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

CONTENTS

Revision history of this document

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

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

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

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Energy efficiency and fuel switching measures in the caustic soda and sodium cyanide plant at Vadodara complex of GACL

Version: 02
Date: 30/12/06

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

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Purpose of the project

The project activity has been carried out at the caustic soda and sodium cyanide manufacturing plants of GACL at Vadodara. It is aimed at replacing the existing technology with higher efficiency technology, and switching to less GHG intensive fuels in these plants thus, contributing towards reduction in CO2 emission from its activities.

The project activity consists of following measures:

1. Energy efficiency measures-
    a. Replacement of Tray dryer system with Paddle dryer system to enable reduction in steam and electricity consumption for drying sodium cyanide.
    b. Replacement of less efficient brine pumps with higher efficiency pumps
    c. Up-gradation of distributed control software system for monitoring and controlling electrolysis process in caustic soda plant and thus, reducing energy consumption.
2. Switching from furnace oil to natural gas in the boiler house of sodium cyanide plant for process steam generation.

3. Switching from natural gas to hydrogen in the firing system of the caustic concentration unit II (CCU-II) for concentration of Caustic soda flakes (CSF).

GACL is the single largest producer of Caustic Soda in India, with a production capacity of 900 TPD. The capacity of caustic production at Vadodara is 465TPD.GACL is accredited with IS/ISO 9001:2000, IS/ISO 14001:2004 and IS 18001:2000 Certifications for its Vadodara complex.

These energy conservation measures have been taken voluntarily by GACL with the view of:

- Contributing towards sustainable development by conserving the resources.
- Reducing air pollution in the area where project activity is carried out.
- Reducing its emissions of greenhouse gases(GHG), thus providing the community with a cleaner environment
- Promoting the use of non-exhaustive natural resources like natural lighting and ventilation system and thus, helping in sustainable development.
- Setting an example to other industries and promoting the practice of adopting cleaner and efficient technology.

A.3. Project participants:

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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)
Ministry of Environment and Forest (MoEF),Government of India (DNA)	Gujarat Alkalies and Chemicals Limited (GACL), Vadodara, India	No (Host Government)

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

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

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A.4.1.1. Host Party(ies):

>>
India

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

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State of Gujarat

A.4.1.3. City/Town/Community etc:

>>
Vadodara

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

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Above mentioned project activity is being carried out by GACL at the Vaododara Complex. It lies on Latitude – 22^o 19' N, and Longitude – 73^o 14'E.It is approachable by road and from national highway no 8. Nearest Railway station and airport are located at Vadodara approximately 20km from the GACL complex.
Map of the site project site is attached in APPENDIX I.

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

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The small scale activity consists of ***energy efficiency and fuel switch project*** and the small scale methodologies applied are:

- ***II C (version 7) – Demand side energy efficiency programmes for specific technologies*** motor replacement

- ***Type II, D (version 7) – Energy efficiency and fuel switching measures for industrial facilities*** Some of these measures include replacement of first Generation electrolyzer cells with IV generation electrolyzer cells in cell house 1 and 2, upgradation of DCS system to have closer watch on electrolysers and thus, reduce energy consumption.

- ***Type III,B (version 9) - Switching fossil fuels*** – For switching from natural gas to hydrogen in the firing system of the caustic concentration unit II (CCU-II) for conversion of caustic soda lye to Caustic soda flakes (CSF) and for switching from furnace oil to natural gas in the boiler house of sodium cyanide plant for process steam generation.

The project activity comprises of various measures whose individual contribution to CO2 reduction might be small but when combined together cause considerable reduction in CO2.

The technology applied in energy efficiency and fuel switching measures for industrial facility include:

- Up-gradation of DCS system - The DCS system helps in maintaining voltage and temperature conditions adequate for carrying out the electrolysis. By up-gradation of the system it provides a closer control on the system and hence, reduces the energy consumption in process due to increase in cell efficiency.

Fossil fuel switching measures:

- CCU-II at caustic soda unit already had a provision for dual firing i.e. Hydrogen or NG. However, for shifting of fuel from NG to Hydrogen, some equipment like additional blowers along with necessary piping and safety interlocks had to be added. But, it did not involve any major technology change.
- The boiler house of sodium cyanide plant did not have a provision for dual firing, hence the system was purchased by incurring a cost of Rs 11,10,000 for effecting the fuel switch.

For switching fuel no new technology has been employed thus, the technical understanding was already available, hence no training was required.

Details on energy efficiency achieved by each project including the CO2 emission reduction is given in Annexure I

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:

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The above activities lead to reduction in energy consumption at the caustic soda and sodium cyanide plant. Thus, leading to a reduction in the emission of CO2.

Regulatory requirements:

- There is no law or regulation in India requiring the chlor-alkali industries to reduce there electricity consumption or thermal energy consumption. Also no law or regulation mandates the use of less GHG intensive fuels by the industries.

- The government does not have any policy/ provision for providing subsidy to industries operating on low GHG fuels and having less electricity consumption.

GACL being a leader in the caustic chlorine industry has taken a lead towards implementation energy efficiency measures in caustic soda plant. It has taken similar measures in sodium cyanide plant also.

The total investment incurred by GACL in energy efficiency measures are approximately INR91 million. In switching from NG to hydrogen GACL faces loss due to loss of market price attached to hydrogen and it amounts to approximately INR 100million.

Thus, no national or sectoral policy and circumstances require GACL to implement these energy efficiency and fuel switch measures. They are a voluntary initiative by GACL.

Thus, from the economic view point of industry this quantum of investment would not have taken place in the absence of CDM incentives.

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

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Please indicate the chosen crediting period and provide the total estimation of emission reduction as well as annual estimates for the chosen period. Information on the emission reductions shall be indicated using the following tabular format

For type (iii) small – scale projects the estimation of project emissions is also required.

Years	Annual estimation reductions in tonnes of CO_2 e
2003	8694
2004	9971
2005	10165
2006	14677
2007	14677
2008	14677
2009	14677
2010	14677

2011	14677
2012	14677
Total estimated reductions (tonnes of CO_2 e)	131572
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	13157.2

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

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The project activity has been funded by internal accruals.
The project proponent has spent approximately **INR 91 million** on the project activity.

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

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As mentioned under *Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project Activities*, the following results into debundling of large CDM project:

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

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

The project activity is not a debundled component of a large scale project activity because, no application for registration of any CDM project activity within 1km of the project boundary of the proposed activity or within last 2 years has not been sent by the same project participant.

SECTION B. Application of a baseline methodology:

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

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The title of approved baseline methodology applied to the project activity is small scale activity are
II C (version 7) – Demand side energy efficiency programmes for specific technologies
II D (version 7) – Energy efficiency and fuel switching measures for industrial facilities
IIIB (version 9) - Switching fossil fuels
as mentioned in APPENDIX B of simplified modalities and procedures for small scale CDM project activities.

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

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II C Demand side energy efficiency programmes for specific technologies-

The energy efficiency measure applied at the project site is replacement of motor of two pumps with efficient motors.

These are specific technologies installed at various locations in the plant and lead to a reduction in annual electricity consumption to 0.25GWh, which is less than 15GWh. Thus, the small scale category IIC is applicable to the project activity.

In the absence of any regulatory requirement and small amount of energy saved by the large proportion of investment and no prevailing practice of carrying out such activities by other similar industries, the project proponent would have continued to use the existing equipments.

According to the selected project category (*Type II, C – Demand-side energy efficiency programmes for specific technologies*) the options number 2 is applicable for possible energy baseline to the current project activity.

As per the baseline methodology, the energy displaced is electricity, the energy baseline is calculated as sum of devices of group "i" replaced or retrofitted of power "p_i" multiplied by average annual operation hours "o_i" of the devices as given by the following formula:

$$E_B = \Sigma_i (n_i . p_i . o_i)/(1 - l)$$

Where,

E_B = annual energy baseline in kWh per year

Σ_i = the sum over the group of "i" devices replaced, for which the replacement is operating during the year, implemented as part of the project.

n_i = the number of devices of the group of "i" devices replaced for which the replacement is operating during the year.

p_i = the power of the devices of the group of "i" devices replaced. In the case of a retrofit programme, "power" is the weighted average of the devices replaced. In the case of new installations, "power" is the weighted average of devices on the market.

o_i = the average annual operating hours of the devices of the group of "i" devices replaced.

l = average technical distribution losses for the grid serving the locations where the devices are installed, expressed as a fraction.

The energy baseline is multiplied by an emission coefficient (measured in kg CO_2equ/kWh) for the electricity displaced.

II D – Energy efficiency and fuel switching measures for industrial facilities

The measures under this category are:

Up-gradation of DCS system, installation of 4th generation cells in the electrolysis process at caustic soda plant and paddle dryer technology for drying on sodium cyanide. This category comprises of energy efficiency measures applied at single industrial facility. All these measures replace the old facility with a new facility and lead to an aggregated reduction in annual electricity consumption by 10.01GWh i.e. less than 15GWh /year. Thus, the above category of small scale activity is applicable to the project activity.

According to the selected project category (***II D – Energy efficiency and fuel switching measures for industrial facilities***) applicable for possible energy baseline to the current project activity:

- The energy baseline consists of the energy use of the existing equipment that is replaced in the case of retrofit measures and of the facility that would otherwise be built in the case of a new facility. In both cases, the electricity component of the energy baseline is adjusted for technical transmission and distribution losses for the electrical grid serving the industrial facility.

- Each energy form in the emission baseline is multiplied by an emission coefficient (in kg CO_2equ/kWh) for the power plants supplying to the units as mentioned for IIC.

- For fossil fuels displaced due to paddle dryer system, the IPCC default values for emission coefficients for NG will be used.

IIIB- Switching of fossil fuel

In CCU-II the basic aim of the activity is to change from fossil fuel (NG) to hydrogen gas. Similarly, in the boiler house at the sodium cyanide plant also the main purpose of the activity is to change from more GHG intensive fossil fuel (furnace oil) to less GHG intensive fossil fuel (NG).Thus cause a reduction in CO2 emission.

This category comprises fossil fuel switching in existing industrial, residential, commercial, institutional or electricity generation applications. Since the project activity primarily aims at reducing emissions through fuel switching, it falls into this category. Also all these measures shall both reduce anthropogenic emissions by sources and directly emit 4507 tCO2 annually i.e. less than 15 kilotonnes of carbon dioxide equivalent annually. Hence this method applies to the project activity.

According to the selected project category (***III B- Switching of fossil fuel***) the baseline for the current project activity will be determined as:

- The emission baseline is the current emissions of the CCU-II firing system and emission from the boiler by firing NG and is expressed as tCO2/t of CSF and tCO2/T of steam respectively.
- Emission coefficients for the fuel used by the generating unit (i.e. CCU-II and boiler house) before and after the fuel switch will be taken as IPCC default values for emission coefficients.

Thus, the baseline emission will occur from burning NG in CCU-II and furnace oil in boiler house.

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:

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Barrier analysis:

The following barriers have been overcome by all the measures in all the three categories of small scale activity applied to the project activity.

Investment analysis:

The details of investment made by GACL on all the projects under the category IIC and II D are provided in table below.

Equipment	Expenditure (Million INR)	Year of investment
Tray dryer	7.66	2002
DCS control system	3.55	2005

Electrolysers	79.58	2004
Motor replacement	0.70	2004
Total Cash Outflow	**90.79**	

The total investment incurred in this process is nearly INR 91 million. The quantum of investment and efforts made by GACL to save marginal amounts of energy is mainly with the view of reducing global warming and GhG emissions reduction.

The pay back period for the project activity has been found to be more than four and a half years. Detailed calculation is given in table below.

Parameter	Value	Unit
Total Energy Savings	11.21	GWh
Total Energy Savings	13250000	KWh
Cost of Electricity	2	Rs/KWh
Total savings	26500000	Rs
	22.5	Million
Principle Investment	90.79607	Million
Investment rendered lost after accounting for depreciation of replaced/removed equipments	20	Million
Total investment	110.7961	Million
Total returns/savings	22.5	Million
Pay back period	**4.92**	**years**

The NPV for the project activity is also found to be negative. The calculations are given in table below:

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cash out flow										
Capital investment	90.80									
Investment rendered lost after accounting for depreciation of replaced/removed equipments	22.00									
Total outflow	112.80									
Loss of opportunity cost										
Intrest @9% as per RBI[1] interest rate against the amount that has been invested	8.17	8.17	8.17	8.17	8.17	8.17	8.17	8.17	8.17	8.17
Cash inflow										
Cash inflow due to electricity saving	22.42	22.42	22.42	22.42	22.42	22.42	22.42	22.42	22.42	22.42
	-98.55	14.25	14.25	14.25	14.25	14.25	14.25	14.25	14.25	14.25
NPV	**-13.13**									

[1] Reserve Bank of India

Thus, the project activity is not financially attractive without CDM revenue.

Fuel switching:

Hydrogen gas, a co-product of the caustic soda process, has demand by other industries in the region for hydrogenation purpose. The price at which hydrogen is being sold by GACL is:

1. Supply of Hydrogen to GEB @ Rs.19 NM3
2. Supply of Hydrogen to M/s.Jayant Agro @ Rs.14/ NM3
3. We have signed a contract with M/s.Luna Chemicals @ Rs.6.25/NM3 (for bulk sale in Dahej)

The quantity of Hydrogen Gas to M/s.GEB is in the range of 1000 NM3/day, to M/s.Jayant Agro in the range of about 5000 NM3/day & contract amount with M/s.Luna Chemicals is around 50000 NM3/day. The average rate of Hydrogen is taken as Rs.7.26 NM3.

There is a demand for the supply of additional hydrogen to various customers like M/s.Jayant Agro, M/s.Indu-Nissan and M/s.Deepak Nitrite.

NG is purchased by GACL from GAIL at the cost of Rs 3.8/SCM. Thus, by replacing the fuel from NG to hydrogen, GACL is losing opportunity cost of INR 50 million per year. Inspite of the market value attached to the co-product GACL has decided to use it for displacing NG.

It is an unusual practice for an industry in India to lose such large opportunity cost every year only to contribute for GHG reduction.

Thus, the above project activity overcomes a financial barrier.

Barrier due to prevailing practice:

- GACL is the one of the first to install 4th generation cells (latest technology) in chlor-alkali industry in India with a large investment. Thus, it has taken not only the financial risk of making investment in a technology which is not prevalent in India but also technological risk. The risk increases because any failure in the cell has a direct effect on the productivity of caustic soda plant.
- Similarly, the paddle dryer technology though available in the world and proven there has not been used in India for sodium cyanide drying process. Thus, GACL will be the first industry to install the technology.
- GACL is leader in Chlor Alkali Industry and there are more than 40 producers of Caustic Soda in the country. From the balance sheet information of M/s. Chem-Fab Alkali and M/s. DCW, it is proved that the GACL is having the lowest energy consumption.

Switching of fossil fuel –

- Hydrogen in CCU-II- All chlor-alkali industries having adequate hydrogen and no facility for transporting the hydrogen to the market, use it as fuel for firing as it does not serve any other useful purpose for them and thus, helps reduce the cost of procuring any other fuel. However, GACL has an existing market for the excess Hydrogen available with it as explained in the financial barrier. Inspite of it GACL has used hydrogen for firing in the CCU-II burner. Thus, for any industry with an infrastructure and buyer for hydrogen it would not be a common practice to use it for internal firing purpose.

- Use of furnace oil, coal and other GHG intensive fuels is more prevalent in the country and in Gujarat also for making process steam due to easy and assured availability. The market price for these fuels has been stable. Thus, use of NG as the only fuel for process steam generation is not a common practice as any short fall in its supply directly affects the productivity of plant.

Hence, the measures implemented by GACL overcome common practice barrier.

Other barriers:

The DCS software upgradation was carried out by Tata-honeywell and the operators and technicians were trained on the operation and other specifications of the software by the software provider. Similarly, the technology of the fourth generation cells and its operating procedures were explained by the technology provider to the operating staff. Training was provided for the tray dryer technology also. The other measures are only replacements and retrofits which do not require any training.

Hence, GACL invested additional efforts in improving the skills of its staff.

Sodium cyanide being very sticky forms a lining in the inner portions of the system, which causes obstruction in the movement of paddles. Thus, increasing the resistivity and electricity consumption. Inorder, to overcome this problem, GACL had to make additional efforts and also it caused disruptions in functioning.

Thus the project activity is additional as it overcomes the above mentioned three barriers and hence is not a business as usual scenario.

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:

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Project Boundary for II C measures:

According to the selected approved project category the project boundary has been described as the physical, geographical location of the brine pumps installed.

Project Boundary for II D measures:

According to the selected methodology project boundary is described as the physical and geographical site of the industrial facility, processes or equipment that are affected by the project activity. The project activity, have been carried out in the industrial facility namely, DCS control system, sodium cyanide drying area, and membrane cells of cell house 1 and 2. These shall remain the project boundary for this category.

Project Boundary for III B measures:

According to the selected methodology project boundary is described as the physical and geographical site where the fuel combustion process has been affected fuel-switching measure. Hence, for the project activity boiler house in sodium cyanide plant and CCU-II furnace are considered individually as project boundary for each of the fuel switch measure.

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

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In the absence of the CDM initiative the project proponent would have continued to use the existing technology, equipments and fuels without any changes thus, not reducing the energy consumption and CO2 emission.

In the project scenario both, the caustic soda plant fulfill there requirement for electricity form NG based captive power plant at Dahej of GACL and from GIPCL. The sodium cyanide plant receives its electricity form Gujarat Urja Vikas Nigam Ltd.(earlier GEB). The caustic soda plant receives 89GWh of electricity from the captive power plant at Dahej complex of GACL and 180GWh of electricity from the GIPCL. Sodium cyanide plant receives 1.25GWh from captive power plant at Dahej and 0.9 from Gujarat Urja Vikas Nigam Ltd. The IPCC emission factor and grid emission factor for CO2 is used for calculating the baseline emissions.

Date of completing the final draft of this baseline section *(DD/MM/YYYY)*: **29/9/2005**
Name of person/entity determining the baseline: PricewaterhouseCoopers (P) Limited as project developer has assisted the project proponent in determining the baseline scenario and baseline emission calculation and estimations. Contact details as below**. Not a project participant**

Organization:	PricewaterhouseCoopers (P) Ltd.
Street/P.O.Box:	252, Veer Savarkar Marg,Shivaji Park, (Opp. Shivaji Park Maidan,Next to Mayor's Bungalow)
Building:	3rd Floor, A Wing
City:	Dadar (W), Mumbai
State/Region:	Maharastra
Postcode/ZIP:	400 028.
Country:	India
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URL:	www.pwc.com
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Title:	Associate Director
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SECTION C. Duration of the project activity / Crediting period:

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

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

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The starting date of the project activity is 18/07/2002.

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

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Expected operational lifetime of the small-scale project activity is 20 years from the date of start of project activity.

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

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Fixed crediting period has been chosen for the project activity

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:

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Not applicable

C.2.2. Fixed crediting period:

>>

10 years

C.2.2.1. Starting date:

>>

1st of January 2003

C.2.2.2. Length:

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The project activity will be registered for a crediting period of 10 years starting from the year 2003 till year 2012

SECTION D. Application of a monitoring methodology and plan:

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

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The approved monitoring methodology for small scale methodologies applied to the project activity are:
II C (version 7) – Demand side energy efficiency programmes for specific technologies
II D (version 7) – Energy efficiency and fuel switching measures for industrial facilities
IIIB (version 9) - Switching fossil fuels

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

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As earlier proved in Section B that the baseline methodology applicable to the project category are:
II C (version 7) – Demand side energy efficiency programmes for specific technologies
II D (version 7) – Energy efficiency and fuel switching measures for industrial facilities
IIIB(version 9) - Switching fossil fuel

Since the applicability of project activity is the same as applicability of baseline methodology, hence it is applicable to the project activity.

II C – Demand side energy efficiency programmes for specific technologies

The selected monitoring methodology covers following measures:

1. Since the project activity replaces existing motors methodology needs to monitor the existing devices replaced, the number and "power" of the replaced devices shall be recorded and monitored.
2. Monitoring shall consist of monitoring the "power" and "operating hours" of the equipments mentioned in the methodology by either: Recording the "power" of the device installed (e.g., lamp or refrigerator) using nameplate data of a sample of the units installed and metering a sample of the units installed for their operating hours using the practice under taken by GACL.

This monitoring shall include annual checks of a sample of non-metered systems to ensure that they are still operating (other evidence of continuing operation, such as on-going rental/lease payments could be a substitute).

3. The transmission and distributing losses from the power provided from Dahej and GEB will be reported from previous statistics. The loss from the GIPCL system has been considered to be negligible because of its proximity to the facility.

II D – Energy efficiency and fuel switching measures for industrial facilities

In the case of retrofit measures, monitoring shall consist of:

(a) Documenting the specifications of the equipment replaced i.e. specifications provided for the paddle dryer by the equipment supplier, DCS upgradation details;
(b) Energy Meter needs to be provided at each of the plant area connecting to the technology change under this category

(c) Energy saving by each technology measure shall be calculated using the average energy consumption mentioned from the records of baseline
(d) The technical transmission and distribution losses will be calculated mentioned in IIC.

IIIB - Switching fossil fuel

The selected monitoring methodology covers following measures:
(a) Monitoring of the fuel used (NG and furnace oil) and output of the boiler house and CCU-II will be kept for three years prior to the fuel switch being implemented;
(b) Monitoring fuel use (H2 and NG) and output of the boiler house and CCU-II will be kept after the fuel switch has been implemented.

D.3 Data to be monitored:

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ID number	Data type	Data variable	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)	For how long is archived data to be kept?	Comment
II C – Demand side energy efficiency programmes for specific technologies									
$\sum Equ_{i,b}$	Text/ numerical	Numbers of devices replaced/ retrofitted of group "i" where "i" refers to motors replaced.	Text/ numerical	E	Once during equipment replacement or retrofitted	100%	Paper	Till the end of crediting period	These values will be taken form the nameplate details or records of the equipment replaced
$\sum Equ_{i,p}$	Power	Rated Power of the motors replaced/ retrofitted	kW	E	-do-	100%	Paper	-do-	From the records available with the purchase or stores department
O_{hrs}	Operating hours	Operating hours of the replaced / retrofitted device	Hrs	E	Daily	100%	Paper	-do-	
$\sum Equ_{j,p}$	Text/ numerical	Numbers of devices installed of group "i" where "i" refers to pumps, lamps, eco-ventilator etc.	Text/ numerical	E	Once during the installation or retrofitting	100%	Paper	-do-	From the information available with the stores department
$\sum Equ_{j,p}$	Power	Rated Power of the device installed	kW	E	-do-	100%	Paper	-do-	From the name plate specification or in the details provided by the supplier at the time of installation
O_{hrs}	Operating hours	Operating hours of the devices installed	Hrs	E	Daily	100%	Paper	-do-	
$EG_{i,y}$	Electricity quantity	Electricity wheeled from the grid (captive	GWh	E	Yearly	100%	Electronic	-do-	Project will monitor and record the actual supply of grid from each source and cross check with the bills.
$\sum_k GENk,y$	Electricity quantity	Electricity imported from the power plants	GWH	E	Yearly	100%	Paper	-do-	Project will monitor and record the actual supply of grid from each source and cross check with the bills.
$NHRk$	Heat rate of the power plant	Net heat rate of the plants supplying electricity	Kcal/kWh	E	Yearly	100%	Paper	-do-	Data to be collected from power plants on yearly basis
$COEF_i$	Emission co-	CO_2 emission co-efficient of each fuel (i) type	tCO_2/TJ	E	Yearly	100%	Paper	-do-	IPCC factors to be used.

ID number	Data type	Data variable	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)	For how long is archived data to be kept?	Comment
	efficient								
$NCV_{FF,i}$	Energy	Average net calorific value of NG	Kcal/kg	E	On every procurement	Sample	Paper/ electronic	For the crediting period	The estimated calorific value will be recorded for each lot at every procurement
II D:									
$E\_{n,y}$	Text/ Numerical	Specifications of the equipment replaced i.e tray dryer,	Text/Numerical	E	Once before replacement	100%	Paper	For the crediting period	From the operation manual of equipment supplier or purchase order or stores
E_Qn,y	Mass/Volume	Measurement of the production from the associated unit	MT	M	Once in week	100%	Paper	For the crediting period	
Q_S_y	Mass	Quantity of steam consumed by the paddle dryer system	MT	M	Daily	100%	Paper	For the crediting period	
$Q\_E_{n,y}$	Power consumption	Quantity of power consumed by each equipment	V, A, or KW	M	Daily	100%	Paper	For the crediting period	This data will be voltage and ampere measurement for 4^{th}. Generation cells
III B –Switching of fossil fuel									
Q_FO_y	Mass	Quantity of furnace oil fed into the boiler system in baseline scenario	MT	M	Daily	100%	Paper	For the crediting period	As per the record keeping style monthly values recorded in the monthly report and from the purchase records
$Q\_NG_{b,y}$	Volume	Quantity of NG into the CCU-II in baseline scenario	SCF or SCM	M	Monthly	100%	Paper	For the crediting period	As per the record keeping style monthly values recorded in the monthly report
$Q\_NG_{i,y}$	Volume	Quantity of NG used in project scenario	SCF or SCM	M	Daily	100%	Paper	For the crediting period	
Q_H2	Volume	Quantity of H2 used in project scenario	SCF or SCM	M	Daily	100%	Paper	For the crediting	

ID number	Data type	Data variable	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)	For how long is archived data to be kept?	Comment
								period	
$NCV_{,i}$	Energy	Average net calorific value of NG and furnace oil	Kcal/kg	E	At the time of procurement or by third party laboratory analysis	Sample	Paper/ Electronic	For the crediting period	The calorific value of NG provided by the supplier in forth-nightly records
$P\_{i,y}$	Mass	Quantity of product manufactured	MT	M	Daily	100%	Paper	For the crediting period	

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

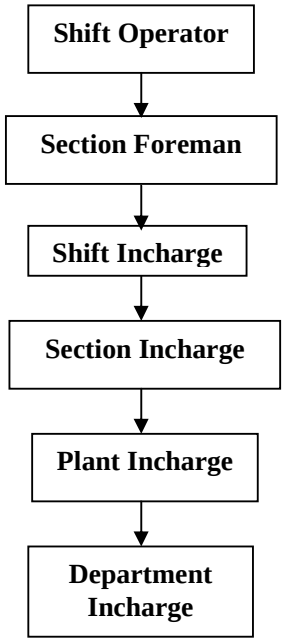
>>

Monitoring systems would follow relevant procedures under the ISO 9001:2004 certified Quality control System of the Vadodara complex. The equipments used for measurements, standards followed and the calibration frequency will be recorded as given in **APPENDIX II**. The performance of all equipments will be checked against the BIS standard or the suppliers standards.

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 at GACL Vadodara complex is as follows:



Similar operational and management structure will be followed during the project activity and is detailed in the monitoring plan in **APPENDIX II**.

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

>>

PricewaterhouseCoopers (P) Limited, whose contact information is set below and has assisted the project proponent in determining the monitoring plan according to the selected monitoring methodology**. Not a project participant.**

Organization:	PricewaterhouseCoopers (P) Ltd.
Street/P.O.Box:	252, Veer Savarkar Marg,Shivaji Park, (Opp. Shivaji Park Maidan,Next to Mayor's Bungalow)
Building:	3rd Floor, A Wing
City:	Dadar (W), Mumbai
State/Region:	Maharastra
Postcode/ZIP:	400 028.
Country:	India
Telephone:	+ 9122 5669 1000 (Board), + 9122 5669 1496 (Direct)
FAX:	+ 9122 5654 7804 / 05
E-Mail:	
URL:	www.pwc.com
Represented by:	
Title:	Associate Director
Salutation:	Dr.
Last Name:	Ram Babu
Middle Name:	
First Name:	P

Department:	Sustainable Business Solutions
Mobile:	+91-9820135929
Direct FAX:	+91-22-24913417
Direct tel:	+91-22-56619341
Personal E-Mail:	ram.babu@in.pwc.com

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

>>

The formula used has been descreibed in section E.1.1.

E.1.1 Selected formulae as provided in appendix B:

>>

IIC:

In the project activity, electricity consumption decreases thus the project activity is a case of displacement of electricity. Hence, the energy baseline is calculated using the follows formula:

$$E_B = Ó_i(n_i . p_i . o_i)/(1 - l)l$$

E_B = annual energy baseline in kWh per year
$Ó_i$ = the sum over the group of "i" devices replaced (e.g. bulb, motor), for which the replacement is operating during the year, implemented as part of the project.
n_i = the number of devices of the group of "i" devices replaced (e.g. bulb, motor) for which the replacement is operating during the year.
p_i = the power of the devices of the group of "i" devices replaced (e.g. 40 W, 5 hp). In the case of a retrofit programme, "power" is the weighted average of the devices replaced. In the case of new installations, "power" is the weighted average of devices on the market.
o_i = the average annual operating hours of the devices of the group of "i" devices replaced.
l = average technical distribution losses for the grid serving the locations where the devices are installed,

The energy baseline is multiplied by an emission coefficient (measured in kg CO_2equ/kWh) for the electricity displaced

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

>>

Not applicable

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:

>>

For IID

In the absence of project activity the same technology of equipment would have continued to be used as in the baseline scenario.

$$EB_{IID} = \Delta E_{s,l} \; x \; PC_{i,j} \; x \; n$$

EB_{IID} = Emission reduction due to project activity
$\Delta E_{s,i}$= Net decrease in specific energy consumption by 'i' technology/measures (eg. Kwh/MT)
PCi,j = Capacity of producing a product 'j' in the unit where the energy efficiency measure 'i' has taken place (e.g. MT/day)
n = number of days in a year when the unit where the energy efficiency measure 'i' has taken place will function
This emission reduction will be multiplied with the CO2 emission factor for the energy generating units.

For IIB: Switching of fossil fuel
The emission for the project activity is calculated as emission coefficient i.etCO2/Mt of product or tCO2 /TJ of energy produced.
This is multiplied by the total energy or product produced.

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

>>

IIC and IID:
According to the selected small scale CDM project category, leakage for the project activity should be calculated when - the energy efficiency technology is equipment is transferred from another activity or if the existing equipment is transferred to another activity. Since, in the project activity no such transfer of equipment has taken place, the leakage need not be considered

III B:
This methodology does not require leakage calculations.

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

>>

This will be 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:

>>

For electricity from Dahej complex:

ERy = EGy/ (1-l) * EFy ……(2)

where
EGy= is the electricity wheeled to Vadodara complex of GACL,
EFy =is the GHG emission factor of the CPP at Dahej
L = is the T&D losses expressed as a fraction.

The emission factor *EFy* of the CPP is represented as *EFy*:

***EFy* = [*GEN*NHR*COEF**44/12] / [*GEN*]……(3)**

In a similar fashion the EF for the GIPCL can also be calculated.

The CO2 emission coefficient COEFi is obtained as

$$COEF_{FF,i} = NCV_{FF,i} * EFCO_{2,\,FF,i} * OXID_{FF,i} \quad \text{.....(5)}$$

Where:
$NCV_{FF,i}$ is the net calorific value (kcal per mass or volume unit) of the fossil fuel
$OXID_{FF,i}$ is the oxidation factor of the fossil fuel
$EFCO_{2,\,FF,i}$ is the CO2 emission factor per unit of energy of the fossil fuel (IPCC default)

The Western grid electricity calculations have been done based on combined margin which is derived from simple OM and BM.

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:

>>

The detailed calculation for each category in the baseline scenario and the emission factor is given in Appendix III and Appendix IV

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

>>

The CO2 reduction under each category and year wise CER flow is provided in table below

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total CER achieved
II-C	0	0	194	194	194	194	194	194	194	194	1549
II-D	429	429	429	4941	4941	4941	4941	4941	4941	4941	35873
III-B	8266	9543	9543	9543	9543	9543	9543	9543	9543	9543	94150
Yearly Flow of CER	8694	9971	10165	14677	14677	14677	14677	14677	14677	14677	131572

SECTION F.: Environmental impacts:

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

>>

The host Party, i.e. Ministry of Environment and Forest, Government of India, does not require Environmental Impact Assessment of small developmental projects within an industrial facility.

However, the project proponent has undertaken an environmental review for the above mentioned energy efficiency measures.

Parameter	Fuel switch in Boiler house	NG to H2 in CCU II	Up-gradation of DCS and 4th generation cell
Surface and ground water quality	Slightly positive	No effect	Slightly positive
Air Quality	Moderately Positive	Moderately Positive	Moderately Positive
Noise Level	No effect	No effect	No effect
Land Environment	Slightly positive	No effect	No effect
Mineral/Natural Resources	No change	Slightly positive	Moderately Positive
Ecology	Slightly positive	Negligibly positive	Negligibly positive
Transportation Mechanism	Slightly positive	No effect	Negligible
Employment	Negligibly negative	No effect	Slightly Positive

Details on environmental assessment are provided in the environmental review report available with GACL.

SECTION G. Stakeholders' comments:

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

>>

GACL identified its employees, suppliers, distributors, local community as the most important stakeholders of the project activity. To invite the stakeholders GACL posted a notice on 20th of September 2005 on the notice board of its Vadodara complex for the meeting on 7th of October 2005.The notice indicated the agenda of meeting, venue and time of meeting. The notification was also posted on the website of GACL from 20th of September to 10th of October 2005 to invite more stakeholders. Also, the stakeholders could post there question on the website of GACL.

The meeting took place outside the premises of GACL in a resort, so that more stakeholders could participate. In the meeting about 70 people were present. It had representatives from the government officials, village surpanch, distributors, suppliers, people from educational institutions and the employees of GACL.

The stakeholder meeting process involved:

a) The meeting was anchored by Mr. Thatte from GACL
b) Welcome speech was given by Mr. V.K. Gulati, Sr. Genral Manager of GACL

c) Election of a Chairperson for the meeting was done among the stakeholder present in the meeting
d) Presentation was given by Mr. K.J. Shah from GACL to introduce the stakeholders about global warming, CDM, Kyoto Protocol, the importance of stakeholder, and CDM initiatives.
e) After the presentation the house was kept open for discussion on any concerns or views that project that stakeholders had on the project.
f) Summation of the concerns expressed by the stakeholder groups and the commitments to address the concerns was made by GACL.
Preparation of draft Minutes of the Meeting and signing by the Chairperson.

All the proceedings of the meeting including the presentation were mainly carried out in local language (Gujarati).

List of participants was prepared during the meeting which includes there name, contact number, address and signature.

G.2. Summary of the comments received:

>

A summary of the comments received from the stakeholders are presented in Minutes of Meeting.

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

>>

The stakeholders asked if GACL is going to carry out any more measures of similar nature in future. Mr. J.B. Sharma of GACL answered that some of the measures it will carry out replacement of first and second generation cells with fourth generation cells. It will expand the hydrogen peroxide production capacity and utilize existing steam by improving the efficiency of steam consumption.

People expressed concern if the eco-ventilator is going to affect the illumination of the working area. It was clarified that the eco-ventilators do not affect the illumination; rather improve the natural lighting.

The comments received during the stakeholder process were answered.

Reply to the questions received on the website was given through e-mail.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

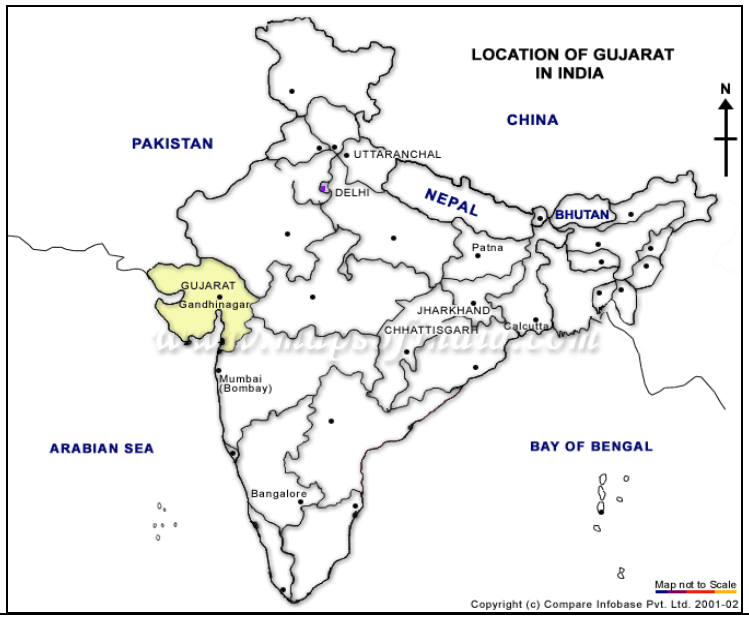
Organization:	Gujarat Alkalies & Chemicals Limited
Street/P.O.Box:	PO Petrochemicals-391346.
Building:	-----
City:	Vadodara
State/Region:	Gujarat
Postfix/ZIP:	391346
Country:	India
Telephone:	+91-265-2232681,2
FAX:	+91-265-2232130, +91-265-2230031
E-Mail:	vkgulati@gacl.co.in
URL:	www.gujaratalkalies.com
Represented by:	Sr. General Manager
Title:	
Salutation:	Mr.
Last Name:	Gulati
Middle Name:	K
First Name:	V
Department:	Materials Management,Export & Resource mobilization
Mobile:	+919824088142
Direct FAX:	+91-265-2230026
Direct tel:	+91-265-2230025 +91-265-2230126
Personal E-Mail:	vkgulati@gacl.co.in

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding has been sought for the project activity. The project proponent will identify potential participants if additional funds are required in the future.

APPENDIX I


LOCATION OF GUJARAT IN INDIA
N
CHINA
PAKISTAN
UTTARANCHAL
DELHI
NEPAL
BHUTAN
Patna
GUJARAT
Gandhinagar
JHARKHAND
CHHATTISGARH
Calcutta
Mumbai (Bombay)
ARABIAN SEA
BAY OF BENGAL
Bangalore
Map not to Scale
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Gujarat
(District Map)
N
PAKISTAN
RAJASTHAN
Banas Kantha
Rann Of Kachchh
Patan
Little Rann Of Kachchh
Mehsana
Kachchh
Sabar Kantha
Gandhi Nagar
Ahmedabad
Gulf of Kuchchh
Surendranagar
Kheda
Panchmahal
Dahod
Jamnagar
Rajkot
Anand
Vadodara
MADHYA PRADESH
Porbander
Bharuch
Narmada
Junagadh
Amreli
Bhavnagar
Surat
Map not to Scale
State Boundry
District Boundry
State Headquarter
District Headquarter
Creek
Gulf of Khambhat
Diu (Daman & Diu)
Navsari
The Dangs
ARABIAN SEA
Daman (Daman & Diu)
Valsad
MAHARASHTRA
DADRA & NAGAR HAVELI
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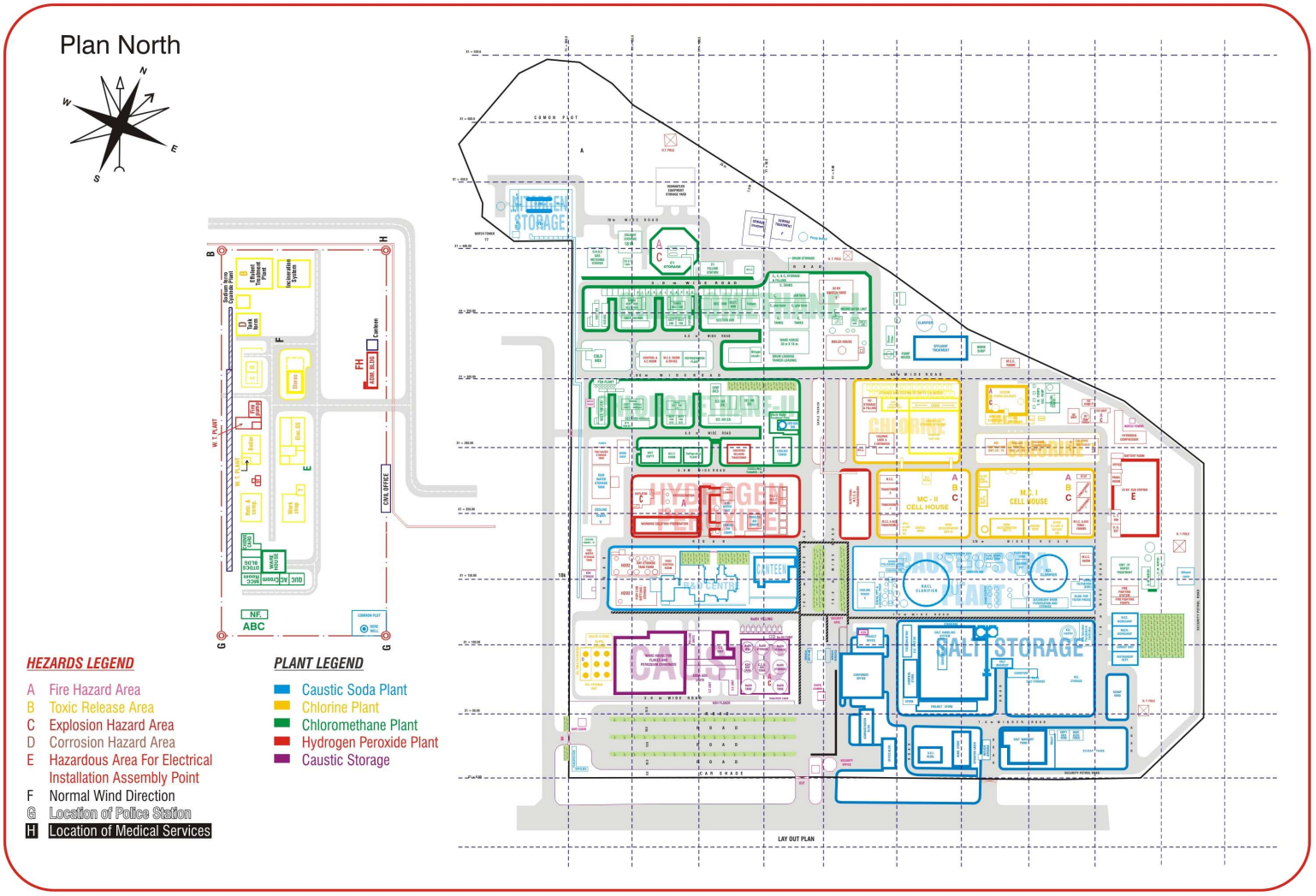
MASTER LAYOUT PLAN OF BARODA COMPLEX



FineLine/bharat/d:/cdr_files/gacl/Map_Final

APPENDIX II: Monitoring Plan

Parameter	The parameter is measured/ calculated/ estimated	Equipment used for measurement	Location of the equipment	ID /reference number	Frequency of measurement	Designation of the person taking field measurement	Name of the person	Is the measuring equipment critical or non-critical(as per ISO 9000)	Frequency of calibration	Designation of the person responsible for calibration of the equipment	Name of the person	Designation of the person keeping the records	Name of the person	Designation of the person reviewing the data	Name of the person reviewing the data
Quantity of NG fired at CCU II	(NG is not being used)														
Quantity of H2 firedat CCU II	Measured	Orifice Flowmeter	CCU Control Room	F1010	Once Daily	Foreman/Sr. Foreman	S R Shah P K Bhavsar V S Patel R S Sisodia	Non Critical	6 Months	Sr. Engineer Asst. Engineer	R D Joshi S R Patel	Sr. Engineer Asst. Engineer	R D Joshi S R Patel	Sr. Manager	A R. Kinkabwala P K Maharaja
Caustic soda flakes produced byh CCU II	Measured	Weiging Scale	CCU Warehouse	nil	Once Daily	Foreman/Sr. Foreman	S R Shah P K Bhavsar V S Patel R S Sisodia	Non Critical	7 Months		R D Joshi S R Patel	Sr. Engineer Asst. Engineer	R D Joshi S R Patel	Sr. Manager	A R. Kinkabwala P K Maharaja
Production from 4th generation cell electrolyzers	Calculated	kA Monitor	MC I,MC II Control Rooms	E9, RA 3, RA 7	Once Daily	Ast. Engineer / Sr. Foreman/ Chargeman	D D Mahida, M G Upadhyay A S Prajapati, N J Patel, C H Patel,	Non Critical	6 Months	Sr. Foreman	G D Puwar, D L Motiwale	Sr. Engineer/ Engineer	P D Hansalia, K R Kavatia	Sr. Manager/ Manager	S G Sringarpure, V M Patel.

Parameter	The parameter is measured/ calculated/ estimated	Equipment used for measurement	Location of the equipment	ID /reference number	Frequency of measurement	Designation of the person taking field measurement	Name of the person	Is the measuring equipment critical or non-critical(as per ISO 9000)	Frequency of calibration	Designation of the person responsible for calibration of the equipment	Name of the person	Designation of the person keeping the records	Name of the person	Designation of the person reviewing the data	Name of the person reviewing the data
specific power consumption be first gneration electrolyzers specific power consumption be fourth gneration electrolyzers							B N Patak, R S Verma, R K Mali, S P Pandey, C S Rawat, R K Gupta, A G Joshi, B K Bhalerao, G A Kataria, P G Sonawane, P H Nasit, P N Patel.								
Electrical energy saving by DCS upgradation	Energy measured	Energy meter	MC I,MC II Control Rooms	FAF Meter	Once Daily	Sr. Technitian	R D Parmar, N M Saparia, P S Patel, R R Pandya,	Non Critical	No Calibration Unless Abnormality	Sr. Manager	R P Agarwal	Sr. Manager	Agarwal	Dy. G M	B C Chokshi
	Production Calculated	Level gauge	CSL & CPL Storage tanks, MC I &MC II	ST 1 to ST 7 LIK 6401,02,03 LI 206,LI	Once Daily	Sr. Foreman/ Chargeman	B N Patak, R S Verma,	Non Critical	No Calibration Unless Abnormality	Sr. Engineer Asst. Engineer	R D Joshi S R Patel	Sr. Engineer Asst. Engineer	R D Joshi S R Patel	Sr. Manager	A R. Kinkabwala P K Maharaja

Parameter	The parameter is measured/ calculated/ estimated	Equipment used for measurement	Location of the equipment	ID /reference number	Frequency of measurement	Designation of the person taking field measurement	Name of the person	Is the measuring equipment critical or non-critical(as per ISO 9000)	Frequency of calibration	Designation of the person responsible for calibration of the equipment	Name of the person	Designation of the person keeping the records	Name of the person	Designation of the person reviewing the data	Name of the person reviewing the data
			Control rooms	5603 FQ 5604			R K Mali, S P Pandey, C S Rawat, R K Gupta, A G Joshi, B K Bhalerao, G A Kataria, P G Sonawne								

APPENDIX III
EMISSION FACTOR CALCULATION

Caustic Soda Plant emission factor		
CCP at Dahej		
Annual power procured from CCP	89020980	Kwh
Specific heat consumption	1959	Kcal/Kwh
	8.20194E-06	TJ/Kwh
IPCC emission factor for C from NG	15.3	tC/TJ
CO2 emission factor of NG	56.1	tCo2/Tj
Specific CO2 emission factor	**460.1289013**	**tCo2/Kwh**
CO2 emission from CCP power	**40961125722**	**tCO2**
GIPCL		
Annual power procured from CCP	180396411	Kwh
IPCC emission factor for C from NG	15.3	tC/TJ
CO2 emission factor of NG	56.1	tCo2/Tj
Specific CO2 emission factor	**450**	**tCO2/GWh**
CO2 emission from CCP power	**81178384950**	**tCO2**
Total power purchased	269.41	Gwh
Total Co2 emission	1.2214E+11	tCO2/yr
CO2 emission factor for Caustic soda plant	**453.34**	**tCO2/GWh**

Sodium Cyanide Plant		
CCP at Dahej		
Annual power procured from CCP	1255341	Kwh
Specific heat consumption	1959	Kcal/Kwh

	8.20194E-06	TJ/Kwh
IPCC emission factor for C from NG	15.3	tC/TJ
CO2 emission factor of NG	56.1	tCo2/Tj
Specific CO2 emission factor	**460.1289013**	**tCo2/GWh**
Western Grid		
Annual power purchased	926877	GWh
CM emission factor for grid	1136	tCO2/GWh
TCO2 from the grid	1052932272	tCO2
Percentage from Dahej	0.575259209	
Percentage from GEB	0.424740791	
Total power purchased	2182218	KWh
CO2 emission	**747.1989266**	**tCO2/GWh**

APPENDIX IV
CER CALCULATION

Calculation for II C:

Sr. No	Equipment Type	Location	No. of units of the equipment before project	Power rating of the equipment (Wh)	No. of units of the equipment after project	Power rating of the new/ replaced equipment (Wh)	Daily hours of operation of the equipment before project	Annual saving in Electricity (GWh)	CO2 emission factor (tCO2/GWh)	Annual CO2 emission reduction (TCO2/yr)	CO2 savings Calculated from Year
5	Replacement of Motor	Brine pump	2	75000	2	45000	24	0.2592	747.00	193.62	2005
	Annual saving achieved							**0.2592**		**193.62**	

Calculation for II D:

Sr. No	Equipment Type	Location	Production capactiy (MT/day)	Specific power consumption before project (KWh/MT)	Specific power consumption after project (KWh/MT)	Energy saving (KWh/ Mt)	Annual days of operation	Annual saving in Electricity (GWh)	CO2 emission factor (tCO2/GWh)	Annual CO2 emission reduction (TCO2/yr)	CO2 savings calculated from year
1	4th genration cell electrolyzers	electrolysis cell 1 &2 (NaOH)-RA-3 and RA-7 and E-9	31.00	2255.43	2130.54	124.89	360.00	1.39	453.35	631.88	2006
2	Energy saved in electrolyzers by DCS Upgradation	DCS control						8.56	453.35	3880.65	2004
3	Tray dryer to paddle dryer -reduction in thermal energy consumption	Sodium Cyanide plant	7.50	1.10	0.18	0.92	330.00	1829.52	0.21	387.43	2003
4	Tray dryer to paddle dryer - electrical energy requirement	Sodium Cyanide plant	7.50	52.64	30.40	22.24	330.00	0.06	747.20	41.13	2003
	Annual Saving							**10.01**		**4941.09**	

FUEL SWITICHING MEASURES

H2 to NG in CCU II at Caustic soda		
Year of fuel switch	2003	
Specific NG consumption	105	SCM/ T of CSF
NCV of NG supplied by GAIL	9800	Kcal/SCM
Specific energy consumption	4.E-03	TJ/T of CSF
IPCC emission factor for carbon	15	tC/Tj
CO2 emission factor	56	tCO2/TJ
Specific emission of CO2 from NG	**0.24**	**tCO2/T of CSF**
Caustic soda production by CCU II	95	MT of CSF/day
Annual operation duration of the plant	360	days
Annual CSF production	34200	Mt/yr
Baseline Co2 emission	**8266**	**tCo2/yr**
Project Emissions		
H2 consumption	380	Nm3/T of CSF
Caustic soda production by CCU II	95	MT of CSF/day
Annual operation duration of the plant	360	days
Annual CSF production	34200	Mt/yr
Annual consumption of H2	12996000	SCM.
CO2 emission factor for H2	0	tCO2/TJ
Project emission	0	tCO2
Emission reduction yearly	**8266**	**tCO2/yr**

Furnace oil to NG in boiler house of Sodium Cyanide plant		
Year of fuel switch	Jun-04	
Baseline		

Specific consumption of FO	0.0819	MT/T
Density of FO	0.923	Kg/L
NCV of FO	10000	Kcal/kg
	9230	kCal/L
Energy in FO	0.00343	TJ/T of steam
IPCC factor for C emission	21.1	TC/TJ
CO2 emission factor	77.36	tCO2/TJ
Co2 emisison coefficient for FO	0.265	tCO2/T of steam produced
Specific consumption of FO	0.018	Kl/T of steam
Specific emission of CO2 from FO	**4.77**	**tCO2/T of steam produced**
Steam production capacity	3	TPH
Annual hours of operation	7920	Hrs
Steam production	23760	MT
Emission from burning FO	**6308.45**	**tCo2/yr**
project activity		
Specific consumptiuion of NG	92	SCM/MT
NCV	9800	Kcal/SCm
Energy in Ng	0.00377	TJ/MT
IPCC factor for C emission	15.3	TC/TJ
CO2 emission factor	56.1	tCO2/TJ
Specific consumption of Ng	0.00377	TJ/MT
Specific CO2 emission factor	**0.21**	**tCO2/MT**
Emission from burning NG	**5031.59**	**tCO2/yr**
Emission reduction	**1276.85**	**tCO2/yr**

- - - - -