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

CONTENTS

SECTION A. General description of project activity

A.1 Title of the project activity:

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Power generation from the proposed 11.2 MW waste heat recovery boiler at the ISA Smelt furnace of the Copper Smelter, Sterlite Industries India Limited (SIIL), Tuticorin

Version 02

25/09/2006

A.2. Description of the project activity:

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Background

Sterlite is among the fastest growing companies in India and has key presence in copper rods, aluminium, aluminium foils and zinc. Sterlite has established India's largest copper smelting and refining plant, a first in the private sector. Sterlite has manufacturing facilities all over India and Copper mines in Australia

Purpose

The purpose of setting up the 11.2 MW waste heat recovery boiler (WHRB) *i.e.* the project activity, is to primarily achieve the following objectives:

- To recover the waste heat from the hot gases coming out at a temperature of 1040 deg C from the ISA smelt furnace of the copper smelter
- To generate the required power for captive purposes so as to provide uninterrupted power supply to the process
- To ensure contribution to sustainable development through social, economic, environmental and technological aspects

The project activity is an energy efficient project that enables conservation of fossil fuels that would otherwise be used to generate equivalent power. The project activity replaces equivalent power generated from a combination of the two captive power plants (24 MW and 22.5 MW) of Sterlite, based on low sulphur heavy stock (LSHS), fossil fuel based TamilNadu Electricity Board[1] (TNEB) and the power wheeled from the coal based captive power plant of The Madras Aluminium Company (MALCO)[2]. By conserving fossil fuels, the project will help reducing the emission of Greenhouse Gases (GHG) into the atmosphere.

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[1] TNEB forms part of the Southern Regional grid of India and wherever TNEB / Southern Regional Grid occurs in this document, it means one and the same

[2] MALCO is a sister concern of Sterlite Industries India Limited

Salient features of the Project

Sterlite has a copper smelter at Tuticorin which is located in the coastal belt of Tamil Nadu, in Southern part of India (Refer Fig 1.1). Sterlite had expanded the copper smelter from 1.8 lakh tons per annum (LTPA) to 3 LTPA and is, implementing a technology designed and developed by Thermal System Private Limited (TSPL), Alstom which involves generation of 11.2 MW of power by means of waste heat recovery boiler which recovers waste heat being released from the copper smelter. The waste heat recovery boiler consists of a fuel oil system designed for continuous operation on furnace oil.

In the project activity, the hot gases coming out of the smelter at 1040 deg C enter the waste heat recovery system, and are further passed through the water bundles thereby passing the gas temperature on to water. The steam generated in this process will be super heated by passing through an external fired super heater to increase the enthalpy and temperature suitable enough to enter into the turbine. In this process, about 45 TPH of steam at 66 bars pressure will be generated from the boiler and 11.2 MW of power will be recovered after superheating. Amount of furnace oil firing in the super heater is estimated at 825-kgs/ hr or 19.8 metric ton per day (MTPD). Also the turbine would be using an air-cooled condenser instead of water-cooled condenser through which 1300 m^3 of water is saved per day.

The project activity would operate for a period of 337 days in a year and is expected to generate about 82.8 Million Units (MU) of power in a year of which **72 MU** would be used by the copper smelter for captive purposes after auxiliary consumption by the project activity. The power generated from the project activity would satisfy about 19.1% of the captive power required by the copper smelter after expansion.

Power consumption by Sterlite over the years (2001 – 2004) indicates that the share of power from the LSHS based captive power plants has increased from 89.47% to 96.70%. TNEB's share of power (based on fossil fuels like coal, lignite, gas and liquid fuel) has reduced to less than 1% and MALCO's share of power (coal based) has reduced from 10.13% to 3.04%.

Prior to the project activity Sterlite was using the ISA Smelt technology with Pierce Smith (P.S) converting route in its copper smelter with the existing capacity of 1.8 LTPA. The ISA smelter furnace off gases (at 1040 deg C temperature) contained 38 g/ m^3 of metallic dust and was being collected with the Electrostatic Precipitator (ESP). As the ESP worked effectively only at 350 deg C the high temperature gases were being cooled down from 1040 deg C to 350 deg C by spraying water and using gas coolers before it was sent out to the Sulphuric Acid Plant (SAP) for recovering SO_2. Considering wastage of significant amount of heat in the gas cooling process, Sterlite evaluated the techno-economic feasibility of implementing the project activity during the copper smelter expansion from 1.8 LTPA to 3.0 LTPA in order to tap the waste heat from the exhaust gases of the copper smelter. Being committed to environmental protection and energy conservation, Sterlite has decided to implement the project activity. The project activity has positively contributed towards the reduction of wastage (in the form of heat energy from waste gases) and reduction in

(demand) use of finite natural resource coal, minimizing depletion or else increasing its availability to other important processes.

Project's contribution to sustainable development

The project activity would replace the power that would otherwise be obtained from the carbon emissive fossil fuels pertaining to the CPP, TNEB grid and MALCO. Therefore this project would essentially contribute to a significant reduction in the greenhouse gases (GHG) emissions.

The use of furnace oil to super heat the steam would release air pollutants such as SO_2 and NO_x. However, to ensure better dispersion of these substances, the stack height has been selected at 70 m which is much higher than what is required by the Central Pollution Control Board (CPCB) requirement (which is 49 m). With the increased height, the dispersion would be higher thus reducing the air quality impact.

Since this project activity generates green power, it has positively contributed towards the reduction in (demand) use of finite natural resources (fossil fuels), minimizing depletion and in turn increasing its availability to other important purposes. Therefore this project activity has excellent environment benefits in terms of reduction in carbon emissions and fossil fuel conservation. The project activity also promotes the use of the latest high efficiency, environment friendly technology in other facilities in the same industrial sectors. The project would provide direct employment to the local people in Tuticorin thereby contributing to social development.

A.3. Project participants:

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Name of Party involved	Private and /or Public entity Project Participants	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (Host Country)	Sterlite Industries (India) Limited	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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The project activity is being implemented at Sterlite Copper, SIPCOT Industrial Complex, Tuticorin, Tamil Nadu, India.

A.4.1.1. Host Party(ies):

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India

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

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Tamil Nadu

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

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SIPCOT Industrial Complex, Tuticorin

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

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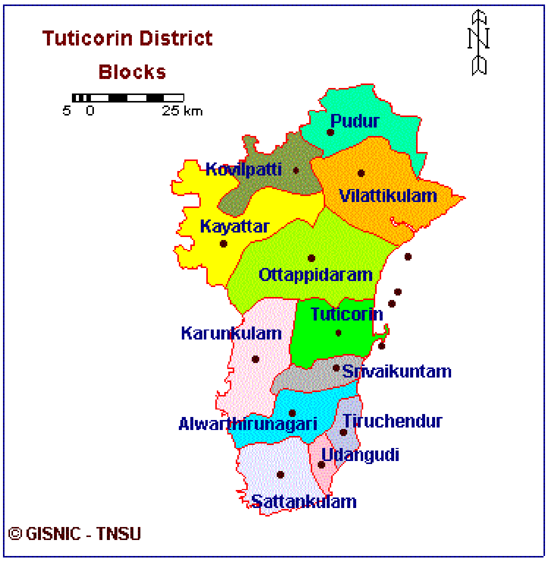
The project activity is being implemented at Sterlite Copper, Tuticorin, Tamil Nadu, India. Sterlite Copper is located in the State Industries Promotion Corporation of Tamil Nadu (SIPCOT) industrial complex of Tuticorin, on the National Highway (N.H.) 45 B . Tuticorin district is located at latitude and longitude of $8^0$45'N and $78^0$13'E respectively. The Sterlite has been operating at this location since 1996 and the SIPCOT provides all the industries located within this industrial complex, with the necessary infrastructure required such as water from Tamirabarani River.

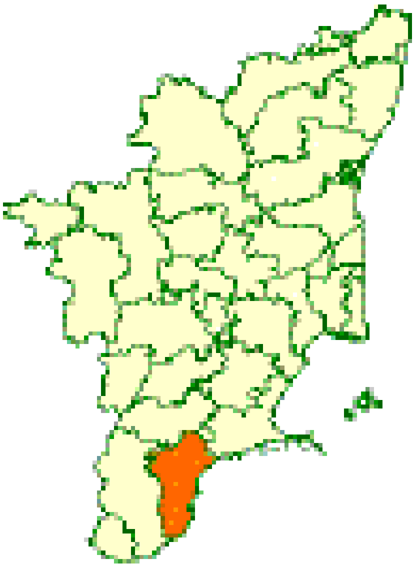
Power is obtained from the two captive power plants based on LSHS as fuel and also from the 110/22 KVA & 230/110 KVA Sub-Stations of Tamil Nadu Electricity Board (TNEB).

SIPCOT industrial estate is thus a fully developed estate provided with the entire infrastructure facilities such as road, railway and goods yard, water supply and drainage. Other facilities such as, safety, green belt, and manpower are also available. The port is located at a distance of 17 km which provides additional advantage and facilities for import and export of materials required.

India



Tuticorin district



Tamil Nadu State

Fig 1.1 Location map of Sterlite Copper, Tuticorin

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

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The project activity may principally be categorized in Category – 1 Energy Industries (Renewable/Non-Renewable Sources) as per the scope of the project activities enlisted in the list of sectoral scopes (version August 2006) & linked approved baseline and monitoring methodologies on the UNFCCC website for accreditation of Designated Operational Entities.

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

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Sterlite is implementing a technology designed and developed by Thermal System Private Limited (TSPL), Alstom for the 11.2 MW power plant. The waste heat recovery system would consist of a fuel oil system and is designed for continuous operation on furnace oil.

Turbine would be using an air-cooled condenser instead of water-cooled condenser by which 1300 m^3 of water is saved per day. The selected technology and equipment of the waste heat recovery boiler are provided in Table 1

Table 1 Technical parameters of Alstom Thermal System for waste heat recovery boiler

Parameter	Alstom – Thermal System
Gas volume (wet)	75882 M^3/hr
Off gas temperature Outlet temperature	1044 deg C 350 deg C
Boiler operating pressure	65 bar
Design pressure	72 bar
Boiler temperature	282 deg C
Feed water pressure	67 bar
Feed water temperature	105 deg C
Heat from gases	26.49 MW
Heat from dust and reaction	1.38 MW
Heat from roof	1 MW
Lining / radiation losses	2%
Heat losses (via insulation/ dust discharge/ design and piping)	120 KW
Total heat gross	28 MW
Steam generation	42.5 TPH
Blow down losses	2%

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

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Year	Annual estimation of emission reductions (tonnes of CO_2e)
2005	22,473
2006	22,473
2007	22,473
2008	22,473
2009	22,473
2010	22,473
2011	22,473
2012	22,473
2013	22,473
2014	22,473
Total estimated reductions (Tonnes of CO_2e)	224,730
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	22,473

A.4.5. Public funding of the project activity:

No public funding from parties included in Annex I is available to the project activity.

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:

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Title: Consolidated baseline methodology for waste gas and/or heat and/or pressure for power generation

Reference – This has reference to the UNFCCC approved consolidated baseline methodology (ACM0004 Version 02), based on the following:

NM0031-rev: OSIL – 10 MW waste heat recovery based captive power project, India

NM0087: Baseline methodology for electricity generation using waste heat recovery in sponge iron plants

NM0088: Baseline methodology for electricity production from waste energy recovery in an industrial manufacturing process

Selected approach is from paragraph 48 of CDM modalities and procedures (M&P) is "Existing actual or historical emissions as applicable"

The approved methodology draws upon the "Version 02 of the tool for the demonstration and assessment of additionality".

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

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The above methodology applies to project activities that generate electricity from waste heat or the combustion of waste gases in industrial facilities and therefore it applies to the project activity as well.

The project activity meets the applicability criteria of ACM0004 as:

- It displaces electricity generation with fossil fuels in the electricity grid as well as displaces captive electricity generation from fossil fuels like LSHS and Coal
- It uses waste heat of the hot gases coming from the ISA furnace of the copper smelter (whereas the use of waste heat from the gas is not the likely baseline scenario)
- There is no fuel switch in the ISA furnace of the copper smelter from where the waste heat is generated. The project activity is not triggered by any fuel switch process.
- The methodology demands realistic background data for the captive power plants at Sterlite in order to determine the baseline emission factor. The share of power supply from captive power plants must be known since in the context of the project activity, baseline emissions are to be calculated as per Option 1 as mentioned in ACM0004.

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

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	Source	Gas		Justification/Explanation
Baseline	Grid electricity generation	CO_2	Included	Main emission source.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Captive electricity generation	CO_2	Included	Main emission source.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project Activity	On-site fossil fuel consumption due to the project activity	CO_2	Included	Maybe an important emission source.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Combustion of waste gas for electricity generation	CO_2	Excluded	It is assumed that this gas would have been burned in the baseline scenario.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.

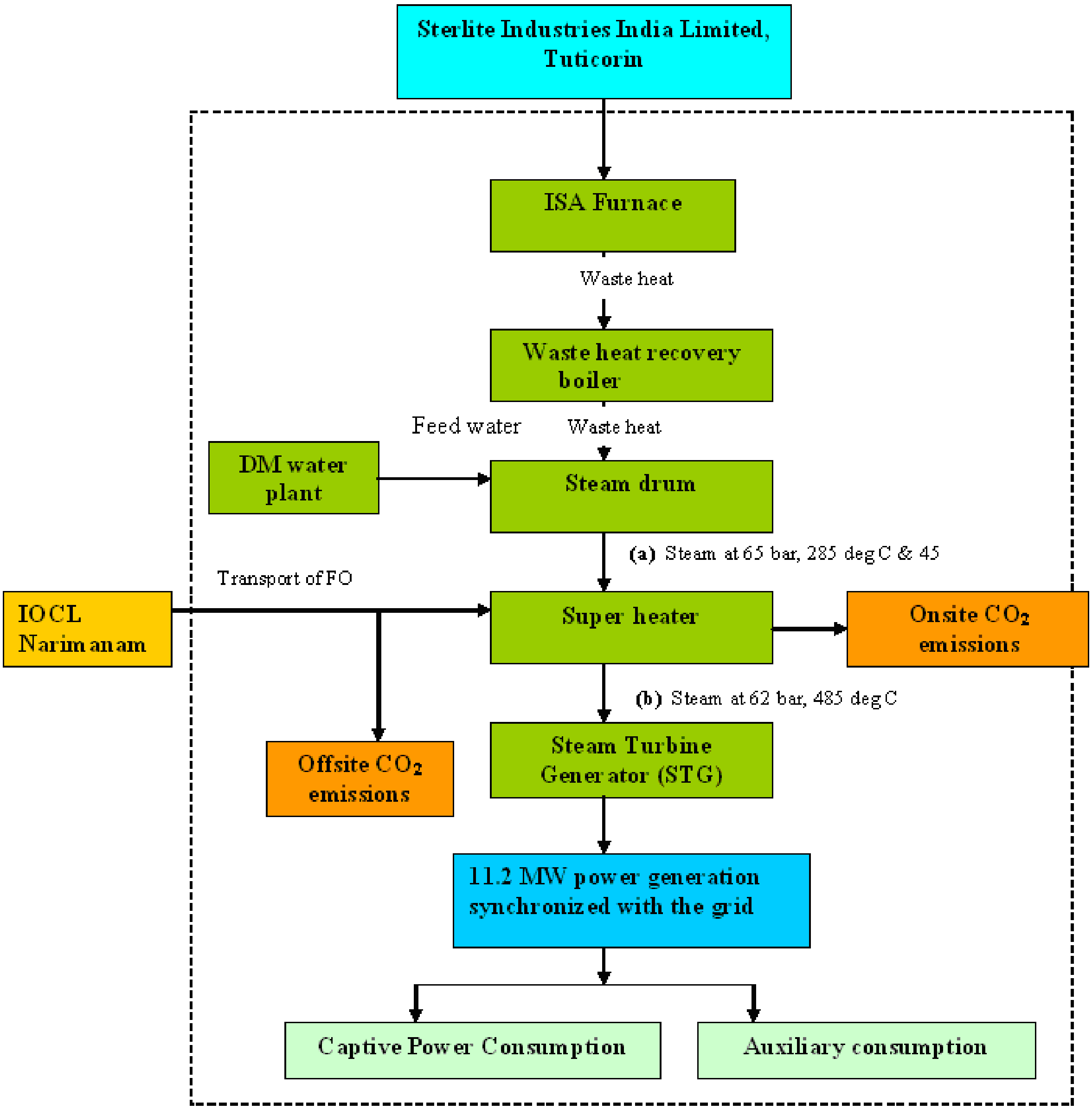

Fig B1: Waste heat recovery boiler at Sterlite Industries India Limited

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

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Identification of alternate baseline scenarios consistent with current laws and regulations:

As highlighted in the baseline methodology the determination of the baseline scenario requires consideration of the following potential alternatives:

(a) The proposed project activity not undertaken as a CDM project activity;

(b) Import of electricity

(b.1) Import of electricity from TNEB/SRG

(b.2) Import of electricity from MALCO

(c) New or existing on-site captive power generation, using other energy sources other than waste heat

(d) A mix of options (b) and (c)

(e) Other uses of the waste heat and waste gases

Option (a): The proposed project activity not undertaken as a CDM project activity

SIIL may generate electricity equivalent (installing captive power plants) to that of the project activity without taking this project activity under the Clean Development Mechanism of the United Nations Framework Convention on Climate Change. This alternative is in compliance with all applicable legal and regulatory requirements, whereas it faces several barriers in way of successful implementation. SIIL took into consideration the CDM benefits before taking up of the project activity, which would help in improving the sustainability of the project activity considering the risks and barriers associated with the implementation and successful running of the project. However, this alternative would not be a credible alternative for SIIL to implement. This can be substantiated through a fact that prior to the expansion of copper smelter, SIIL did not have waste heat recovery from copper smelter.

Option (b) Import of Electricity

(b.1): Import of electricity from TNEB/SRG

In this scenario Sterlite will neither implement the project activity nor would they build a new captive power plant based on LSHS to satisfy the additional captive power requirement. The expansion of the copper smelting facility from 1.8 LTPA to 3 LTPA increases the electrical demand of the facility. Importing electric power from the grid is the most convenient option for SIIL to proceed with. Thus meeting the increased power demand through grid imports is an attractive alternative. The various economic and regulatory barriers encountered in the construction of a new waste heat recovery boiler or captive power plant based on LSHS, obtaining relevant clearances and ensuring efficient operation and maintenance of the plant would be avoided by continuing to draw the additional power requirement

(appx 11.2 MW equivalent) from the grid. In the absence of the project activity this option would have been the easiest (though not cheapest) for Sterlite.

(b.2): Import of electricity from MALCO

In this option, Sterlite would be wheeling in electricity in the absence of the project activity from the coal based captive power plants of MALCO. This option was open to project activity since a wheeling agreement was already existing with SIIL.

Option (c): On-site captive power generation, using other energy sources other than waste heat

In examining option (c) it is necessary to consider fuels, materials and technology available at the project site.

Natural gas as a possible fuel can be ruled out on account of a lack of infrastructure for its supply to the project activity, in other words, supply constraints rule out natural gas as an option.

Wind & Hydro are unreliable sources of power and are thus not serious contenders. In addition wind/hydro is highly capital intensive and the gestation period for either is very long.

In the case of **Coal & diesel (including other liquid fossil fuel)** there will be a need for dual infrastructure and is therefore not seen favourable.

Of the potential options for captive units, SIIL had limited to power generation from **LSHS** fired captive power plant. For Sterlite, the business as usual (BAU) scenario would be using LSHS as fuel to meet their captive power requirements without recovering waste heat. In this scenario the increased electricity demand of 11.2 MW due to capacity expansion of the facility will be met by a larger capacity LSHS based captive power plant. Considering that Sterlite has already implemented the captive power plant based on LSHS as fuel (24 MW during 2001) in their facility premises, it is likely that Sterlite would have implemented a large capacity (22.5 + 11.5 = i.e. about 34 MW) LSHS based captive power plant to satisfy the increased demand of the expanded copper smelter, as it would be easier for the company to construct and manage a larger capacity (34 MW) power plant as the required expertise is already available. There would not be many barriers for Sterlite to build a larger capacity LSHS based captive power plant when compared to power generation from a new waste heat recovery boiler since they already have two LSHS based captive power plants at their facility premises. Therefore in the absence of the project activity it is likely that Sterlite could have opted for this alternative. Also this alternative is in compliance with all applicable legal and regulatory requirements making it a viable baseline scenario.

Option (d): The continuation of the current situation whether captive or grid-based power supply

The existing 24 MW and 22.5 MW LSHS based power plants would be operated as it is and the additional power from copper smelter facility expansion (equivalent to about 11.2 MW) would be withdrawn from the TNEB grid and MALCO. But this would not be an economically attractive alternative as the table under analysis will show in the later part of this section.

Option (e): Other uses of waste heat and waste gases

Apart from power generation the only other use of such waste gases is for heat generation. In this alternative the waste heat could be used for heating purposes. This alternative was not seriously considered because there is no demand for such heating services at the plant whereas there was a need / demand for more power.

In examining option (e), other uses of waste heat and waste gases, there have been no attempts to utilize the gases for other purposes. The majority of plants have traditionally released the gases into the atmosphere and the installation of waste heat recovery steam generators has been only considered recently.

Analysis

Power consumption by SIIL over the years (2001 – 2004) indicates that the share of power from the LSHS based captive power plants has increased from 89.47% to 96.70%. TNEB's share of power (based on fossil fuels like coal, lignite, gas and liquid fuel) has reduced to less than 1% and MALCO's share of power (coal based) has reduced from 10.13% to 3.04%. SIIL evaluated the economical attractiveness of each of the sources contributing to their power needs and the alternative consolidating the imports from the CPP's of SIIL was considered to be most conservative.

Economic cost comparison for various sources in April 2003

Alternative	Cost / kWh (in INR)	Significant Aspects	Other Considerations
1) Import of Electricity from State grid	19.60	Less capital intensive Purchase cost is high	No clearances / approvals required
2) Import from MALCO	2.90	No capital investment is required Purchase cost is high	No clearances / approvals required
3) Power generation from Captive Power Plant of M/s. Sterlite Industries (India) Ltd	2.89	Higher capital investment Generation cost is low	Clearances / approvals are required In house expertise is available to implement this alternative
Combination of 1,2 & 3	3.07	Capital intensive Cost is high	Clearances / approvals are required

The economic analysis of all plausible alternatives to the project activity was determined on basis of INR/kWh. Based on this analysis it was found that LSHS based engine generator set having steam generation from exhaust of engine was most attractive. The comparison at the staring of the project is given in above table.

It may also be noted that the most economical option is also generating least amount of CO_2/kWh and hence is most conservative option also.

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):

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As per the decision 17/cp.7 paragraph 43, a CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity.

As per the selected methodology ACM0004, the "Tool for the demonstration and assessment of additionality" Annex 1 to the EB 16 report (See Fig B2) has been used to justify the additionality of the project which is discussed in this section.

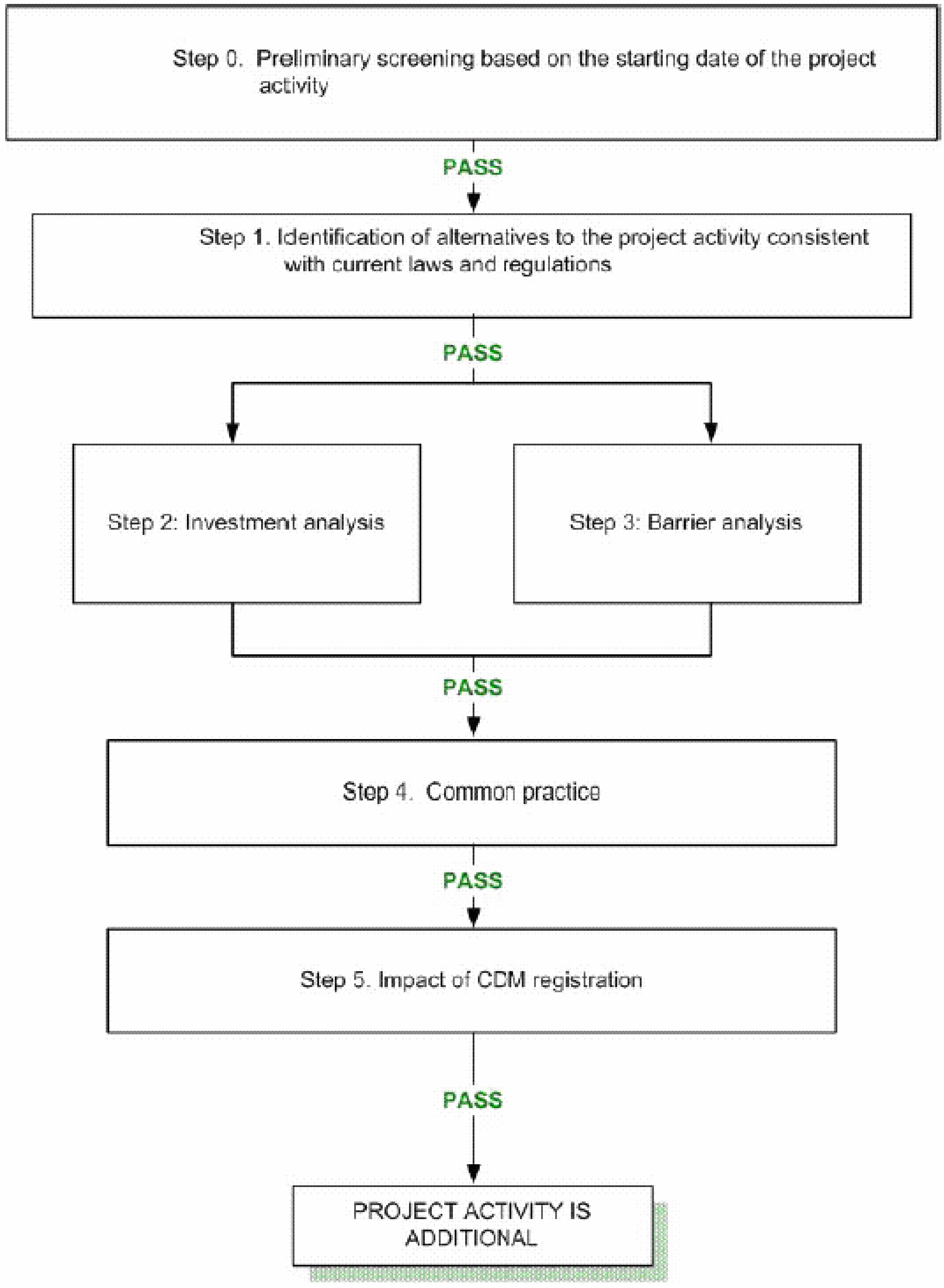

Fig B2 Flowchart for demonstrating additionality of the project

Step 0: Preliminary Screening based on the starting date of the project activity

If project participants wish to have the crediting period starting prior to the registration of their project activity, they shall:

(a) *Provide evidence that the registration date of the CDM project activity falls between 1 January 2000 and the date of the registration of a first CDM project activity, bearing in mind that only CDM project activities submitted for registration before 31 December 2006 may claim for a crediting period starting before the date of registration:*

The construction of the project activity started in April 2003 which is after January 1, 2000. The project activity is likely to be submitted for registration as a CDM project activity at UNFCCC before December 31, 2005.

(b) Provide evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity. This evidence shall be based on (preferably official, legal and/or other corporate) documentation that was available to third parties at, or prior to, the start of the project activity.

(c) Order placed on reputed consultant for CDM advisory services for the project (interactions started in September 2002). Actual order is placed 27 February 2003.

This clears the preliminary screening criteria of UNFCCC for registration of eligible project activity as a CDM project.

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

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

In lieu with section B4, we have four possible feasible alternatives available with the project proponent, namely:

Alternative
1) Import of Electricity from State grid
2) Import from MALCO
3) Power generation from Captive Power Plant of M/s. Sterlite Industries (India) Ltd
4) Combination of 1,2 & 3

Sterlite identified the different potential alternatives (as detailed in Section B.4) to project activity available to all other such facilities in India and has opted to go ahead with option (c), which is the most plausible alternative for SIIL.

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

All possible and the identified baseline scenario are in compliance with all applicable legal and regulatory requirements. Moreover, there is no legal binding on SIIL to implement the project activity, which reinstates that the project is clearly additional.

In accordance with the Fig B1 we proceed to either

- Step 2 - Investment analysis

(OR)

- Step 3 - Barrier analysis

Sterlite has faced several barriers and risks during the implementation of the project activity and therefore it is discussed in greater detail in order to further elaborate on the reasons due to which, this alternative cannot be the baseline. In view of overall project scenario, Sterlite proceeds to establish project additionality by conducting 'Barrier Analysis' as under.

Step 3: Barrier Analysis

Sterlite is required to determine whether the project activity faces barriers that:

(a) Prevent the implementation of this type of project activity; and

(b) Do not prevent the implementation of at least one of the alternatives

The above study has been done by means of the following sub-steps:

Sub-step 3a: Identify of barriers that would prevent the implementation of the project activity

The project activity proposes to utilize the waste heat recovered from the ISA furnace of the copper smelter for captive power generation. This not being the usual practice in the industry, Sterlite faced significant technological and economical barriers and risks which were overcome due to the persistent efforts taken by Sterlite in implementing the project in order to bring about additional green house gas emissions reductions.

Investment barriers

The cost of implementing the project activity was in the order of Rs.2000 lakhs. Any other plant under normal circumstances would have proposed to use the captive power generated from the captive power plants (most economically feasible option), whereas Sterlite has implemented the project activity irrespective of investment barriers. This aspect is further discussed by integrating with the technological barriers in the sections below.

Technological barriers

In the similar project sector, socio-economic environment and geographic conditions the project activity uses a technology, which has limited penetration. The project activity recovers energy from waste to generate power and is environment friendly thereby enabling reduction of GHG. Further, the equipment used by the project activity is an environmental friendly and energy efficient technology.

The technology for a typical Metallurgical Boiler is not available in India and hence the technology had to be transferred from M/s Alstom, Germany through M/s Thermal Systems India Limited, Hyderabad, which has increased the project cost. Boiler stoppages and associated production losses were envisaged at the time of conceptualisation of the project and there was significant reduction in plant availability during installation and commissioning stages. The total cost of the project is Rs. 2950 Lakhs, out of

which approximately 200 Lakhs was spent for technology transfer. Sterlite does not have captive copper mines at Tuticorin and has to procure concentrates for the smelter from external market. High chloride and fluoride content in the concentrates used in the smelter can lead to corrosion of the boiler tubes and bring down its lifetime. Hence Sterlite is forced to obtain selective concentrates with low chloride and fluoride contents at a higher cost as a result of the project activity.

Copper concentrates contain approximately 30 % of Sulphur and there is always a possibility of sulphur condensation which can cause some corrosion in the boiler tubes and reduce its lifetime. Corrosion due to the sulphur can cause tube leaks which will bring the production to a halt as the corrosion can be arrested only after stopping of production, cooling the boiler and testing it. This could amount to a heavy production loss to the tune of 10-12 hrs of shutdown which would cause a monetary loss of approximately Rs. 24 Lakhs per stoppage. Moreover the high pressure joints like flange joints etc. are susceptible to leaks which is a potential safety hazard and adequate measures have been taken to minimize the damages, by providing more safety measures which leads to an extra expenditure to the tune of Rs. 100 Lakhs and a refurbishment cost of around Rs. 30 Lakhs per year.

Another risk arises if there is any boiler water leakage. Since the boiler tubes are exposed to the furnace, and the pressure is very high, any leaking of tubes will damage the refractory bricks of the furnace, instead of evaporating. This will lead to the shutdown of the furnace and entail refractory change. The refractory change could cost Sterlite Rs. 300 Lakhs and production will be stopped for 30 days leading to a production loss of Rs. 6,000 Lakhs.

The Boiler requires demineralised water, generated by a DM Water Plant within the premises of the facility. The blow-down water from the DM Plant is acidic in nature and cannot be let out to the ground as it is an environmental hazard. Therefore an effluent treatment plant (ETP) has to be set up, which would cost around Rs. 30 lakhs and lead to a running cost of Rs. 2 lakhs per month. This is an additional cost due to installation of boiler. Also, the operation of the boiler demands venting of steam intermittently which results in huge loss of DM Water which cannot be recycled. This DM water lost as steam is a permanent loss. In a month around 200 metric tonnes of DM Water will be vented leading to an additional expense of Rs. 5 Lakhs per year. The project activity needs high value spares which are very essential. Hence an inventory costing around Rs. 100 Lakhs is to be maintained to achieve uninterrupted production. Change of evaporator bundle due to any damage will require mammoth hydraulic cranes which can lift the bundles to a height of 30 metres approximately. Thus the regular maintenance of a waste heat recovery system is more expensive and technically difficult to operate compared to a custom boiler.

Managerial barriers

Since the expertise of the project proponents is in copper production, they have limited experience and the managerial resources for operation and maintenance of advanced technology (Alstom, Germany),

captive power project. This was one major hindrance faced by Sterlite while developing the project. The metallurgical boiler runs on flue gas from the furnace which contains impurities like sulphur, ammonia, and other heavy metal particles. The running of boilers demands additional manpower specialised in the boiler operation of such kinds. Hence the manpower cost for specialised manpower is very high. The maintenance cost of the boiler is about Rs. 11 Lakhs per month. Moreover people have been sent abroad and to other similar boiler operating plants to gain experience in operation. This had led to additional expense at Sterlite's facility for that period. The project activity is additional as it over comes the managerial barriers by taking up risk of implementing the waste heat recovery boiler, which is not the core business of Sterlite.

Additionality test for Regulatory/Legal requirements

There is no legal binding on Sterlite to implement the project activity as waste heat recovery is not mandatory. The above tests and analysis suggests that the project activity is additional and the anthropogenic emissions of GHG by sources will be reduced below those that would have occurred in the absence of the registered CDM project activity.

Sub-step (3b). Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the project activity already considered in step 3a):

It has been observed in Sub-step 3(a) that the Sterlite's project activity had its associated technological and managerial barriers to successful implementation, which have been overcome in order to implement the project and reduce additional green house gas reductions.

The two other most realistic alternatives available to Sterlite in the absence of the project activity were evaluated. Alternatives (b), (c) are common practices in the industry, would lead to lower economic cost and would not divert too many resources from Sterlite's core business. Import of new technology and requirement of special maintenance would not arise had the alternative (b), (c) or (d) been selected. Thus significant barriers do not exist for the alternatives discussed above and thus does not prevent the wide spread implementation of it.

Step 4: Common Practice Analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity:

At the time of project implementation, of the three smelters in India, Sterlite had the distinction of having installed the only ISA smelter in the country. The other two smelters belonged to namely Hindustan Copper and Birla Copper. The Hindustan Copper smelter was a flash furnace smelter with a capacity of 47,000 TPA. This was very small when compared to that of SIIL. On the other hand, the Birla Copper smelter which was also a flash furnace smelter had a capacity of around 250,000 TPA. The capacity of 180,000 TPA at Sterlite cannot be compared with those of the existent smelters at the time of project conceptualization. Even though Birla Copper smelter had a Waste Heat Recovery Boiler, the fossil fuel used to superheat the steam was none other than coal. Hence it is evident that even though Sterlite had a

one of it's kind ISA smelter installed in India, they did not resort to the common practice methods of the other smelters present at that point of time by implementing the project activity (using fuel oil instead of coal to superheat the steam which would produce lesser GHG emissions)

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

It is not mandatory/regulatory for ISA copper smelters/other industries in India to be equipped with waste heat recovery systems. There were no similar options in practice at the time of project implementation and any other plant under normal circumstances would have proposed to use conventional sources of power like that of grid or captive based generated power. Another option for them would be to implement a larger capacity captive power plant based on LSHS as fuel. From Steps 1 and 3 it can be concluded that alternatives (b) and (c) do not have impediments which prevent its implementation.

Step 5 - Impact of CDM registration

The benefits and incentives expected due to approval and registration of the project activity as a CDM project will certainly improve the sustainability of the project activity. The consideration of CDM funds before the project activity implementation has enabled Sterlite to take strong initiatives to overcome the identified barriers (Step 3) to the project activity.

As mentioned in Step 0, before implementation of the project activity Sterlite considered all the barriers discussed above. Any of them especially investment and technological risks could result in project failure resulting in huge financial losses.

The corporate decision to invest in the project was, guided by the anthropogenic greenhouse gas emission reductions that would result from the project activity and its associated carbon financing through sale of CERs, under the CDM. Sterlite took a decision during 2002 – 03 to bear the additional transaction costs such as preparing the documents for CDM, supporting CDM initiatives and developing and maintaining M&V protocol to fulfil CDM requirements

The project activity would not have occurred in the absence of the CDM simply because no sufficient financial assistance, policy initiatives, or other incentives exist locally to foster its development in India. Also, without the carbon financing for the project activity, Sterlite would not have taken the investment and technological risks in order to implement the project activity. Further CDM fund will provide additional coverage to the risk due to economic, technical problems related to the operation of the project activity, resulting in untimely shut downs of plant and its associated loss of production. In such an event the BAU baseline option is continued with release of carbon dioxide emissions.

As per the above-mentioned steps the project activity is additional and the anthropogenic emissions of GHG by sources will be reduced below those that would have occurred in the absence of the registered CDM project activity. In line with the estimated baseline, the emission reductions of the project activity are calculated based on the avoided power generation of the LSHS based captive power plant as per the

methodology ACM0004 and therefore the project activity will reduce **224,730** tons of CO_2 in 10 years of crediting period (2005-2014).

Further with CDM project activity registration, other energy intensive facilities in India would take up similar initiatives under CDM by overcoming the barriers to project activity implementation resulting in higher quantum of anthropogenic greenhouse gas emissions reductions.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Since the power plant uses waste heat as the main fuel for power generation and furnace oil as auxiliary fuel for superheating the steam, the project leads to minimum GHG on-site emissions caused primarily from using furnace oil to super-heat the steam. However, in business as usual (BAU) scenario, the ISA furnace of the copper smelter would have had no provision for waste heat recovery boiler and Sterlite would have implemented a larger capacity LSHS based captive power plant in order to cater to the demands of the expanded copper smelter

Project Emissions

The net onsite emissions which are from use of furnace oil for superheating steam is given by:

$$PE_y = \sum_i Q_i x NCV_i x EF_i x \frac{44}{12} x OXID_i$$

Where

PE_y Project emissions in year y (tCO_2)

Q_i Mass or volume of fuel consumed i (t or m^3)

NCV_i Net calorific value per mass or volume unit of fuel i (TJ/ (t or m^3))

EF_i Carbon emissions factor per unit of energy of fuel i (tC/TJ)

$OXID_i$ Oxidation factor of the fuel (%)

Baseline Emissions

Baseline emissions are given as:

$$BE_{electricity,y} = EG_y \, . \, EF_{electricity,y}$$

Where

EG_y Net quantity of electricity supplied to the manufacturing facility by the project during the year *y* in MWh

EF_y CO_2 baseline emission factor for the electricity displaced due to the project activity during the year *y* (tCO_2/MWh)

In determining the *net* quantity of electricity supplied, project participants shall subtract the quantity of electricity required for the operation of the power plant.

In accordance with the context of the project activity, baseline emissions are calculated using the guidance given under option 1 in the ACM0004, which applies since the baseline scenario includes captive power generation.

Hence,

$$EF_{electricity,y} = EF_{Sterlite-captive,y}$$

Where

EF_y CO_2 baseline emission factor for electricity displaced due to the project activity during the year *y* (tCO_2/MWh)

$EF_{Sterlite-captive,y}$ CO_2 baseline emission factor of Sterlite's LSHS based CPP for the captive electricity displaced due to the project activity during the year *y* (tCO_2/MWh)

Calculation of captive electricity baseline emission factor

The emission factor for captive power plant is calculated as per the following equations:

$$Eff_{captive} = \frac{(GEN_{sterlite1,\,y} + GEN_{sterlite2,\,y})}{(NCV_{lshs})\ x\ (LSHS\ consumption\ for\ electricity\ generation)}\ x\ \frac{3.6}{1000}$$

Where,

$Eff_{captive}$ is the energy efficiency of the CPPs 1 and 2

$GEN_{sterlite1,y}$ is the total electricity generation of CPP 1 (24 MW) in MWh,

$GEN_{sterlite2,y}$ is the total electricity generation of CPP 2 (22.5 MW) in MWh,

NCV_{lshs} is the calorific value of LSHS in TJ/tonne,

LSHS consumption for electricity generation is given in tonnes,

3.6/1000 is the TJ to MWh conversion factor

$$LSHS\ consumption\ for\ electricity\ generation = (F_{lshs,\ sterlite1,\ y}\ x\ K_{lshs,\ sterlite1}) + (F_{lshs,\ sterlite2,\ y}\ x\ K_{lshs,\ sterlite2})$$

Where,

LSHS consumption for electricity generation is given in tonnes,

$F_{lshs,sterlite1,y}$ is the amount of fossil fuel (LSHS) consumed by CPP 1 in tonnes,

$F_{lshs,sterlite2,y}$ is the amount of fossil fuel (LSHS) consumed by CPP 2 in tonnes,

$K_{lshs,sterlite1}$ is the proportion of LSHS used for electricity generation in CPP 1,

$K_{lshs,sterlite2}$ is the proportion of LSHS used for electricity generation in CPP 2,

$$K_{lshs,\ sterlite1} = 1 - \frac{H_{sterlite1}}{(F_{lshs,\ sterlite1,\ y})\ x\ NCV_{lshs}}$$

Where,

$K_{lshs,sterlite1}$ is the proportion of LSHS used for electricity generation in CPP 1,

$H_{sterlite1}$ is the energy in steam in CPP 1 in TJ,

$F_{lshs,sterlite1,y}$ is the amount of fossil fuel (LSHS) consumed by CPP 1 in tonnes,

NCV_{lshs} is the calorific value of LSHS in TJ/tonne

$$K_{lshs,\ sterlite2} = 1 - \frac{H_{sterlite2}}{(F_{lshs,\ sterlite2,\ y})\ x\ NCV_{lshs}}$$

Where,

$K_{lshs,sterlite2}$ is the proportion of LSHS used for electricity generation in CPP 2,

$H_{sterlite2}$ is the energy in steam in CPP 2 in TJ,

$F_{lshs,sterlite2,y}$ is the amount of fossil fuel (LSHS) consumed by CPP 2 in tonnes,

NCV_{lshs} is the calorific value of LSHS in TJ/tonne

$$EF_{captive,y} = \frac{EF_{CO2,i}}{Eff_{captive}} \times \frac{44}{12} \times \frac{3.6TJ}{1000MWh}$$

Where,

$EF_{captive,y}$ Emissions factor for captive power generation (tCO_2/MWh)

$EF_{CO2,i}$	CO_2 emissions factor of fuel used in captive power generation (tC/TJ)
$Eff_{captive}$	Efficiency of the captive power generation (%)
44/12	Carbon to Carbon Dioxide conversion factor
3.6/1000	TJ to MWh conversion factor

Estimated Leakage

No leakage is considered in the ACM0004 methodology. Leakage arising due to transport of furnace oil would be negligible and would almost be equal to the leakage from transport of LSHS in the absence of the project activity. Hence we can take L_y equivalent to zero.

Emission Reduction

The emission reduction ER_y by the project activity during a given year y is the difference between the baseline emissions through substitution of electricity generation with fossil fuels (BE_y) and project emissions (PE_y) and the leakage (L_y), as follows:

$$ER_y = BE_y - PE_y - L_y$$

Where

ER_y	Emission reductions of the project activity during the year y in tons of CO_2
BE_y	Baseline emissions due to displacement of electricity during the year y in tons of CO_2
PE_y	Project emissions during the year y in tons of CO_2
L_y	Leakage emissions (taken as zero here)

Since the leakage is not considered here, we can take it as zero and the emission reduction equation necessarily reduces to:

$$ER_y = BE_y - PE_y$$

For determining the emission coefficients, the emission factors or net calorific values are used and guidance is also taken from the 2000 IPCC Good Practice Guidance

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

Data / Parameter:	$F_{lshs,Sterlite\ 1,y}$
Data unit:	Tonnes
Description:	Amount of fossil fuel (LSHS), consumed by captive power plant 1 at Sterlite

	(24 MW)
Source of data used:	SIIL
Value applied:	79,079 (this is the reflected value over 2002, 2003, 2004 and 2005)
Justification of the choice of data or description of measurement methods and procedures actually applied :	It is analogous to the variables described for the simple OM method for plants *m*.
Any comment:	Data type: Quantity Instrument Used: LSHS flow meter For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	$F_{lshs,Sterlite\ 2,y}$
Data unit:	Tonnes
Description:	Amount of fossil fuel (LSHS), consumed by captive power plant 2 at Sterlite (22.5 MW)
Source of data used:	SIIL
Value applied:	41,849 (this is the reflected value over 2004 and 2005)
Justification of the choice of data or description of measurement methods and procedures actually applied :	It is analogous to the variables described for the simple OM method for plants *m*.
Any comment:	Data type: Quantity Instrument Used: LSHS flow meter For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	$GEN_{sterlite\ 1,y}$
Data unit:	MWh
Description:	Electricity generation of captive power plant 1 at Sterlite (24 MW)
Source of data used:	SIIL
Value applied:	365,926 (this is the reflected value over 2002, 2003, 2004 and 2005)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.
Any comment:	Obtained from power producer.

	For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	$GEN_{sterlite\ 2,y}$
Data unit:	MWh
Description:	Electricity generation of captive power plant 2 at Sterlite (22.5 MW)
Source of data used:	SIIL
Value applied:	197,792 (this is the reflected value over 2004 and 2005)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.
Any comment:	Obtained from power producer. For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	$EF_{CO2,lshs}$
Data unit:	tC/TJ
Description:	CO_2 emission factor of LSHS used in CPP 1 (24 MW) and CPP 2 (22.5 MW)
Source of data used:	IPCC
Value applied:	21.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is the default IPCC value for LSHS.
Any comment:	Default IPCC value. Data type: Emission factor For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	NCV_{lshs}
Data unit:	TJ/tonne
Description:	Net calorific value of LSHS used in CPP 1 (24 MW) and CPP 2 (22.5 MW)
Source of data used:	SIIL
Value applied:	0.402
Justification of the choice of data or description of measurement methods and procedures	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.

actually applied :	
Any comment:	Data type: Heat Value Instrument used: Bomb Calorimeter For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	$Eff_{captive}$
Data unit:	%
Description:	Energy efficiency of captive power plant 1 at Sterlite (24 MW)
Source of data used:	SIIL
Value applied:	0.46
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.
Any comment:	Depending on option in baseline measured before or after implementation For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	$Eff_{captive}$
Data unit:	%
Description:	Energy efficiency of captive power plant 2 at Sterlite (22.5 MW)
Source of data used:	SIIL
Value applied:	0.46
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.
Any comment:	Depending on option in baseline measured before or after implementation For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	$P_{sterlite\ 1}$
Data unit:	Kg/cm^2
Description:	Average pressure of steam from CPP 1 (24 MW).
Source of data used:	SIIL
Value applied:	12.69 (this is the reflected value over 2002, 2003, 2004 and 2005)
Justification of the choice of data or description of measurement methods	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.

and procedures actually applied :	
Any comment:	Instrument used: Steam pressure gauge Data type: pressure For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	$T_{sterlite\ 1}$
Data unit:	^{0}C
Description:	Average temperature of steam CPP 1 (24 MW).
Source of data used:	SIIL
Value applied:	261 (this is the reflected value over 2002, 2003, 2004 and 2005)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.
Any comment:	Instrument used : Steam Temperature Indicator Data type: Temperature For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	$Q_{sterlite\ 1}$
Data unit:	Tonnes
Description:	Steam generation from CPP 1 (24 MW)
Source of data used:	SIIL
Value applied:	98,797 (this is the reflected value over 2002, 2003, 2004 and 2005)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.
Any comment:	Instrument used: Steam flow meter Data type: Quantity For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	$P_{sterlite\ 2}$
Data unit:	Kg/cm^2
Description:	Average pressure of steam from CPP 2 (22.5 MW).
Source of data used:	SIIL
Value applied:	12.67 (this is the reflected value over 2004 and 2005)

Justification of the choice of data or description of measurement methods and procedures actually applied :	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.
Any comment:	Instrument used : Steam pressure guage Data type: pressure For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	$T_{sterlite\ 2}$
Data unit:	^{0}C
Description:	Average temperature of steam CPP 2 (22.5 MW).
Source of data used:	SIIL
Value applied:	226 (this is the reflected value over 2004 and 2005)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.
Any comment:	Instrument used: Steam temperature indicator Data type: Temperature For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	$Q_{sterlite\ 2}$
Data unit:	Tonnes
Description:	Flow rate of steam from CPP 2 (22.5 MW).
Source of data used:	SIIL
Value applied:	73,293 (this is the reflected value over 2004 and 2005)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.
Any comment:	Instrument used: Steam Flow meter Data type: Quantity For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	$H_{sterlite1}$
Data unit:	TJ
Description:	Energy in steam of CPP 1 (24 MW)
Source of data used:	SIIL
Value applied:	285.15
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.
Any comment:	The energy is calculated by multiplying the quantity of the steam and the enthalpy of the same at the corresponding temperature and pressure value. Data type: Quantity For how long archived data to be kept: Credit period + 2 years

Data / Parameter:	$H_{sterlite2}$
Data unit:	TJ
Description:	Energy in steam of CPP 2 (22.5 MW)
Source of data used:	SIIL
Value applied:	211.54
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.
Any comment:	The energy is calculated by multiplying the quantity of the steam and the enthalpy of the same at the corresponding temperature and pressure value. Data type: Quantity For how long archived data to be kept: Credit period + 2 years

B.6.3 Ex-ante calculation of emission reductions:

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Net Onsite Emissions from project activity

The net onsite emissions which are from use of furnace oil for superheating steam is given by:

$$PE_y = \sum_i Q_i x NCV_i x EF_i x \frac{44}{12} x OXID_i$$

Where

PE_y	Project emissions in year *y* (tCO_2)
Q_i	Mass or volume of fuel *i* consumed (t or m^3)
NCV_i	Net calorific value per mass or volume unit of fuel *i* (TJ/ (t or m^3))
EF_i	Carbon emissions factor per unit of energy of fuel *i* (tC/TJ)
$OXID_i$	Oxidation factor of the fuel (%)

As per the above for the project activity, the onsite CO_2 emissions from furnace oil usage in superheating steam is about **20,727** tons of CO_2 per year. Density of fuel will be considered while calculating

Leakage

No leakage is considered in the ACM0004 methodology. Leakage arising due to transport of furnace oil would be negligible and would almost be equal to the leakage from transport of LSHS in the absence of the project activity. Hence the net project activity emission from use of onsite furnace oil for superheating steam is estimated as **20,727** tons of CO_2 per year.

Baseline Emissions

The project activity displaces equivalent power generation from LSHS based captive power plants in proportions determined for the most recent 3 years (Table B.1). Estimation of baseline emissions has been carried out as per the approved consolidated baseline methodology (ACM0004) by using Option 1.

Table B.1 Proportion of power consumption by Sterlite from various sources during recent 3 years

Source of power	**Proportion of power (%) during Year**		
	2001 – 02	**2002 – 03**	**2003 – 04**
TNEB grid	0.40	1.72	0.26
MALCO's coal based CPP	10.13	8.77	3.04
Sterlite's LSHS based CPP	89.47	89.51	96.70

As SIIL's captive power plants dominate contributing to the electricity demands of SIIL, the baseline emissions are the amount of emissions avoided in the baseline scenario (avoidance of fossil fuel based electricity generated in the captive power plants of SIIL).

Calculation of baseline emission factor (of SIIL captive power plants):

$$K_{lshs,\,sterlite1} = 1 - \frac{H_{sterlite1}}{(F_{lshs,\,sterlite1,\,y})\ x\ NCV_{lshs}} \quad ; \quad K_{lshs,\,sterlite2} = 1 - \frac{H_{sterlite2}}{(F_{lshs,\,sterlite2,\,y})\ x\ NCV_{lshs}}$$

$$K_{lshs,\,sterlite1} = 1 - \frac{285.15}{79{,}079 \; x \; 0.0402} \quad ; \quad K_{lshs,\,sterlite2} = 1 - \frac{211.54}{41{,}849 \; x \; 0.0402}$$

$$K_{lshs,\,sterlite1} = 0.910 \quad ; \quad K_{lshs,\,sterlite2} = 0.874$$

$$LSHS\ consumption\ for\ electricity\ generation = (F_{lshs,\,sterlite1,\,y}\ x\ K_{lshs,\,sterlite1}) + (F_{lshs,\,sterlite2,\,y}\ x\ K_{lshs,\,sterlite2})$$

$$LSHS\ consumption\ for\ electricity\ generation = (79{,}079\ x\ 0.910) + (41{,}849\ x\ 0.874)$$

$$LSHS\ consumption\ for\ electricity\ generation = 108{,}572\ \text{tonnes}$$

$$Eff_{captive} = \frac{(GEN_{sterlite1,\,y} + GEN_{sterlite2,\,y})}{(NCV_{lshs})\ x\ (LSHS\ consumption\ for\ electricity\ generation)}\ x\ \frac{3.6}{1000}$$

$$Eff_{captive} = \frac{(365{,}925.79 + 197{,}791.67)}{(0.0402\ x\ 108{,}572)}\ x\ \frac{3.6}{1000}$$

$$Eff_{captive} = 0.46$$

$$EF_{captive,y} = \frac{EF_{CO2,i}}{Eff_{captive}} \times \frac{44}{12} \times \frac{3.6TJ}{1000MWh}$$

$$EF_{captive,y} = \frac{21.1}{0.46} \times \frac{44}{12} \times \frac{3.6TJ}{1000MWh}$$

$$EF_{captive,y} = 0.60\ \text{kgCO}_2\text{/kWh}$$

Considering that the project activity replaces **72 MU** of power that would otherwise be generated from the LSHS based captive power plant of Sterlite, the baseline emissions are estimated to be **43,200** tons CO_2 annually.

Emission Reduction

Following formula is used to determine Emission reduction:

$$\mathbf{ER_y = BE_{electricity} - PE_y}$$

Where

ER_y	Emissions reductions of the project activity during the year *y* in tons of CO_2
$BE_{electricity,y}$	Baseline emissions due to displacement of electricity during the year *y* in tons of CO_2
PE_y	Project emissions during the year *y* in tons of CO_2

Using above formulae emission reductions have been calculated for 10 years of credit period and is tabulated as under.

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

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Sr. No.	Operating Years	Baseline Emission Factor ($kgCO_2/kWh$)	Baseline Emissions (tCO_2)	Project Emissions (tCO_2)	Emission Reductions (tCO_2)
1.	2005	0.600	43,200	20,727	22,473
2.	2006	0.600	43,200	20,727	22,473
3.	2007	0.600	43,200	20,727	22,473
4.	2008	0.600	43,200	20,727	22,473
5.	2009	0.600	43,200	20,727	22,473
6.	2010	0.600	43,200	20,727	22,473
7.	2011	0.600	43,200	20,727	22,473
8.	2012	0.600	43,200	20,727	22,473
9.	2013	0.600	43,200	20,727	22,473
10.	2014	0.600	43,200	20,727	22,473
		Total	**432,000**	**207,270**	**224,730**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	EG_{GEN}
Data unit:	MWh/yr
Description:	Total electricity generated. The data is quantitative.
Source of data to be used:	SIIL
Value of data applied for the purpose of	82,800

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	100% of the data is to be monitored and measured online continuously. The data will be archived electronically.
QA/QC procedures to be applied:	This data will be used for the calculation of project electricity generation. Hence QA/QC procedures will be applied.
Any comment:	Instrument Used: Energy meter Data Type: Quantity

Data / Parameter:	EG_{AUX}
Data unit:	MWh/yr
Description:	Auxiliary electricity. The data is quantitative.
Source of data to be used:	SIIL
Value of data applied for the purpose of calculating expected emission reductions in section B.5	10,800
Description of measurement methods and procedures to be applied:	100% of the data is to be monitored and measured online continuously. The data will be archived electronically.
QA/QC procedures to be applied:	This data will be used for the calculation of project electricity generation. Hence QA/QC procedures will be applied.
Any comment:	Instrument Used: Energy meter Data Type: Quantity

Data / Parameter:	EG_y
Data unit:	MWh/yr
Description:	Net electricity supplied to the facility. The data is quantitative.
Source of data to be used:	SIIL
Value of data applied for the purpose of calculating expected emission reductions in	72,000

section B.5	
Description of measurement methods and procedures to be applied:	100% of the data is to be monitored and calculated continuously using the empirical formula: EG_{GEN} - EG_{AUX} The data will be archived electronically.
QA/QC procedures to be applied:	This data will be used for the calculation of project electricity generation. Hence QA/QC procedures will be applied.
Any comment:	Instrument Used: Energy meter Data Type: Quantity

Data / Parameter:	*Auxillary fuel consumption* Q_{fo}
Data unit:	MTPD (Metric Tonnes Per Day)
Description:	Quantity of auxiliary fuel (fuel oil) used by project activity.
Source of data used:	SIIL
Value applied:	19.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.
Any comment:	Instrument used: Fuel oil flow meter Data type: Quantity

Data / Parameter:	NCV_{fo}
Data unit:	TJ/tonne
Description:	Net calorific value of fuel (fuel oil).
Source of data used:	SIIL
Value applied:	0.403
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.
Any comment:	Data type: Heat Value Instrument used: Bomb Calorimeter

Data / Parameter:	EF_{fo}
Data unit:	tC/TJ

Description:	Carbon emissions factor of fuel (fuel oil).
Source of data used:	SIIL
Value applied:	21.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deduced from calculations using data parameters (obtained from SIIL) that are best suited to the current scenario.
Any comment:	Data type: Emission factor

B.7.2 Description of the monitoring plan:

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The project proponent has a clear project management structure in place and the detailed monitoring plan for the CDM project activity is provided in Annex 4

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)

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Date: 25/09/2006

Mr. T. Venkatesan, Chief Executive Officer

Sterlite Industries India Limited

Post Box No 19, SIPCOT Industrial Complex

Madurai Bypass Road, Tuticorin – 628002

Tamil Nadu, INDIA

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:

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The construction of the project activity began in 10/04/2003

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

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Life time of the project : 20 years, 0 months

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

The project activity will use the fixed crediting period of 10 years

C.2.1. Renewable crediting period

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

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Not applicable

C.2.1.2. Length of the first crediting period:

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Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

26/07/2005

C.2.2.2. Length:

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Length (max 10 years) : 10 years

SECTION D. Environmental impacts

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

>>

Assessment of environmental impacts due to the project activity has been carried out and a separate report is available as Enclosure – I

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:

>>

A host party regulation necessitates conducting Environmental Impact Assessment (EIA) for the expansion of the copper smelter and the project activity forms a part of the expansion activity. As the expansion proposal exceeded Rs.100 crores investment, it is necessary to obtain environmental clearance from the Ministry of Environment and Forest (MoEF), Government of India (GoI). Sterlite has obtained the environmental clearance for the copper smelter expansion activity from MoEF, GoI.

SECTION E. Stakeholders' comments

>>

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

>>

Stakeholder's list includes Government and Non-Governmental parties, which are involved in the project at various stages. SIIL decided to consult with the stakeholders and get their views on the CDM project activity. The list of stakeholders identified for the project activity are as under:

1. Elected body of representatives administering the local area (village Panchayat)
2. Tamil Nadu Pollution Control Board (TNPCB)
3. Ministry of Environment and Forests (MoEF), Government of India
4. Non Governmental Organizations (NGO's)
5. Consultants
6. Equipment suppliers

SIIL representatives and sent formal invitations to the identified stakeholders on April 15, 2005. The stakeholder consultation process was held on 20^{th} April 2005, by the project proponent to consult with the stakeholders on their views and possible concerns if any, regarding the project activity. The meeting was held at the conference hall of SIIL and representatives from local body, NGO's, equipment suppliers attended the meeting. SIIL representatives lectured on the aspects of project activity and clarified the doubts of the attendees with regard to CDM.

E.2. Summary of the comments received:

>>

Stakeholder's Involvement

The village Panchayat/ local elected body of representatives administering the local area are a true representation of the local population in a democratic country like India and hence their consent / permission to set up the project is necessary. Sterlite has completed the necessary consultation and documented the stakeholder's approval for the project.

Local population comprises the local people in and around the project area including the local manpower used for working at the plant site. The operation and maintenance of the project activity would generate direct employment for 8 persons.

The project will not displace any local population. The project is unlikely to cause any adverse social impacts to the local population.

Public hearing document

A public hearing was heard and all those participated in the hearing have encouraged the venture undertaken by Sterlite.

Tamil Nadu Pollution Control Board (TNPCB)

The copper smelter expansion project has received No Objection Certificate (NOC) from the TNPCB and Consent for operating the plant under Section 21 of the Air (Prevention and Control of Pollution) Act 1981 as amended.

The copper smelter expansion project has received Consent to operate for the discharge of sewage trade effluent under Section 25 of the Water (Prevention and Control of Pollution), 1974 as amended.

The SIPCOT industrial complex would supply the water requirement for the project, which is stored in 4 reservoirs within Sterlite Copper premises. The water is primarily surface water, which is procured from the Tamira Barani River flowing at about 15-20 Km East of Sterlite. Groundwater would not be drawn (though available at the site), as the surface water is available in plenty.

Project Consultants

Project consultants have been involved in the project to take care of various pre contract and post contract project activities like preparation of Detailed Project Report (DPR), basic and detailed engineering documents, tender documents, selection of vendors / suppliers, supervision of project implementation, successful commissioning and trial runs.

Equipment suppliers

Equipment suppliers have supplied the equipments as per the specifications finalized for the project and will be responsible for successful erection and commissioning of the same at the site and for performance.

Non-governmental organizations

NGO' have appreciated the upcoming of the project activity.

Stakeholder's Comments

Sterlite has received the necessary approvals and consents from various authorities required for project implementation. The approvals include those from TNPCB, TNEB, Panchayat (Public and local people

around Sterlite). There were no comments whatsoever from the stakeholders criticizing the upcoming of the project activity, rather all the stakeholders have encouraged the upcoming of the same.

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

>>

The comments and important clauses mentioned in the project documents like Detailed Project Report (DPR), environmental clearances; local clearances etc were considered while preparing the CDM project development document. As per the UNFCCC requirement the PDD will be published at the validator's website for public comments.

Since there were no negative comments received from the stakeholders regarding the project activity, there was no need to incorporate any changes or take due action. Instead they only voiced their full hearted support in favour of the project activity. They appreciated the effort and initiative the project proponent took to educate them on the workings of CDM projects.

ANNEXURES

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization	**Sterlite Industries India Limited**
Street/ P.O Box	Post Box No 19, SIPCOT Industrial Complex, Madurai Bypass Road
Building	
City	Tuticorin – 628002
State/ Region	Tamil Nadu
Postfix/ ZIP	628002
Telephone	+91-461-2340591
Fax	+91-461-2340203
E-mail	
URL	**www.sterlite.com**
Represented by	
Title	Chief Executive Officer
Salutation	Mr.
Last Name	T
Middle Name	
First Name	Venkatesan
Department	Works
Mobile	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding for this project.

Annex 3

BASELINE INFORMATION

Source of information: Records and documents maintained at Sterlite

SOURCE OF POWER TO STERLITE COPPER FACILITY AT TUTICORIN				
Years	TNEB (Fossil fuel) (MU)	MALCO (coal) (MU)	24 MW (LSHS) (MU)	22.5 MW (LSHS) (MU)
Jan - Dec 00	468.81	186.54	0	0
Aug - Dec 01	766.29	606.68	390.60	0
Jan - Dec 02	7.31	185.19	1635.84	0
Jan - Dec 03	36.38	185.4	1891.85	0
Jan - Dec 04	5.27	62.66	744.77	909.96
Jan - Jul 05	3.93	22.99	613.46	787.21

GENERATION DATA FOR CPP 1: 24 MW LSHS BASED POWER PLANT

YEAR	GROSS UNIT GENERATION (LAC UNITS)	AUXILLARY CONSUMPTION (LAC UNITS)	NET UNIT GENERATION (LAC UNITS)	LSHS CONSUMPTION (MT)
7th Sep 2001 - 31st Dec 2001	380.00	6.30	373.70	7907.41
1st Jan 2002 - 31st Dec 2002	1663.61	28.69	1634.91	34983.87
1st Jan 2003 - 31st Dec 2003	1922.84	31.00	1891.85	40401.38
1st Jan 2004 - 31st Dec 2004	765.59	20.82	744.77	16315.63
1st Jan 2005 - 21st Jul 2005	626.74	13.28	613.46	13435.78

GENERATION DATA FOR CPP 2: 22.5 LSHS BASED POWER PLANT

YEAR	GROSS UNIT GENERATION (LAC UNITS)	AUXILLARY CONSUMPTION (LAC UNITS)	NET UNIT GENERATION (LAC UNITS)	LSHS CONSUMPTION (MT)
7th Feb 2004 - 31st Dec 2004	**1273.75**	**27.26**	**1246.49**	**26374.34**
1st Jan 2005 - 21st Jul 2005	**804.14**	**16.93**	**787.21**	**16629.59**

CALORIFIC VALUES OF LSHS RECEIVED

Note: Calorific Value is almost constant

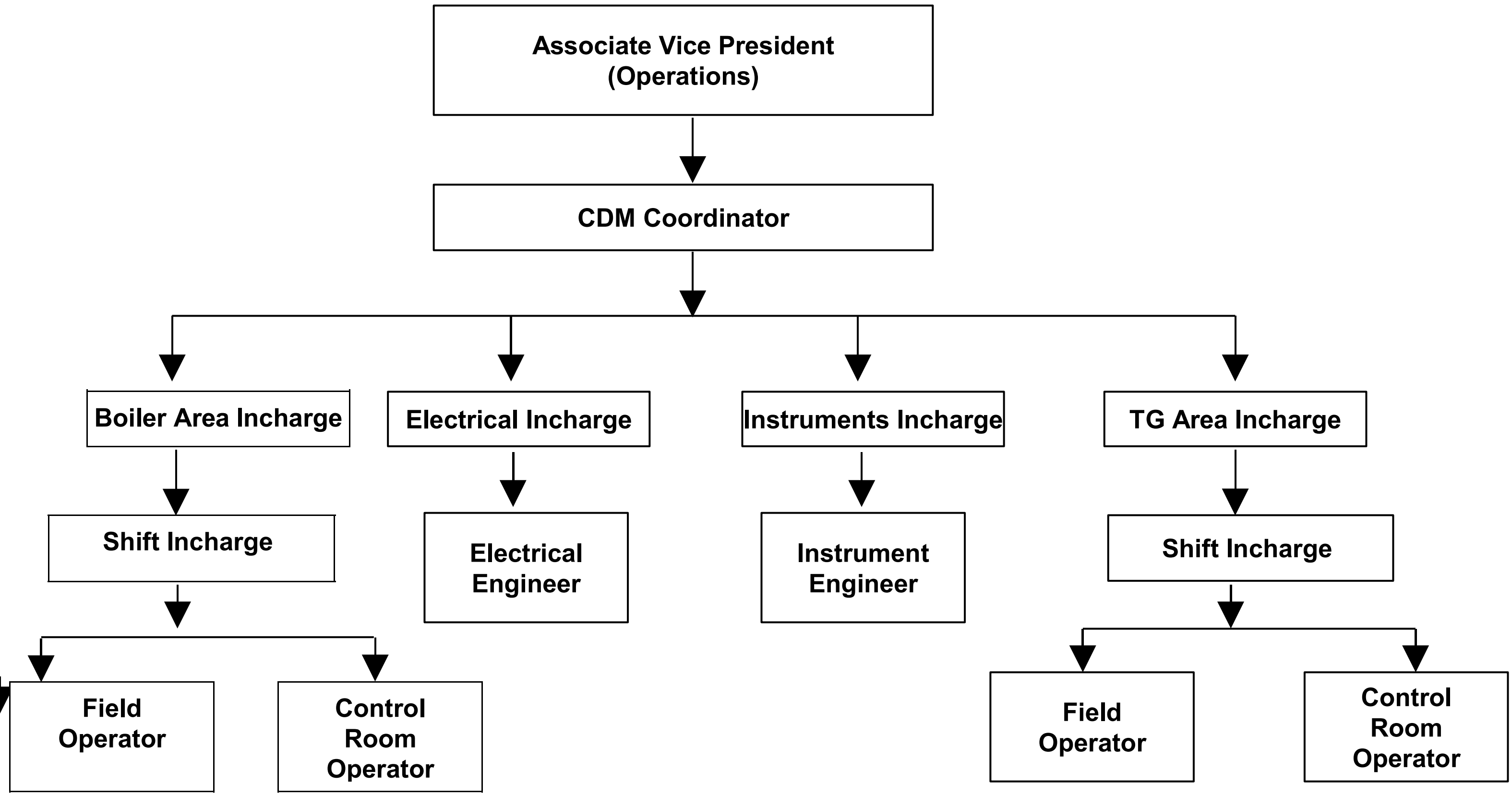
SAMPLING DATE	NET CALORIFIC VALUE (Cal/gm)	GROSS CALORIFIC VALUE (Cal/gm)	DENSITY @15 DegC (gm/ml)	SULPHUR CONTENT (% BY WT)
21/01/03	9690	10280	0.989	1.12
14/03/03	9600	10200	0.917	0.45
02/04/03	9600	10230	0.911	0.15
26/06/03	9680	10250	0.977	2.96
18/07/03	9620	10240	0.916	0.45
28/08/03	9630	10250	0.915	0.22
24/12/03	9580	10190	0.890	0.36
31/05/04	9680	10270	0.958	1.73
22/06/04	9630	10260	0.908	0.19
10/11/04	9590	10230	0.899	0.23

Annex 4

MONITORING INFORMATION

CDM TEAM:

The CDM team comprises of personnel from the WHR Boiler, Steam TG, Electrical & Instrumentation departments. Field Operator & Control room operator will report to respective area incharge who in turn report to the CDM Coordinator. The team is headed by a Associate Vice President (Operations). The organization structure of the CDM team is given in Figure 1.



- Operate the WHRB and 11.2 MW Turbine Generator in compliance with the CDM Project Design Document
- MONITOR EMISSION REDUCTIONS GENERATED BY THE PROJECT ACTIVITY
- Maintain records of relevant data for verification of CERs.
- Ensure accuracy of data by proper maintenance and calibration of monitoring equipment
- Take the necessary permission from Associate Vice President (Operations) before changing any monitoring equipment related to project activity.
- Take all preventive measures to ensure plant availability at all times

DATA MONITORING:

Monitoring methods of process parameters and equipments are as below:

Online Monitoring

Local / Field Monitoring

Online Monitoring

Online monitoring involves monitoring process parameters from a central control room or computer by data transfer through a wired network. These data are archived in a computer / digital media.

The system can be programmed to compile data and generate reports and provides flexibility for data usage. Generally, critical parameters like power produced, condition of steam & boiler parameters are continuously monitored by the DCS.

Local or Field Monitoring

The monitoring instruments used in the Field level monitoring generally consist of gauges and meters with a local display/output at the measuring point. Certain critical data are manually recorded in logbooks by technicians.

Equipments Used:

Operator stations of DCS, Digital and Analog Panel Indicators are used for online monitoring of process and equipments. Energy meters, flow meters, pressure gauges, temperature gauges, vacuum gauges and level gauges are used for local/field monitoring purpose. DCS acts as the "window" to the entire process. It is used to monitor, display, control, collect, store the process data and for generating reports. Following is the list of monitoring equipments to be used:

Sl.No.	List of Monitoring Equipments	Equipment Sl.No.	Location	Service	Make
1	ISA WHB STEAM DRUM PRESSURE	PI 11855	Steam drum	Steam	Rosemount
2	ISA WHB STEAM DRUM LEVEL	LI 11833	Steam drum	Water	Rosemount
3	ISA WHB MAIN STEAM TEMPERATURE	TI 11859	Ground level	Steam	Rosemount
4	ISA WHB SH STEAM INLET TEMPERATURE	TI 11950	Level 3	Steam	Rosemount
5	ISA WHB SH FURNACE OIL FLOW	FIC 11975A	Super heater	Furnace oil	ESH
6	ISA WHB SATURATED STEAM FLOW	FI 11857	Ground level	Steam	Rosemount

Sl.No.	List of Monitoring Equipments	Equipment Sl.No.	Location	Service	Make
7	ISA WHB GAS INLET TEMPERATURE	TI 11867	Level 4	Gas	Rosemount
8	ISA WHB GAS OUTLET	TI 11868	Level 5	Gas	Rosemount

	TEMPERATURE				
9	NEW ISA FURNACE DRAFT PRESSURE CONTROL	PIC 11700	Level 8 & 9	SO_2 Gas	Rosemount
10	ISA WHB GAS INLET PRESSURE	PI 11869	Level 4	SO_2 Gas	Rosemount
11	ISA WHB GAS OUTLET PRESSURE	PI 11870	Level 5	SO_2 Gas	Rosemount
12	ISA WHB CHANNEL 2 PRESSURE	PI 11871	Level 12	SO_2 Gas	Rosemount
13	ISA WHB FEED WATER DISSOLVED O2	AI 11876	Level 3 cabin	Feed water	Rosemount
14	ISA WHB FEED WATER CONDUCTIVITY	AI 11877	Level 3 cabin	Feed water	Rosemount
15	ISA WHB SATURATED STEAM CONDUCTIVITY	AI 11886	Level 3 cabin	Sat. steam	Rosemount
16	ISA WHB BLOW DOWN WATER CONDUCTIVITY	AI 11882	Level 3 cabin	Water	Rosemount
17	ISA WHB SH STEAM LINE CONDUCTIVITY	AI 11890	Level 3 cabin	Condensate	Rosemount
18	ISA WHB BLOW DOWN WATER PH	AI 11881	SWAS	Water	Rosemount
19	TURBINE STEAM FLOW	FI 101B	STG	Steam	Yokogowa
20	SUPERHEATED STEAM PRESSURE	PIC 11959	Super Heater	Steam	Rosemount
21	SUPERHEATED STEAM TEMPERATURE	TIC 11953	Super Heater	Steam	Rosemount
22	ISA WHB CH-1 SKIN TEMPERATURE	TI 11846	Level 8 WHRB	SO_2 Gas	Rosemount
23	ISA WHB CH-5 SKIN TEMPERATURE	TI 11849	WHRB	SO_2 Gas	Rosemount

Frequency of Monitoring:

The monitoring frequency of a parameter depends on its significance to the process. Critical process parameters are generally monitored on a continuous basis. Apart from monitoring the process online in DCS, all critical process parameters of Boiler, Turbine and Equipments are monitored every hour and recorded. Other parameters are monitored in appropriate intervals.

Energy parameters:

All energy related parameters like steam generation, energy production, auxiliary consumption are monitored on a real-time basis in digital energy meters and logged in storage devices through the computer. Following is the list of power measuring instruments to be used:

Sl.No.	List of Monitoring Equipments	Equipment Sl.No.	Location	Make

1	MCC Incomer 1	1K 007671	STG	HPL-SOCOMEC
2	MCC Incomer 2	1K 007672	STG	HPL-SOCOMEC
3	Gross Generation Meter	030801 148	STG	HPL-SOCOMEC
4	Boiler Recirculation Pump 1	E33/35-0403	SS 1	ENERCON
5	Boiler Recirculation Pump 2	1103/G147/1380	SS 1	ICD
6	Boiler Feed Water Pump VSD 1	1031700957	SS 7	ABB
7	Boiler Feed Water Pump VSD 2	1031701043	SS 7	ABB

Fuel parameters:

Quantity of fuel used (FO in superheater) is monitored on a real time basis and its calorific value are monitored monthly once.

DATA RECORDING:

Methods of recording project data:

Logbooks consisting all critical parameters of Boiler and Turbine are prepared and maintained for recording the process data. Trained Operators/Technicians are assigned the responsibility of monitoring and recording the process parameters in logbooks. Energy related parameters (like kWh generated, exported etc) are continuously recorded by respective energy meters and are also captured by DCS and stored in the computer. FO consumption in the superheater is continuously recorded using flow meter and stored in the computer manually.

Recording Frequency:

All critical parameters of Boiler and Turbine are monitored on an hourly basis and recorded in logbooks meant for the purpose. Energy related parameters are monitored continuously on a real time basis. FO quantity is recorded on daily basis and calorific value is monitored once in a month.

Data Archiving:

DCS is used to collect, store the process data and for generating reports. History of process data can be viewed in DCS as Trend display and Log file list. Process data Log books of the previous two years are stored.

Review Procedures & Frequency:

Respective Area Incharge of Boiler & STG reviews the progress of the implementation of documented procedures and quality system records on a daily basis.

CALIBRATION METHODS:

Calibration procedures are adopted to maintain accuracy of equipments/instruments of the plant.

The Calibration of Monitoring Equipment for CDM is as per procedure mentioned in the Sterlite ISO Docs as follows:

1. SI:IN:7.6:001
2. SI:IN:7.6:014
3. SI:IN:7.6:015
4. SI:IN:7.6:018

Scheduled training is given for personnel on calibration of equipments and Instruments.

CALIBRATION FREQUENCY

Periodic calibration schedule which spreads over the year for all electrical and electronic instruments are prepared and maintained. As per the schedule, calibration of instruments and equipments are being carried out and recorded in calibration reports.

POTENTIAL RISKS

We at Sterlite believe in identifying and reducing the risk. On same policy the various potential risks are identified within our plant. Potential risks inline with CDM also is covered in our main risk register of boiler and turbine which can be referred by the smelter ISO Document SSF: 8.2.3 / 24 rev 1 & utility ISO Document SSF: 8.2.3 / 24 rev 4 respectively.

ELECTRICAL AND INSTRUMENTATION MAINTENANCE PROCEDURE:

Maintenance procedures are adopted as below to ensure trouble free running of the plant to get optimum level of output.

- Regular Maintenance procedures
- Maintenance and breakdown reports for analysis
- Stock critical spares
- Training on equipments and instruments

Preventive and Breakdown maintenance procedures are prepared and documented for various types of equipments like Boiler, superheater, turbine, High/ low capacity motors, HT/LT panels, HT/LT Transformers, Alternator, Exciter, Control panels in the respective departments.

Maintenance Frequency:

Periodic maintenance schedule that spreads over a year for all electrical equipments and Instruments are maintained and as per the schedule, works are being executed and recorded in maintenance reports.

EMERGENCY PREPAREDNESS:

Emergencies which can lead to unintended GHGs can be countered with the various documents referred herewith

1. Sterlite Emergency Preparedness and Response Plan Doc. No. IS: V/Rev: 5 Dated 14.04.05
2. Emergency Organisation has to be followed in case of Emergency as per Sterlite Emergency Organisation
3. Situation has to be controlled by Emergency Teams identified by Sterlite
4. For reporting any emergency the Sterlite communication Network has to be followed

RESPONSIBILITIES UNDER CDM:

CDM responsibilities of WHRB Department:

- The team will ensure the required quantity of Steam at required pressure to the TG.
- The team should co-ordinate with the instrumentation team for the calibration of CDM monitoring equipments.
- The team will take the monthly average calorific value of the FO from the utility department and a report of the same will be sent to the CDM coordinator.
- Incase of non-availability of steam due to ISA smelt shut down, the department shall intimate the TG Area Incharge.
- The team will ensure on a daily basis that FO flow meter is functioning properly and that data is logged in the computer on daily basis.
- The team will verify, compile and send monthly reports on total FO consumed and its average calorific value to the CDM coordinator

CDM responsibilities of the TG department:

- The team will ensure the required power generation from the Steam Turbine Generator.
- The team will co-ordinate with the electrical team for the calibration of Energy Meters.
- The team should co-ordinate with the instrumentation team for the calibration of CDM monitoring equipments.
- The team will verify, compile and send a daily report of steam generated, energy generated, auxiliary consumption, captive consumption and energy exported to the CDM coordinator

CDM responsibilities of the Instrumentation department:

- The main CDM responsibility of this team is to ensure that all CDM parameters of the boiler & STG (Annexure 1) are monitored & calibrated as and when required.

- The team will ensure that all the instruments related to the project activity will be working properly.
- The team will ensure that any change of the monitoring equipment if needed is taken through Associate Vice President (Operations) and should be recorded.

CDM responsibilities of the Electrical department:

- The team will ensure on a daily basis that all energy meters are functioning properly.
- The team will arrange for the calibration and certification of all energy meters by a reputed agency on an annual basis

CDM responsibilities of the CDM Coordinator:

- The CDM coordinator engineer will ensure that all CDM related parameters are monitored
- Receives report of CDM parameters from the respective department, compiles the same to calculate the CERs generated and reports it to the CDM committee head
- Stores the reports for CDM Verification
- Reviews and guides the departments in terms of their functions related to CDM
- Prepares a monitoring report at the end of the year to be submitted to the UNFCCC.

CDM committee meeting:
The committee meets once a month to review the CDM performance of the plant. The CERs generated are compared with the expected CERs and corrective actions are taken.

UNCERTANITIES RELATED TO GHG EMISSIONS:

Various uncertainties are mentioned in the Sterlite ISO Document with Document No. SR 1.101.2

TRAINING OF PERSONNELS:

Various member of the CDM team will be trained time to time according to the departmental needs

CDM Internal Audit:

Sterlite Industries India Limited is an ISO 9001:2000, ISO 14001:2004 & OHSAS 18001:1999 certified company. CDM internal audit requirements will be covered in the internal QESMS Audit conducted every quarter once.

Monitoring parameters and related equipment details

Sr. No.	Data description	Procedure for monitoring the parameter	Traceability of instrument calibration	Tag no. OR equipment serial no. of instrument	Service & Tech. def. of instrument	Make of instrument	Location of instrument	Calibration Method	LC & range of instrument	Accuracy Class	Linkage with system management, ISO doc no.
1	Auxiliary fuel consumption ***(Q_i)***	Online Measurement in DCS	NABL	FIC 11975A	Service - Measuring FO Flow to Superheater, Technical Definition - Mass Flowmeter	M/s E & H	Super Heater	Factory Calibrated	LC - 1 Kg/hr, Range - 0 to 1000 Kg/hr	+/-1%	SI:IN: 7.6:018
2	Calorific value of LSHS at captive plant 1 at Sterlite ***($NCV_{sterlite\ 1}$)***	Third party Inspection – Shiva Labs Bangalore	NABL		Service – For calculating the calorific value. Definition – Bomb Calorimeter	M/s Culture Instruments	Shiva Labs –Bangalore	Calibration using the Standard Benzoic Acid traceable to Batch No. 02401 B	LC – 100 cal/gm Range – 100 – 15000 cal/g	Accuracy - +/- 20 Cal/g	-
3	Calorific value of LSHS at captive plant 2 at Sterlite ***($NCV_{sterlite\ 2}$)***	Third party Inspection – Shiva Labs Bangalore	NABL		Service – For calculating the calorific value. Definition – Bomb Calorimeter	M/s Culture Instruments	Shiva Labs –Bangalore	Calibration using the Standard Benzoic Acid traceable to Batch No. 02401 B	LC – 100 cal/gm Range – 100 – 15000 cal/g	Accuracy - +/- 20 Cal/g	-
4	Carbon emission factor of LSHS at captive plant 1 at Sterlite ***($EF_{sterlite\ 1}$)***	IPCC	-	-	-	-	-	-	-	-	-
5	Carbon emission factor of LSHS at captive plant 2 at Sterlite ***($EF_{sterlite\ 2}$)***	IPCC	-	-	-	-	-	-	-	-	-
6	Total electricity generated ***(EG_{GEN})***	Energy Monitoring System, Log book	NABL	030801148	Service - Electricity Generation from TG, Technical Definition - Energy Meter	M/s HPL-SOCOMEC	Turbine Generator House	Third Party Calibration	LC - 1 KWH, Range - 1 to 17.146 MW	Class I	Third Party Calibration - Every Year
7	Auxiliary electricity (EGAUX)										
i)	MCC Incomer I	Energy Monitoring System, Log book	NABL	1K 007671	Service - Auxillary Consumption for TG, Technical Definition - Energy Meter	M/s HPL-SOCOMEC	Turbine Generator House	Third Party Calibration	LC - 40 KWH, Range - 1 to 1.44 MW	Class I	Third Party Calibration - Every Year
ii)	MCC Incomer 2	Energy Monitoring System, Log book	NABL	1K 007672	Service - Auxillary Consumption for TG, Technical Definition - Energy Meter	M/s HPL-SOCOMEC	Turbine Generator House	Third Party Calibration	LC - 40 KWH, Range - 1 to 1.44 MW	Class I	Third Party Calibration - Every Year

iii)	Boiler RC Pump 1	Energy Monitoring System, Log book	NABL	E33/35-0403	Service - Electricity Consumption for Boiler RC Pump -1, Technical Definition - Energy Meter	M/s Enercon	Sub Station # 1	Third Party Calibration	LC - 1 KWH, Range - 1 to 0.572 MW	Class I	Third Party Calibration - Every Year
iv)	Boiler RC Pump 2	Energy Monitoring System, Log book	NABL	1103/G147/1 380	Service - Electricity Consumption for Boiler RC Pump 2, Technical Definition -Energy Meter	M/s ICD	Sub Station # 1	Third Party Calibration	LC - 1 KWH, Range - Range - 1 to 0.572 MW	Class I	Third Party Calibration - Every Year
v)	Boiler Feed Water Pump - 1 VSD	Energy Monitoring System, Log book	NABL	1031700957	Service - Electricity Consumption for BFW Pump - 1, Technical Definition - Energy Meter	M/s ABB	Sub Station # 7	As per Industry Standard - No calibration is applicable for VSD	LC - 1 KWH, Range - Range - 1 to 0.431 MW	There is no accuracy class applicable for VSD	As per Industry Standard - No calibration is applicable for VSD
vi)	Boiler Feed Water Pump - 2 VSD	Energy Monitoring System, Log book	NABL	1031701043	Service - Electricity Consumption for BFW Pump - 2, Technical Definition - Energy Meter	M/s ABB	Sub Station # 7	As per Industry Standard - No calibration is applicable for VSD	LC - 1 KWH, Range - Range - 1 to 0.431 MW	There is no accuracy class applicable for VSD	As per Industry Standard - No calibration is applicable for VSD

Appendices

Appendix A

Abbreviations

ACM	Approved Consolidated Methodology
BAU	Business As Usual
CC	Climate Change
CDM	Clean Development Mechanism
CER	Certified Emission Reductions
CO_2	Carbon di-oxide
CO_2e	Carbon di-oxide equivalent
COP	Conference of Parties
CPCB	Central Pollution Control Board
CPP	Captive Power Plant
DCS	Distributed Control System
DM	Demineralised
DOE	Designated Operational Entity
DPR	Detailed Project Report
EB	Executive Board
ESP	Electro Static Precipitator
EIA	Environmental Impact Assessment
ETP	Effluent Treatment Plant
FO	Furnace oil
GHG	Greenhouse Gas
GoI	Government of India
GoTN	Government of Tamil Nadu
GWh	Giga Watt hour
IOCL	Indian Oil Corporation Limited

IPCC	Inter-governmental Panel on Climate Change
KP	Kyoto Protocol
Km	Kilo meter
KV	Kilo Volt
KW	Kilo Watt
KWh	Kilo Watt hour
LSHS	Low Sulphur Heavy Stock
LTPA	Lakh Tons Per Annum
Lakh	1,00,000
MALCO	The Madras Aluminium Company
MoEF	Ministry of Environment and Forests
MoU	Memorandum of Understanding
MT	Metric Ton
MTPA	Metric Ton Per Annum
MTPD	Metric Ton Per Day
MW	Mega Watt
MWh	Mega Watt Hour
M&P	Modalities & Procedures
NGO	Non Governmental Organization
NH	National Highway
NOx	Nitrogen Oxides
NOC	No Objection Certificate
PLF	Plant Load Factor
PM	Particulate Matter
P.S	Pierce Smith
SAP	Sulphuric Acid Plant

SEB	State Electricity Board
SO_2	Sulphur Di-oxide
SPM	Solid Particulate Matter
SRG	Southern Regional Grid
SIIL	Sterlite Industries India Limited
SIPCOT	State Industries Promotion Corporation of Tamil Nadu
STG	Steam Turbine Generator
tC/TJ	Tons carbon per Trillion Joules
TDS	Total Dissolved Solids
T&D	Transmission & Distribution
TJ	Trillion Joules
TNEB	Tamil Nadu Electricity Board
TNPCB	Tamil Nadu Pollution Control Board
TPH	Tones Per Hour
UNFCCC	United Nations Framework Convention on Climate Change
WHRB	Waste Heat Recovery Boiler

Appendix B

Reference List

Sr.No	Particulars of the references
	Kyoto protocol / UNFCCC Related
1.	Kyoto Protocol to the United Nations Framework Convention on Climate Change
2.	Website of United Nations Framework Convention on Climate Change (UNFCCC), http://unfccc.int
3.	UNFCCC Decision 17/CP.7: Modalities and procedures for a clean development mechanism as defined in article 12 of the Kyoto Protocol.
4.	UNFCCC, Clean Development Mechanism-Project Design Document (CDM-PDD) version 02 (in effect as of: July, 2004)
	Project Related
5	Various project related information / documents / data received from Sterlite
	Baseline Related
6.	A paper on Anthropogenic Emissions from Energy Activities in India: Generation and Source Characterisation by Moti L.Mittal and C.Sharma.

Enclosures

Enclosure I

Report on Environmental Impact

The environmental impacts can be either categorized as primary or secondary impacts. Primary impacts are those that can be attributed directly to the project itself while secondary impacts are those, which are induced indirectly because of the development activity which may be triggered by the primary impact.

The impact of the project on the environment can occur at two stages:

1. Construction phase
2. Operational phase

Impacts during construction phase

The impacts during construction phase due to the construction of the project activity (waste heat recovery boiler) are listed as given here:

Air quality impacts:

- Due to particulate emissions from site clearing
- Due to particulate emissions from quarrying operations offsite
- Due to vehicular emissions from transportation of raw materials such as cement, sand, gravel etc
- Due to particulate emissions from construction activities such as pre-casting, fabrication, welding etc

Noise level increase:

(i) From earth moving equipments used for site clearing

(ii) From quarrying operations offsite

(iii) From transportation of raw materials such as cement, sand, gravel etc

(iv) From construction activities onsite

Land and soil impacts:

- Land requirement to the extent of 900 sqm.
- From change/ replacement of existing land-use by site clearing
- From soil erosion due to removal of vegetation
- From solid wastes disposed on land from construction activities

Water environment impacts

- From consumption of water for construction purposes, which would be met from the SIPCOT industrial complex

Impacts on ecology

- Removal of vegetation at the site

Impacts on socioeconomic environment

- Employment opportunities to local people

The above represents a broad range of environmental impacts during the construction phase of the waste heat recovery boiler.

It should be noted that the impacts due to construction activities are mostly short-term and will cease to exist beyond the construction phase. Hence good environmental management practice incorporated during the construction phase for each of the activities reduced the impact. The EMP and mitigative measures are given in the following sections.

Impacts during operational phase

The impacts during operational phase of the project activity are listed as given here:

Air quality impacts:

The project activity is designed for continuous operation on furnace oil and the fuel requirement by the plant for consumption is about 19.8 MTPD. Air pollution from the system is mainly from release of SO_2 and NOx releases. The stack emission characteristics are:

- 1 No of stack
- Stack height of 70m
- Stack inner diameter of 1000 mm
- Flue gas temperature of 188 deg C
- Flue gas velocity of 13.2 +/- 5% m/s
- Flue gas volume of 12500 m^3/hr
- SOx emission rate of 528 mg/m^3

As per CPCB guidelines (Stack height (H) = 14 q $^{0.3}$), where q is the emission rate of pollutant, the height of stack should only be 49 m however, Sterlite proposes to provide a stack height of about 70m to ensure better dispersion of emissions. Considering this stack height, the air quality impacts are reduced significantly.

Noise level increase:

Noise level increase due to transportation of vehicles carrying the furnace oil to the WHRB was assessed. The National Highway 45B (Tuticorin – Madurai) which is adjacent to Sterlite's premises is already a very busy road with a significant number of vehicles plying during peak hours. Moreover Sterlite's existing plant operations demand raw materials such as furnace oil, which are transported on road.

Hence the noise levels due to the project activity would be only incremental to the existing traffic noise at the site and is only additional to what already exists at the site.

Water quality impacts:

The boiler blow down is the only source of wastewater generation from the WHRB with the quantity of boiler blow down being about 60 m^3/day.

The timing of the blow down has been so selected that the wastewater would have the following quality parameters:

- Total Dissolved Solids (TDS) of 1000-2000 mg/l
- Total Suspended Solids (TSS) of 50-100 mg/l
- Orthophosphate of 10-20 mg/l
- Chloride of 15-50 mg/l and
- Sulphate of 10-50 mg/l.

The above quality of wastewater (from boiler blow down) is ideal for usage in slag granulation system of the copper smelter. Hence the entire blow down from boiler would be effectively used in the copper smelter contributing to Zero discharge

Hence no impact is likely on the water environment during operation of the project activity.

Ecological impacts:

As zero discharge would be maintained at Sterlite, the project will not cause any impact on the aquatic ecosystem.

Land and soil impacts:

The solid waste generated from the project activity if any, would be disposed in a secured landfill located within the Sterlite premises. As the secured landfill is well lined on the sides and bottom, there would be no soil pollution from the operation of the project activity.

Socio-economic impacts

Employment opportunities are created and about 75% of the employees at Sterlite are local people. The project activity would result in the direct employment of 8 persons. In addition, indirect employment for fuel transporters is also enhanced.

In general, the following is a breakup of employees at Sterlite

- 476 people directly employed with Sterlite
- 1025 people employed on contract basis
- 3200 people are indirectly employed due to Sterlite's operations

The workforce required for the ongoing and proposed projects would result in marginal increase in demand for housing, communication, educational, health and recreational facilities for their permanent employees.

Environmental Management Plan (EMP)

The EMP is prepared to basically manage the various impacts arising from construction and operational phases of the project activity.

Air environment

Construction phase

The following mitigation measures were undertaken during construction phase:

1. Spraying of water at regular intervals to control fugitive dust emissions from construction activities
2. Closing materials in trucks with tarpaulin during transportation of raw materials to the site to prevent dust emissions
3. Regular and periodic emission check for transportation vehicles
4. Use of personal protective equipment (PPE) like goggles and nose masks to reduce impact of dust emissions during construction activities

Operational phase

The management of Sterlite has provided adequate measures to contain the SO_2 as well as fluorine emissions below the prescribed CPCB / SPCB standards for the existing capacity. The measures to control stack emissions from this project activity are as given below.

1. To minimize the ground level concentrations of the pollutants,

- A stack height of 70 m would be provided which is much environmentally friendly when compared to the CPCB norms. As per CPCB norms the stack height required is 49m as per the formula $H = 14q^{1.3}$ where q is the emission rate of the pollutant.
- The greater the stack height, the better the dispersion of pollutants and hence lesser ground level concentrations. This minimizes the impact on ambient air quality

2. An automatic tripping interlock whenever SO_2 emissions exceed the limit, would be incorporated in the plant which will keep a check on the SO_2 emissions
3. Safety equipments are to be provided to the employees working in the oil storage areas
4. Ventilation and frequent work rotations are to be provided to employees to reduce the exposure to high temperature in the boiler room

Noise environment

1. Periodic noise control checks on vehicles
2. Provision of ear plugs, work rotation, adequate training
3. Incorporation of noise control measures at source i.e. at the boiler and auxiliary units such as acoustic laggings, plenum chambers and silencers
4. Sound proofing/ glass paneling of critical operating stations
5. Regular noise level monitoring at the project activity and surrounding area
6. Plantation of green belt which acts as a attenuator of noise

Land and soil environment

1. Improvement of soil quality and plantation of suitable tolerant species in the study area.

2. The oil sludge and spent oil wastes from the project activity are to be sold to authorized parties to reduce impact of hazardous wastes on land and soil

Water environment

It is necessary to periodically check for wastewater quality so that the quality satisfies the needs of the slag granulation system thereby providing for Zero discharge

Though the project activity would not discharge any wastewater on land or water body, periodic monitoring of water (groundwater) and wastewater in and around Sterlite is being monitored as per the requirement of the Tamil Nadu Pollution Control Board (TNPCB).

Ecological environment

1. Green belt would be developed to increase the efficiency of noise attenuation.
2. Site clearing and destruction of trees would be minimized

Socioeconomic Environment

1. Program on environmental education and public participation to create proper understanding of the project activities with the local people
2. Adequate medical facilities for staff and their families
3. Upgradation of local skill base and preference to local population

Post-project monitoring

Stack emissions and ambient air quality at Sterlite are already being monitored periodically to meet statutory requirements.

A full-fledged environmental cell has been set up with qualified staff and the laboratory is equipped with State-of-the-Art analytical instruments for all analysis.

At present Sterlite is monitoring the existing 9 ambient air monitoring stations. Sterlite has already installed 3 continuous ambient air quality analyzers and is in the process of installing 2 more continuous ambient air quality analyzers.