CLEAN DEVELOPMENT MECHANISM
SIMPLIFIED PROJECT DESIGN DOCUMENT
FOR SMALL-SCALE PROJECT ACTIVITIES (SSC-CDM-PDD)
Version 02

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.

SECTION A. General description of the small-scale project activity

A.1. Title of the small-scale project activity:

Energy efficiency improvement in power generation at Sajjan India Limited, Ankhleshwar, Gujarat;
Version 01, 07/12/2006

A.2. Description of the small-scale project activity:

Sajjan India Limited (SIL) formed in 1983, has aimed at implementation of energy efficient technology for steam, chilled water and power production, at the company's modern manufacturing facility at Ankhleshwar, Gujarat, India. Sajjan India Limited (SIL) is into business of manufacturing of speciality chemicals.

The use of grid power (western grid) that is predominantly based on coal, and use of lignite onsite to produce steam, pushed the company to look for alternatives with efficient technologies based on cleaner fuel(s). The project activity has reduced the release of CO_2 emissions into the atmosphere and has enabled conservation of environment and natural resources such as lignite and oil.

Purpose

The basic objective of the project is to reduce energy consumption per unit of power, steam and refrigeration production through implementation of energy efficient technologies at SIL. The project utilizes natural gas (NG), a cleaner fuel, effectively through the use of highly efficient process of combined heat, power and refrigeration generation. The project replaces lignite based process steam and grid power operated compressor based chilled water generation. Further, the project paves way for NG based power generation substituting grid supplied electricity for onsite consumption.

The project was planned to be implemented in three phases. The first two phases are complete with installation of two 1 MW each capacity NG engine generator sets, complete with two waste heat recovery boilers and a vapour absorption machine (VAM). In the third phase, SIL has plans to implement one more 1 MW NG fired engine generator with a waste heat recovery boiler and a VAM for steam and chilled water generation respectively. Besides SIL is in the process of converting a coal fired boiler to 14.5 TPH capacities NG fired one. This third phase is expected to get over by March 2007. The annual demand or requirement of NG for the project is met through piped gas network by Gujarat Gas Company Limited (GGCL).

The details of phase wise implementation are given below:

Phase wise project implementation details at SIL Ankleshwar

Phase	Activity	Date
1	NG fired engine generator with waste heat recovery boiler and NG/FO fired boiler was commissioned.	November 2002
2	NG fired engine generator with waste heat recovery boiler and Jacket heat recovery VAM was commissioned	September 2005
3	NG fired engine generator with waste heat recovery boiler, Jacket heat recovery VAM and NG fired boiler will be commissioned.	March 2007 (Expected)

Project Activity's Contribution to Sustainable Development

Government of India has stipulated the following indicators for sustainable development in the interim approval guidelines for CDM projects – Social well being, Economic well being, Environmental well being, and Technological well being.

SIL believes that the project activity will contribute positively to the 'Sustainable Development of India'. The four pillars of sustainable development have been addressed as follows:

Socio-economic well-being:

- The project activity has reduced the demand in power deficit grid.
- The project activity helped to create business opportunity for local stakeholders such as suppliers, manufacturers, contractors etc.
- There has been a reduction in fuel consumption thorough energy efficiency measures
- SIL has employed local people during construction and operation at project site.

Environmental well-being:

- The project activity uses clean fuel and efficient technology for power, steam and chilled water generation, which would, reduces green house emissions in to atmosphere, over project lifetime.

- The project would contribute towards the reduction in (demand) use of lignite minimizing depletion or else increasing availability to other important processes.

Technological well-being:

- The technology selected for the project activity is an efficient and friendly one. It includes 4 stroke, 20 cylinder water cooled engines, waste heat recovery steam boilers, jacket heat recovery heat exchangers and a vapour absorption machines.

- The process is highly efficient (efficiency of 75-80%) as compared to of grid power generation efficiency (efficiency of 30-35%).

- The area has good supply of NG and the success of the project at SIL will give a boost for other industries to replicate the highly efficient process in their manufacturing. .

A.3. Project participants:

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (Host)	Sajjan India Limited (Private Entity)	No

A.4. Technical description of the small-scale project activity:

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A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party (ies):

India

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

Gujarat

A.4.1.3. City/Town/Community etc:

Ankleshwar

A.4.1.4. Detail of physical location, including information allowing the unique identification of this small-scale project activity(ies):

The project activity is located at Plot no. 6117-6119, Gujarat Industrial Development Corporation (G.I.D.C), Ankleshwar, Gujarat, India. The site is located in Industrial Township called G.I.D.C. which is the biggest industrial township in Asia. The location is selected considering various aspects like availability of natural gas supplies through out the year, infrastructure and availability of semi skilled and skilled labour. Ankleshwar is well connected by Indian national highway 8 (Mumbai to New Delhi) and by the western railway division of Indian railways. The nearest railway station, at Ankleshwar, and the nearest airport, at Vadodara, is located at a distance of 6 kilometres and 80 kilometres respectively from the SIL project site.

The geographical location of Ankleshwar is detailed in the maps (not to scale) below:

Map of India showing location of **Gujarat**

(Source:http://www.mapsofindia.com/maps/india/india-political-map.gif)

Map of Gujarat with location of **Ankleshwar** near Bharuch
21.38 N (Latitude) and 73.02 E (Longitude)

A.4.2. Type and category (ies.) and technology of the small-scale project activity:

Type and Category of Project Activity

The project meets the applicability criteria of the small scale CDM project activity category, Type-II: energy efficiency improvement projects (D: Energy efficiency and fuel switching measures for industrial facilities) of the 'Indicative simplified baseline and monitoring methodologies for selected small CDM project activity categories'.

Main Category: Type II – Energy efficiency improvement project

Sub Category: D Energy efficiency and fuel switching measures for industrial facilities

As per the provisions of appendix B of simplified modalities and procedures for small scale CDM project activities (version 07), Type II D "Comprises any energy efficiency and fuel switching measure implemented at a single industrial facility. This category covers project activities aimed primarily at energy efficiency; a project activity that involves primarily fuel switching falls into category III.B. Examples include energy efficiency measures (such as efficient motors), fuel switching measures (such as switching from steam or compressed air to electricity) and efficiency measures for specific industrial processes (such as steel furnaces, paper drying, tobacco curing, etc.). The measures may replace existing equipment or be installed in a new facility. The aggregate energy savings of a single project may not exceed the equivalent of 15 GWhe per year. A total saving of 15 GWhe per year is equivalent to a maximal saving of 45 GWhth per year in fuel input."

The project activity applicability:

1. The project activity comprises energy efficiency and fuel switch measure at single facility
2. The project activity replaces existing Lignite Fired Boiler
3. The aggregate thermal savings will be **18.055 GWh, which is below the limit of small scale project activity of this category**.

The baseline and emission reduction calculations from the project would be based on paragraphs 3 and 4 of appendix B (Version 07, dated 28th November 2005) and the monitoring methodology would be based on guidance provided in paragraph 6, 7 and 8 of II D of the same appendix B.

Project activity with technology details

The technology employs Natural gas fired engine generator(s) coupled with an alternator to generate power. The engine(s) uses leanox method in which a mixture of gas and surplus of air minimizes emissions at the combustion stage. This intake air gas mixture is pressure charged by using exhaust gas turbocharger. The exhaust flue gases are used by waste heat recovery boiler(s) during phase 1 and 2 (also proposed in phase 3) to produce process steam. The excess heat is trapped by jacket heat recovery system(s) and is used to raise the temperature of feed water to already existing lignite fired boiler in phase 1 and operate a Vapor Absorption Machine (VAM) in phase 2 (also proposed in phase 3).

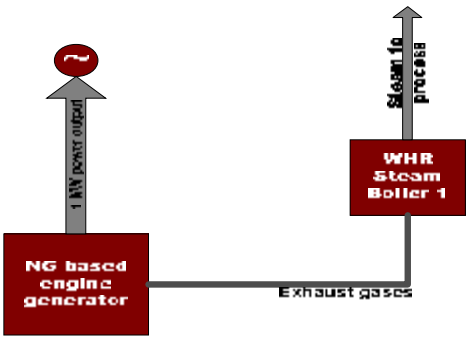
The technical specifications of additional equipments used in the project activity are as follows:

Technical Specifications:

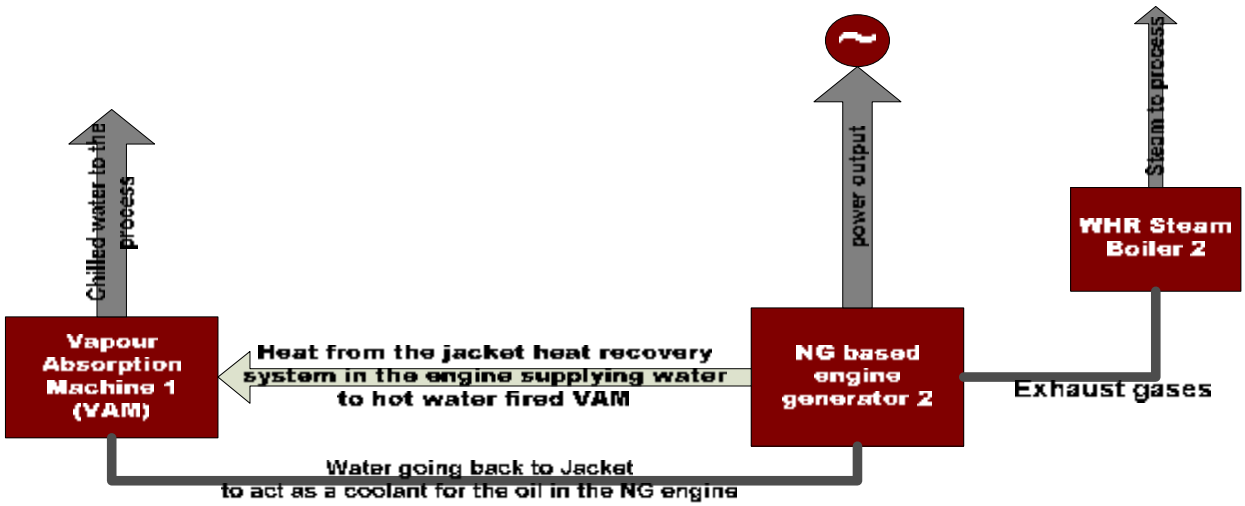
Sr. No.	Equipment	Specifications
1.	Natural gas fired engine generator 1	Engine - Jenbacher, Austria make, 1077 KW, model J320GS B05, Sr.no. 361981; Alternator: Stamford make, 1064 KW, model HC.I734F2-CG, Sr.no.0152526/01; Set: Jenbacher, 1048 KW, 1500 RPM, Sr.no. 3619231, year of Mfg: 2002.
2.	Natural gas fired engine generator 2 & 3	Engine – GE Jenbacher, Austria make, 1095 KW, model-J320GS C05, Sr.no. 4312401; Alternator: Stamford make, 1156 KW, model PE734C2, Sr.no.A05C376100; Set: GE Jenbacher, 1065 KW, 1500 RPM, and Sr.no. 4312411, year of Mfg: 2005.
3.	Waste heat recovery steam boiler 1	Exhaust gas flow – 5728 kg/hr @ 500 deg C, heating surface 206 M2, IBR, Class-1, working pressure- 10.55 kg/cm^2,
4.	Waste heat Recovery steam Boiler 2 & 3	Exhaust gas flow – 5680 kg/hr @ 427 deg C, heating surface 206 M2, IBR, Class-1, working pressure- 10.55 kg/cm^2
5.	Jacket heat recovery Vapour absorption machine 1 & 2	107 TR capacity @ 5 deg C, Hot water temp in/out-90/81 flow 50 m^3/hr.
6.	Natural gas fired boiler	14.5 Ton Boiler, 33 bar, 350deg C
7	FO/NG boiler	6 Tons Boiler, 17 Bar, 184.15 deg C

The block diagrams below represent the power generation and heat recovery system as explained.

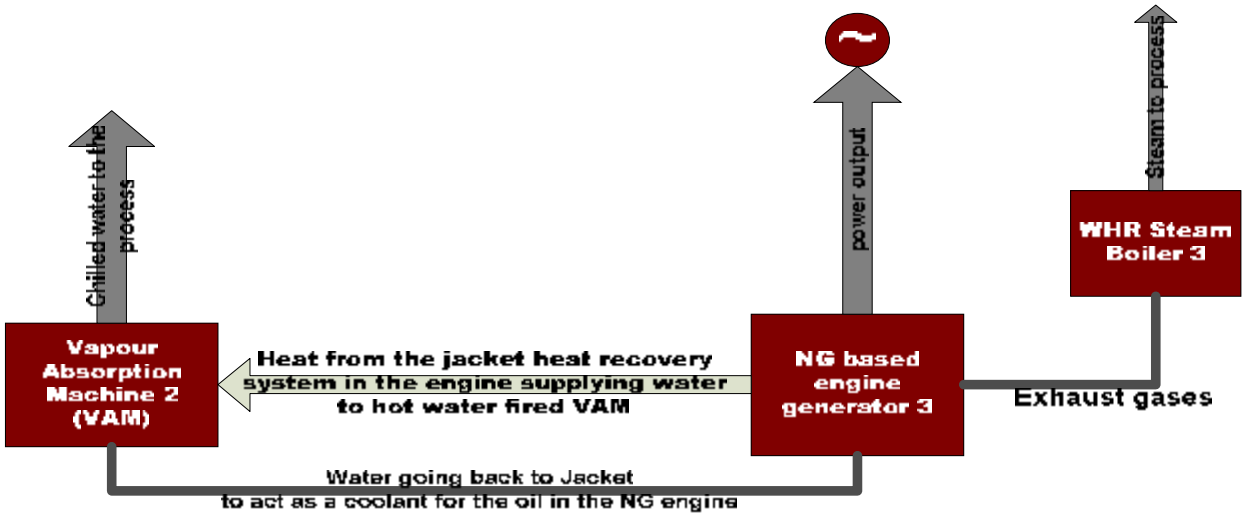
Phase 1-Implemented



Phase 2- Implemented



Phase 3- Proposed



A.4.3. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed small-scale project activity, including why the emission reductions would not occur in the absence of the proposed small-scale project activity, taking into account national and/or sectoral policies and circumstances:

The project activity will reduce GHG emissions by using the higher efficiency power generation system with the additional steam and chilled water available for the process application and less GHG fuel usage. The additional steam and chilled water from the gas engine (with WHR boilers and VAMs) will reduce the fuel consumption in the boiler and savings in grid power respectively, which would have been used for the equivalent steam and chilled water production.

In the project scenario, the project activity utilizes efficient technology with natural gas, a cleaner fuel, for captive power generation with utilization of heat from exhaust gases and jacket heat recovery system to produce additional steam and chilled water.

In absence of the project activity, the project proponent would have continued with the baseline scenario i.e. usage of electricity from the western grid and steam & chilled water generation from lignite boiler(s). Therefore, on account of higher efficiency of operation through waste heat recovery to generate steam and chilled water, coupled with power production from NG as a fuel, SIL has achieved reduction in GHG emissions.

Though the Ministry of Environment and Forest (MoEF), Ministry of Power (MoP) and Bureau of energy efficiency (BEE) in India encourage energy efficient operations, they do not require manufacturing industries to use specific technologies for power production or use of specific fuel. The project proponent has implemented the project activity over and above the national or sectoral requirements. The GHG reductions achieved by the project activity are additional to those directed by the governmental policies and regulations. The other "additionality" criteria of the project activity are dealt with in section B.

A.4.3.1 Estimated amount of emission reductions over the chosen crediting period:

Table 1: Emission reductions at SIL

Years	Annual estimation of emission reductions* (in tonnes of CO_2 e)
2007-08	25732
2008-09	25732
2009-10	25732
2010-11	25732
2011-12	25732
2012-13	25732
2013-14	25732
2014-15	25732
2015-16	25732
2016-17	25732
Total estimated reductions (tonnes of CO_2 e)	257320
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	25732

A.4.4. Public funding of the small-scale project activity:

There is no public funding available for the project activity.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a larger project activity:

According to appendix C of simplified modalities and procedures for small scale CDM project activities, ***'debundling'*** is defined as the fragmentation of a large project activity into smaller parts. A small-scale project activity that is part of a large project activity is not eligible to use the simplified modalities and procedures for small scale CDM project activities.

According to para 2 of appendix C[1]

A proposed small scale project activity shall deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure;
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closet point.

The project activity only comprises installation of energy efficient measures at SIL manufacturing plant at Ankleshwar ,and the situations prevailing prior to such implementation has never been considered as a CDM project activity, which confirms the small scale project activity is not a debundled component of a larger project activity.

[1] Appendix C to the simplified M&P for the small scale CDM project activities, http://cdm.unfccc.int/Projects/pac/ssclistmeth.pdf

SECTION B. Application of a baseline methodology:

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

Main Category: Type II – Energy efficiency improvement projects

Sub Category: II. D-Energy efficiency and fuel switching measures for industrial facilities

The reference has been taken from the list of the small-scale CDM project activity categories contained in 'Appendix B of the simplified M&P for small-scale CDM project activities-Version 7 (28th November 2005)'.

B.2 Project category applicable to the small-scale project activity:

The project activity fits under Type II.D – Energy efficiency and fuel switching measures for industrial facilities under Appendix B as it uses an efficient power generation system with the fuel switching measures for steam and power generation. The indicative simplified baseline and monitoring methodology applicable to category II.D has been used for the project including baseline calculations. The emission reduction calculation is based on specific emissions per unit of power generated or steam generated before and after the project activity. For the calculation of emissions related to steam use, IPCC values are used to estimate GHG emissions from fossil fuel used to produce steam.

The applicability criteria(s) of the applied methodology, AMS II D, with relevant project justification(s), are as follows:

- *The category comprises any energy efficiency and fuel switching measures implemented at a single industrial facility:* The Project is implemented at chemical manufacturing plant of Sajjan India Limited at Ankleshwar.
- *The category covers project activities aimed primarily at energy efficiency:* The project activity primarily aims at energy efficiency improvement through combined heat, power and refrigeration generation as compared to pre project scenario where the grid power was used for chilled water generation and other process uses and lignite was used to produce steam.
- *The project activity may replace existing equipment or be installed in a new facility:* The project activity replaces lignite fired boiler with natural gas fired boiler and engine generator (with associated waste heat recovery boilers and VAMs).

- *The aggregate energy savings of a single project may not exceed the equivalent of 15 GWhe per year. A total savings of 15 GWh_e per year is equivalent to a maximum saving of 45 GWh_{th} per year in fuel input*: The project activity will reduce the input thermal energy to the tune of 12.85 GWh, which is below the limit of small scale project activity of this category. The project proponent will be within the small scale limit for the same production in future also.

For estimating emissions from grid electricity use, the electricity used is multiplied by an emission coefficient (measured in kg CO2equ/kWh) for the electricity displaced calculated in accordance with provisions of paragraphs 6 or 7 for category I.D project, as per which the emission coefficient (measured in kgCO2/kWh) is calculated in a transparent and conservative manner as under:

The average of the "approximate operating margin" and the "build margin", where,
i) The "approximate operating margin" is the weighted average emissions (in kgCO2equ/kWh) of all generating sources surviving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;
ii) The "build margin" is the weighted average emissions (in kgCO2equ/kWh) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of the most recent 20% of existing plants or the 5 most recent plants;

OR

The weighted average emissions (in kgCO2equ/kWh) of current generation mix.
To assess the applicability of the relevant baseline methodology, a complete analysis of western regional electricity grid was carried out along with the study of various related issues like technology scenario, policy matters, which can further be used for preparation of baseline scenario and calculation of baseline emission factor of the grid. The information regarding baseline and project data is presented in the table below:

Table 2: Baseline and project activity data requirement and data source

S.No.	Parameter	Data source
	Baseline Scenario	
1	Total Power Imported from GEB	Plant
2	Electricity Emission Factor	Published report for the quantity generated and IPCC emission factor

3	Chilled Water Generated	Plant
4	Energy Consumed by Chilling Compressors	Plant
5	Steam Generation from Lignite fired boiler	Plant
6	Quantity of Lignite Consumed	Plant
7	Calorific Value of Lignite	Plant/supplier
8	Emission Factor (EF) of Lignite	IPCC
9	Oxidation Factor for Coal	IPCC
Project Scenario		
10	NG Consumption in CPPs	Plant
11	Calorific Value of NG	Plant/Supplier
12	Emission Factor (EF) of NG	IPCC
13	Quantity of steam generated from the waste heat recovery boilers	Plant
14	Chilled Water Generated in VAMs	Plant
15	Oxidation Factor of Gas	IPCC
16	Quantity of Steam Generated from NG boiler	Plant
17	Quantity of NG consumed in NG fired boiler	Plant

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

In accordance with paragraph 7 of the simplified modalities and procedures for small-scale CDM project activities, a simplified baseline and monitoring methodology listed in Appendix B may be used for a small-scale CDM project activity if project participants are able to demonstrate to a designated operational entity that the project activity would otherwise not be implemented due to the existence of one or more barrier(s) listed in Attachment A of Appendix. B. These barriers are:

- Investment barrier
- Technological barrier
- Barrier due to prevailing practice
- Other barriers

The implementation of the project activity is a voluntary step undertaken by with no direct or indirect mandate by law.

The main driving force to this 'Climate change initiative' is:

- GHG reduction due to higher efficiency, enhanced waste heat recovery and low carbon intensive fuel
- The reduction in the fossil fuel quantities on account of better efficiencies

However, the project proponent was aware of the various barriers associated to project implementation.

But it is realized that the availability of carbon financing against a sale consideration of carbon credits generated due to project activity would help to overcome these barriers. Some of the key barriers are discussed below:

Investment barrier

Alternatives to the project activity:

The other options for power generation for SIL were:

1. Electricity from State Electricity Grid and steam generation from boiler running on Lignite (Pre project practice)
2. Steam Turbine based power plant - Condensing
3. NG fired engine generator (Current Practice)
4. Steam Turbine based power plant – Back Pressure

Investment comparison analysis

The four options were available with the project proponent other than baseline scenario. SIL called for proposals from vendors namely Hi Rel and Jenbacher. The supply of electricity from electricity board is not under project proponent control; therefore this option is not opted in financial calculations. Unit cost of service i.e. leverized cost of electricity production in Rs/KWh of the CDM project activity and its three alternatives is calculated and a comparison is made.

Calculation and comparison of financial indicators

The result of leverized cost of electricity production calculation comparison analysis is as follows:

Option	***Unit Cost (Rs/KWh)***
Steam Turbine based power plant – Condensing	2.41
NG fired Engine generation	3.136
Steam Turbine based power plant – Back Pressure	0.64
Steam Turbine based power plant – Extraction cum Condensing	1.82

Despite the fact, NG fired engine power generation being expensive in terms of higher unit cost of power generation; SIL went ahead with a view to implement efficient environmental friendly technology considering associated CDM benefits will come later.

Technological barrier: The technological barriers faced by SIL, considering imported genset, were enormous. The lack availability of proper spares and service was always an issue considering the plant is operational throughout the year. Only three Jenbacher & one Doetz gensets were installed in Ankleshwar and nearby region. As the technology, there was no service set up available in India for Jenbacher/Doetz gas engines.

Other barriers: The project requires uninterrupted availability of consistent quality gas supply. SIL, after the project conceptualization, faced a barrier as GGCL expressed their sudden inability to ensure the gas supply. An agreement, between SIL and GGCL on consistent gas supply to the former, could only be signed after 4 months of ordering the genset. Further, there was no agreement on gas price as GGCL did not bind itself for any fixed prices. In case of any break down of genset, gas consumption can go below 80% of contracted quantity and heavy penalties need to be paid to GGCL.

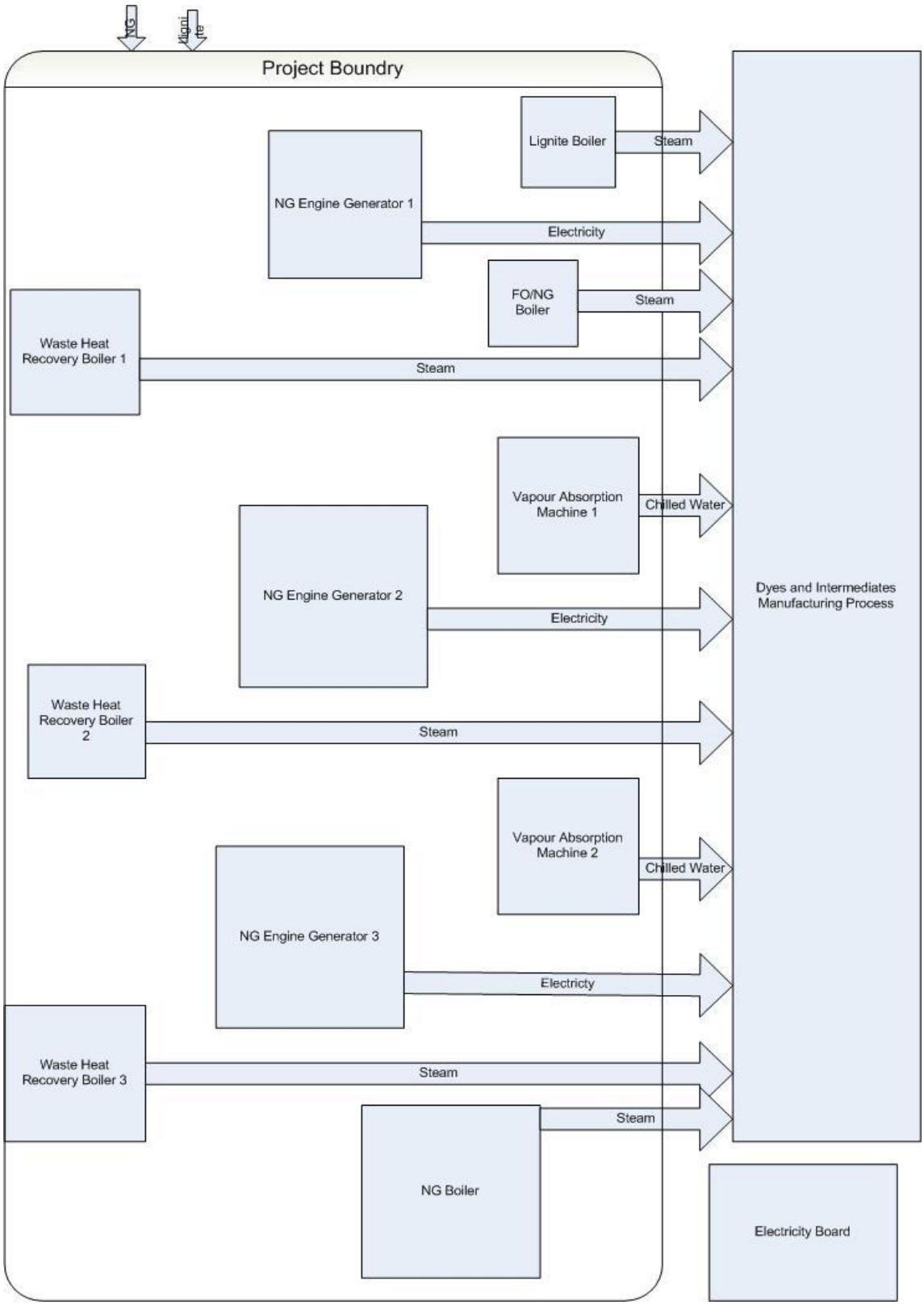
The project proponent, in spite of these risks and barriers identified , still went ahead with the project implementation that will lead to lesser greenhouse gas emission into the atmosphere..

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

The project boundary is NG fired power generation house and boiler house located within the plant (SIL) premises at GIDC, Ankleshwar. Following are the components of project boundary.

1. NG fired engine generator (3 nos.)
2. Lignite fired boiler (1 no.)
3. NG fired boiler (1 no.)
4. Waste heat recovery boiler (3 nos.)
5. Vapor Absorption Machine (2 nos.)
6. FO/NG fired boiler (1 no.)

Pictorial representation of the project boundary is given in the following page:


NG
Lignite
Project Boundry
Lignite Boiler
Steam
NG Engine Generator 1
Electricity
FO/NG Boiler
Steam
Waste Heat Recovery Boiler 1
Steam
Vapour Absorption Machine 1
Chilled Water
NG Engine Generator 2
Electricity
Dyes and Intermediates Manufacturing Process
Waste Heat Recovery Boiler 2
Steam
Vapour Absorption Machine 2
Chilled Water
NG Engine Generator 3
Electricty
Waste Heat Recovery Boiler 3
Steam
Steam
NG Boiler
Electricity Board

B.5. Details of the baseline and its development:

Date of completing the baseline: 14/11/2006

Name of person/entity determining the baseline: Sajjan India Limited and their consultants.

SECTION C. Duration of the project activity / Crediting period:

C.1. Duration of the small-scale project activity:

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C.1.1. Starting date of the small-scale project activity:

17/11/2002

C.1.2. Expected operational lifetime of the small-scale project activity:

15 Years 0 months

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

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C.2.1. Renewable crediting period:

Not Applicable

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

Not Applicable

C.2.1.2. Length of the first crediting period:

Not Applicable

C.2.2. Fixed crediting period:

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C.2.2.1. Starting date:

Starting date (DD/MM/YY): Crediting period would start from the date of registration of the project

C.2.2.2. Length:

10 years 0 months

SECTION D. Application of a monitoring methodology and plan:

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

Title: Monitoring Methodology for the category II D – Energy efficiency and fuel switching measures for industrial facilities.

Reference: 'Paragraph 6 to 8' as provided in Type II.D. of Appendix B of the simplified modalities and procedures for small-scale CDM project activities - Indicative Simplified Baseline and Monitoring Methodologies for Selected Small-Scale CDM Project Activity Categories.

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

As established in Section A.4.2 the project activity falls under Category II.D. Energy efficient power and steam generation leads to mitigation of GHG emissions that would have been produced by the inefficient operation. In order to monitor the mitigation of GHG due to the project activity, the fuel used and electricity/steam generated quantities need to be measured. The project activity is the installation of new equipment and retrofit of existing equipment. The monitoring methodology covers both the aspects i.e. new equipment and retrofit.

In the monitoring plan mainly following data is monitored:

1. Energy use/Energy generated of all the equipments.
2. Fuel used for generation of electricity and steam.
3. Electricity imported from electricity board.

Based on the monitored data and the IPCC emission factors the baseline emissions and project activity emissions are calculated.

There is no technology transfer in the project activity therefore the project activity doesn't lead to any leakage emissions. The difference between the baseline and project emissions is reported as emission reduction from the project activity.

D.3 Data to be monitored:

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

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m). calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	Comment
Monitoring parameters in NG based engine generator								
P.1.	*Quantity of Fuel used*	*Plant*	*SCM*	*Measured*	*Monthly*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.2	*Calorific Value of fuel used*	*Gas Supplier*	*Kcal/SCM*	*Measured*	*Monthly*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.3	*Quantity of Electricity generated – Gross*	*Plant*	*KWh*	*Measured*	*Continuous Recording & monthly reporting*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.4	*Quantity of Auxiliary Consumption*	*Plant*	*KWh*	*Measured*	*Continuous Recording & monthly reporting*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
Monitoring Parameters in NG fired Boiler								
P.5.	*Quantity of Fuel used*	*Plant*	*SCM*	*Measured*	*Monthly*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.6.	*Calorific Value of fuel*	*Gas Supplier*	*Kcal / Kg*	*Measured*	*Monthly*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.7.	*Quantity of*	*Plant*	*Tons*	*Measured*	*Continuous*	*100%*	*Paper & Electronic*	*Data archived:*

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m). calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	Comment
	steam generated by NG fired boiler				*Recording & monthly reporting*			*Crediting period + 2 yrs*
P.8	*Temperature of steam produced*	*Plant*	*°C*	*Measured*	*Daily*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.9	*Pressure of the steam produced*	*Plant*	*Kg/cm_2*	*Measured*	*Daily*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.10	*Enthalpy of steam produced*	*Plant*	*KJ/KG*	*Calculated*	*Monthly average*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
Monitoring Parameters in NG/FO Boiler								
P.11	*Quantity of Fuel used*	*Plant*	*SCM*	*Measured*	*Monthly*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.12.	*Calorific Value of fuel*	*Gas Supplier*	*Kcal / Kg*	*Measured*	*Monthly*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.13.	*Quantity of steam generated by NG/FO fired boiler*	*Plant*	*Tons*	*Measured*	*Continuous Recording & monthly reporting*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.14	*Temperature of steam produced*	*Plant*	*°C*	*Measured*	*Daily*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.15	*Pressure of the steam produced*	*Plant*	*Kg/cm_2*	*Measured*	*Daily*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m). calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	Comment
P.16	*Enthalpy of steam produced*	*Plant*	*KJ/KG*	*Calculated*	*Monthly average*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
Monitoring Parameters in Waste Heat Recovery Boilers								
P.17.	*Quantity of steam generated by waste heat boilers*	*Plant*	*Tons*	*Measured*	*Continuous Recording & monthly reporting*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.18	*Temperature of steam produced*	*Plant*	*°C*	*Measured*	*Daily*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.19	*Pressure of the steam produced*	*Plant*	*Kg/cm_2*	*Measured*	*Daily*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.20	*Enthalpy of steam produced*	*Plant*	*KJ/KG*	*Calculated*	*Monthly average*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
Monitoring Parameters in Project VAMs								
P.21.	*Quantity of Chilled water produced by project VAMs*	*Plant*	*TR*	*Measured*	*Continuous Recording & monthly reporting*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*

D.4. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:

Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
P.1.	*Low*	*ISO 9001 or similar type of quality system is required*
P.2.	*Low*	*ISO 9001 or similar type of quality system is required*
P.3.	*Low*	*ISO 9001 or similar type of quality system is required*
P.4.	*Low*	*ISO 9001 or similar type of quality system is required*
P.5.	*Low*	*ISO 9001 or similar type of quality system is required*
P.6.	*Low*	*ISO 9001 or similar type of quality system is required*
P.7.	*Low*	*ISO 9001 or similar type of quality system is required*
P.8.	*Low*	*ISO 9001 or similar type of quality system is required*
P.9.	*Low*	*ISO 9001 or similar type of quality system is required*
P.10.	*Low*	*ISO 9001 or similar type of quality system is required*
P.11.	*Low*	*ISO 9001 or similar type of quality system is required*
P.12.	*Low*	*ISO 9001 or similar type of quality system is required*
P.13.	*Low*	*ISO 9001 or similar type of quality system is required*
P.14.	*Low*	*ISO 9001 or similar type of quality system is required*
P.15.	*Low*	*ISO 9001 or similar type of quality system is required*
P.16.	*Low*	*ISO 9001 or similar type of quality system is required*
P.17.	*Low*	*ISO 9001 or similar type of quality system is required*
P.18.	*Low*	*ISO 9001 or similar type of quality system is required*
P.19.	*Low*	*ISO 9001 or similar type of quality system is required*
P.20.	*Low*	*ISO 9001 or similar type of quality system is required*
P.21.	*Low*	*ISO 9001 or similar type of quality system is required*

Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:

Emission monitoring and calculation procedure will follow the following organizational structure. All data and calculation formula required to proceed is given in the section E.

Organizational Structure for monitoring

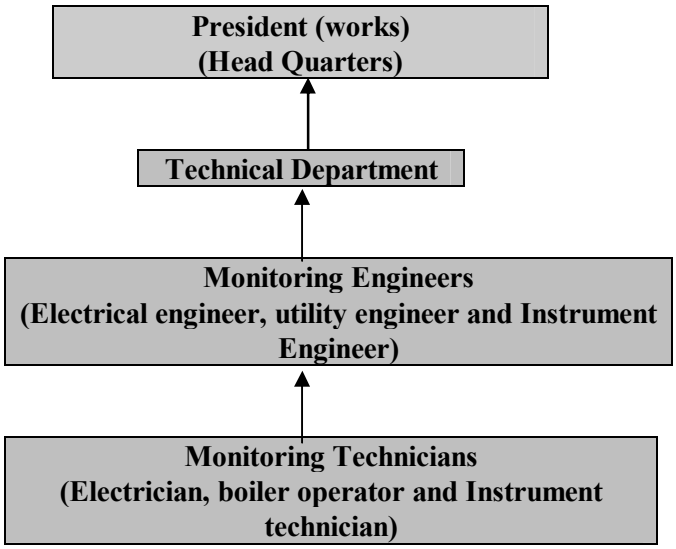

Table 4: Monitoring and Calculation Activities and responsibility

Monitoring and calculation activities	Procedure and responsibility
Data Source and Collection	Readings of various meters will be recorded by technicians.
Frequency	Monitoring frequency should be as per section D of PDD
Review	All received data is reviewed by engineers in CDM cell
Data compilation	All the data is compiled and stored in CDM cell
Emission calculation	Emission reduction calculation will be done annual based on the data collected. Engineers/Project In charge of CDM cell will do the calculations
Review	Plant In charge will review the calculation
Emission data review	Final calculations is reviewed and approved by Vice President
Record Keeping	All calculation and data record will be kept with the CDM cell.

D.6. Name of person/entity determining the monitoring methodology:

Sajjan India Limited & their associated consultants

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

No formulae for GHG emission reduction is specified for Category II.D. of Appendix B of the Simplified Modalities and procedures for Small-scale CDM project activities.

E.1.1 Selected formulae as provided in appendix B:

>>

E.1.2 Description of formulae when not provided in appendix B:

>>

E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:

Project emission calculation:

Step 1: Specific emission factor for each generation device:

1. For NG fired engine Generators

$PSEF_{EG} = (Fi \times CVi \times OXIDi \times EFi)/Elect_{Proj\text{-}EG}$

Where
$PSEF_{EG}$ = Project specific emission factor for NG fired engine generator ($kgCO_2/KWh$)
F_i = Consumption of fuel i used in the project scenario (SCM)
CV_i = Calorific value of fuel i used in the project scenario (GJ/SCuM)
EF_i = Carbon dioxide mission factor per unit energy of fuel i ($kgCO_2/GJ$)
$OXID_i$ = IPCC Oxidation factor for fuel i
$Elect_{Proj\text{-}EG}$ = Electricity generated by engine generators in project scenario (KWh)

$Elect_{Proj\text{-}EG} = Gross\text{-}Elect_{Proj\text{-}EG} - Aux\text{-}Elect_{Proj\text{-}EG}$

Where
$Gross\text{-}Elect_{Proj\text{-}EG}$ = Gross electricity generated by engine generators in project scenario (KWh)
$Aux\text{-}Elect_{Proj\text{-}EG}$ = Auxiliary consumption in engine generators in project scenario (KWh)

2. ***For NG fired boiler***

$PSEF_{NBG} = (Fi \times CVi \times OXIDi \times EFi)/(Enthalpy_{Proj\text{-}NGB} * Steam_{Proj\text{-}NGB})$

Where
$PSEF_{NGB}$ = Project specific emission factor for NG fired boiler (tCO_2/TJ of steam produced)
F_i = Consumption of fuel i used in the project scenario (SCuM)
CV_i = Calorific value of fuel i used in the project scenario (GJ/SCuM)
EF_i = Carbon dioxide emission factor per unit energy of fuel i ($kgCO_2/GJ$)
$OXID_i$ = IPCC Oxidation factor for fuel i

Steam $_{Proj\text{-}NGB}$ = Steam generated by NG fired boiler in project scenario (Tons)
$Enthalpy_{Proj\text{-}NGB}$ = Enthalpy of steam produced by NG fired boiler in project scenario (KJ/Kg)

3. *For FO/ NG fired boiler*

$PSEF_{FO/NGB} = (Fi \times CVi \times OXIDi \times EFi)/(Enthalpy_{Proj\text{-}FO/NGB} * Steam_{Proj\text{-}FO/NGB})$

Where
$PSEF_{FO/NGB}$ = Project specific emission factor for FO/NG fired boiler (tCO_2/TJ of steam produced)
F_i = Consumption of fuel i used in the project scenario (SCuM)
CV_i = Calorific value of fuel i used in the project scenario (GJ/SCuM)
EF_i = Carbon dioxide emission factor per unit energy of fuel i ($kgCO_2$/GJ)
$OXID_i$ = IPCC Oxidation factor for fuel i
Steam $_{Proj\text{-}FO/NGB}$ = Steam generated by FO/NG fired boiler in project scenario (Tons)
$Enthalpy_{Proj\text{-}FO/NGB}$ = Enthalpy of steam produced by FO/NG fired boiler in project scenario (KJ/Kg)

Step 2: Annual project emission

$E_{Project} = (PSEF_{EG} x\ Elect_{Proj\text{-}EG} + PSEF_{NGB} x\ Steam_{Proj\text{-}NGB} + PSEF_{FO/NGB} x\ Steam_{Proj\text{-}FO/NGB})/1000$

Where
$E_{Project}$ = Emission from the project activity (tCO_2)

E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities

There is no technology transfer in project activity and the equipment installed are new and thus, as per paragraph 5 of Category II.D. of Small Scale Project Activities, no leakage calculation is required for the project activity. Leakage will thus be 0.

E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the small-scale project activity emissions:

The project activity emission will remain same as project emissions i.e. equal to $E_{PROJECT}$

E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:

Baseline emission calculation:

Step 1: Specific emission factor for each generation device:

1. For Lignite Fired Boiler

$BSEF_{LB} = (Fi \times CVi \times OXIDi \times EFi)/(Enthalpy_{Base\text{-}LB} * Steam_{Base\text{-}LB})$

Where
$BSEF_{LB}$ = Baseline specific emission factor for Lignite fired boiler (tCO_2/TJ of steam produced)
F_i = Consumption of fuel i used in the baseline scenario (Tons)
CV_i = Calorific value of fuel i used in the baseline scenario (GJ/ton)
EF_i = Emission factor per unit energy of fuel i (tCO_2/GJ)
$OXID_i$ = IPCC Oxidation factor for fuel i
$Steam_{Base-LB}$ = Steam produced by Lignite fired boiler in baseline scenario (Tons)
$Enthalpy_{Base-LB}$ = Enthalpy of steam produced in the baseline scenario (KJ/Kg)

2. For Chilled Water Generation

$$BSEF_{C-Water} = (Elect_{Base-COMP} \times EF_{Grid}) / C\text{-}Water_{Base-VAM}$$

Where
$BSEF_{C-Water}$ = Baseline Specific emission factor for chilled water generation ($kgCO_2$/TR)
$Elect_{Base-COMP}$ = Energy Consumed by chilling compressors (KWh)
EF_{Grid} = Emission Factor of the Grid (kg CO_2/KWh)
$C\text{-}Water_{Base}$ = Baseline chilled water generation (TR)

Step 2: Annual baseline emission

$$E_{Baseline} = (Elect_{Proj-EG} \times EF_{Grid} + Enthalpy_{Proj-WHR} * Steam_{Proj-WHR} \times BSEF_{LB} + Enthalpy_{Proj-NGB} * Steam_{Proj-NGB} \times BSEF_{LB} + Enthalpy_{Proj-FO/NGB} * Steam_{Proj-FO/NGB} \times BSEF_{LB} + C\text{-}Water_{Proj-VAM} \times BSEF_{C-Water}) / 1000$$

Where
$E_{Baseline}$ = Emissions from the baseline activity (tCO_2)
EF_{Grid} = Grid emission factor (kg CO_2 / KWh)
$BSEF_{LB}$ = Baseline specific emission factor for Lignite fired boiler (tCO_2/TJ of steam produced)
$Steam_{Proj-WHR}$ = Steam generated by the waste heat recovery boilers in project scenario (Tons)
$Steam_{Proj-NGB}$ = Steam generated by the NG fired boiler in project scenario (Tons)
$Steam_{Proj-FO/NGB}$ = Steam generated by the NG fired boiler in project scenario (Tons)
$Enthalpy_{Proj-WHR}$ = Enthalpy of steam generated by WHR boiler in project scenario (KJ/Kg)
$Enthalpy_{Proj-NGB}$ = Enthalpy of steam generated by WHR boiler in project scenario (KJ/Kg)
$Enthalpy_{Proj-FO/NGB}$ = Enthalpy of steam generated by WHR boiler in project scenario (KJ/Kg)
$C\text{-}Water_{Proj-VAM}$ = Chilled water generated in VAMs in project scenario (TR)
$Elect_{Proj-EG}$ = Electricity generated by the natural gas fired engine generators in project scenario, this is equivalent to electricity procured from the grid in baseline scenario.
$BSEF_{C-Water}$ = Baseline Specific emission factor for chilled water generation ($kgCO_2$/TR)

E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:

CO2 emission reduction due to the project activity = (Baseline emission) – (Project emission)

E.2 Table providing values obtained when applying formulae above:

Years	Annual estimation of baseline emission (in tonnes of CO_2e)	Annual estimation of project emissions (in tonnes of CO_2e)	Annual estimation of emission reductions* (in tonnes of CO_2 e)
2007-08	54789	29057	25732
2008-09	54789	29057	25732
2009-10	54789	29057	25732
2010-11	54789	29057	25732
2011-12	54789	29057	25732
2012-13	54789	29057	25732
2013-14	54789	29057	25732
2014-15	54789	29057	25732
2015-16	54789	29057	25732
2016-17	54789	29057	25732
Total estimated reductions (tonnes of CO_2 e)	547890	290570	257320
Total number of crediting years	**10**	**10**	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	54789	29057	25732

SECTION F.: Environmental impacts:

F.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The Ministry of Environment and Forests (MoEF), Government of India, under the Environment Impact Assessment Notification vide S.O. 60(E) dated 27/01/94 has listed a set of industrial activities in Schedule I[2] of the notification which for setting up new projects or modernization/ expansion will require environmental clearance and will have to conduct an Environment Impact Assessment (EIA) study. However, the project under consideration does not require any EIA to be conducted as the activity is not included in Schedule I.

Article 12 of the Kyoto Protocol requires that a CDM project activity contribute to the sustainable development of the host country. Assessing the project activity's positive and negative impacts on the local environment and on society is thus a key element for each CDM project.

SIL's CDM project activity ensures maximum global and local benefits in relation to certain environmental and social issues and is a small step towards sustainable development.

The primary objective of the project is to reduce the emissions. By this way project activity reduces environmental impacts related to emissions from steam and power consumption.

The project activity does not have any significant negative environmental impact at the site. The GHG emission reductions from project activity benefit the global environment. The short summary of Environmental impacts is given in table.

Environment Impact Assessment table

SL. NO.	ENVIRONMNETAL IMPACTS & BENEFITS	REMARKS
A.	CATEGORY: ENVIRONMENTAL – AIR QUALITY	
1.	The project activity is using natural gas as fuel for steam and power generation. Natural gas is cleanest fossil fuel, so the activity has reduced the emissions based on the grid based electricity and lignite fired boiler steam – the case earlier.	The project activity reduces emission of CO_2-a global entity.
B	CATEGORY: ENVIRONMENTAL –WATER	
1	The project activity does not contribute to water pollution	
D	CATEGORY: ENVIRONMENTAL – NOISE GENERATION	
1	The project does not contribute to noise pollution.	

[2] http://www.envfor.nic.in/legis/eia

SECTION G. Stakeholders' comments:

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

SIL had organized stakeholder consultation meetings with local stakeholders, employees in the area with the objective to inform the interested stakeholders on the environmental and social impacts of the project activity and discuss their concerns regarding the project activity. Invitation for stakeholder consultation meetings were sent out requesting the members to participate and communicate any suggestions/objections regarding the project activity.

The other stakeholders identified for the project activity were as under:

1. Local population
2. Employees
3. State pollution control board
4. Consultants
5. Gujarat Gas Company Limited
6. Equipment suppliers

Stakeholders list includes the government and non-government parties, which are involved in the project activity at various stages. At the appropriate stage of the project development, consulted/would consult stakeholders / relevant bodies to get the comments. The comments received are available on request.

G.2. Summary of the comments received:

Local population comprises of the local people in and around the project area. The project activity was implemented inside the boundaries of SILs Ankleshwar plant and did not require any displacement of local population. Thus, there would be no adverse impact on the local population. SIL has completed the necessary consultation with the local population and received positive comments.

Gujarat State Pollution Control Board (GSPCB) has prescribed standards for environmental compliance and monitors the adherence to the standards. GSPCB has granted Consent to Establish (CTE) and consent to operate (CTO).

The village panchayat and suppliers of equipments have lauded the efforts of SIL towards cleaner and efficient operation at its premises.

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

No negative comments received on the project activity.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Sajjan India Limited
Street/P.O.Box:	Senapati Bapat Marg, Lower Parel
Building:	Matulya Centre, #2 Ground Floor
City:	Mumbai
State/Region:	Maharashtra
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Country:	India
Telephone:	91 22/24974400/ 24974401
FAX:	91 22/24950588/24951098
E-Mail:	sil@sajjan.com , sajjan@bom2.vsnl.net.in
URL:	www.sajjanindia.com
Represented by:	
Title:	Vice President
Salutation:	Mr.
Last Name:	Todi
Middle Name:	-
First Name:	Vijaykumar
Department:	-
Mobile:	
Direct FAX:	91 22/24950588/24951098
Direct tel:	-
Personal E-Mail:	vkt@sajjan.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding received for the project.

Appendix I : Emission Reduction Calculations

Certified Emission Reduction for energy efficieny improvement project at Sajjan India Limited, Ankleshwar, Gujarat, India												
Electricity & steam Generation scenario	**Units**	**Baseline**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NG based Engine Generators												
Calorific value of fuel (NG) used	GJ/SCuM	0	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
Gross Electricty generated by the fuel used	kWh	0	21610400	21610400	21610400	21610400	21610400	21610400	21610400	21610400	21610400	21610400
Auxilliary Consumption	kWh	0	650000	650000	650000	650000	650000	650000	650000	650000	650000	650000
Net Electricity generated by the fuel used	kWh	0	20960400	20960400	20960400	20960400	20960400	20960400	20960400	20960400	20960400	20960400
Fuel consumption in Gas turbine	SCuM	0	5942860	5942860	5942860	5942860	5942860	5942860	5942860	5942860	5942860	5942860
Quantity of steam generated from the waste heat recovery boilers	Tons	0	13000	13000	13000	13000	13000	13000	13000	13000	13000	13000
Temperature	C	184.15	184.15	184.15	184.15	184.15	184.15	184.15	184.15	184.15	184.15	184.15
Steam pressure	kg/cm2	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33
Enthalpy of Steam	KJ/kg	2781.3	2781.3	2781.3	2781.3	2781.3	2781.3	2781.3	2781.3	2781.3	2781.3	2781.3
Chilled Water Generated in VAMs	TR	0	1690000	1690000	1690000	1690000	1690000	1690000	1690000	1690000	1690000	1690000

Emission factor	Equ kg CO_2/GJ	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1
IPCC Oxidation Factor for Gas		0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995
Specific emissions	kg CO_2/kWh	0	0.560	0.562	0.562	0.562	0.562	0.562	0.562	0.562	0.562	0.562
Chilled Water Generation												
Chilled Water Generated	TR	472000	0	0	0	0	0	0	0	0	0	0
Energy Consumed by Chilling Compressors	KWh	401200	0	0	0	0	0	0	0	0	0	0
Specific emissions	kg CO_2/TR	0.757	0	0	0	0	0	0	0	0	0	0
Power from GEB												
Total power imported from GEB	kWh	20960400.00	0	0	0	0	0	0	0	0	0	0
Emission factor	kg CO_2/kWh	0.890	0.890	0.890	0.890	0.890	0.890	0.890	0.890	0.890	0.890	0.890
Steam generation from Lignite Fired Boiler												
Total steam generation required	Tons	10989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temperature	C	184.15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Steam pressure	kg/cm2	17.33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Enthalpy of Steam	KJ/kg	2781.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Quantity of Lignite required	tonnes	2605	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calorific value of Lignite	GJ/ton	13.376	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IPCC Oxidation Factor for		0.98	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980

Coal												
Emission factor	equ $kgCO_2/GJ$	101.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Specific emissions	tCO2/TJ of Steam produced	112.955	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Steam generation from 6 TPH NG/FO boiler												
Quantity of NG required	SCuM	0	2556114	2556114	2556114	2556114	2556114	2556114	2556114	2556114	2556114	2556114
Calorific value of NG	GJ/SCuM	0	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
Temperature	C	0	184.15	184.15	184.15	184.15	184.15	184.15	184.15	184.15	184.15	184.15
Pressure of Steam	kg/cm2	0	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33
Enthalpy of Steam	KJ/kg	0	2781.300	2781.300	2781.300	2781.300	2781.300	2781.300	2781.300	2781.300	2781.300	2781.300
Quantity of steam generated	tonnes	0	26483	26483	26483	26483	26483	26483	26483	26483	26483	26483
Emission factor	equ $kgCO_2/GJ$	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1
IPCC Oxidation Factor for gas		0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995
Specific emissions	tCO_2/TJ of steam produced	0.00	68845987.23	68845987.23	68845987.23	68845987.23	68845987.23	68845987.23	68845987.23	68845987.23	68845987.23	68845987.23
Steam generation from 14.5 TPH NG boiler												
Quantity of NG required	SCuM	0	6177275	6177275	6177275	6177275	6177275	6177275	6177275	6177275	6177275	6177275
Calorific value of NG	GJ/SCuM	0	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
Pressure of Steam	kg/cm2	0	33.7	33.7	33.7	33.7	33.7	33.7	33.7	33.7	33.7	33.7
Temperature	C	0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0
Enthalpy of Steam	KJ/kg	0	3105.7	3105.7	3105.7	3105.7	3105.7	3105.7	3105.7	3105.7	3105.7	3105.7
Quantity of	tonnes	0	64000	64000	64000	64000	64000	64000	64000	64000	64000	64000

steam generated												
Emission factor	equ $kgCO_2/GJ$	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1
IPCC Oxidation Factor for gas		0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995
Specific emissions	tCO_2/TJ of steam produced	0.00	61654810.28	61654810.28	61654810.28	61654810.28	61654810.28	61654810.28	61654810.28	61654810.28	61654810.28	61654810.28
Baseline and Project emission calculations												
Baseline emissions	ton CO_2/annum		54789	54789	54789	54789	54789	54789	54789	54789	54789	54789
Project activity emissions	ton CO_2/annum		29057	29057	29057	29057	29057	29057	29057	29057	29057	29057
Annual Emission reduction	ton CO_2/annum		**25732**	**25732**	**25732**	**25732**	**25732**	**25732**	**25732**	**25732**	**25732**	**25732**

Appendix II : Grid Emission Factor

Source : www.cea.nic.in (Calculation as per ACM0002 Ver 06)

Weighted Average Emission Rate (tCO2/MWh)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North	0.71	0.73	0.74	0.71	0.72
East	1.10	1.04	1.09	1.07	1.06
South	0.75	0.75	0.83	0.84	0.78
West	0.93	1.02	0.94	0.90	0.92
North-East	0.37	0.37	0.34	0.36	0.45
India	0.83	0.86	0.87	0.85	0.84
Simple Operating Margin (tCO2/MWh)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North	0.95	0.98	1.00	0.99	0.98
East	1.23	1.19	1.18	1.19	1.18
South	1.03	1.01	1.02	1.01	1.00
West	1.02	1.12	1.03	0.99	1.01
North-East	0.66	0.65	0.65	0.61	0.79
India	1.02	1.06	1.04	1.02	1.02
Build Margin (tCO2/MWh) (not adjusted for imports)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North					0.54
East					0.86
South					0.73
West					0.77
North-East					0.09
India					0.70
Combined Margin in tCO2/MWh (incl. Imports)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North	0.74	0.76	0.77	0.76	0.76
East	1.05	1.03	1.02	1.03	1.02
South	0.88	0.87	0.88	0.87	0.86
West	0.90	0.94	0.90	0.88	0.89
North-East	0.38	0.37	0.37	0.35	0.44
India	0.86	0.88	0.87	0.86	0.86

Gross Generation Total (GWh)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North	144,290	151,190	155,331	165,717	168,735
East	58,327	63,583	65,332	75,249	85,435
South	128,805	131,747	134,231	138,371	143,932
West	159,865	165,500	173,402	172,480	183,755
North-East	5,206	5,243	5,486	5,879	7,904
India	496,493	517,262	533,780	557,696	589,761

20% of Gross Generation (GWh)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North	28,858	30,238	31,066	33,143	33,747
East	11,665	12,717	13,066	15,050	17,087
South	25,761	26,349	26,846	27,674	28,786
West	31,973	33,100	34,680	34,496	36,751
North-East	1,041	1,049	1,097	1,176	1,581
Net Generation Total (GWh)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North	135,254	141,420	144,676	155,017	157,269
East	52,797	57,654	58,988	68,317	77,967
South	121,040	123,473	125,268	128,225	134,552
West	148,067	152,789	160,615	159,638	170,580
North-East	5,085	5,126	5,372	5,758	7,776
India	462,243	480,463	494,918	516,956	548,144
20% of Net Generation (GWh)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North	27,051	28,284	28,935	31,003	31,454
East	10,559	11,531	11,798	13,663	15,593
South	24,208	24,695	25,054	25,645	26,910
West	29,613	30,558	32,123	31,928	34,116
North-East	1,017	1,025	1,074	1,152	1,555
Share of Must-Run (Hydro/Nuclear) (%)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North	25.9%	25.7%	26.1%	28.1%	26.8%
East	10.9%	13.5%	7.6%	10.3%	10.5%
South	28.1%	25.5%	18.6%	16.2%	21.6%
West	8.3%	8.5%	8.4%	9.1%	8.8%
North-East	43.1%	42.4%	48.4%	41.8%	55.4%
Net Generation OM (GWh)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North	100,214	105,082	106,875	111,424	115,129
East	47,017	49,865	54,523	61,267	69,745
South	86,996	91,946	101,928	107,456	105,445
West	135,726	139,838	147,056	145,122	155,586
North-East	2,892	2,952	2,774	3,350	3,469
India	372,845	389,683	413,156	428,619	449,374

IMPORT DATA					
Net Imports (GWh)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North	0	0	0	0	3,616
East	489	555	357	1,689	0
South	1,162	1,357	518	0	0
West	321	0	797	962	285
North-East	0	0	0	0	2,099
Share of Net Imports (%)					
	2000/01	2001/02	2002/03	2003/04	2004/05

North	0.0%	0.0%	0.0%	0.0%	2.3%
East	0.9%	1.0%	0.6%	2.5%	0.0%
South	1.0%	1.1%	0.4%	0.0%	0.0%
West	0.2%	0.0%	0.5%	0.6%	0.2%
North-East	0.0%	0.0%	0.0%	0.0%	27.0%

Gross Generation BM (GWh)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North					34,283
East					17,394
South					30,091
West					40,286
North-East					2,067
India					124,121
Net Generation BM (GWh)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North					32,293
East					16,042
South					28,165
West					37,837
North-East					2,052
India					116,389

EMISSION DATA					
Absolute Emissions Total (tCO2)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North	95,563,002	102,909,475	106,874,884	110,045,815	112,109,909
East	57,830,162	61,238,587	66,085,166	74,919,620	84,395,050
South	89,079,903	92,464,571	104,399,643	108,265,267	105,090,651
West	138,485,626	156,449,139	151,385,665	144,340,246	157,882,622
North-East	1,899,897	1,914,716	1,815,717	2,056,883	2,255,262
India	382,858,591	414,976,488	430,561,074	439,627,831	461,733,493
Absolute Emissions OM (tCO2)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North	95,563,002	102,909,475	106,874,884	110,045,815	112,109,909
East	57,830,162	61,238,587	66,085,166	74,919,620	84,395,050
South	89,079,903	92,464,571	104,399,643	108,265,267	105,090,651
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India	382,858,591	414,976,488	430,561,074	439,627,831	461,733,493
Absolute Emissions BM (tCO2)					
	2000/01	2001/02	2002/03	2003/04	2004/05
North					17,287,345
East					13,828,319
South					20,491,417
West					29,193,210
North-East					191,174
India					80,991,465