilised per tonne of metal produced*	*Project Proponent*	*Relevant units for source (n), tonnes (coal),* m^3*(natur*	*C*	*N/A*	*N/A*	*N/A*	*Preset as quantified in the baseline analysis* *Where fossil fuel consumption for source (n) is identified as material in the baseline analysis, this information should be monitored. Where it is not, it may be ignored to reduce monitoring transaction costs.*

	(source n)		*al gas), etc*					*As with electricity, billing dockets will have been used to verify actual fuel use.*

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Emissions associated with baseline Si-Mn alloy production in the baseline scenario are determined as set out below:

$$BE_y = BE_y(offsite) + BE_y(onsite) \qquad \textbf{Equation 9}$$

Where:

BE_y: Baseline emissions (year y)

BE_y (offsite): Offsite electricity emissions associated with the material being produced (tCO_2e in year y) (e.g., emissions associated with the use of grid electricity)

BE_y (onsite): Onsite baseline emissions associated with the material being produced (such as coal/gas/oil use) (tCO_2e in year y)

$$BE_y(offsite) = EG_{by} \times EF_y(offsite) \qquad \textbf{Equation 10}$$
$$= (EG_{by/t} \times QP_{by}) \times EF_y(offsite)$$

Where:

EG_{by}: Quantity of baseline grid electricity in year y (MWh) – calculated through ($EG_{by/t}$ x QP_{by})

EF_y (offsite): Grid electricity emissions factor in year y (tCO_2e/MWh)- as per ACM0002, see below

$EG_{by/t}$: Grid electricity consumed per tonne of metal produced in the baseline scenario in year y (as defined in the baseline analysis)

QP_{by}: Quantity of production in year y (relevant units)

The project boundaries exclude on site fossil fuel use in the baseline analysis as the project is not expected to have a material impact on fossil fuel consumption or emissions. However there exists a risk that consumption may increase, and as such consumption of coke and coal in each furnace will be monitored post retrofitting. Where they increase beyond an annual average consumption per tonne of alloy produced in each furnace as set out in above, associated emissions will be quantified in the monitoring process using equations 11 and 12 below using the data set out below to inform the baseline performance of each furnace in relation to coal consumption.

Table 2-(Reproduced): Average Fossil Fuel Consumption per Tonne Si-Mn

Average Coal and Coke Consumption from Last Three Years	**Coal**	**Coke**
	T Coal/Si-Mn (A_{bny} –Coal)	T Coke/Si-Mn (A_{bny} –Coke)
Furnace 1	0.7978	0.0425
Furnace 3	0.8282	0.0425
Furnace 5	0.8849	0.0578
Furnace 6	0.9301	0.0496
Furnace 7	0.8853	0.0458

$$BE_y(onsite) = QP_{by} \text{ x } EF_{by}(onsite)$$ **Equation 11**

Where:

QP_{by}: Quantity of production in year y (relevant units)

EF_{by}(onsite): Baseline emissions factor for any emissions taking place onsite (if appropriate) in tCO_2e/ production unit. EF_{by}(onsite) will be defined as the emission factor associated with production of a single unit of product through on site fossil fuel use

$$EF_{by}(onsite) = \sum(A_{bny} \text{ x } EF_{ny\text{-}on})$$ **Equation 12**

Where:

A_{bny}: Quantity of each individual source (n) of onsite fossil fuel in relevant units (tonnes, m^3) per individual unit of product (in relevant units) in year y - i.e. amount of coal used per tonne of product produced as defined in Table 2, above.

EF_{ny-on}: Emissions factor applied for that source (n), in year y, using the relevant IPCC emissions factor (tCO_2)

$$EF_y(offsite) = \omega_{om} * EF\_OM_y + \omega_{bm} * EF\_BM_y$$ **Equation 13**

Where:

***EF_y(offsite)*:** Emission factor (tCO_2e / MWh)

***ω_{OM}*:** Operating Margin weight, which is 0.5 by default

***EF_OM*:** Operating Margin emission factor (tCO_2e / MWh)

***ω_{BM}*:** Build Margin weight, which is 0.5 by default

***EF_BM*:** Build Margin emission factor (tCO_2e / MWh)

***y*:** A given year

and

$$EF\_OM_y = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y} * COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \frac{\sum_{i,j} F_{i,k,y} * COEF_{i,k}}{\sum_j GEN_{k.y}}$$ **Equation 14**

Where:
EF_OM: Operating Margin emission factor (tCO_2e / MWh)
***F*:** Amount of fuel *i* consumed by relevant power sources *j*
***COEF*:** CO_2 emission coefficient of fuel (t CO_2/ t)
***GEN*:** Electricity supplied by the plant to the grid (MWh)
***i*:** Refers to each fuel type
***j*:** Refers to operation power sources delivering electricity to the grid, not including low-operating cost and must-run power plants.
***k*:** Refers to power sources delivering to the grid from low cost/must run sources.
***y*:** Refers to a given year

$$\lambda_y(\%) = \frac{Number\ of\ hours\ Low\ Cost / Must\ Run\ Plants\ are\ on\ the\ Margin}{Total\ Number\ of\ Hours\ per\ Year}$$ **Equation 15**

Equation 16

$$EF\_BM_y = \frac{\sum_{i,m} F_{i,m,y} * COEF_{i,m}}{\sum_{m} GEN_{j,y}}$$

Where:
***EF_BM*:** Build Margin emission factor (tCO_2e / MWh) and
***m*:** Refers to last additions power sources delivering electricity to the grid.

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

Not applicable, as this will not be done.

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not applicable

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Not applicable

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

No negative sources of leakage have been identified.

The process will however see improved manganese recovery from the ore, and consequently reduce the rate of depletion of this non-renewable manganese ore resource. The recovery efficiency of manganese from the ore will improve by some 2.5%, reducing waste significantly. For every tonne of manganese alloy

produced, 5% less ore will be required. This has an impact on upstream energy use and GHG emissions not directly quantified as part of this analysis- a brief assessment indicates some 40,000t CO_2e may be reduced upstream. (This is taken from work carried out by manganese ore producers in South Africa that have estimated that manganese ore production can lead to lifecycle emissions (up to the point of smelting) of some 5-10 tonnes CO_2e/tonne finished manganese product). This additional process benefit is not quantified here, and therefore is an example of positive leakage associated with the project.

The potential for leakage could arise if on site fossil fuel consumption per tonne of alloy product produce increases over an above current consumption rates. The project is expected to actually see a reduction in coal consumption- a benefit that is not quantified or claimed in this project. However to ensure that no increase in coal consumption occurs coal use will be monitored, and included as monitored emissions only if its consumption rises above pre defined historic trends in coal use- see section D 2.1.2 and D.2.1.4 for equations setting out how such emissions are monitored.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Following monitoring and quantification of project (PE_y) and baseline (BE_y) emissions project emissions reductions (ER_y) in year y can be determined. The emission reductions (ER_y) of the project activity during a given year y is the difference between the monitored baseline, monitored project emissions and emissions due to leakage, as expressed in the formula below.

$$ER_y = BE_y - PE_y - L_y \qquad \textbf{Equation 17}$$

Where

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

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.

D 2-1. $EG_{py/t}$ Electricity consumption per tonne Si-Mn	*Low*	*Electricity consumption data will be tracked by internal Transalloys procedures, and are subject to metering by a third party. Quantification will be subject to Transalloys own internal QA/QC procedures*
D2 9 QP_y Quantity of Si-Mn alloy produced in the facility	*Low*	*Si-MN production will be tracked by internal Transalloys procedures, and verified through sales receipts. Quantification will be subject to Transalloys own internal QA/QC procedures*
D2-10 A_{pny} Quantity of any fossil fuel utilised per tonne of metal produced (source n)	*Low*	*Electricity consumption data will be tracked by internal Transalloys procedures, and are subject to metering by a third party. Quantification will be subject to Transalloys own internal QA/QC procedures*
All others	*Low*	*Default data (for emission factors) and grid statistics data will be used. All the sources where data where obtained are cited and come from reputable sources.*

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

Transalloys, and its Highveld parent, implement an ISO 14001 management system. This process will underpin the relevant project monitoring plan. The responsible individual for carrying out this monitoring will be Mr Henk Bouwer, Production Manager.

D.5 Name of person/entity determining the monitoring methodology:

This monitoring determined in August 2004. The entity determining the baseline and participating in the project as the Carbon Advisor is EcoSecurities Ltd., UK, listed in Annex 1 of this document.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

This analysis will quantify emissions arising as a result of electricity consumption in both project and baseline scenarios. The project boundaries exclude on site fossil fuel use in the baseline analysis as the project is not expected to have a material impact on fossil fuel consumption, and hence emissions. However there exists a risk that on site emissions may increase, and as such consumption of coke and coal in each furnace will be monitored post retrofitting. Where they increase beyond an annual average consumption per tonne of alloy produced as set out in Table 2, above, associated emissions will be quantified in the monitoring process as set out in section D2.1.2 and D.2.1.4

The following equations are used to quantify emissions in the project scenario.

$$PE_y = PE_y(offsite) + PE_y(onsite) \qquad \textbf{Equation 18}$$

Where:

PE_y: Project emissions in year y

$PE_y(offsite)$: Offsite electricity emissions associated with the material being produced in year y (tCO_2e) (e.g., emissions associated with the use of grid electricity)

$PE_y(onsite)$: Onsite project emissions associate with the material being produced in year y (such as coal/gas/oil use) (tCO_2e)

As set out above, $PE_y(onsite)$ (emissions arising through onsite fossil fuel use) is expected to be zero for the purposes of project emissions quantification, as no material change is expected in fossil fuel consumption as a result of the project. Hence equation 18 becomes:

$$PE_y = PE_y(offsite) \qquad \textbf{Equation 18-rev}$$

$$PE_y(offsite) = EG_{py} \times EF_y(offsite) \qquad \textbf{Equation 19}$$

$$= (EG_{py/t} \times QP_y) \times EF_y(offsite)$$

Where:

EG_{py}: Quantity of project grid electricity in year y (MWh) – calculated through ($EG_{py/t}$ x QP_y)

$EF_y(offsite)$: Grid electricity emissions factor in year y (tCO_2e/MWh) NB: This emissions factor for grid electricity is defined by following ACM002 or another approved methodology for calculation of emissions associated with grid

connected renewable electricity generation if sufficient data to underpin ACM0002 is not available, as appropriate

$EG_{py/t}$: Grid electricity consumed per tonne of metal produced in the project scenario in year y

QP_y: Quantity of production in year y (relevant units)

In order to quantify grid electricity related emissions, the following equations are applied here from ACM0002 to determine a grid CEF:

EF_y will be calculated as:

$$EF_y = w_{OM} * EF\_OM_y + w_{BM} * EF\_BM_y$$ **Equation 20**

Where:

EF_y: Emission factor (tCO_2e/MWh). = EF_y(offsite)

w_{OM}: Operating Margin weight, which is 0.5 by default.

EF_OM: Operating Margin emission factor (tCO_2e/MWh).

w_{BM}: Build Margin weight, which is 0.5 by default.

EF_BM: Build Margin emission factor (tCO_2e/MWh).

y: refers to a given year.

The grid emissions factor calculations are based on the combined margin using the "Simple Operating Margin", option (a) of the ACM0002 as the hydro or other renewable energy sources do not make up greater than 50% of the energy generated. Also, the data required for calculating option (c),"Dispatch Data Analysis" is not publicly available. The calculation of these components are as follows:

$$EF\_OM_y = \frac{\sum_{i,j} F_{i,j,y} * COEF_{i,j}}{\sum_j GEN_{j,y}}$$ **Equation 21**

$$EF\_BM_y = \frac{\sum_{i,m} F_{i,m,y} * COEF_{i,m}}{\sum_m GEN_{j,y}}$$ **Equation 22**

Where:

EF_OM Operating Margin emission factor (tCO_2e / MWh).

EF_BM: Build Margin emission factor (tCO_2e / MWh).

F: amount of fuel *i* consumed by relevant power sources *j*

COEF: CO_2 emission coefficient of fuel (t CO_2/ t).

GEN: Electricity supplied by the plant to the grid (MWh).

i: refers to each fuel type.

j: refers to operation power sources delivering electricity to the grid, not including low-operating cost and must-run power plants.

y: refers to a given year.

m: refers to last 20% by energy of additional power sources, delivering electricity to the grid.

Utilising grid related data (as set out in Annex 3) a CEF for the South African grid can be calculated through application of ACM0002 of 0.977 t CO_2/MWh.

Each furnace in the Transalloys project could produce potentially different amounts of manganese alloy. In addition they will be retrofitted at different times, as opposed to all at once. The output of each in the project scenario- post retrofitting- is set out with the timing of the upgrade in Table 3, below.

Table 3: Projected Retrofitting and Production Profile

Furnace	Size	Retrofitting Timing	Projected Si-Mn production (tonnes pa)	Historic Average Si-Mn production (tonnes pa)	Incremental Si-Mn production (tonnes pa)
Furnace 1	22MVA	March – May 2006	28,705	22,453	6,252
Furnace 3	22MVA	July – September 2006	28,705	21,534	7,171
Furnace 5	48MVA	March – May 2005	57,410	36,046	21,364
Furnace 6	22MVA	July – September 2005	28,705	22,323	6,382
Furnace 7	48MVA	(Pilot Phase) July – September 2004	57,410	38,624	18,786
Total			**200,935**	**140,979**	**59,955**

Table 3 also sets out the historic production of Si-Mn in the Transalloys process, using the last three years of available data to quantify average annual production from each furnace over this time frame. The project will see a retrofitting that is aimed to smooth historic fluctuations to increase output from the facility. As can be seen output will increase by a third over the time frame of the project.

Applying the grid factor determined using equation 19 above the following summary of project emissions can be presented

Table 4: Project Emissions Profile (T CO_2e)

	Sept 04-Aug 05	Sept 05-Aug 06	Sept 06-Aug 07	Sept 07-Aug 08	Sept 08-Aug 09	Sept 09-Aug 10	Sept 10-Aug 11	Sept 11-Aug 12	Sept 12-Aug 13	Sept 13-Aug 14
Furnace 7	255,202	255,202	255,202	255,202	255,202	255,202	255,202	255,202	255,202	255,202
Furnace 5	84,646	253,939	253,939	253,939	253,939	253,939	253,939	253,939	253,939	253,939
Furnace 6	0	131,209	131,209	131,209	131,209	131,209	131,209	131,209	131,209	131,209
Furnace 1	0	38,886	116,658	116,658	116,658	116,658	116,658	116,658	116,658	116,658
Furnace 3	0	0	115,001	115,001	115,001	115,001	115,001	115,001	115,001	115,001
Total	339,849	679,236	872,008	872,008	872,008	872,008	872,008	872,008	872,008	872,008

This leads to project emissions across the crediting period of: 7,995,149 tonnes CO_2e

E.2. Estimated leakage:

No leakage is expected.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

The sum of E.1 and E.2 is equal to the emissions profile presented in Table 4, above, and reproduced here.

Table 4: Project Emissions Profile (T CO_2e)

	Sept 04-Aug 05	Sept 05-Aug 06	Sept 06-Aug 07	Sept 07-Aug 08	Sept 08-Aug 09	Sept 09-Aug 10	Sept 10-Aug 11	Sept 11-Aug 12	Sept 12-Aug 13	Sept 13-Aug 14
Furnace 7	255,202	255,202	255,202	255,202	255,202	255,202	255,202	255,202	255,202	255,202
Furnace 5	84,646	253,939	253,939	253,939	253,939	253,939	253,939	253,939	253,939	253,939
Furnace 6	0	131,209	131,209	131,209	131,209	131,209	131,209	131,209	131,209	131,209
Furnace 1	0	38,886	116,658	116,658	116,658	116,658	116,658	116,658	116,658	116,658
Furnace 3	0	0	115,001	115,001	115,001	115,001	115,001	115,001	115,001	115,001
Total	339,849	679,236	872,008	872,008	872,008	872,008	872,008	872,008	872,008	872,008

This leads to project emissions across the crediting period of: 7,995,149 tonnes CO_2e

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

This analysis will quantify emissions arising as a result of electricity consumption in both project and baseline scenarios. The project boundaries exclude on site fossil fuel use in the baseline analysis as the project is not expected to have a material impact on fossil fuel consumption, and hence emissions. However there exists a risk that on site emissions may increase, and as such consumption of coke and coal in each furnace will be monitored post retrofitting. Where they increase beyond an annual average consumption per tonne of alloy produced as set out in Table 2, above, associated emissions will be quantified in the monitoring process as set out in section D2.1.2 and D.2.1.4

The following equations are used to quantify emissions in the baseline scenario.

$$BE_y = BE_y(offsite) + BE_y(onsite) \qquad \textbf{Equation 23}$$

<u>Where:</u>

BE_y: Baseline emissions (year y)

BE_y (offsite): Offsite electricity emissions associated with the material being produced (tCO_2e in year y) (e.g., emissions associated with the use of grid electricity)

BE_y (onsite): Onsite baseline emissions associated with the material being produced (such as coal/gas/oil use) (tCO_2e in year y)

As set out above, BE_y(onsite) (emissions arising through onsite fossil fuel use) is expected to be zero for the purposes of baseline emissions quantification, as no material change is expected in fossil fuel consumption as a result of the project. Hence equation 23 becomes:

$$BE_y = BE_y(offsite) \qquad \textbf{Equation 23-rev}$$

$$BE_y(offsite) = EG_{by} \times EF_y(offsite) \qquad \textbf{Equation 24}$$

$$= (EG_{py/t} \times QP_y) \times EF_y(offsite)$$

<u>Where:</u>

EG_{by}: Quantity of baseline grid electricity in year y (MWh)

EF_y (offsite): Grid electricity emissions factor in year y (tCO_2e/MWh) NB: This emissions factor for grid electricity is defined by following ACM0002 or another approved methodology for calculation of emissions associated with grid connected renewable electricity generation if sufficient data to underpin ACM0002 is not available, as appropriate

$EG_{by/t}$: Grid electricity consumed per tonne of metal produced in the project scenario in year y

QP_{by}: Quantity of production in year y (relevant units)

In order to quantify grid electricity related emissions, the following equations are applied here from ACM0002 to determine a grid CEF:

EF_y will be calculated as:

$$EF_y(offsite) = w_{OM} * EF\_OM_y + w_{BM} * EF\_BM_y \qquad \textbf{Equation 25}$$

Where:

$EF_y(offiste)$: Emission factor (tCO_2e/MWh).

w_{OM}: Operating Margin weight, which is 0.5 by default.

EF_OM: Operating Margin emission factor (tCO_2e/MWh).

w_{BM}: Build Margin weight, which is 0.5 by default.

EF_BM: Build Margin emission factor (tCO_2e/MWh).

y: refers to a given year.

The grid emissions factor calculations are based on the combined margin using the "Simple Operating Margin", option (a) of the ACM0002 as the hydro or other renewable energy sources do not make up greater than 50% of the energy generated. Also, the data required for calculating option (c),"Dispatch Data Analysis" is not publicly available. The calculation of these components are as follows:

$$EF\_OM_y = \frac{\sum_{i,j} F_{i,j,y} * COEF_{i,j}}{\sum_j GEN_{j,y}}$$ **Equation 26**

$$EF\_BM_y = \frac{\sum_{i,m} F_{i,m,y} * COEF_{i,m}}{\sum_m GEN_{j,y}}$$ **Equation 27**

Where:

EF_OM Operating Margin emission factor (tCO_2e / MWh).

EF_BM: Build Margin emission factor (tCO_2e / MWh).

F: amount of fuel *i* consumed by relevant power sources *j*

COEF: CO_2 emission coefficient of fuel (t CO_2/ t).

GEN: Electricity supplied by the plant to the grid (MWh).

i: refers to each fuel type.

j: refers to operation power sources delivering electricity to the grid, not including low-operating cost and must-run power plants.

y: refers to a given year.

m: refers to last 20% by energy of additional power sources, delivering electricity to the grid.

Utilising grid related data (as set out in Annex 3) a CEF for the South African grid can be calculated through application of ACM0002 of 0.977 t CO_2/MWh.

As discussed in E1, above each furnace in the Transalloys project could produce potentially different amounts of manganese alloy. In addition they will be retrofitted at different times, as opposed to all at

once. The output of each in the project scenario- post retrofitting- is set out with the timing of the upgrade in Table 5, below. The table sets out the historic production of Si-Mn in the Transalloys process, using the last three years of available data to quantify average annual production from each furnace over this time frame. The project will see a retrofitting that is aimed to smooth historic fluctuations to increase output from the facility. As can be seen output will increase by a third over the timeframe of the project.

Table 5: Projected Retrofitting and Production Profile

Furnace	Size	Retrofitting Timing	Projected Si-Mn production (tonnes pa)	Historic Average Si-Mn production (tonnes pa)	Incremental Si-Mn production (tonnes pa)
Furnace 1	22MVA	March – May 2006	28,705	22,453	6,252
Furnace 3	22MVA	July – September 2006	28,705	21,534	7,171
Furnace 5	48MVA	March – May 2005	57,410	36,046	21,364
Furnace 6	22MVA	July – September 2005	28,705	22,323	6,382
Furnace 7	48MVA	(Pilot Phase) July – September 2004	57,410	38,624	18,786
Total			**200,935**	**140,979**	**59,955**

Although clear that Transalloys would have not been able to meet an increase in demand from their current facilities, it is also clear there is growing global appetite for Si-Mn alloy, and South Africa is at the heart of this supply. However, there is little information available in the public domain to quantify emissions from incremental production of Si-Mn alloy. Unlike emissions arising from use of electricity in a fossil fuel fired grid system, emissions and energy use by technology in the manganese alloy industry is not available in the public domain- this information is deemed by operators as being commercially sensitive. However, it is reasonable to assume that an increase in demand would lead to an increase in production somewhere. It is also reasonable to assume that this increased supply would occur from a manganese-alloy production facility in South Africa. As discussed above, it is impossible to know exactly what the technologies (and associated energy use and emissions) of other potential plants making good this incremental supply in South Africa. However, it is again reasonable to assume that they do not produce manganese alloy in a mode that differs much from the current facilities existing at Transalloys. The proposed project activity will install a state-of-the-art technology, the method of its introduction being amongst the first of its kind in South Africa, and probably in the world. It is, therefore, proposed that the most reliable data available is the historic emissions of Si-Mn alloy on the Transalloys facility itself (i.e., data that can be easily monitored and verified). Consequently it is proposed that this data is extrapolated to quantify emissions from the expected incremental production in the project scenario.

Applying the grid factor above using equation 24 above the following summary of project emissions can be presented.

Table 6: Baseline Emissions Profile

	Sept 04-Aug 05	Sept 05-Aug 06	Sept 06-Aug 07	Sept 07-Aug 08	Sept 08-Aug 09	Sept 09-Aug 10	Sept 10-Aug 11	Sept 11-Aug 12	Sept 12-Aug 13	Sept 13-Aug 14
Furnace 7	283,247	283,247	283,247	283,247	283,247	283,247	283,247	283,247	283,247	283,247
Furnace 5	93,994	281,983	281,983	281,983	281,983	281,983	281,983	281,983	281,983	281,983
Furnace 6	0	145,231	145,231	145,231	145,231	145,231	145,231	145,231	145,231	145,231
Furnace 1	0	43,560	130,680	130,680	130,680	130,680	130,680	130,680	130,680	130,680
Furnace 3	0	0	129,023	129,023	129,023	129,023	129,023	129,023	129,023	129,023
Total	377,241	754,021	970,164	970,164	970,164	970,164	970,164	970,164	970,164	970,164

This leads to baseline emissions across the crediting period of: 8,892,575 CO_2e

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

The table below summarises annual project and baseline emissions and emissions reductions.

Table 7: Project and Baseline Emissions & Emissions Reductions (T CO_2e)

Summary Emissions & Emissions Reductions

		Sept 04-Aug 05	Sept 05-Aug 06	Sept 06-Aug 07	Sept 07-Aug 08	Sept 08-Aug 09	Sept 09-Aug 10	Sept 10-Aug 11	Sept 11-Aug 12	Sept 12-Aug 13	Sept 13-Aug 14
Furnace 7	Baseline Emissions	283,247	283,247	283,247	283,247	283,247	283,247	283,247	283,247	283,247	283,247
	Project Emissions	255,202	255,202	255,202	255,202	255,202	255,202	255,202	255,202	255,202	255,202
	Emissions Reductions	28,045	28,045	28,045	28,045	28,045	28,045	28,045	28,045	28,045	28,045
Furnace 5	Baseline Emissions	93,994	281,983	281,983	281,983	281,983	281,983	281,983	281,983	281,983	281,983
	Project Emissions	84,646	253,939	253,939	253,939	253,939	253,939	253,939	253,939	253,939	253,939
	Emissions Reductions	9,348	28,045	28,045	28,045	28,045	28,045	28,045	28,045	28,045	28,045
Furnace 6	Baseline Emissions	0	145,231	145,231	145,231	145,231	145,231	145,231	145,231	145,231	145,231
	Project Emissions	0	131,209	131,209	131,209	131,209	131,209	131,209	131,209	131,209	131,209
	Emissions Reductions	0	14,022	14,022	14,022	14,022	14,022	14,022	14,022	14,022	14,022
Furnace 1	Baseline Emissions	0	43,560	130,680	130,680	130,680	130,680	130,680	130,680	130,680	130,680
	Project Emissions	0	38,886	116,658	116,658	116,658	116,658	116,658	116,658	116,658	116,658
	Emissions Reductions	0	4,674	14,022	14,022	14,022	14,022	14,022	14,022	14,022	14,022
Furnace 3	Baseline Emissions	0	0	129,023	129,023	129,023	129,023	129,023	129,023	129,023	129,023
	Project Emissions	0	0	115,001	115,001	115,001	115,001	115,001	115,001	115,001	115,001
	Emissions	0	0	14,022	14,022	14,022	14,022	14,022	14,022	14,022	14,022

	Reductions										
Total	Baseline Emissions	377,241	754,021	970,164	970,164	970,164	970,164	970,164	970,164	970,164	970,164
	Project Emissions	339,849	679,236	872,008	872,008	872,008	872,008	872,008	872,008	872,008	872,008
	Emissions Reductions	37,393	74,785	98,156	98,156	98,156	98,156	98,156	98,156	98,156	98,156

Table 8: Summary of Project and Baseline Emissions & Emissions Reductions Across Crediting Period

Total (Crediting Period)	
Baseline Emissions	8,892,575t CO_2e
Project Emissions	7,995,149t CO_2e
Emissions Reductions	897,426t CO_2e

E.6. Table providing values obtained when applying formulae above:

Electricity Generated Emissions Reductions	**Per Year**	**Total Crediting Period (10 years)**
Operating Margin Emissions Factor (EF_OM_y tCO_2/MWh)	0.977	0.977
Build Margin Emissions Factor (EF_BM_y in tCO_2/MWh)	0.978	0.978
Baseline Emissions Factor (EF_y in tCO_2/MWh)	0.977	0.977
Electricity Conserved by Project- Year 10 (*EG* MWh)	100,467	918,553
Baseline Emissions –Year 10 (*BE* tCO_2)	970,164	8,892,575
Project Emissions –Year 10 (*PE* tCO_2)	872,008	7,995,149
Emissions reduction from electricity conservation- Year 10 (tCO_2/year)	**98,156**	**897,426**

SECTION F. Environmental impacts

F.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. However, it is expected to have an impact nationally, as it reduces 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.

Furthermore, it is possible that the project will lead to coal consumption reduction in the plant as a reduction agent of the manganese, which is also a positive environmental impact of the project that has not been taken into account for the emission reduction calculations.

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.

F.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 G. Stakeholders' comments

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

Stakeholder consultation is being undertaken.

G.2. Summary of the comments received:

Summary of the comments received will be included in this section in due course.

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

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project sponsor:

Organization:	Transalloys
Street/P.O.Box:	Private Bag 7216
Building:	
City:	Witbank
State/Region:	Gauteng Province
Postfix/ZIP:	1035
Country:	South Africa
Telephone:	+27 13 693 8071
FAX:	
FAX:	
E-Mail:	henk@hiveld.co.za
URL:	
Represented by:	
Title:	Production Manager
Salutation:	Mr.
Last Name:	
Last Name:	Bouwer
Middle Name:	
First Name:	Henk
Department:	Production
Mobile:	
Direct FAX:	+27 13 693 7173
Direct tel:	
Personal E-Mail:	henk@hiveld.co.za

Project Annex 1 sponsor and Carbon Advisor:

Organization:	EcoSecurities Group Ltd.
Street/P.O.Box:	21 Beaumont Street
Building:	-
City:	Oxford
State/Region:	-
Postfix/ZIP:	-
Country:	United Kingdom
Telephone:	44 1865 202 635
FAX:	44 1865 251 438
E-Mail:	uk@ecosecurities.com
URL:	www.ecosecurities.com
Represented by:	
Title:	Director
Salutation:	Dr.
Last Name:	Moura Costa
Middle Name:	
First Name:	Pedro
Mobile:	
Direct FAX:	
Direct tel:	44 1865 202 635
Personal E-Mail:	pedro@ecosecurities.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This project will not receive any public funding.

Annex 3

BASELINE INFORMATION

Table: Database used for combined margin emissions factor calculation.

BUILD MARGIN DATA

Plant Name	Technology	Fuel Type	MWh	MW	Fuel Consumption	Year On-Line
Majuba	steam	coal	4,600,976	3,843	6,511,374	1996
Kendal	steam	coal	26,006,905	3,840	39,229,687	1993
Lethabo	steam	coal	22,019,627	3,558	29,504,941	1990
Tutuka	steam	coal	11,185,646	3,510	17,129,229	1990
Matimba	steam	coal	25,145,393	3,690	37,042,898	1988

Operating Margin Data 2002

Plant Name	Technology	Fuel Type	MWh	MW	Fuel Consumption Unit	Fuel Consumption per year	Year Plant Online	State or Private
Majuba	Steam	Coal	4,600,976	3,843	tonnes	6,961,108	1996	Private
Kendal	Steam	Coal	26,006,905	3,840	tonnes	39,347,494	1993	Private
Lethabo	Steam	Coal	22,019,627	3,558	tonnes	33,314,889	1990	Private
Tutuka	Steam	Coal	11,185,646	3,510	tonnes	16,923,472	1990	Private
Matimba	Steam	Coal	25,145,393	3,690	tonnes	38,044,058	1988	Private
Duvha	Steam	Coal	23,320,444	3450	tonnes	35,282,977	1984	Private
Matla	Steam	Coal	25,577,292	3450	tonnes	38,697,505	1983	Private
Kriel	Steam	Coal	19,165,265	2850	tonnes	28,996,343	1979	Private
Hendrina	Steam	Coal	12,752,987	1895	tonnes	19,294,802	1976	Private
Acacia	Steam	Kerosene	197	171	tonnes	298	1976	Private
Port Rex	Steam	Kerosene	28	171	tonnes	42	1976	Private
Arnot	Steam	Coal	11,974,764	1980	tonnes	18,117,379	1975	Private

Athlone	Steam	Coal	76,596	180	tonnes	115,887	N/A	State
Bloemfontein	Steam	Coal	8,233	103	tonnes	12,456	N/A	State
Orlando	Steam	Coal	8,233	300	tonnes	12,456	N/A	State
Pretoria West	Steam	Coal	167,099	170	tonnes	252,815	N/A	State
Rooiwal	Steam	Coal	949,078	300	tonnes	1,435,920	N/A	State
Athlone	Steam	Kerosene	867	180	tonnes	1,311	N/A	State
Johannesburg	Steam	Kerosene	4,048	176	tonnes	6,124	N/A	State
Roggebaai	Steam	Kerosene	2,787	50	tonnes	4,216	N/A	State
Kelvin	Steam	Coal	1,721,353	540	tonnes	2,604,344	N/A	State
Sasol Synth Fuels	Steam	Coal	4,421,074	600	tonnes	6,688,923	N/A	Private
Sasol Chem Ind	Steam	Coal	808,079	139	tonnes	1,222,594	N/A	Private

Operating Margin Data 2001

Plant Name	Technology	Fuel Type	MWh	MW	Fuel Consumption Unit	Fuel Consumption per year	Year Plant Online	State or Private
Majuba	Steam	Coal	5,616,086	3,843	tonnes	8,496,932	1996	Private
Kendal	Steam	Coal	24,326,123	3,840	tonnes	36,804,532	1993	Private
Lethabo	Steam	Coal	21,907,040	3,558	tonnes	33,144,549	1990	Private
Tutuka	Steam	Coal	8,398,787	3,510	tonnes	12,707,057	1990	Private
Matimba	Steam	Coal	23,822,748	3,690	tonnes	36,042,945	1988	Private
Duvha	Steam	Coal	22,616,252	3450	tonnes	34,217,560	1984	Private
Matla	Steam	Coal	25,256,641	3450	tonnes	38,212,372	1983	Private
Kriel	Steam	Coal	19,428,746	2850	tonnes	29,394,981	1979	Private
Hendrina	Steam	Coal	12,460,428	1895	tonnes	18,852,171	1976	Private
Acacia	Steam	Kerosene	197	171	tonnes	298	1976	Private
Port Rex	Steam	Kerosene	28	171	tonnes	42	1976	Private
Arnot	Steam	Coal	11,390,033	1980	tonnes	17,232,702	1975	Private
Athlone	Steam	Coal	79,273	180	tonnes	119,937	N/A	State
Bloemfontein	Steam	Coal	21,437	103	tonnes	32,433	N/A	State
Orlando	Steam	Coal	0	300	tonnes	0	N/A	State
Pretoria West	Steam	Coal	74,983	170	tonnes	113,447	N/A	State

Rooiwal	Steam	Coal	433,983	300	tonnes	656,600	N/A	State
Athlone	Steam	Kerosene	685	180	tonnes	1,036	N/A	State
Johannesburg	Steam	Kerosene	4,048	176	tonnes	6,124	N/A	State
Roggebaai	Steam	Kerosene	1,707	50	tonnes	2,583	N/A	State
Kelvin	Steam	Coal	1,626,933	540	tonnes	2,461,490	N/A	State
Sasol Synth Fuels	Steam	Coal	5,107,703	600	tonnes	7,727,767	N/A	Private
Sasol Chem Ind	Steam	Coal	705,439	139	tonnes	1,067,303	N/A	Private

Operating Margin Data 2000

Plant Name	Technology	Fuel Type	MWh	MW	Fuel Consumption Unit	Fuel Consumption per year	Year Plant Online	State or Private
Majuba	Steam	Coal	4,278,340	3,843	tonnes	6,472,972	1996	Private
Kendal	Steam	Coal	25,279,546	3,840	tonnes	38,247,026	1993	Private
Lethabo	Steam	Coal	22,319,026	3,558	tonnes	33,767,868	1990	Private
Tutuka	Steam	Coal	10,089,338	3,510	tonnes	15,264,799	1990	Private
Matimba	Steam	Coal	23,085,200	3,690	tonnes	34,927,061	1988	Private
Duvha	Steam	Coal	23,530,675	3450	tonnes	35,601,049	1984	Private
Matla	Steam	Coal	25,085,200	3450	tonnes	37,952,988	1983	Private
Kriel	Steam	Coal	16,392,855	2850	tonnes	24,801,789	1979	Private
Hendrina	Steam	Coal	12,530,513	1895	tonnes	18,958,207	1976	Private
Acacia	Steam	Kerosene	36	171	tonnes	54	1976	Private
Port Rex	Steam	Kerosene	1,399	171	tonnes	2,117	1976	Private
Arnot	Steam	Coal	9,135,768	1980	tonnes	13,822,082	1975	Private
Athlone	Steam	Coal	65,753	180	tonnes	99,482	N/A	State
Bloemfontein	Steam	Coal	21,266	103	tonnes	32,175	N/A	State
Orlando	Steam	Coal	0	300	tonnes	0	N/A	State
Pretoria West	Steam	Coal	37,028	170	tonnes	56,022	N/A	State
Rooiwal	Steam	Coal	533,000	300	tonnes	806,409	N/A	State
Athlone	Steam	Kerosene	618	180	tonnes	#REF!	N/A	State
Johannesburg	Steam	Kerosene	4,048	176	tonnes	935	N/A	State
Roggebaai	Steam	Kerosene	0	50	tonnes	6,124	N/A	State

Kelvin	Steam	Coal	1,654,015	540	tonnes	0	N/A	State
Sasol Synth Fuels	Steam	Coal	5,107,703	600	tonnes	2,502,464	N/A	Private
Sasol Chem Ind	Steam	Coal	705,439	139	tonnes	7,727,767	N/A	Private

Summary Emissions & Emissions Reductions

		Sept 04-Aug 05	Sept 05-Aug 06	Sept 06-Aug 07	Sept 07-Aug 08	Sept 08-Aug 09	Sept 09-Aug 10	Sept 10-Aug 11	Sept 11-Aug 12	Sept 12-Aug 13	Sept 13-Aug 14
Furnace 7	Baseline Emissions	283,247	283,247	283,247	283,247	283,247	283,247	283,247	283,247	283,247	283,247
	Project Emissions	255,202	255,202	255,202	255,202	255,202	255,202	255,202	255,202	255,202	255,202
	Emissions Reductions	28,045	28,045	28,045	28,045	28,045	28,045	28,045	28,045	28,045	28,045
Furnace 5	Baseline Emissions	93,994	281,983	281,983	281,983	281,983	281,983	281,983	281,983	281,983	281,983
	Project Emissions	84,646	253,939	253,939	253,939	253,939	253,939	253,939	253,939	253,939	253,939
	Emissions Reductions	9,348	28,045	28,045	28,045	28,045	28,045	28,045	28,045	28,045	28,045
Furnace 6	Baseline Emissions	0	145,231	145,231	145,231	145,231	145,231	145,231	145,231	145,231	145,231
	Project Emissions	0	131,209	131,209	131,209	131,209	131,209	131,209	131,209	131,209	131,209
	Emissions Reductions	0	14,022	14,022	14,022	14,022	14,022	14,022	14,022	14,022	14,022
Furnace 1	Baseline Emissions	0	43,560	130,680	130,680	130,680	130,680	130,680	130,680	130,680	130,680
	Project Emissions	0	38,886	116,658	116,658	116,658	116,658	116,658	116,658	116,658	116,658
	Emissions Reductions	0	4,674	14,022	14,022	14,022	14,022	14,022	14,022	14,022	14,022
Furnace 3	Baseline Emissions	0	0	129,023	129,023	129,023	129,023	129,023	129,023	129,023	129,023
	Project Emissions	0	0	115,001	115,001	115,001	115,001	115,001	115,001	115,001	115,001
	Emissions Reductions	0	0	14,022	14,022	14,022	14,022	14,022	14,022	14,022	14,022
Total	Baseline Emissions	377,241	754,021	970,164	970,164	970,164	970,164	970,164	970,164	970,164	970,164
	Project Emissions	339,849	679,236	872,008	872,008	872,008	872,008	872,008	872,008	872,008	872,008
	Emissions Reductions	37,393	74,785	98,156	98,156	98,156	98,156	98,156	98,156	98,156	98,156

Total (Crediting Period)	
Baseline Emissions	8,892,575t CO_2e
Project Emissions	7,995,149t CO_2e
Emissions Reductions	897,426t CO_2e

Annex 4

MONITORING PLAN

TransAlloys, and its Highveld parent, implement an ISO 14001 management system. This process will underpin the relevant project monitoring plan, which will monitor all the variables listed in tables in section D.2.1.