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

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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:

>>

Title: Up-gradation of Gas Turbine 1 (GT 1) and Gas Turbine 2 (GT 2) at co-generation plant of Hazira Gas Processing Complex (HGPC) of Oil and Natural Gas Corporation Limited (ONGC).

Version 06,
Dated: 20 December 2011

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

>>

ONGC's Hazira Gas-Processing Complex (HGPC) consists of facilities for receiving natural gas (NG) along with associated condensate from an off-shore field at a rate of 20 Million Metric Newton M^3($MMNM^3$) per day. After separating the condensate, which is processed in condensate fractionation units, the gas is processed through various steps to recover liquefied petroleum gas (LPG) and there is a reduction in its dew point to less than 5 degrees centigrade (C) in order to make it suitable for transportation over long distances. Prior to gas processing, the gas is sent to gas sweetening unit where the acid gas is recovered and further processed to obtain sulphur. The major products manufactured at HGPC are lean sweet gas, LPG, natural gas liquids (NGL) and sulphur.

The HGPC receives economical, quality and uninterrupted supply of electrical power and steam from the cogeneration plant at ONGC, Hazira which was set up in the financial year (FY) 1987 - 1988. The cogeneration plant consists of three nos. of Gas Turbine Generators (GTG) to cater the power demand of Hazira Plant. GT-1 & GT 2, which are of General Electric (GE) make were commissioned in 1988 and fitted with standard technology components. GT-3 is of Bharat Heavy Electricals Limited (BHEL) make was commissioned in 1997 and fitted with up-rated parts.

Gas turbines are high-tech capital equipments and are vital for operations hence Original Equipment Manufacturers (OEM) continuously strive to augment the gas turbine's performance by improving the design/ material of its components through research and development (R&D). Such developments are extensively tested and offered to customers in the form of new components commonly called up-rated parts. Aim of these up-rated parts, is to satisfy varied requirement of gas turbine owners, such as improvement in output, efficiency or reduction in maintenance intervals and related. New machines are traditionally supplied with up-rated parts. For older machines, these up-rated parts are available as retrofit and usually suggested for installation at the time of scheduled inspections, so that separate outage of gas turbine is not required for fitment of up-rated parts.

As the existing GT 1 and GT 2 will be completing their expected life time, ONGC is required to replace the entire hot gas path (HGP) components fitted in the gas turbine machines as at present ONGC does not have spare HGP components in stock. Under such circumstances ONGC has the option either to: (a)

procure new HGP components of standard technology (Old Design) or (b) opt for up-rated components, which offer higher efficiency and output.

A comparative analysis was made to assess both scenarios (a) and (b) described above by considering one, major inspection cycle (i.e. of 6 years, which is the normal life span of the components). Accordingly maintenance costs (including cost of spares, component repairs and services) have been compared for two scenarios.

It was assessed that the purchase of up-rated spares in place of old technology spares requires an incremental cost of Rs 4.78 Crores / gas turbine and further, the IRR of the project is below the hurdle rate of 10 % for ONGC. Despite unfavourable financial indicators (like higher incremental costs and lower IRR of scenario (b)), ONGC has decided to go for the up-rated components in order to achieve their objective of continuous thrust towards energy conservation and therefore reduction in greenhouse gas (GHG) emissions. The purpose of undertaking the project is to reduce the fossil fuel consumption (NG), and therefore reduce the CO_2 emissions that would otherwise have been released by burning of natural gas (NG) in the GTG. The project would result in reduction of heat rate by 3.3% which would result in saving of 3,926,673 Standard Cubic Meter (SCM) of NG annually. In absence of the project activity, equivalent quantity of NG would have been burnt, thereby resulting in **8231** tonCO_2 emission annually.

The project would contribute to sustainable development of the host country India in the following ways:

The project activity saves NG for better applications and contributes to environmental protection.

The project activity would help in minimizing environmental pollution by reducing emissions of CO_2 and other air pollutants (SPM, SO_2, NO_x). The project is based on the noble principle that 'energy saved is energy generated'. The project would contribute to enhancement of skills in employees and workers, and would provide benefits to equipment suppliers and technical consultants.

A.3. Project participants:

>>

Table A.1 Project participants of the CDM project activity

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)	ONGC (Public Entity)	No

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

>>

The technology adopted for the project activity is the MS5001 P N/T turbine model which incorporates the latest gas turbine technology that has been adapted to the MS5001 turbines. It is the maximum hot gas path up rate for MS5001P turbines.

The new technology hardware includes the hot gas path hardware from the combustion liners through to the second stage bucket. The P N/T package improves output power significantly due to improved aerodynamics, primarily due to an increase in firing temperature. Output is further improved with the recommended options of reduced camber Inlet Guide Vane IGV's and advanced seals. Fuel efficiency is also improved.

Several of these improvements can be purchased individually with the prime consideration being increase in component life, however, the full New Technology (N/T) package has been proposed in order to facilitate the increase in firing temperature, which accounts for the major part of the output and heat-rate performance improvement. This new-technology includes all the necessary parts for the extension of inspection intervals.

The net reduction in heat rate would be 3.3% after implementation of the project activity.

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

>>

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:

>> **Surat**

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

>>

Table A.2 Details of physical location of project site

Place	Hazira
Post Office	ONGC Nagar
City	Surat
Pin	394 518
State	Gujarat
Country	India

The map showing the location of the project activity is shown below.

Fig A.1 Location of Hazira Plant

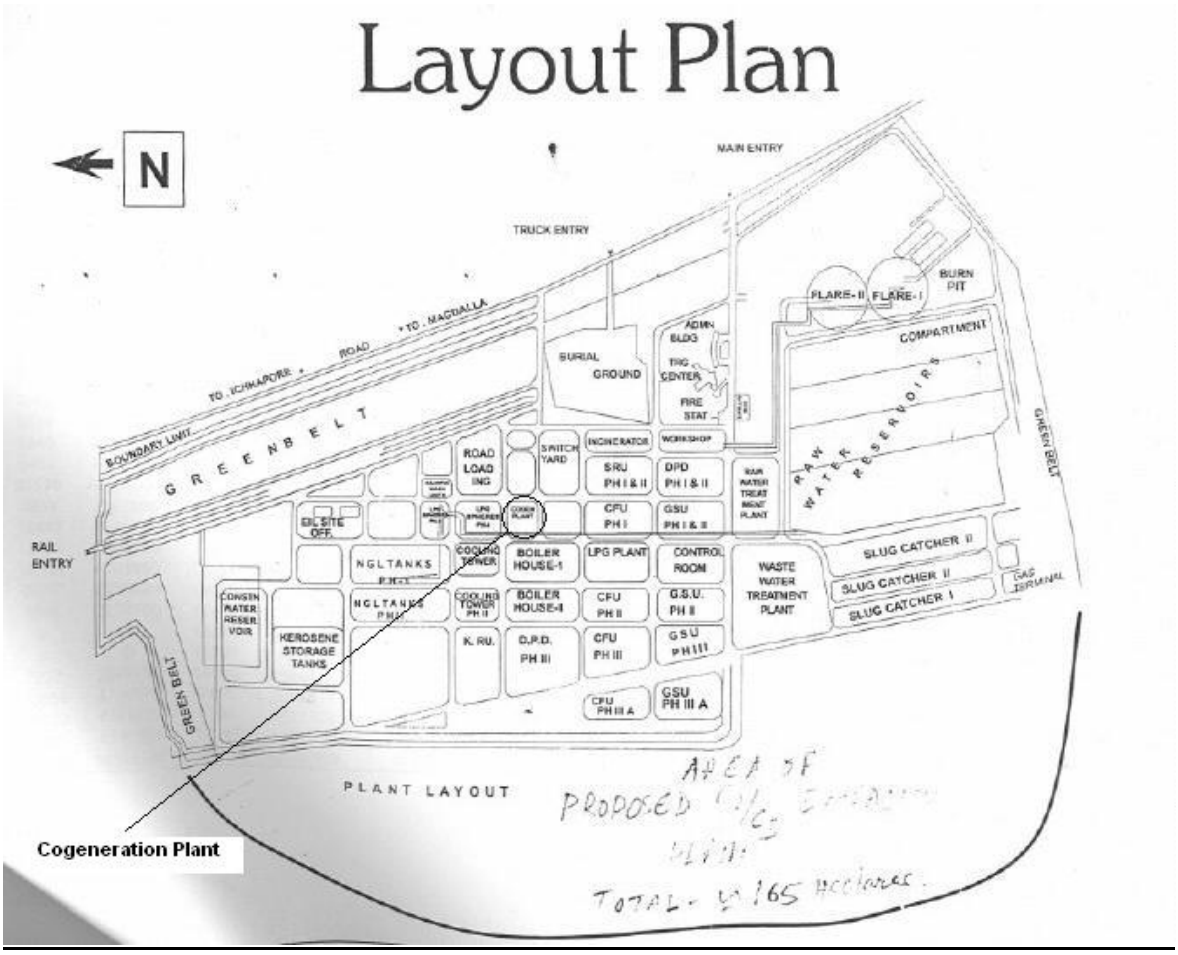


Fig A.2 Layout of ONGC, Hazira

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

>>

The project activity is a small scale potential CDM project, which fits under the Category 4: 'Manufacturing Industries' as per 'List of Sectoral Scopes' available in UNFCCC website. As per Appendix B of the simplified modalities and procedures for small scale CDM project activities, the small scale methodology AMS II.D – Version 08 ie. "Type II – Energy efficiency improvement projects of Category II.D – Energy efficiency and fuel switching measures for industrial facilities" has been selected for the project as it meets the following requirements:

1. The project activity is an energy efficiency project implemented at a single industrial facility.

2. The energy efficiency measures of retrofiting existing equipments of Gas Turbines at HGPC aimed primarily for improving the energy efficiency of the facility.

3. The maximum thermal energy saving in the project activity is 38.5 GWh thermal which is below the limit of 180 GWh thermal as specified in the methodology AMS II.D.

As explained above, the project activity meets all the applicability criteria of the methodology as well as the stipulations of small scale projects.

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 aims at up-gradation of GT1 and GT2 at HGPC, ONGC Hazira plant. The up-gradation will result in a reduction of 3.3% heat rate. This would result in reduction of fuel consumption to the tune of **3,926,673** SCM of NG annually. In the absence of the project activity equivalent quantity of NG would be burnt in the gas turbine, which would result in annual emissions of 8231 tons of CO_2. Thus the project activity would enable reduce GHG emissions through the energy conservation measures proposed.

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

>>

The estimated emission reductions for the chosen period of 10 years (2007 – 17) would be 82310 tons CO_2.

Table A.3: Estimated emission reduction

Years	Annual estimation of emission reductions in tones of CO2eq
2007-08	8231
2008-09	8231
2009-10	8231
2010-11	8231
2011-12	8231
2012-13	8231
2013-14	8231
2014-15	8231
2015-16	8231
2016-17	8231
Total estimated reductions (tCO2e)	**82310**
Total no of crediting years	**10**
Annual average over the crediting period of estimated reductions (tones of CO2 e)	**8231**

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

>>

No public funding is available for the project from countries included in Annex 1.

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

>>

The proposed small-scale project activity is not a debundled component of a large project activity since there is no 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
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

SECTION B. Application of a baseline methodology:

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

>>

Title: Small scale methodology AMS. II.D – Version 08
Type II. Energy efficiency improvement projects.
Category D - Energy efficiency and fuel switching measures for industrial facilities.

Reference: Paragraph '3 and 4' 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.

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

>>The project activity is a small scale potential CDM project, which fits under the Category 4: 'Manufacturing Industries' as per 'List of Sectoral Scopes' available in UNFCCC website. As per Appendix B of the simplified modalities and procedures for small scale CDM project activities, the small scale methodology AMS II.D i.e. "Type II – Energy efficiency improvement projects of Category II.D – Energy efficiency and fuel switching measures for industrial facilities" has been selected for the project as it meets the following requirements:

1. The project activity is an energy efficiency project implemented at a single industrial facility.
2. The energy efficiency measures of retrofiting existing equipments of Gas Turbines at HGPC aimed primarily for improving the energy efficiency of the facility.
3. The maximum thermal energy saving in the project activity is 38.5 GWhth which is below the limit of 180 GWhth as specified in the methodology AMS II.D.

As explained above, the project activity meets all the applicability criteria of the methodology as well as the stipulations of small scale projects. The parameter used to determine the baseline for the project activity, is the heat rate. The project activity reduces the heat rate by 3.3%. The following parameters are to be monitored to arrive at baseline emissions of the project activity

Table B.1 Parameters used to determine baseline for the project activity for both GT1 and GT2

Sl No	Parameters used to determine baseline	Unit	Remarks
1	Fuel consumption (NG)	SCM	Energy use in the existing equipment/ gas turbine i.e in pre-project scenario
2	Power Generation	kWh	Power generation from above fuel used in pre-project scenario
3	Net Calorific Value (NCV) of NG used	Kcal/SCM	In pre-project scenario

The baseline heat rate has been fixed based on the monitored historical fuel consumption and power generation data for the period of 2003-06.

The fuel consumption is measured in NM^3 and converted to SM^3 using the conversion ratio of 1.055. the originally calculated base line heat rate (as in the regd PDD) was 3302Kcal/Kwh using the historical data of NG consumption, calorific value of NG and the power generation from the two GTs from 2003-06.The emission reduction calculation, however, considered the NG value in NM^3 units, as the conversion to SM^3 was missed out. The recalculated base line heat rate using the NG consumption in SM^3 is 3483 Kcal/Kwh.

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 which are as below:

- 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:

- Reduction in the use of fossil fuel quantities on account of better efficiencies
- GHG reduction due to lesser use of fossil fuels

The project proponent was aware of the various barriers associated to project implementation but it was realised 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 faced by the project proponent for the project activity are discussed below:

Investment barrier

Alternatives to the project activity:

The project alternatives/ options that are available to ONGC are listed below:

1) Replacement of existing equipment with standard technical components

2) Replacement of existing components with up–rated components involving higher cost and lower return. (Project activity).

Investment comparison analysis:

ONGC performed detailed cost comparison of options (1) and (2).

An analysis was made spreading over one major inspection cycle i.e. 6 years, which is the normal life span of the components. Accordingly the maintenance costs (including cost of spares, component repairs and services) have been compared for two scenarios.

- If the operation is continued with standard technical components as per Option (1), the total cost of 2 gas turbines would be Rs 9.82 Crores

- If the machines are up-rated with new components as per Option (2), the cost involved for 2 gas turbines would be Rs 19.39 Crores

Comparing the two options, it is apparent that going for the up-rated components is a costlier proposition for ONGC. The purchase of up-rated spares in place of old (standard) technology spares involves an incremental cost of Rs 4.78 Crores / GT. Further more the expenditure for supplies required for up-rating two gas turbines will be Rs. 15.02 Crores. ONGC has calculated an IRR based on the incremental cost associated with uprated components over standard components where the additional cost associated due to adoption uprated components only are considered . This IRR works out to be 9.63% without considering CDM revenue stream, whereas the IRR would improve to 14.15% with the consideration of CDM funds. The proceeds from the sale of CERs will help the project to cross the hurdle rate (of 10% for ONGC) and will increase its financial viability.

Technological barrier: Gas turbines are high-tech capital equipment and are vital for operations. In general, continuous augmentation of components is required to sustain its performance by improving components' design, which is done by OEMs through R&D. These developments are required to overcome technological barriers for consistent performance of such equipments and in turn requires investments on ONGCs part.

The above section describes the significant investment barriers faced by ONGC towards the project activity. It is apparent that option (1) is the baseline or business as usual (BAU) scenario for the project activity, which did not face such barriers.

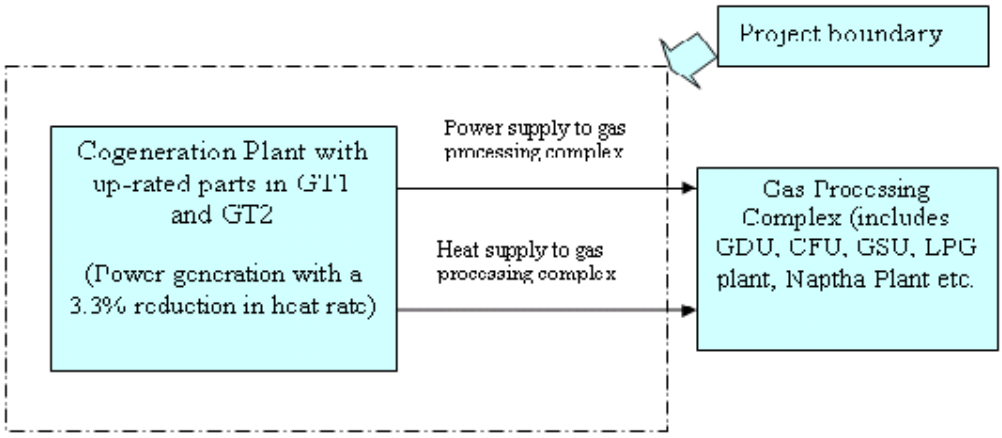
The financial barrier faced by ONGC demonstrates that the project activity is over and above BAU scenario and is additional.

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 the physical, geographical site of the facility / equipment affected by the project activity. The boundary encompasses the cogeneration plant where the project activity (gas turbines are up-rated) is being implemented and all the other gas processing facilities such as HGPC, Gas Sweetening Unit (GSU), Crude Fractionating Unit (CFU), LPG plant, Glycol Dehydrating Unit (GDU) etc. A schematic diagram for project boundary is shown below.

Fig B.1 Project boundary for the proposed project activity at ONGC, Hazira



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

>>

Date for completion of the baseline study: 11/05/2006

The baseline has been prepared by ONGC limited and its associated experts.

Contact information:

Oil and Natural Gas Corporation (ONGC) Limited

Hazira Plant, P.O.

ONGC Nagar Surat – 394 518,

Gujarat.

The entity is a project participant listed in Annex1.

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

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

>>

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

>>

07/07/2006

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

>>

12 years 0 months

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

>>

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:

>>

C.2.2.1. Starting date:

>>

01/04/2007

C.2.2.2. Length:

>>

10 years

SECTION D. Application of a monitoring methodology and plan:

>>

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 and 7' 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 and B.2, the project activity falls under Category II.D. Energy efficient power generation from the up-rated GT 1 and GT2 would lead to mitigation of GHG emissions that would have been released into the atmosphere by the less efficient operation of gas turbine with standard technical components. The project activity involves the installation of up-rated equipments in place of existing equipment. The monitoring methodology covers both the aspects i.e. new equipment and retrofit.

In order to monitor the mitigation of GHG due to the project activity, the fuel used and electricity generated quantities needs to be measured for both pre-project (existing equipment) and project (with retrofit) scenarios representing the baseline emissions and emission reductions respectively. In the monitoring plan the following data would be monitored for both GT1 and GT2:

1. Energy use/Energy generated of all the equipments.
2. Fuel used for generation of electricity and steam.

Based on the monitored data and the Intergovernmental Panel for Climate Change (IPCC) emission factors, the baseline emissions and project activity emissions are calculated.

There is no technology transfer in the project activity and therefore, the project activity would not lead to any leakage emissions. The difference between the baseline and project emissions would be the emission reductions 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	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 gas turbines (GT1 and GT2) during project activity								
P.1	*Quantity of fuel used(NG)*	*Plant*	*SCM (NM^3x1.055)*	*Measured*	*Monthly*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.2	*Net Calorific value of fuel*	*Plant*	*GJ/SCM*	*Measured*	*Monthly*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.3	*Gross Quantity of electricity generated*	*Plant*	*KWh*	*Measured*	*Continuous recording & monthly reporting*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.4	*Heat Rate*	*Plant*	*Kcal/KWh*	*Calculated*	*Monthly*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*
P.5	*Uprated Components identitification number*	*Plalnt*	-	-	*Yearly*	*100%*	*Paper & Electronic*	*Data archived: Crediting period + 2 yrs*

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

ID number	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 gas turbines (GT1 and GT2) in pre-project scenario								
B.1	*Quantity of fuel used(NG)*	*Plant*	*SCM (NM^3x1.055)*	*Measured*	*Monthly*	*3 year data before project*	*Paper OR Electronic*	*Data archived: Crediting period + 2 yrs*
B.2	*Net Calorific value of fuel*	*Plant*	*GJ/SCM*	*Measured*	*Monthly*	*3 year data before project*	*Paper OR Electronic*	*Data archived: Crediting period + 2 yrs*
B.3	*Quantity of electricity generated*	*Plant*	*KWh*	*Measured*	*Continuous recording & monthly reports*	*3 year data before project*	*Paper OR Electronic*	*Data archived: Crediting period + 2 yrs*
B.4	*Heat Rate*	*Plant*	*Kcal/KWh*	*Calculated*	*Monthly*	*3 year data before project*	*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.*
B.1	*Low*	*ISO 9001 or similar type of quality system is required.*
B.2	*Low*	*ISO 9001 or similar type of quality system is required.*
B.3	*Low*	*ISO 9001 or similar type of quality system is required.*
B.4	*Low*	*ISO 9001 or similar type of quality system is required.*

D.5. 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:

>>
The operational and management structure that will monitor the project activity is described in Fig D.1 below and the monitoring activities and responsibility is also listed in Table D.1 below:

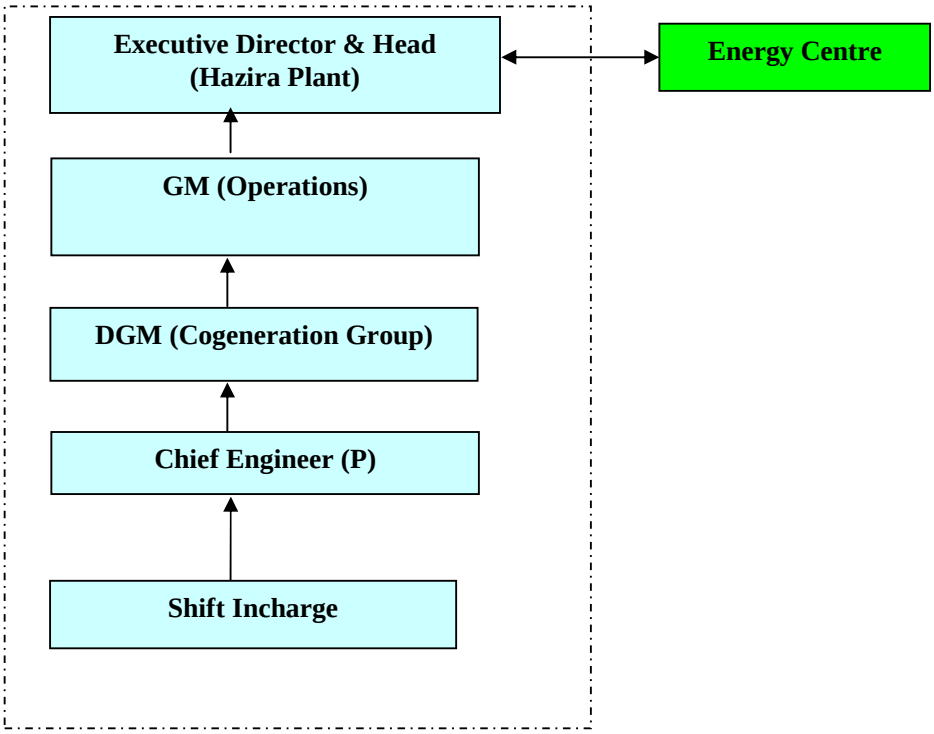


Fig D.1 Organisation structure and responsibility for CDM data gathering and reporting

Table D.1: Monitoring activities and responsibility

Monitoring activities	Procedure and responsibility
Data source and collection	ONGC has state of the art computerised monitoring system installed in the plant. This ensures accurate and continuous monitoring of all the data.
Frequency	Monitoring frequency would be as per section D.3 of this chapter
Review	All received data would be reviewed by the engineers in the CDM cell.
Data compilation	All the data would be compiled and stored in the CDM cell.
Emission calculation	Emission reduction calculations will be done annually based on the data collected and recorded. Engineers/Executives of CDM cell will

	do the calculations
Review	Sr. Manager/Manager, Corporate Engineering will review the calculation.
Emission data review	Final calculations would be reviewed and approved by DGM (Cogeneration Section)
Record keeping	All calculation and data record will be kept with the CDM cell with a retention period of 12 years

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

>>

The monitoring methodology has been prepared by ONGC limited and its associated experts.

Contact information: Oil and Natural Gas Corporation Limited Hazira Plant, P.O. ONGC Nagar Surat – 394 518, Gujarat. The entity is a project participant listed in Annex1.

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

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E.1.1 Selected formulae as provided in appendix B:

>>

No formula is 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:

>>

The step by step procedure to compute *PE* (project emission) is shown below:

$$Heat\ Rate_{project} = (Q_{project} * NCV_{project}) / EG_{Gen,project} \quad \textbf{(1)}$$

where:

$Heat\ Rate_{project}$ Reduced heat rate in Kcal / Kwh

$Q_{project}$ Quantity of fuel consumed in SCM (NM^3x1.055)

$NCV_{project}$ Net Calorific value of the fuel in Kcal/SCM

$EG_{Gen,project}$ Electrical energy generated in Kwh

$$REI = Q_{project} * NCV_{project} \quad \textbf{(2)}$$

Where,

REI Reduced energy input in Kcal

$Q_{project}$ Quantity of fuel consumed in SCM (NM^3x1.055)

$NCV_{project}$ Net Calorific value of the fuel in Kcal/SCM

$$PE = REI * EF \quad \textbf{(3)}$$

Where,

PE Project Emission in tCO_2

REI Reduced energy input in TJ

EF IPCC emission factor of the gas in tCO_2/TJ

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

>>

Not Applicable

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

>>

Same as E.1.2.1

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:

>>

The step by step procedure to compute *BE* (baseline emission) is shown below:

$$Heat\ Rate_{preproject} = Q_{baseline} * NCV_{baseline} / EG_{Gen,baseline} \quad (1)$$

where:

$Heat\ Rate_{preproject}$	Heat rate in Kcal / Kwh
$Q_{baseline}$	Quantity of fuel consumed in baseline scenario (SCM) (NM^3x1.055)
$NCV_{baseline}$	Net Calorific value of the fuel in baseline scenario (Kcal/SCM)
$EG_{Gen,\ baseline}$	Electrical energy generated in baseline (Kwh)

$$TEC = Heat\ Rate_{preproject} * EG_{Gen\ Average} * 4.186/10^9 \quad (2)$$

Where,

TEC	Total energy content of the fuel in TJ
Heat Rate $_{preproject}$	Heat rate in pre project scenario Kcal / Kwh
EG $_{Gen\ Average}$	Average Gross Electricity generated in baseline period in Kwh

$BE = TEC * EF$ **(3)**

Where,

BE Baseline emission in tCO_2e

TEC Total energy content of the fuel in TJ

EF IPCC emission factor of the gas in tCO_2e/TJ

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:

>>

$ER = BE – PE$

where:

ER Emission reduction in tCO2

BE Baseline emission in tCO2

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

>>

Year	Annual estimation of emission reduction in tones of CO_2 e
2007 – 2008	8231
2008 – 2009	8231
2009 – 2010	8231
2010 – 2011	8231
2011 – 2012	8231
2012 – 2013	8231
2013 – 2014	8231
2014 – 2015	8231
2015 – 2016	8231
2016 – 2017	8231
Total estimated reductions (tones of CO_2 e)	82310
Total number of crediting years	**10 years**
Annual average over the crediting period of estimated reductions (tones of CO_2 e)	8231

SECTION F.: Environmental impacts:

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

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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[1] 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 of the above mentioned notification.

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.

ONGC'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 of captive power generation process at HGPC. By this way, the project activity would reduce environmental impacts related to emissions from combustion of fossil fuels like NG. The project activity would not have any significant negative environmental impact at the site. The GHG emission reductions from project activity would benefit the global environment. The short summary of environmental impacts is given in table F.1 as below.

Table E.1: Environmental Impacts of project activity

SL NO	ENVIRONMENTAL IMPACTS & BENEFITS	REMARKS
A	CATEGORY: ENVIRONMENTAL – AIR QUALITY	
1	The project activity would use natural gas as fuel for power generation. The project being an energy efficient project activity reduces fossil fuel combustion thereby reducing environmental pollution.	The project activity reduces emissions of CO_2 - a GHG gas.
B	CATEGORY: ENVIRONMENTAL – WATER	
1	The project activity does not contribute to water pollution.	
D	CATEGORY: ENVIRONMENTAL – NOISE GENERATION	
1	The project activity does not contribute to noise pollution.	-

[1] 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:

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Identification of Stakeholders

The stakeholders identified for the project are as under.

- Local community
- Employees working at the cogeneration plant
- Project Consultants & Equipment Suppliers

ONGC has received comments from the Association of Scientific and Technical Officers (ASTO) as per which the main objective of the heat enhancement project is to reduce the heat rate of the gas turbines and therefore the reduction in fuel (gas) consumption by the gas turbines. ASTO has appreciated the efforts made by ONGC, Hazira plant for enabling environmental protection due to reduced fuel requirement and has also indicated that the project is beneficial to the organisation, employees and society at large.

G.2. Summary of the comments received:

>>

The project aimed at enhancing energy efficiency is an environmentally friendly project, which results in reduction in fuel gas consumption. It did not require any displacement of any local population. The project has therefore not caused any adverse social impacts on local population but has rather helped in improving their quality of life by reducing the fuel gas emissions and pollution.

ONGC Hazira plant has received comments from the Association of Scientific and Technical Officers (ASTO) who has indicated that implementation of this project will result in reduction of fuel gas consumption and will thereby protect environment by reducing the fuel gas emissions. ASTO has appreciated the efforts made by ONGC towards environmental protection and fuel conservation and they believe that this project is beneficial to organization, employees and society at large.

ONGC Hazira plant also received comment from S. S. Construction who is the regular O & M contractor working in the plant and maintains a large work force of over 50 personnels in the plant. They appreciated ONGC Hazira's effort which will go a long way in improving the environment and thus benefit their workforce.

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

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No adverse comments have been received from global stakeholders consultation

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Oil and Natural Gas Corporation (ONGC) Ltd.
Street/P.O.Box:	Energy centre, 10 floor
Building:	South Tower, SCOPE Minar Laxmi Nagar
City:	Delhi
State/Region:	-
Postfix/ZIP:	110092
Country:	India
Telephone:	91 11/22440829/ 22406479
FAX:	91 11/22011783
E-Mail:	chakraborty_ab@ongc.co.in
URL:	www.ongcindia.com
Represented by:	
Title:	General Manager
Salutation:	Mr.
Last Name:	Chakraborty
Middle Name:	-
First Name:	Ashok B.
Department:	Alternate Energy
Mobile:	
Direct FAX:	+91-011-2201 1783
Direct tel:	+91-011-22440829
Personal E-Mail:	chakraborty_ab@ongc.co.in

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding from annex 1 countries are available in the project activity

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Appendix I

STATEMENT SHOWING IRR WITHOUT CONSIDERING CDM BENEFIT

YEAR	CAPEX (OUTFLOW)	DEP	SAVINGS IN R&M	ADDL REV	GROSS REVENUE	INCOME TAX @33.66%	NET REVENUE	CASH INFLOW
A	B	C	D	E	F=(D+E-C)	G	H=(F-G)	I=(C+H)
0	71072910.6							-71072910.59
1		7107291	1275000	12281826.44	6449535.4	2170914	4278621.8	11385912.83
2		7107291	1275000	12281826.44	6449535.4	2170914	4278621.8	11385912.83
3		7107291	1275000	12281826.44	6449535.4	2170914	4278621.8	11385912.83
4		7107291	1275000	12281826.44	6449535.4	2170914	4278621.8	11385912.83
5		7107291	1275000	12281826.44	6449535.4	2170914	4278621.8	11385912.83
6		7107291	1275000	12281826.44	6449535.4	2170914	4278621.8	11385912.83
7		7107291	1275000	12281826.44	6449535.4	2170914	4278621.8	11385912.83
8		7107291	1275000	12281826.44	6449535.4	2170914	4278621.8	11385912.83
9		7107291	1275000	12281826.44	6449535.4	2170914	4278621.8	11385912.83
10		7107291	1275000	12281826.44	6449535.4	2170914	4278621.8	11385912.83
TOTAL		71072911	12750000	122818264.4	64495354	21709136	42786218	113859128.3
ACTUAL IRR								**9.634**

Note:

1. Capital cost depreciated by straight line method for 10 years
2. Detailed calculation for additional revenue is as follows: (i)+(ii)+(iii)+(iv)
   (i) Profit earned per year due increased output @ 10.6 % = 19.2 MW x 1000 x 0.106 x Rs (1.90 - 1.16) x 12 months x 214 hrs per month 3890527
   (ii) Profit due to less outage per year on account of wheel of power @ 9.91 MW = 9.91 MW x 1000 x 24hrs x Rs (4.16 - 1.16) x 4.33 days 3094073
   (iii) Profit due to less outage per year on account of sale of power @ 4.57 MW = 4.57 MW x 1000 x 24hrs x Rs (1.90 - 1.16) x 4.33 days 353526.3
   (iv) Saving due to heat rate reduction by 3.3% per GT per year = (51.37 / 3) x 24 hrs x 337.96 days x 355 nm3 / MWh x 1.055 x 0.033 x Rs. 2.88 / sm3 4943700
3. Capex has been worked out considering BQ dtd Sept. 04 and escalated @ 6% per annum 12281826
4. Operational hours of each machine calculated based on the average run hours of all the three GTs for last six years
5. Average power generation calculated based on the power generation by there GTs for the last two years

STATEMENT SHOWING IRR AFTER CONSIDERING CDM BENEFIT

YEAR	CAPEX (OUTFLOW)	DEP	SAVINGS IN R&M	ADDL REV	CDM BENEFIT	GROSS REVENUE	INCOME TAX @33.66%	NET REVENUE	CASH INFLOW
A	B	C	D	E	F	G=(D+E+F-C)	H	I=(G-H)	J=(I+C)
0	71072910.6								-71072910.59
1		7107291	1275000	12281826.44	3500000	9949535.385	3349014	6600521.8	13707812.83
2		7107291	1275000	12281826.44	3500000	9949535.385	3349014	6600521.8	13707812.83
3		7107291	1275000	12281826.44	3500000	9949535.385	3349014	6600521.8	13707812.83
4		7107291	1275000	12281826.44	3500000	9949535.385	3349014	6600521.8	13707812.83
5		7107291	1275000	12281826.44	3500000	9949535.385	3349014	6600521.8	13707812.83
6		7107291	1275000	12281826.44	3500000	9949535.385	3349014	6600521.8	13707812.83
7		7107291	1275000	12281826.44	3500000	9949535.385	3349014	6600521.8	13707812.83
8		7107291	1275000	12281826.44	3500000	9949535.385	3349014	6600521.8	13707812.83
9		7107291	1275000	12281826.44	3500000	9949535.385	3349014	6600521.8	13707812.83
10		7107291	1275000	12281826.44	3500000	9949535.385	3349014	6600521.8	13707812.83
TOTAL		71072911	12750000	122818264.4	35000000	99495353.85	33490136	66005218	137078128.3
ACTUAL IRR									14.15

Note:
1. Capital cost depreciated by straight line method for 10 years
2. Detailed calculation for additional revenue is as follows: (i)+(ii)+(iii)+(iv)
   (i) Profit earned per year due increased output @ 10.6 % = 19.2 MW x 1000 x 0.106 x Rs (1.90 - 1.16) x 12 months x 214 hrs per month
   (ii) Profit due to less outage per year on account of wheel of power @ 9.91 MW = 9.91 MW x 1000 x 24hrs x (Rs 4.16 - 1.16) x 4.33 days
   (iii) Profit due to less outage per year on account of sale of power @ 4.57 MW = 4.57 MW x 1000 x 24hrs x Rs (1.90 -1.16) x 4.33 days
   (iv) Saving due to heat rate reduction by 3.3% per GT per year = (52.88 / 3) x 24 hrs x 340 days x 355 nm3 / MWh x 1.055 x 0.033 x Rs. 2.387 / sm3
3. CDM benift Rs. 3500000 considered per year
4. Capex has been worked out considering BQ dtd Sept. 04 and escalated @ 6% per annum
5. Operational hours of each machine calculated based on the average run hours of all the three GTs for last six years
6. Average power generation calculated based on the power generation by there GTs for the last two years

Appendix II

Abbreviation

BAU	Business As Usual
BHEL	Bharat Heavy Electrical Limited
CDM	Clean Development Mechanism
CFU	Crude Fractionating Unit
DGM	Deputy General Manager
FY	Financial Year
GDU	Glycol Dehydrating Unit
GE	General Electric
GHG	Green House Gas
GJ	Giga Joule
GM	General Manager
GoI	Government of India
GSU	Gas Sweetening Unit
GT	Gas Turbine
GTG	Gas Turbine Generator
GWh	Giga
HGP	Hot Gas Path
HGPC	Hazira Gas Processing Complex
Hr	Hour
IGV	Inlet Guide Vane
IPCC	Intergovernmental Panel for Climate Change (IPCC)
IRR	Internal Rate of Return
ISO	International Organisation for Standardisation
Kcal	Kilo Calorie
KWh	Kilo Watt Hour
LPG	Liquefied Petroleum Gas
$MMNM^3$	Million Metric Newton M^3
MoEF	Ministry of Environment and Forest
MWh	Mega Watt Hour
N/T	New Technology
NG	Natural Gas
NGL	Natural Gas Liquid
OEM	Original Equipment Manufacturers
ONGC	Oil and Natural Gas Corporation
P	Production
PO	Post Office
QA	Quality Assurance
QC	Quality Control
R&D	Research and Development
SCM	Standard Cubic Meter
SPM	Suspended Particulate Matter
UNFCCC	United Nations Framework Convention on Climate Change

Appendix III
Reference List

Sl No	Reference
1	Kyoto Protocol to the United Nations Framework Convention For Climate Change(UNFCCC) **www.unfccc.int/cdm**
2	Website of United Nations Framework Convention For Climate Change(UNFCCC) **http://unfccc.int**
3	UNFCCC decision17/CP.7 : Modalities and procedures for a clean development mechanism as defined in article 12 of the Kyoto protocol
6	Website of Climate Change Cell, Ministry of Environment and Forest, Government of India**.** **www.envfor.nic.in**
7	Oil & Natural Gas Corporation Ltd, ONGC Home, **www.ongcindia.com**
8	Website of Climate Change Cell, Ministry of Environment and Forest, Govt of India**.** **www.envfor.nic.in**
9	Website of Indiainfoline - **www.indiainfoline.com**
10	Website of the Maps of India – **www.mapsofindia.com**
11	Approved Methodology Smallscale projects AMS II.D – Energy efficiency and fuel switching measures for industrial facilities, available on UNFCCC website cdm.unfccc.int