**PROJECT DESIGN DOCUMENT FORM
FOR SMALL-SCALE CDM PROJECT ACTIVITIES (F-CDM-SSC-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Amine Circulation Pumps Energy Efficiency at Hazira works of ONGC
Version number of the PDD	05
Completion date of the PDD	18/06/2013
Project participant(s)	Oil and Natural Gas Corporation (ONGC) Ltd
Host Party(ies)	India
Sectoral scope(s) and selected methodology(ies)	Sectoral Scope 4: Manufacturing industries AMS II: D, "Energy Efficiency and Fuel Switching Measures for Industrial Facilities", version 11
Estimated amount of annual average GHG emission reductions	4043 tCO_{2e}

SECTION A. Description of project activity
A.1. Purpose and general description of project activity
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Oil and Gas Corporation Limited (ONGC) is one of the leading oil & gas producers in the country. One of the major oil and gas fields owned as well as operated by it, is located off the coast of Mumbai and is collectively known as Mumbai Offshore. ONGC has a gas processing facility located at Hazira in the state of Gujarat, which carries out processing of gas received from the Mumbai offshore fields.

During processing, desulphurisation is one of the operations carried out to remove sulphur (which is present in the form of H_2S) from the natural gas received. This removal of H_2S is carried out in Gas Sweetening Units (GSU's) mainly consisting of eight absorption towers. These towers use Methyl Di-Ethanol Amine (Amine) as the absorbent. The lean amine (free from H_2S) is pumped into the absorption tower using eight stage high capacity centrifugal pumps. Each absorption tower is serviced by two such pumps, one operating and another standby. The rich amine containing H_2S absorbed from the sour gas, is stripped of the H_2S in the sulphur recovery units, and re-circulated back into the tower. The GSU facility comprising of two trains, currently, processes approximately 41 million metric standard cubic meters of gas per day.

The amine charge pumps are critical to the operation of GSU's. They are energy intensive and constitute about 15% of the total power load of the Hazira Processing Plant. Sharing the global concern regarding the climate change, and with the objective of carrying out its operations in more sustainable manner, ONGC aimed at improving energy efficiency of the amine charge pumps involved in its operations. This energy efficiency measure is effected, by way of reduction in differential pressure via technological intervention, to achieve savings in the energy consumption of the amine circulation pumps.

Fig-1- Eight Stage Amine Circulation Pump

Technological Intervention:
In the course of operation of the pumps it was observed that, the discharge pressure requirement of amine circulation pumps was reduced as compared to the design conditions. This was realized in view of reduction in sour gas (natural gas containing H2S and CO2) pressure. Thus, keeping in mind the current operating parameters, with the emphasis on energy efficiency measures, various options to optimize pump measures and energy consumption were deliberated as below;

- Replacing the Pumps
- Taper Trimming of Existing Pumps
- Stage Blanking – *Reduction of one Stage, Pump effectively becomes 7 stage instead of the original eight stage configuration.*
- A combination of Stage Blanking and Taper Trimming

It was decided to carry out "taper trimming" on a trial basis. Accordingly, the taper trimming of two pumps in Gas Sweetening Unit – 1 (GSU – 1) was carried out in 2005. An independent review of the pump performance and energy efficiency by way of taper trimming was carried out between August – November 2005, through Petroleum Conservation Research Association (PCRA) of India, a nodal body which lays down guidelines in energy conservation and assists the Government of India in policy decisions. The PCRA, on 12th January 2006 presented its findings of the study and confirmed that there was a power saving of 30.5 KWh per pump due to taper trimming. It thus recommended, carrying out of taper trimming of other pumps as well, in a phase-wise manner. It was also decided to examine the feasibility of additional energy savings by carrying out "stage blanking".

Stage Blanking, mainly deals with re-configuration of the pump, so that its optimal duty point (discharge head) is much closer to the required operating point (discharge pressure requirements), as compared to standard design conditions. Stage Blanking effectively means reduction of one stage. Effectively in a multi-stage pump, one stage is reduced by blanking. This blanking is carried out by replacing the impeller of one stage, with a blanking bush. This ensures creation of a special blank section, that facilitates the smooth transfer of fluid from the previous stage diffuser outlet, directly to the impeller inlet of following stage.

While the option of doing the stage blanking was considered as a good initiative from the view point of energy efficiency, the management at large had the apprehensions regarding the success of such an initiative on one part and about putting the pump (and the whole plant) at risk on the other. Such apprehensions were largely based on the fact that there was no example to follow as far as stage blanking of amine circulation pumps in India is concerned. With no previous successful demonstration of operation of pumps with stage blanking, there were perceived risks to go ahead with such an activity. In view of the apprehensions, discussions were held with the OEM, the experienced plant operations personnel specialized in pump and flow dynamics, etc. Based on these discussions the following technical risks were flagged at the time of project go-ahead, which could impact the smooth and sustained operations of the gas processing units.

- The risk of normal operation and pump running parameters differing considerably from the OEM suggested curves with respect to discharge pressure and the flowrate. The possibility of insufficient discharge pressure build up, cannot be ruled out because of the removal of one stage. This may lead to change in operational efficiencies, leading to loss in the pumps ability to transport fluid. The pump related fluid dynamics would be drastically changed, as a result of change in design and removal of one stage. It may also result to variation in the pump's ability to handle the design level suction pressure parameters, and thus adversely affect pump delivery and operational efficiencies.
- The modification may lead to mechanical problems during the normal running of the pump, due to any harmonial imbalance occurring as a result of loss of one complete stage. Harmonic imbalance during operations may lead to mis-alignment of pump shaft, and increase in chances of internal local sheer, along internal pump walls. This may lead to abnormal vibrations or even fatigue failure over a period of time, as a result of continued operations in less that sub-optimal conditions. Consistent exposure to abnormal vibrations result, is anticipated to result in progressive and localized structural damage, and may be caused as a result of dislocation

movements within the pump shaft, and power train with the damage being cumulative. Increase in mechanical problems perceived, would ultimately hamper pump delivery parameters, thus reducing the life of the pump and increase the mechanical maintenance activities of all the sub-components of the pump. Chances of harmonic distortion percolating to other equipments / instruments connected within the pump operational closed system loop, are perceived to be very high, as well.

- The possibilities of the pressure switch in the discharge not functioning optimally, at reduced settings also exist. The mal-functioning of the pressure switch may result in pump not getting started at the desired time interval, or may result in pump being operational inspite of insufficient discharge pressure not being built up. This may also adversely impact the continued and sustained optimal operations of the pump. This needs to be viewed in light of the fact that such pressure switches has the range within which they work the best.
- Any possible outage in the pump, may disrupt processing of the gas handled by one train, as it may happen that the stand-by pump may not be available due to maintenance requirements. This will lead to reduction the gas processing capacity. The reduction in the gas processing capacity will necessitate reduction in the gas production rate. This is largely due to the fact the unlike crude oil gas is not stored in large quantities before being processed. Thus even a temporary reduction in the rate of processing will lead to reduction in the output. The reduction in the output is directly related to the larger issue of loss of revenue on one part and the responsibility of the organisation to satisfy the demand of the nation on the other.

However, considering the savings in energy consumption, and after reconfirmation of the modified design condition meeting operating parameters from the OEM via performance curves, it was decided to part mitigate the risks of lack of successful demonstration, by going ahead with the technological intervention to effect energy efficiency measures considering CDM benefits.

With this view of the management, a combination of stage blanking and taper trimming of the impellers in one of the stages was planned. A work order for Stage Blanking, with modified rotor assembly installation and commissioning on actual basis was placed on M/S Bharat Pumps and Compressor Ltd., Naini, Allahabad on 10th March 2006. The pump was received on 8th July 2006, with installation and re-commissioning carried out on 28th July 2006. The pressure switch setting was changed from 75 kg/cm^2 to 70 kg/cm^2. The trial runs were satisfactory and fairly met all process and operational requirements. Further to this it was observed that the current drawn by the motor of the pump reduced by 10-12 Amperes resulting in savings in power consumption. Considering the fact, that the major contributing factor in power savings is stage blanking, it was decided to go ahead with only stage blanking for all the remaining pumps contained in both the GSU trains, in a phase wise manner.
The plan / commissioning schedule for the implementation of Stage Blanking of remaining pumps is tabulated as below;

As a standard practice, modifications in the remaining pumps would be carried out at the time of overhauling of the same. Thus the implementation of a part of the project activity would be delayed. Based on a broad statistical guesstimate taking into consideration the changed scenario of modified maintenance practices and its effect on the health of the pumps, operational requirement trends and other contributing factors, the remaining pumps may undergo major repair and stage blanking by 2016.

GHG Mitigation:
Incorporation of stage blanking in amine circulation pumps would lead to reduction in the consumption of power, while at the same time meeting the operational requirements of the facility. This reduction in the power consumption, leads to reduction in the need to generate power in the fossil fuel based power plants, and thus leads to corresponding reductions in emissions of carbon dioxide, which is one of the Green House Gases (GHG) covered under the Kyoto Protocol.

Sustainable Development:
The CDM activity proposed by ONGC is in-line with the Host Country (Government of India) sustainable development criteria which is based on the following;

- Social well-being,
- Economic well-being,
- Environmental well-being and,
- Technological well-being.

The four criteria are well met based on the reductions in GHG emissions. These reductions are effected by the reduced consumption in electricity, correspondingly reduced demand of fossil fuels for power generation.

The Ministry of Environment and Forests (MoEF, India's Designated National Authority) is recently diverting all its major focus towards energy security and energy efficiency policy recommendations. Enhancing energy supply and access is a key component of the national development strategy, driven by the imperatives of sustainable development. The reduced demand of fossil fuels, reductions in GHG emissions play a major role in combating the harmful effects of climate change and global warming, (the very essence of Kyoto Protocol and Clean Development Mechanism) and thereby ensuring Social, Economic and Environmental well-being.

The project contributes to sustainable development by;

- Reduction in Fossil Fuel combustion – a non-renewable resource of limited availability
- Reduction in GHG emissions (mainly carbon dioxide) & other pollutants associated with the use of fossil fuels.
- Encouraging other facilities irrespective of sector to adopt energy efficient measures,
- Enhancing the productivity of the plant and thereby of the country, by reducing the energy costs.
- Releasing the available primary source of energy, for processes wherever it is necessary.

Also, the technology intervention of stage blanking and taper trimming, proposed under the CDM project will not have any adverse impact on all the above four fold criteria and as compared to the 'business as usual' scenario of the continuation of operation of pumps without any modification.

A.2. Location of project activity

A.2.1. Host Party(ies)

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India

A.2.2. Region/State/Province etc.

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Surat, Gujarat.

A.2.3. City/Town/Community etc.

>>
Hazira

A.2.4. Physical/ Geographical location

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The works are located at Hazira in Surat district, State of Gujarat, in India.

Hazira is located 230km north of Mumbai, 21 km from Surat city on the right bank of river Tapi. Unimpeded passage to the Arabian Sea is just 8 km away, with the Surat-Hazira port at a distance of 10.2 km from the works. The industrial hub is well connected with the National Highway #8 passing by the town and the presence of an airport just 8 km away.

Longitude – 21˚ 9' 42" N
Latitude – 72˚ 43' 44" E

Hazira
Gujarat
India

A.3. Technologies and/or measures
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Stage Blanking, mainly deals with re-configuration of the pump, so that its optimal duty point (discharge head) is much closer to the required operating point (discharge pressure requirements), as compared to standard design conditions. Stage Blanking effectively means reduction of one stage. Effectively in a multi-stage pump, one stage is reduced by blanking. This blanking is carried out by replacing the

impeller of one stage, with a blanking bush. This ensures creation of a special blank section, that facilitates the smooth transfer of fluid from the previous stage diffuser outlet, directly to the impeller inlet of following stage.

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- The risk of normal operation and pump running parameters differing considerably from the OEM suggested curves with respect to discharge pressure and the flowrate. The possibility of insufficient discharge pressure build up, cannot be ruled out because of the removal of one stage. This may lead to change in operational efficiencies, leading to loss in the pumps ability to transport fluid. The pump related fluid dynamics would be drastically changed, as a result of change in design and removal of one stage. It may also result to variation in the pump's ability to handle the design level suction pressure parameters, and thus adversely affect pump delivery and operational efficiencies.
- The modification may lead to mechanical problems during the normal running of the pump, due to any harmonial imbalance occurring as a result of loss of one complete stage. Harmonic imbalance during operations may lead to mis-alignment of pump shaft, and increase in chances of internal local sheer, along internal pump walls. This may lead to abnormal vibrations or even fatigue failure over a period of time, as a result of continued operations in less that sub-optimal conditions. Consistent exposure to abnormal vibrations result, is anticipated to result in progressive and localized structural damage, and may be caused as a result of dislocation movements within the pump shaft, and power train with the damage being cumulative. Increase in mechanical problems perceived, would ultimately hamper pump delivery parameters, thus reducing the life of the pump and increase the mechanical maintenance activities of all the sub-components of the pump. Chances of harmonic distortion percolating to other equipments / instruments connected within the pump operational closed system loop, are perceived to be very high, as well.
- The possibilities of the pressure switch in the discharge not functioning optimally, at reduced settings also exist. The mal-functioning of the pressure switch may result in pump not getting started at the desired time interval, or may result in pump being operational inspite of insufficient discharge pressure not being built up. This may also adversely impact the continued and sustained optimal operations of the pump. This needs to be viewed in light of the fact that such pressure switches has the range within which they work the best.
- Any possible outage in the pump, may disrupt processing of the gas handled by one train, as it may happen that the stand-by pump may not be available due to maintenance requirements. This will lead to reduction the gas processing capacity. The reduction in the gas processing capacity will necessitate reduction in the gas production rate. This is largely due to the fact the unlike crude oil gas is not stored in large quantities before being processed. Thus even a temporary reduction in the rate of processing will lead to reduction in the output. The reduction in the output is directly related to the larger issue of loss of revenue on one part and the responsibility of the organisation to satisfy the demand of the nation on the other.

However, considering the savings in energy consumption, and after reconfirmation of the modified design condition meeting operating parameters from the OEM via performance curves, it was decided to part mitigate the risks of lack of successful demonstration, by going ahead with the technological intervention to effect energy efficiency measures considering CDM benefits.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (Host)	Oil and Natural Gas Corporation (ONGC) Ltd. (A Public Sector Enterprise/ Government of India Undertaking)	No

A.5. Public funding of project activity
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The project has been implemented by ONGC using its own funds and resources .There is no external funding involved in the project. No Official Development Assistance (ODA) & Global Environment Facility (GEF) fund has been used for the project.

A.6. Debundling for project activity
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As per the Appendix C of the "Simplified Modalities and Procedures for Small Scale CDM Activities" a proposed small scale project activity shall be deemed to be a de-bundled component of a large scale project activity if there is a registered small scale CDM 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 and
- Registered within the previous two years and
- Whose boundary is within 1 km of the project boundary of the proposed small scale activity at the closest point

The project activity is not a de-bundled component of a large project activity as there is no small scale CDM project activity or an application registered by ONGC, in the same project category in the last two years within 1 km of the project boundary of the proposed small scale project activity.

SECTION B. Application of selected approved baseline and monitoring methodology
B.1. Reference of methodology
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Type II: Energy Efficiency Improvement Projects

Category AMS II: D, Version 11. "Energy Efficiency and Fuel Switching Measures for Industrial Facilities"

Version: 11, Sectoral Scope 4.

B.2. Project activity eligibility
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The justifications to the use of simplified modalities and procedures for small scale CDM project activity and the choice of the project category are as per the table below;

Applicability Criteria of Approved Methodology AMS II D version 11, as well as Small Scale CDM activity.	Project Activity	Comments
Any energy efficiency and fuel switch measure	The project deals with the energy efficiency measures implemented for the amine circulation pumps	Methodology Applicable
Implemented at a single industrial, mining or mineral production facility	The project is implemented at the Hazira Gas processing complex, a single industrial facility	Methodology Applicable
Category primarily aimed at energy efficiency	There is no fuel switch or any other related measure involved in the proposed CDM project activity. Hence it aims, primarily at Energy Efficiency	Methodology Applicable
The energy efficiency measures may replace, modify, or retrofit existing facilities or to be installed in a new facility	The activity deals with modification of existing amine charge pumps in the production facility	Methodology Applicable
Aggregate savings of a single project may not exceed the equivalent of 60 GWh_e per year.	Aggregate energy savings of the project does not exceed 4957 MWh_e in any year of the crediting period.	Methodology Applicable
Applicable to project activities where it is possible to directly measure and record energy use within the project boundary	It is possible to measure and record the energy consumption figures for the amine circulation pumps	Methodology Applicable
Applicable to project activities where the impact of the measures implemented (improvements in energy efficiency) by the project activity can be clearly distinguished from the changes in energy use	The impact of the energy saving measure at the amine circulation pumps can be observed with the reduction in the power consumption, which would have otherwise have had to be generated at the captive plant in the gas processing complex	Methodology Applicable

The above parameters demonstrate that the approved methodology AMS II D applies to the CDM project activity under consideration. The project also qualifies as small scale activity and will remain under the limits of small scale activity types during every year of the crediting period, as the annual energy savings on account of energy efficiency improvements will not exceed 60 GWh_e in any year of the crediting period.

B.3. Project boundary

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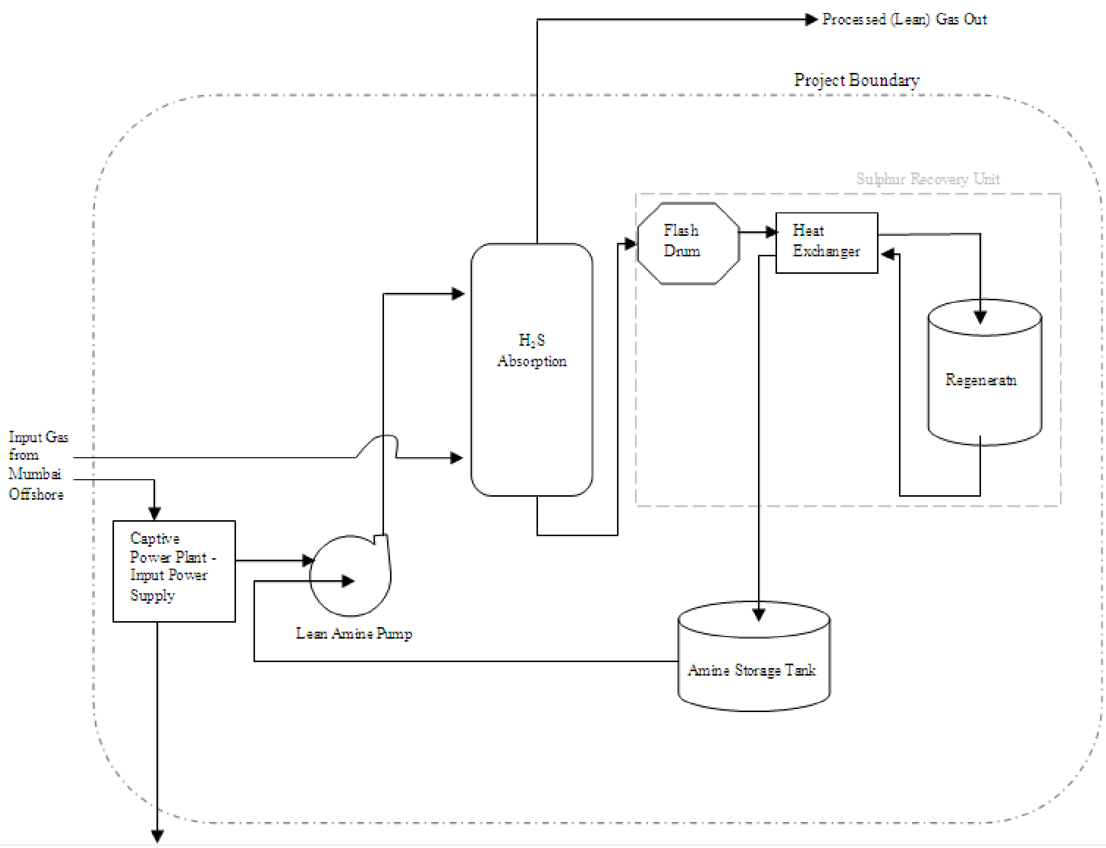
As per the approved methodology AMS II D, the project boundary is defined as the physical, geographical, site of the industrial, mining or mineral production facility, processes or equipments that are affected by the project activity.

The proposed CDM project aims at achieving savings in energy consumption by implementing energy efficiency measures for the amine charge pumps. These pumps are the integral part of the Gas Sweetening Unit of the Hazira Gas Processing Complex of ONGC.

The captive natural gas based power plant and the Gas Sweetening Units (only GSU I and GSU II) form the project boundary (based upon the criteria listed above – processes or equipments that are affected by the project activity), as the process is affected by the energy efficiency measure implemented for the amine charge pumps. Accordingly, only the ten amine charge pumps servicing GSU I and GSU (for series 31-35), and the captive natural gas based power plant would be the part of the project boundary. The remaining six amine charge pumps, namely for 36,37and 38 series would not be considered as the part of the project boundary, and subsequently the part of CDM project. activity.

The chart below depicts the Gas Sweetening Unit process, and the project boundary.



B.4. Establishment and description of baseline scenario

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The development of the baseline is carried out as per the guidelines laid down in the approved methodology AMS II D;

Baseline Criteria as enlisted in Approved Methodology AMS II D, Version 11,	**Baseline as applicable to the Project Activity.**
In the case of replacement, modification or retrofit measures, the baseline consists of the energy baseline of the existing facility or the sub-system that is being replaced, modified or retrofitted.	Current levels of Power Consumption, of the Amine Charge Pumps without any technical intervention, form the energy baseline of the sub-system that is being replaced, modified or retrofitted.
In the absence of the CDM project activity, the existing facility would continue to consume the energy (ECbaseline, in GWh/year) at historical average levels (EChistorical, in GWh/year) until the time at which the industrial or mining and mineral production facility would be likely to be replaced, modified or retrofitted in the absence of the CDM project.	The existing Amine Charge Pumps would be needed to be replaced after 12 years from now. This point of replacement is arrived at, taking into consideration the typical average lifetime of the Pump based on common practices in the sector and the country. This is also based on the confirmation of the residual life of the pumps by the experts. Therefore, in the absence of the CDM project activity, the existing amine charge pumps (without technological intervention) would continue to consume the power at the historical average levels during the entire crediting period.
Each energy form in the emissions baseline is multiplied by an emission coefficient (in kgCO_2e/KWh). For Electricity displaced, the emission coefficient is calculated in accordance with the provisions under the category I D. For fossil fuels, IPCC default values for emission coefficients may be used.	For the project activity under consideration, electricity is displaced as a result of the energy efficiency improvement measure. Thereby the emission coefficient calculations in accordance with the provisions under category I D apply. Category I D covers “Grid Connected Renewable Energy Generation”. However, the electricity displaced in the proposed CDM activity, would have been supplied by the Captive Gas based generation plant at the Hazira processing works of ONGC, as is currently the case. Thereby more specific to the project, for the electricity displaced from fossil fuel (natural gas) based captive power generation plant, the energy baseline is calculated as per the approach depicted in Section B.6.1.
Leakage is to be considered if energy efficient technology equipment transferred from another activity or if the existing equipment is transferred from another activity.	Since for the current project activity, the existing amine charge pumps are modified for energy efficiency measures, there is no transfer of equipment from another facility. Therefore leakage is not considered.

As per the applicable methodology AMS II D, “Energy Efficiency and Fuel Switch Measures for Industrial Facilities” , paragraph 6 – in the absence of the CDM project activity, the existing facility would continue to consume energy (ECbaseline, in GWh/year) at historical average levels (EChistorical, in GWh/year), until the time at which the industrial or mining and mineral production facility would be

likely to be replaced,modified or retrofitted in the absence of the CDM project activity. This date is defined as the DATEBaselineRetrofit. In this case, the pumps would have continued consume energy at baseline levels, until January 2020, as per the residual life of the pumps[1].

The DATERetrofit is therefore defined as 8th January 2020, for the project activity.

B.5. Demonstration of additionality
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As mentioned above the proposed CDM initiative qualifies under the category "AMS II. D: Energy Efficiency and Fuel Switch Measures for Industrial Facilities" of the Simplified Modalities and Procedures for Small Scale CDM Activities; this can only be used if the project participant can demonstrate that the project activity is additional, and would not have otherwise implemented due to the existence of one or more barriers as enlisted below. A CDM project activity is considered additional if and only if anthropogenic emissions of greenhouse gases are reduced below those levels that would have occurred in the absence of the CDM activity.

In the absence of CDM, the project activity would not have occurred due to the following barriers;

Technological Barrier
A less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty, and would have led to higher emissions.

The project activity in the business as usual scenario (i.e. in the absence of the proposed CDM activity) would have continued to operate without any technological intervention, and correspondingly continued with the historical levels of energy consumption. The smooth, consistent and continued operations of the amine charge pumps are critical for the Gas Sweetening Units, which carry out critical processes of the Hazira Gas Processing Unit. The technology for the modification of the pumps (stage blanking) is not developed in the country. There are perceived technical risks associated with such kind of a technical intervention mainly revolving around the possibility of operating parameters differing considerably from the OEM suggested curves with respect to discharge pressure and flow rate. The modification may also lead to some mechanical problems during operations of the pump, as a result of a possible harmonial imbalance leading to abnormal vibrations or fatigue failure over a period of time. The pressure switch may not function properly at reduced settings. Overall any outage of a single pump may significantly affect processing of gas handled by one train, i.e. approximately 5 MMSCMD.

Only pilot level tests have been carried out, that too at the project proponent's facility and nowhere else. The operators and technicians were needed to be updated and trained on the possible modifications to be carried out and the technical know-how essential to maintain system integrity, and good O&M practices. Although the pilot level trials have been acceptable, the uninterrupted and consistent performance by way of such technological intervention is yet to be observed. Thus there is a perceived technical risk associated with the project.

Common Practice/Lack of Demonstration Barrier
Unless compliances or adherence norms are present, or there is any significant incentive towards use of energy efficient technologies, there would be no additional investments/expenditure towards environmental sustainability and lower GHG emissions;

[1] As per the certificate obtained from the OEM, "Bharat Pumps & Compressors Limited" for the residual life of the amine circulation pumps

The technological intervention, enabling energy efficiency for the amine charge pumps and thereby reductions in energy consumptions, is currently not commercially established across the country. There has been no demonstration of the use of such energy efficient technology for amine charge pumps. Also, the OEM infrastructure for executing the modification of the said pumps is presently available with only one vendor in India. In India, for the manufacturing sector, energy efficiency is not under the purview of any legal act or policy. Also, there are no regulations either at State or Municipal or Country level that compel or constrain the facility from implementing energy efficiency projects, thereby depicting lack of a strong drive towards improving the energy efficiency. The non-existence of any energy efficiency compliance regulations from the Government and other Nodal Authorities, thereby also act as common practice barriers.

The following chronological order, details the sequence of activities in the implementation of the project activity.

Particulars	Timelines
PCRA suggestions to examine the feasibility of Stage Blanking, based upon their Energy Audit in 2005-06	Jan 2006
Performance curves obtained from Bharat Pumps and Compressors Limited, after the request by ONGC to evaluate feasibility of Stage Blanking	Jan 2006
Performance Curves obtained from David Brown Guinard Pumps, France, after the request by ONGC to evaluate feasibility of Stage Blanking	Jan 2006
Deliberations with regards to the technical risks associated with the Proposed CDM project activity.	Feb 2006
Internal meeting for decision to go ahead with the proposed CDM project activity.	Feb 2006
Issue of work order for carrying out of Stage Blanking of the first pump TAG Number – 31P301B	Mar 2006
Communication initiated with CDM project development consultants, so as to initiate the procedure for internal approvals	Jul 2006
Awareness training to Operations and Management personnel, with regards to the technological intervention	Jul 2006
Installation and Stage Blanking of the first pump with Stage Blanking	Jul 2006
Floating of internal working paper to engage consultant for CDM Project Development	Sep 2006
Internal Approval received from the Director Onshore	Sep 2006
Proposal for re-appropriation of budget	Sep 2006
Revision of Purchase Requisition (PR)	Nov 2006 – Feb 2007
Tender Committee Meeting	Mar 2007
Tendering Process	Apr – Oct 2007
Installation and Commissioning of the second stage blanked pump TAG Number – 32P301B	Jul 2007
Installation and Commissioning of the third stage blanked pump TAG Number – 35P301A	Aug 2007
Appointment of consultant for CDM project development	Oct 2007
Installation and Commissioning of the fourth stage blanked pump TAG Number – 33P301B	Apr 2008
Stake-holder Consultation meeting for CDM project development	Jun 2008

Project submitted to the Designated National Authority, as a request for Host Country Approval	Sep 2008
Installation and Commissioning of the fifth stage blanked pump TAG Number – 34P301A	Sep 2008
Meeting with the National CDM Authority for application of HCA	Oct 2008
Appointment of Designated Operational Entity for the validation of the project	Oct 2008
Receipt of Host Country Approval by the Authorised Designated National Authority, (DNA) for India, i.e. Ministry of Environment and Forests	Feb 2009

B.6. Emission reductions
B.6.1. Explanation of methodological choices
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The calculations for energy baseline for the power consumption by the Amine charge pumps in the project boundary are carried out as below; the power for the same is supplied by the captive natural gas based generation unit within the industrial facility.

The methodological tools referred for the calculations are;

- Tool to calculate project emissions from electricity consumption
- Tool to calculate project or leakage CO_2 emissions from Fossil Fuel Combustion.

The emission reductions associated with the project activity can be computed based upon the following relationship;

$$\mathbf{ER_{ECy} = BE_{EC,y} - PE_{EC,y}}$$

Where;
ER_{ECy} = Emission reductions in the period Y (tCO_2)
$BE_{EC,y}$ = Baseline emissions that would have occurred in the baseline scenario, during period ‘Y’ (tCO_2)
$PE_{EC,y}$ = Project emissions during the period Y (tCO_2)

Baseline Emissions that would have happened in the absence of the project activity, would be computed by the multiplication of estimated Baseline Energy Consumption (**$EC_{PJB,y}$**) and the emission factor for the applicable for the source of power (**$EF_{CP,y}$**).

In order to estimate the consumption of power which would take place in the baseline scenario a relationship has been developed between the power consumption load and the gas flow rate. The relationship has been developed using historical data regarding the power load and the corresponding gas flow rates prior to the technical intervention carried out as the proposed CDM project. The energy consumption which would have occurred in the baseline scenario, will be determined by monitoring the actual rate of Sour Gas Processed (**$FG_{PJ,y}$**), and using the relationship developed below to compute the corresponding values of Baseline Emissions.

$$\mathbf{L_{Base,y} = 8.12 * Q_y + 706.08}$$

Where;
$L_{Base,y}$ = Average Load during the period ‘Y’ (KW)
$Q_{,y}$ = Average Rate of Gas Processing during period ‘Y’ in the tower connected to the pump (MMSCMD)

$$\mathbf{EC_{PJB,y} = T_y * L_{Base,y}}$$

Where;
$EC_{PJB,y}$ = Energy consumption that would have occurred in the baseline scenario, during period 'Y' (MWh)
T_y = Duration of operation of the pump during the period 'Y' (Thousand Hours)
$L_{Base,y}$ = Average Load during the period 'Y' (KW)

$$BE_{EC,y} = EC_{PJB,y} * EF_{CP,y}$$

Where;
$BE_{EC,y}$ = Baseline emissions that would have occurred in the baseline scenario, during period 'Y' (tCO_2)
$EC_{PJB,y}$ = Energy consumption that would have occurred in the baseline scenario, during period 'Y' (MWh)
$EF_{CP,y}$ = Emission factor for the captive power plant in the year y (tCO_2/MWh)

Project Emissions from the consumption of Electricity from an off-grid captive power plant are calculated based on the electricity consumed by the project activity and the emission factor of the captive power plant using the following formula;

$$PE_{EC,y} = EC_{PJ,y} * EF_{CP,y}$$

Where;
$PE_{EC,y}$ are the project emissions during the year (tCO_2/year)
$EC_{PJ,y}$ is the quantity of energy consumed by the project activity during the year y (MWh)
$EF_{CP,y}$ is the emission factor for the captive power plant in the year y (tCO_2/MWh)

Emission factor for the captive power plant is calculated as follows;

$$EF_{CP,y} = \left(\sum_k \sum_i FC_{k,i,y} * COEF_{i,y} \right) / \left(\sum_k EG_y \right)$$

Where;
$EF_{CP,y}$ is the emission factor for the captive power plant in the year y (tCO_2/MWh)
$FC_{k,i,y}$ is the quantity of fossil fuel type *i* fired in the captive power plant *k* in the year *y* (mass or volume unit)
$COEF_{i,y}$ is the CO_2 emission coefficient for the fuel type *i* in the year *y* (tCO_2 / mass or volume unit)
EG_y is the quantity of energy generated in the captive power plant k in the year y (MWh)

$COEF_{i,y}$ is calculated according to the procedures provided in the latest approved version of the "tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"

$$COEF_{i,y} = NCV_{i,y} * EF_{CO2,NG}$$

Where;
$COEF_{i,y}$ is CO_2 emission coefficient of the fuel type *i* in the year *y* (tCO_2 / mass or volume unit)
$NCV_{i,y}$ is the weighted average net calorific value of the fuel type *i* in the year y. (GJ/mass or volume unit);
$EF_{CO2,NG}$ is the weighted average CO_2 emission factor of fuel type *i* in the year *y* (tCO_2 / GJ)

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$EF_{CO2, NG}$
Unit	tCO_2/TJ
Description	Emission factor for natural gas
Source of data	IPCC default values at the upper limit of uncertainty at a 95% confidence level as provided in table 1.4 of the Chapter 1 of Volume 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	58.30
Choice of data or Measurement methods and procedures	The IPCC default value is given in terms of emissions per unit of energy, this takes care of any possible variation in the composition of the gas.
Purpose of data	The parameter is used to calculate baseline and project emissions
Additional comment	-

B.6.3. Ex-ante calculation of emission reductions

>>

The Ex-ante calculations of Emission Reductions are considered after the computation of energy savings in power consumption figures, as compared to the baseline scenario.

CER Calculations based on approved methodology II D.	Value	Unit	Comments
Gas flow rate	5.4	MMSCMD	Average rate of gas processing in a given tower connected to the pump
Energy Load on the pump	750	KW	Computed based on the relationship between the gas flow rate and the load
Hours of operations	8760	Hrs / Yr.	The Pump is expected to be operational 24 hours a day and 365 days a year. This will be possible as two pumps are connected to each tower. One of the pumps operates at a given point of time and one is standby
Estimated Energy Consumption per pump set in the Baseline Scenario, as computed from the above mentioned relationship	6569	MWh/ Yr.	Computed based on the load and the expected hours of operation per year
Energy Consumption per pump set as observed in the Project Activity.	5446	MWh/Yr	Computed based on the expected reduction in the energy consumption due to the intervention. However actual energy consumption under the project activity will be monitored
Savings of Energy Per Pump Set	1123	MWh/Yr	Difference in the energy consumption in Baseline and Proposed CDM Scenario.
Total number of Pumps	10	Nos.	As per the operating parameters adhered to by the project participant as a process requirement
Number of Pumps operating at a time	5	Nos.	

Energy Savings per annum	5615	MWh/Yr	Calculated based upon the usage of operational pumps annually multiplied by the energy savings per pump set.
Emission Coefficient for Electricity Displaced	0.72	tCO2/MWh	Calculations based upon elaborations listed Section B.6.1 Explanation of Methodical Choices. The tool to calculate project emissions from electricity consumption and the tool to calculate project or leakage CO2 emissions from fossil fuel combustions are utilized.
Estimated CER 's	4043	Numbers /Yr.	

B.6.4. Summary of ex-ante estimates of emission reductions

Year	Baseline emissions (tCO_2 e)	Project emissions (tCO_2 e)	Leakage (tCO_2 e)	Emission reductions (tCO_2 e)
Year 1	23649	19606	0	4043
Year 2	23649	19606	0	4043
Year 3	23649	19606	0	4043
Year 4	23649	19606	0	4043
Year 5	23649	19606	0	4043
Year 6	23649	19606	0	4043
Year 7	23649	19606	0	4043
Year 8	23649	19606	0	4043
Year 9	23649	19606	0	4043
Year 10	23649	19606	0	4043
Total	236490	196060	0	40430
Total number of crediting years	10			
Annual average over the crediting period	23649	19606	0	4043

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$Q_{,,y}$
Unit	MMSCMD (Million Metric Standard Cubic Meters Per Day)
Description	Average Rate of Gas Processed by the Project Activity, in the period 'Y' for each pump
Source of data	Onsite Measurements (use of in-line flow meters)
Value(s) applied	5.4
Measurement methods and procedures	Separate online meter for each of the pump will be used. The meter would give readings in Thousand NM^3 per hour for the gas processed, which would subsequently be multiplied by 0.025 to compute the rate of gas processing in MMSCMD. Readings would be noted down in every 2 hours of operation. The average flow rate of the gas for the period will be determined using weighted average of different readings of gas flowrate through a given train, as compared with the hours of operation.
Monitoring frequency	Every 2 hours
QA/QC procedures	-
Purpose of data	Parameter is used to calculate baseline emissions
Additional comment	Data shall be kept till two years after the end of the crediting period

Data / Parameter	$NCV_{NG,y}$
Unit	Kcal/NM3
Description	Weighted average net calorific value of the Natural Gas fired, in the period 'Y'
Source of data	In-house sampling and calculations
Value(s) applied	8338.12
Measurement methods and procedures	Use of analytical instruments by the project participants, in-line with national and international fuel standards. The NCV shall be obtained for each fuel delivery, from which the weighted average annual values shall be calculated.
Monitoring frequency	Each Fuel delivery
QA/QC procedures	The online measurement of the calorific value will be done on sample basis using the analytical methods and proceedings.
Purpose of data	The parameter is used to calculate baseline and project emissions
Additional comment	Data shall be kept till two years after the end of the crediting period

Data / Parameter	$FC_{GT1, NG}$
Unit	NM3/Yr
Description	Total Quantity of Natural Gas fired in the Captive Generator GT – 1, in the period 'Y'
Source of data	Onsite Measurements by online volumetric flow meters
Value(s) applied	20676179
Measurement methods and procedures	The data will be used to calculate the emission factor for the captive power plant. The Hazira gas processing facility measures and monitors the volume of Natural gas fired at its in-house captive generation unit GT – 1. Suitable QMS and reporting procedures are followed for the measurement and upkeep of this data.
Monitoring frequency	Continuous
QA/QC procedures	The parameter would be monitored continuously. The flow meters will be calibrated regularly as per the requirements specified by the OEM
Purpose of data	The parameter is used to calculate baseline and project emissions
Additional comment	Data shall be kept till two years after the end of the crediting period

Data / Parameter	$FC_{GT2, NG}$
Unit	NM3/Yr
Description	Total Quantity of Natural Gas fired in the Captive Generator GT – 2, in the period 'Y'
Source of data	Onsite Measurements by online volumetric flow meters
Value(s) applied	51120297
Measurement methods and procedures	The data will be used to calculate the emission factor for the captive power plant The Hazira gas processing facility measures and monitors the volume of Natural gas fired at its in-house captive generation unit GT – 2. Suitable QMS and reporting procedures are followed for the measurement and upkeep of this data.
Monitoring frequency	Continuous
QA/QC procedures	The parameter would be monitored continuously. The flow meters will be calibrated regularly as per the requirements specified by the OEM
Purpose of data	The parameter is used to calculate baseline and project emissions
Additional comment	Data shall be kept till two years after the end of the crediting period

Data / Parameter	**$FC_{GT3, NG}$**
Unit	NM3/Yr
Description	Total Quantity of Natural Gas fired in the Captive Generator GT – 3, in the period 'Y'
Source of data	Onsite Measurements by online volumetric flow meters
Value(s) applied	19254377
Measurement methods and procedures	The data will be used to calculate the emission factor for the captive power plant The Hazira gas processing facility measures and monitors the volume of Natural gas fired at its in-house captive generation unit GT – 3. Suitable QMS and reporting procedures are followed for the measurement and upkeep of this data.
Monitoring frequency	Continuous
QA/QC procedures	The parameter would be monitored continuously. The flow meters will be calibrated regularly as per the requirements specified by the OEM
Purpose of data	The parameter is used to calculate baseline and project emissions
Additional comment	Data shall be kept till two years after the end of the crediting period

Data / Parameter	**$EG_{GT1,y}$**
Unit	MWh / Yr
Description	Total Quantity of Net Electricity Generated in the Captive Generator GT-1, in the period 'Y'
Source of data	Onsite Measurements
Value(s) applied	57049
Measurement methods and procedures	The data will be used to calculate the emission factor for the captive power plant. Hazira Gas processing facility uses in-line energy meters, to measure and monitor the net quantity of energy generated in the Captive Natural Gas based power generator. Suitable QMS and reporting procedures are followed for the measurement and upkeep of this data.
Monitoring frequency	Continuous
QA/QC procedures	The parameter would be monitored continuously. The energy meters shall be consistently checked for accuracy by periodic calibration as prescribed by the OEM of the metering equipment and the Statutory Bodies.
Purpose of data	The parameter is used to calculate baseline and project emissions
Additional comment	Data shall be kept till two years after the end of the crediting period

Data / Parameter	$EG_{GT2,y}$
Unit	MWh /Yr
Description	Total Quantity of Net Electricity Generated in the Captive Generator GT-2, in the Period 'Y'
Source of data	Onsite Measurements
Value(s) applied	144840
Measurement methods and procedures	The data will be used to calculate the emission factor for the captive power plant. Hazira Gas processing facility uses in-line energy meters, to measure and monitor the net quantity of energy generated in the Captive Natural Gas based power generator. Suitable QMS and reporting procedures are followed for the measurement and upkeep of this data.
Monitoring frequency	Continuous
QA/QC procedures	The parameter would be monitored continuously. The energy meters shall be consistently checked for accuracy by periodic calibration as prescribed by the OEM of the metering equipment and the Statutory Bodies.
Purpose of data	The parameter is used to calculate baseline and project emissions
Additional comment	Data shall be kept till two years after the end of the crediting period

Data / Parameter	$EG_{GT3,y}$
Unit	MWh / Yr
Description	Total Quantity of Net Electricity Generated in the Captive Generator GT-3, in the period 'Y'
Source of data	Onsite Measurements
Value(s) applied	54609
Measurement methods and procedures	The data will be used to calculate the emission factor for the captive power plant. Hazira Gas processing facility uses in-line energy meters, to measure and monitor the net quantity of energy generated in the Captive Natural Gas based power generator. Suitable QMS and reporting procedures are followed for the measurement and upkeep of this data.
Monitoring frequency	Continuous
QA/QC procedures	The parameter would be monitored continuously. The energy meters shall be consistently checked for accuracy by periodic calibration as prescribed by the OEM of the metering equipment and the Statutory Bodies.
Purpose of data	The parameter is used to calculate baseline and project emissions
Additional comment	Data shall be kept till two years after the end of the crediting period

Data / Parameter	**$EC_{PJ,y}$**
Unit	MWh / Yr.
Description	Quantity of Energy consumed by the Project Activity, in the Period 'Y'
Source of data	Onsite Measurements (use of in-line energy meters). Separate meters would be used for each of the pumps, and the values would be computed based upon per pump set.
Value(s) applied	5446
Measurement methods and procedures	Online integrator type meters will be used.
Monitoring frequency	Continuous
QA/QC procedures	The parameter would be monitored continuously. Separate energy meters are installed for each of the Amine circulation pumps, within the Gas Sweetening Units. Meters will be calibrated as per standard OEM requirements.
Purpose of data	The parameter is used to calculate project emissions
Additional comment	Data shall be kept till two years after the end of the crediting period

Data / Parameter	**T_y**
Unit	Thousand Hours / Yr.
Description	Duration of the operations of the pump, during the period 'Y'
Source of data	Onsite Measurements (use of in-line energy meters)
Value(s) applied	8760
Measurement methods and procedures	Number of Hours of Pump operation would be duly logged in the Operations Log Book.
Monitoring frequency	-
QA/QC procedures	-
Purpose of data	The parameter is used to calculate baseline emissions
Additional comment	Data shall be kept till two years after the end of the crediting period

Data / Parameter	Specifications of the Pumps Modified
Unit	-
Description	Documentation of the Specifications of the Modified Pumps
Source of data	Specification Sheet from the Pump Modifier
Value(s) applied	The specifications of the pumps modified would be monitored as per the table below. Specific details on the values would be separately provided to the DOE along with the Monitoring Report, at the time of verifications;
Measurement methods and procedures	The exact specifications would be based upon the specification sheet supplied from the Pump Modifier. The frequency of monitoring would be once only, at the time of modification of each of the pumps.
Monitoring frequency	-
QA/QC procedures	Since the specifications would be monitored as per the specification sheet supplied by the Pump Modifier, who is an independent agency having suitable expertise in the field, adequate QA/QC is ensured. However, the specifications can be cross checked keeping in mind the performance curves of the original pump replaced
Purpose of data	-
Additional comment	-

Particulars	**Value**
Pump ID	
Make	
Type	
Number of Stages	
Capacity (m^3/hr)	
Head (m)	
RPM	
Motor Rating (kW)	

B.7.2. Sampling plan
>>
Not Applicable

B.7.3. Other elements of monitoring plan
>>
The monitoring and verification procedures outlined here, define a project specific standard against which the proposed CDM activity's performance and conformance with all the relevant criteria shall be monitored and verified.

The monitoring plan includes;

- Relevant data collection, compilation and archiving, consistent with the good practices prescribed/followed.

- Data interpretation and computation techniques for monitoring and verification of GHG Emissions.

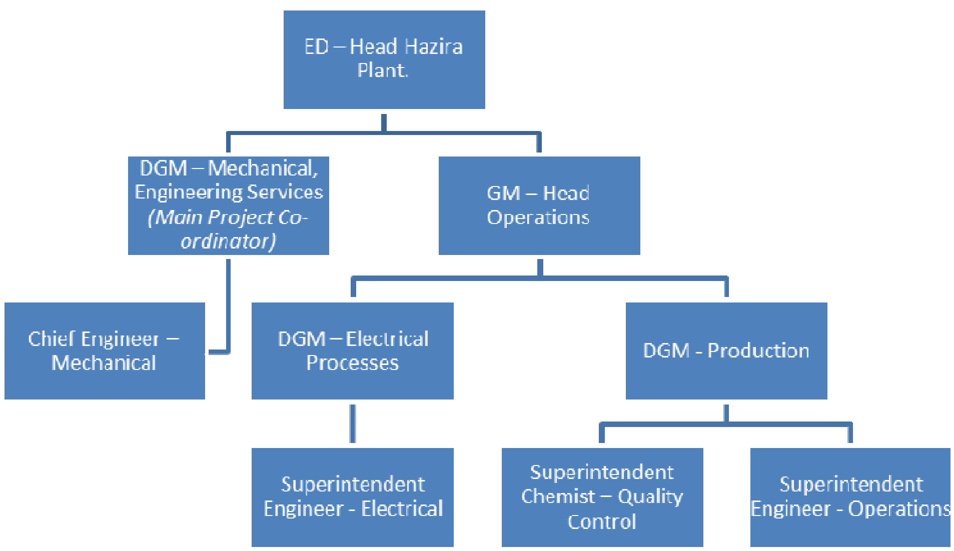
With reference to the guidelines laid down in the applicable methodology AMS II D; Energy Efficiency and Fuel Switch Measures for Industrial Facility, in the specific case of replacement, modification and retrofit measures, the monitoring shall consist of –

- Documenting the specifications of the equipment replaced/modified – Accordingly the technical specifications and operating parameters of the 8 stage amine circulation pump would be recorded, documented and archived.
- Metering the energy use of the industrial or mining and mineral production facility, processes or equipment affected by the project activity – thus the metering of the energy consumption of the stage blanked pumps would be carried real time, and values would be recorded daily.
- Calculating the energy savings using the metered energy consumption data obtained.

For the monitoring plan to be developed specifically for this CDM project activity the following points are considered;

- Assignment of the monitoring and verification responsibilities, to the relevant in-house personnel, establishing their reporting relationships for the CDM activity, within the existing organizational structure/framework and responsibilities.
- Adaptation of existing reporting and Management Information Systems to incorporate the monitoring and verification plan of the CDM activity into ONGC's day-to-day operations.

ONGC has the following operational and management structure currently;



Monitoring Roles and Responsibilities;

- DGM – Mechanical, of the Engineering Services Department has been chosen as the Main CDM project co-ordinator from the proposed CDM project. He would ensure that, the monitoring plan is strictly adhered to, relevant data collected and archived, and forwarded to the Group General Manager of ONGC's Carbon Management Group, based in New Delhi.
- The Chief Engineer – Mechanical would be responsible for documenting specifications of the equipment replaced. He would also, closely work with the Superintendent Engineer – Operations

for the monitoring and archiving of the quantity of gas fired in the generators; and with the Superintendent Engineer – Electrical for the monitoring and archiving of the quantity of energy consumed by the lean amine circulation pumps. He would carry out all the necessary computations as described in the project design document computation of emission reductions taken place in each year of the crediting period, and update the same to the DGM – Mechanical of Engineering Services Department. The Chief Engineer, Mechanical would also be responsible for overlooking the pump switch over procedures from time to time, and ensuring periodic maintenance of the pumps. A typical maintenance and pump start-up procedure is attached herewith as Annexure 4. The periodic review would be carried out once a month, with reference to the average rate of sour gas processed and the corresponding energy consumption in the project scenario by the Chief Engineer Mechanical, and any discrepancies or deviations would be duly reported.

- The Superintendent Engineer – Operations would be primarily responsible for the monitoring and archiving of the quantity of the gas fired in the in-house captive generators. He would also be additionally responsible for timely and prompt update of the data to the DGM – Mechanical of the Engineering Services Department, and report discrepancies immediately if any.
- The Superintendent Engineer – Electrical would be responsible for monitoring and archiving of the quantity of energy consumed by the lean amine pumps. This monitoring of data would be carried out by reviewing of the daily readings reported by the in-line energy meters installed for individual pumps. The energy meters would be calibrated suitably as per the standard statutory requirements or alternatively once a year as deemed necessary. It would be responsibility of the Superintendent Engineer – Electrical, to ensure the accuracy class, and calibration frequency is maintained as per standard OEM guidelines. Also, he would compute the reduction in the consumption of energy, as compared to the established baseline scenario with the same frequency as recording of the data. He would also be additionally responsible for timely and prompt update of the data to the DGM – Mechanical of the Engineering Services Department, and report discrepancies immediately if any.
- The Superintendent Engineer - Quality Control would be responsible for obtaining the Net Calorific Value of each fuel delivery, i.e. the gas received to be fired in the generators. He would also compute the annual weighted average figures for the same and update the data to DGM – Mechanical of the Engineering Services Department.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>
10/03/2006

C.1.2. Expected operational lifetime of project activity

>>
12 years

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>
Fixed

C.2.2. Start date of crediting period

>>
The crediting period will start from the date of registration of the project with the CDM Executive Board. Expected start date of the crediting period is 01/08/2009

C.2.3. Length of crediting period
>>
10 years 0 months

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts
>>
As the CDM project activity is an energy efficiency measure for an existing industrial facility, the host party does not require any documentation on the analysis of environmental impacts of the project activity otherwise also there is no impact on the environment due to the project.

SECTION E. Local stakeholder consultation
E.1. Solicitation of comments from local stakeholders
>>
The impacts to the local stake-holders and environment were deliberated during the stake-holder consultation meeting held at Hazira works of ONGC on 13/06/2008

The following stake-holders were identified to have been impacted by the CDM project activity;
- Internal employees of the Project Proponent from finance, technical, power generation, plant operations, maintenance and other relevant departments.
- Technology provider / OEM supplier for the pumps
- Local residents & industries
- Civic Bodies / Statutory Authorities.

Accordingly, invitations were sent to representatives/heads of various departments identified within the project proponent's organization. Invitations were also sent to representatives of;

- Technology provider and the pump supplier, OEM M/S Bharat Pumps and Compressor Limited, Naini,
- NGO "Lok Vikas Sanstha" – a representative of the local residents and community
- Sarpanch – Bhatpore Gram Panchayat
- IOCL, GAIL, HPCL – major local industries in Hazira

The agenda of the meeting was as follows;
- Discussion on general environment and social concerns.
- Discussions on initiatives being undertaken by ONGC to address the well being of the environment and the community.
- Discussion on proposed CDM project to address the issue of climate change/global warming.

The meeting schedule undertaken was;
- Welcome and Introduction – by ONGC
- Introduction to Climate Change and Clean Development Mechanism – by Deloitte
- Introduction to the Technology being used – by ONGC
- Introduction to the proposed CDM project – by Deloitte
- Discussion Forum

E.2. Summary of comments received
>>
The discussion was initiated with clarifications regarding climate change, and the various ways and means to mitigate GHG emissions. The participants in the stake-holder consultations were consciously

curious about day to day GHG emission reductions, so as to how they can play a role in it. They were accordingly enlightened about simpler methods like the use of CFL's instead of incandescent bulbs, switching off lights when not required, setting the air conditioner thermostat on adequate cooling levels, use of carpooling to travel similar locations, use of energy efficient appliances, better insulation materials etc. Participants from local industries, enquired about other kinds of projects apart from energy efficiency measures, that can possibly reduce GHG emissions

There were two main comments which can be specifically highlighted as per the table below;

Details of the Stake-holder	**Comments**
Mr. Dhirajbhai Patel *Sarpanch, Bhatpore Village*	Mr. Patel specifically queried about the quantum of savings in electricity consumption due to the project activity in consideration. He expressed his desire to make available this spare capacity (effected as a result of savings in consumption, via the proposed CDM activity) to the neighbouring villages. He expressed, this would help a great deal, as these villages are characterised by intermittent power supply due to frequent outages / breakdowns.
Mr. K. N. Tabrej *H.P.C.L, Hazira*	Mr. Tabrej, was concerned about the quantum of savings in gas actually achieved as a result of reduction in its requirement, subsequent to the reduced power generation needs. Possible effects of the reduced consumption of gas were deliberated. The reduced consumption implied increased availability of gas in the local area for the SME's and other industrial vehicles, and maybe translating to reduced price of gas.

E.3. Report on consideration of comments received

>>

Mainly, the comments raised by the stake-holders were concerned with macro-level issues to be resolved by the State Government, at a policy and regulations level. The project proponent, however being a Government of India undertaking promised to strongly back the case of local residents and the nearby community. While other apprehensions/queries/issues related to GHG mitigation, Climate Change and Clean Development Mechanism were resolved during the discussion forum, suggestions and comments were well received. Following is the due account taken for the specific comments received;

Details of the Stake-holder	**Comments**	**Due Account Taken**
Mr. Dhirajbhai Patel *Sarpanch, Bhatpore Village*	Mr. Patel specifically queried about the quantum of savings in electricity consumption due to the project activity in consideration. He expressed his desire to make available this spare capacity (effected as a result of savings in consumption, via the proposed CDM activity) to the neighbouring villages. He expressed, this would help a great deal, as these villages are characterised by intermittent power supply due to frequent outrages / breakdowns.	Mr. Patel's query was aptly addressed by Mr. B. K. Prasad (DGM – Mechanical) from ONGC, that as per the local regulation, the saved electricity would be supplied to the State Electricity Board Grid, which would be subsequently available for public distribution. Mr. V. K. Yadav (GM – Mechanical) who heads Mechanical department at ONGC also promised to push forth the case of additional power

		distribution to the nearby villages from the state grid.
Mr. K. N. Tabrej *H.P.C.L, Hazira*	Mr. Tabrej, was concerned about the quantum of savings in gas actually achieved as a result of reduction in its requirement, subsequent to the reduced power generation needs. Possible effects of the reduced consumption of gas were deliberated. The reduced consumption implied increased availability of gas in the local area for the SME's and other industrial vehicles, and maybe translating to reduced price of gas.	The participants of the stake-holders consultation meeting unanimously agreed that, the reduction in consumption of gas by the proposed CDM activity, would in-fact be beneficial in the long run, as the gas can be put to use, where it is more necessary, especially keeping in mind the energy crisis currently faced globally.

SECTION F. Approval and authorization
>>

Letter of Approval received from National CDM Authority, Ministry of Environment and Forest, Government of India

- - - - -

Appendix 1: Contact information of project participants

Organization	Oil and Natural Gas Corporation (ONGC) Ltd
Street/P.O. Box	Laxmi Nagar
Building	10th Floor, South Tower,Scope Minar
City	New Delhi
State/Region	-
Postcode	110092
Country	India
Telephone	91 11 22440829/22406479
Fax	91 11 22025479
E-mail	chakraborty_ab@ongc.co.in
Website	www.ongcindia.com
Contact person	
Title	Group General Manager
Salutation	Mr.
Last name	Chakraborty
Middle name	B.
First name	Ashok
Department	Carbon Management Group
Mobile	+91 9868282058
Direct fax	
Direct tel.	
Personal e-mail	

Appendix 2: Affirmation regarding public funding

No public funding is involved in this project activity. The entire cost of the project has been borne by ONGC Ltd.

Appendix 3: Applicability of selected methodology

Typical Specifications for Amine Circulation Pumps Prior to Modification (Stage Blanking):

Specifications, as supplied by the OEM for the amine circulation pumps, prior to the modification of the same are as per the table below; The same would be used as a reference for comparison against the specifications of the pumps after modification, which would be monitored as per the guidelines of the applicable methodology.

Particulars	**Value**
Pump ID	31P301A
Make	Pompes Guinard, France (David Brown Guinard Pumps)
Type	Centrifugal Horizontally Split Volute Pump
Number of Stages	8 Stage
Capacity (m^3/hr)	224 (Normal) ; 269 (Rated)
Head (m)	787.4
RPM	2980
Motor Rating (kW)	840

Particulars	**Value**
Pump ID	31P301B
Make	Pompes Guinard, France (David Brown Guinard Pumps)
Type	Centrifugal Horizontally Split Volute Pump
Number of Stages	8 Stage
Capacity (m^3/hr)	224 (Normal) ; 269 (Rated)
Head (m)	787.4
RPM	2980
Motor Rating (kW)	840

Particulars	**Value**
Pump ID	32P301A
Make	Pompes Guinard, France (David Brown Guinard Pumps)
Type	Centrifugal Horizontally Split Volute Pump
Number of Stages	8 Stage
Capacity (m^3/hr)	224 (Normal) ; 269 (Rated)
Head (m)	787.4
RPM	2980
Motor Rating (kW)	840

Particulars	**Value**
Pump ID	32P301B
Make	Pompes Guinard, France (David Brown Guinard Pumps)
Type	Centrifugal Horizontally Split Volute Pump
Number of Stages	8 Stage
Capacity (m^3/hr)	224 (Normal) ; 269 (Rated)
Head (m)	787.4
RPM	2980
Motor Rating (kW)	840

Particulars	**Value**
Pump ID	33P301A
Make	Pompes Guinard, France (David Brown Guinard Pumps)
Type	Centrifugal Horizontally Split Volute Pump
Number of Stages	8 Stage
Capacity (m^3/hr)	224 (Normal) ; 269 (Rated)
Head (m)	787.4
RPM	2980
Motor Rating (kW)	840

Particulars	**Value**
Pump ID	33P301B
Make	Pompes Guinard, France (David Brown Guinard Pumps)
Type	Centrifugal Horizontally Split Volute Pump
Number of Stages	8 Stage
Capacity (m^3/hr)	224 (Normal) ; 269 (Rated)
Head (m)	787.4
RPM	2980
Motor Rating (kW)	840

Particulars	**Value**
Pump ID	34P301A
Make	Pompes Guinard, France (David Brown Guinard Pumps)
Type	Centrifugal Horizontally Split Volute Pump

Number of Stages	8 Stage
Capacity (m^3/hr)	224 (Normal) ; 269 (Rated)
Head (m)	787.4
RPM	2980
Motor Rating (kW)	840

Particulars	**Value**
Pump ID	34P301B
Make	Pompes Guinard, France (David Brown Guinard Pumps)
Type	Centrifugal Horizontally Split Volute Pump
Number of Stages	8 Stage
Capacity (m^3/hr)	224 (Normal) ; 269 (Rated)
Head (m)	787.4
RPM	2980
Motor Rating (kW)	840

Particulars	**Value**
Pump ID	35P301A
Make	Pompes Guinard, France (David Brown Guinard Pumps)
Type	Centrifugal Horizontally Split Volute Pump
Number of Stages	8 Stage
Capacity (m^3/hr)	224 (Normal) ; 269 (Rated)
Head (m)	787.4
RPM	2980
Motor Rating (kW)	840

Particulars	**Value**
Pump ID	35P301B
Make	Pompes Guinard, France (David Brown Guinard Pumps)
Type	Centrifugal Horizontally Split Volute Pump
Number of Stages	8 Stage
Capacity (m^3/hr)	224 (Normal) ; 269 (Rated)
Head (m)	787.4
RPM	2980
Motor Rating (kW)	840

For other relevant details please refer Section B.4 in the Project Design Document for the baseline information.

Appendix 4: Further background information on ex ante calculation of emission reductions

Please refer Section B.6 above for details on ex-ante calculation of emission reductions

Appendix 5: Further background information on monitoring plan

Please refer Section B.7.3in the above Project Design Document for the more details on application of a monitoring methodology and brief description of the monitoring plan.

Training Needs for Stage Blanking:

A technological intervention such as "Stage Blanking", i.e. blanking of one stage and replacing one impeller by a blanking bush, involves significant technical risks for smooth operations. Accordingly specific training needs are defined for the operating personnel, as well as the maintenance staff as below;

1. Every new operating personnel will have to undertake intensive in-house seven day training, covering the basic process equipment overview, adsorption towers, amine circulation pumps, metering equipment and associated safety measures.
2. The stage-blanked pump, involves change in design of the pump, and thereby calls for closer monitoring of the normal operating parameters, more specifically discharge pressure and processing flowrates. Accordingly, the operating personnel would be trained to closely monitor the operating parameters and take necessary action, including the procedures for pump shut down in case of deviations from the acceptable parameters. This training may be carried out every three months, or as frequently
3. Technical risks in terms of mechanical issues during the running of the pump as a result of unbalance, leading to abnormal vibrations or even fatigue over a period of time are envisaged. Suitable mechanical engineering and maintenance training would be provided to the operating personnel every six months.
4. Prior to re-commissioning of each of the stage-blanked pump, special training would be provided on the basic fundamentals of stage-blanking, the kind of technological intervention affected, the changes in the pressure switch rating to be carried out, and emergency operations/activities to be carried out during pump outage. This may also include the training on the basic start-up and shut-down procedures.

All the above identified training needs and suggested modules would be documented including the names/profiles/educational & operational background/other relevant details of the relevant personnel trained. The basic educational and informational module would be standardised, as per standard prevalent best practices with guidance obtained from OEM and ISO certifications. The same would be updated from time to time, in case of advancements in training / maintenance demands.

Maintenance Needs:

As described earlier, stage blanking involves replacement of an impeller with a blanking bush. Such a kind of technological intervention is exposed to number of operational risks. It is imperative therefore, to have a well-defined maintenance schedule. The maintenance needs are defined to be carried out at specific time intervals, and combine both the preventive and curative maintenance schedules.

Daily / Weekly Maintenance Schedules;

- During daily/weekly maintenance emphasis is made on ensuring that the normal operating parameters are adhered to. Accordingly the schedules are designed to mainly check and monitor suction as well as discharge pressures, the current drawn and manual inspection of abnormal noise during operations etc. Also manual checks are carried out daily for overheating of the

pump, leakages of amine and lube oil etc. Any deviation from the standard operating parameters is immediately documented and remedial measures are initiated.

Short-term periodic schedules;

- The short term periodic maintenance schedules mainly deal with the preventive maintenance procedures. Accordingly bearing inspection is carried out every 4000 hours of pump operations. During the bearing inspection, there are well defined maintenance needs to be carried out in terms of cleaning the suction strainer, checking and re-aligning the pump/motor, total replacement of lube oil, checking the condition and appropriate replacement of Journal bearings. The short term periodic maintenance schedules shall be duly documented and consulted before the commencement of any maintenance related activity or pump switch over.

Long term periodic maintenance schedules;

- Internal inspection and maintenance schedules are carried out as per the OEM guidelines/ standard best maintenance practices and SAP generated maintenance task lists, after every 12,000 hours of pump operations. The long term periodic maintenance schedule shall be duly documented with regards to the activities carried out.

<u>Typical Procedure for Start-up / Switch Over:</u>

Switch over between in-line and standby pumps would be carried out as per requirements. Monitoring and Documentation would be carried out, for the number of hours each pump is operational, the switch over frequency for each of the pumps and the standby hours as well. The following guidelines would be considered for each pump switch over;

1. Check Liquid Level in Amine Tank (T301) in local Level Indicator. Confirm the same from Control Room.
2. Ensure that the Casing Drain lines of the Pump are CLOSED.
3. Ensure that the Main Isolation Valve near Amine Tank is in OPEN condition.
4. Ensure that the Suction Isolation Valve of Pump is in OPEN condition.
5. Ensure that there is NO Positive PRESSURE in Amine Sump (V305).
6. Check the Lube Oil Level in Oil Cups of Amine Pump.
7. Open the Isolation Valves of Priming line over First Stage Impeller.
8. Open the Open Sump Drain and Ensure that there is NO Air / Gas coming with Amine.
9. Close the Isolation Valves of Priming line over first stage impeller and Open the Isolation Valve of Priming line over Final Stage. Ensure that there is NO Air / Gas coming with Amine.
10. Open the Vent on Pressure Gauge of Suction and Discharge, if provided. Ensure that NO Air / Gas are coming from the Vent of Both Pressure Gauges.
11. Close the Isolation Valves of Priming Lines.
12. Crack Open (approx. 1/3rd) the Discharge Isolation Valve of Pump.
13. Start the Pump and simultaneously increase the Discharge Valve Opening to Maximum.
14. In case of Change Over: Reduce the Opening of Discharge Valve of Other Pump (up to 50% approx.) and Stop the Pump and immediately close the Discharge Valve before the Pump comes to Halt.
15. Check the Amperage and discharge Pressure of the Running Pump.
16. Check & confirm the flow from Control room.

Notes –

1. If NO FLOW is observed on starting a Pump, STOP the Pump immediately and inform Mechanical Maintenance. Don't try to Re-start the Pump.
2. Never try to open the Valves of Priming Lines of a Running Amine Pump for releasing Air.
3. Never try to start the Pump without Priming even it was not depressurized / drained.
4. Don't run an Amine Pump with discharge valve Closed.
5. 31-P301-B/32-P301-B/33-P301-B/34-P301-A/35-P301-A pumps are One Stage Blanked. Discharge Pressure of this pump is lower than the discharge Pressure of its Standby. This Pump cannot deliver FLOW unless and until the Other Pump is stopped.
6. Don't run both Amine Pumps of a train simultaneously for prolonged duration.

<u>Typical Procedure for Start-up / Switch Over:</u>

Switch over between in-line and standby pumps would be carried out as per requirements.

Appendix 6: Summary of post registration changes

As a standard practice, modifications in the remaining pumps would be carried out at the time of overhauling of the same. Thus the implementation of a part of the project activity would be delayed. Based on a broad statistical guesstimate taking into consideration the changed scenario of modified maintenance practices and its effect on the health of the pumps, operational requirement trends and other contributing factors, the remaining pumps may undergo major repair and stage blanking by 2016.

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for small-scale CDM project activities” (EB 66, Annex 9).
03	EB 28, Annex 34 15 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.
02	EB 20, Annex 14 08 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>.
01	EB 07, Annex 05 21 January 2003	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		