CDM PROJECT DESIGN DOCUMENT (PDD)

PROJECT FOR GHG EMISSION REDUCTION BY THERMAL OXIDATION OF HFC 23

at

HCFC 22 PLANT

of

GUJARAT FLUOROCHEMICALS LIMITED (GFL)

November 14, 2003

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Abbreviations:

$Q_{HCFC\ 22}$	Quantity of HCFC production
$Q_{HFC\ 23}$	Quantity of HFC 23 fed to thermal oxidiser
$Q_{BL\ HFC\ 23}$	Baseline HFC 23 destruction
Composition of HFC 23	Composition of HFC 23 gas fed to thermal oxidiser
E_P	Total GHG emission due to thermal oxidation process
E_{TOP}	GHG emission generated by the thermal oxidation process
E_L	GHG leakage due to the thermal oxidation process
E_R	GHG emission reduction measured in CO2 equivalent
$GWP_{HFC\ 23}$	GWP of HFC 23
Q_{Fuel}	Quantity of fuel input to thermal oxidiser
Q_{Power}	Power consumed by thermal oxidation system
Q_{Steam}	Quantity of steam fed to thermal oxidiser
$Q_{HFC\ NO}$	Quantity of HFC 23 remaining in flue gases coming out from Thermal oxidation system
$Q_{Solid\ Waste}$	Solid waste generated from ETP and CaF2 and CaCl2 settling.
C_{Fuel}	No. of carbon atoms in a molecule of fuel
M_{Fuel}	Molecular weight of fuel
Z_Y	Fraction of waste stream, HFC 23, required to be destroyed by the regulations of the host country in the year Y.
$F_{HFC\ 23}$	GHG emission factor for thermal oxidation of HFC 23
$F_{HFC\ 23\ NO}$	Fraction of HFC 23 not thermally oxidised
F_{LPG}	GHG emission factor for burning LPG
F_{Power}	Factor defining MT of CO2 emission on generation of 1 unit of power
F_{Steam}	Factor defining MT of CO2 emission on generation of 1 MT of steam

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$F_{Solid\ Waste}$	Factor defining MT of CO2 emission on transporting 1 MT of solid waste
$F_{Fuel\ Transport}$	Factor defining MT of CO2 emission on burning of 1 MT of transport fuel
$F_{Transport}$	Factor defining MT of fuel required to transport 1 MT of fuel for safe disposal in land fill sites
$Q_{Ca\ (OH)\ 2}$	Quantity of Ca (OH) 2 (hydrated lime) fed to thermal oxidation system.
Q_{NaOH}	Quantity of NaOH (caustic soda) fed to thermal oxidation system.
$F_{Ca\ (OH)\ 2}$	Factor defining MT of CO2 emission on production of 1 MT of Ca (OH) 2
F_{NaOH}	Factor defining MT of CO2 emission on production of 1 MT of NaOH
$F_{NaOH\text{-}Power}$	Power used in production of 1 MT of NaOH (caustic soda, 100% from common salt (NaCl).
COD / BOD	Chemical oxygen demand / biological oxygen demand
SS	Suspended solids
GHG	Greenhouse gas
SKO	Superior kerosene oil

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A. GENERAL DESCRIPTION OF PROJECT ACTIVITY

A.1 Title of the project activity

Project for GHG emission reduction by thermal oxidation of HFC 23 in Gujarat, India.

A.2 Description of the project activity

A.2.1 The 'Project Activity' includes development, design, engineering, procurement, finance, construction, operation and maintenance of a system for thermal oxidation of HFC 23 (Chemical Formulae: CHF_3) followed by treatment of combustion gases prior to safe disposal of all emissions and discharges.

A.2.2 HFC 23 is inevitably generated as a by-product in the production of HCFC 22 (Chemical Formulae: $CHClF_2$). Though HCFC22 is not listed in the Annex A of the Kyoto Protocol as a greenhouse gas, it is recognized as a greenhouse gas by the IPCC. HFC 23 has low toxicity but it is a greenhouse gas (commonly referred to as GHG) with a GWP of 11,700 (Reference IPCC 2nd Assessment Report). Though HFC 23's emission is controlled under the Kyoto Protocol, there are no regulations on the emission of HFC 23 in India since there is no toxic effect of HFC 23. HFC 23 has very low volume use in a specific fire fighting application, ultra low temperature application and in the processing of semi-conductors but there is no known market for HFC 23 in India.

The typical mass ratio of HFC 23 to HCFC 22 being 3-4% on mass basis (The IPCC GHG Recovery Good Practice Guidance Report set its default value, defined as tonnes of HFC 23 produced per tonne of HCFC 22 produced, as 4%), while the lowest % achieved at GFL in last three years is 2.9%. The % HFC 23 is similar to 2.9% cut-off rate indicated for a similar project in Korea (Ulsan Chemical Co. Ltd related F-CDM-Nmpu Document ID Number (s) F-CDM-Nmpu-0007), which uses approved CDM Methodology AM 0001. The GFL project also uses approved Methodology AM 0001. For the purpose of carbon credit calculation and subject to validation, a rate of 2.9% is considered to set a cut off for the baseline.

A.2.3 Gujarat Fluorochemicals Limited (hereinafter referred to as GFL) operates a HCFC 22 plant in Ranjitnagar, Dist. Panchmahals, Gujarat, India since 1989. The plant uses Chloroform ($CHCl_3$), Fluorspar (CaF_2) and Sulphuric Acid as the main feedstock and produces HCFC 22 in a swing plant operation with by-product HFC 23, which is being vented to atmosphere (the swing plant makes R 11 & R 12 on campaign basis with R 22). GFL wishes to take up thermal oxidation of HFC 23, the by-product of HCFC 22, as a CDM project on voluntary basis. Under this project activity, GFL shall additionally install, operate and maintain a HFC23 collection and thermal oxidation system to decompose HFC23 into its products of combustion. The thermal oxidation system in combination with the existing HCFC plant will enable GFL to avoid HFC23 emissions (GHG emissions), which would in the absence of the project activity have been vented to the atmosphere. The installation of thermal oxidation facility would not only make GFL contribute to society by restricting release of GHG but would give economic and technical benefits to the country by providing direct and in-direct employment and transfer of thermal oxidation technology to the country and thus contributing to sustainable development.

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A.2.4 Process technology for thermal oxidation of HFC 23 is not available indigenously. Though there are indigenous processes for incineration of wastes but none of these companies have any experience with HFCs. GFL proposes to import the thermal oxidation plant from experienced licensing / engineering companies as well as the incinerator plant suppliers using Ineos Fluor Holdings Ltd (and its subsidiaries including Ineos Fluor Limited) as the technology sponsor, who have substantial operating experience in thermal oxidation of Chlorinated or Fluorinated or mixture of chlorinated and fluorinated hydrocarbons.

Ineos Fluor Holdings Ltd. has considerable experience of specifying, commissioning and operating thermal oxidiser for the destruction of HFC 23 from HCFC 22 production. Ineos Fluor Holdings Ltd. has carried out GHG emission reduction by thermal oxidation of HFC 23 at Runcorn UK since 1999. This activity was acknowledged by the UK Climate Programme (2000) as delivering significant emission reductions (The United Kingdom ratified the Kyoto Protocol on 31 May 2002). This new treatment unit, which converts the by-product waste gases into harmless salts and water vapour, has been designed and constructed to the highest environmental standards.

A.2.5 The proposed process is single stage thermal oxidation of HFC 23 (along with a small carryover of HCFC 22 and air). The proposed process thermally oxidises HFC 23 at around 1,200^{0}C in an oxidation chamber (furnace). As HFC 23 has a comparatively low calorific value, a small quantity of LPG / any other fuel, as supplemental fuel, along with air and steam is introduced into the oxidation chamber. The oxidation temperature of equal to or more than 1,200^{0}C ensures that dioxins formation is prevented, when coupled with very rapid quenching.

A.2.6 The resulting gaseous products of combustion are mainly carbon dioxide and water vapour along with hydrogen fluoride and hydrogen chloride besides nitrogen and oxygen. Other gases like CO, NOx, N2O, SO2 and Dioxins also are expected to be generated but at low levels, such that their emission is within accepted levels. This gas stream is then cooled by direct contact with water in a cooling system, whereby acids (hydrochloric acid and hydrogen fluoride) and moisture are absorbed to produce aqueous solution. This solution is recovered and/or neutralized with slaked lime (hydrated lime) to produce calcium chloride (CaCl2) and calcium fluoride (CaF2)), which are transferred to a settling / precipitation tank where settled solids (CaF2 and CaCl2) are removed and filtrate (mother liquor) is removed as overflow. Settled solid are processed to remove water and then used as landfill for safe disposal. The off gases from quench are scrubbed with caustic solution to neutralise and remove remaining hydrogen chloride and hydrogen fluoride. The neutralised and cooled gases comprising N2, O2 and CO2 with low levels of moisture and meeting environmental standards are vented to atmosphere through a stack.

A.2.7 The thermal oxidation system would have the following facilities as part of the system:

- HFC 23 collection & storage facility
- Thermal oxidation chamber
- Direct cooling system (quench)
- Caustic scrubbing

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- Neutralisation & settling / precipitation to the extent required

- Water treatment plant to provide make-up process water.
- Cooling water system.
- Compressed air system.
- Effluent treatment plant to treat aqueous effluent from settler / precipitator, caustic scrubber, water treatment plant and cooling water system and recycle water for cooling and neutralisation system.
- Solid waste treatment and disposal in a secured landfill fully meeting the prescribed guidelines.

A.2.8 The thermal oxidation facility will have an instantaneous design capacity to handle the entire emission of HFC 23 from GFL's HCFC 22 plant matching its instantaneous capacity in terms of HFC 23 quantity, flow rate and composition of the vent stream from HCFC 22 plant.

A.2.9 The objectives of setting up the project include:

- Contribute to the global initiatives towards mitigation of climate change through a reduction in GHG emissions in the said unit;
- Transfer of technology for CO_2 abatement and reduction of greenhouse gas emissions and its testing and development;
- Indirectly contribute to improved service delivery to a limited extent;
- Improve micro-economic efficiency of the sector through various innovations incorporated in the project activity;
- Contribute to the development of local economy and create jobs and employment, particularly in rural areas, which is a priority concern for Government of India;
- Build Capacity and Empowerment of vulnerable sections of the rural communities in the vicinity of the project;
- Indirectly increase income security of vulnerable sections of the society through redistribution benefits on account of the economic activities associated with the project;
- Contribute to mitigate water and natural resource scarcity in and around the project area.

A detailed discussion on project's contribution to sustainable development has been included at Annex 12.

A.3 Project participants

A.3.1.1 Project promoter:

Gujarat Fluorochemicals Limited, Gujarat, India

Role:

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- Implementing the project activity, comprising of the development design, engineering, procurement, finance, construction, operation and maintenance of the system for thermal oxidation of HFC23
- Owning and transacting of the entire emission reductions resulting out of the project save and except the emission reductions allocated to the project participants
- Communicating with the CDM EB and UNFCCC on behalf of all project participants in respect of all matters concerning the project activity, including changes in project participants and allocation of emission reductions

Contact information:

Gujarat Fluorochemicals Limited
Survey Number 16/3, 26 and 27
Village Ranjitnagar
Taluka Ghoghamba
District Panchmahals
Gujarat, India

Vadodara office:	New Delhi office:
ABS Towers, 2nd Floor	A-6, Connaught Place
Old Padra Road	New Delhi 110 001
Vadodara 390 007	India
Gujarat, India	

Registration No.	9362 State Code 04	
Registration Date	February 1987	
Contact Person:	Mr. Deepak Asher	Mr. V.K. Soni
Telephone:	+ 91 (265) 2330-057	+ 91 (11) 2332 4509 / 4245
Telefax:	+ 91 (265) 2310-312	+ 91 (11) 2332 5128 / 4773
E-mail	deepak_asher@yahoo.com	vksoni@gfl.co.in

A.3.1.2 Other participants

(a) Technology sponsor:

Ineos Fluor Limited, United Kingdom

Role (subject to detailed contract between GFL and Ineos):

- Providing technical and other advise and assistance on all aspects of project activity implementation and operations thereafter
- Providing guidance on all aspects of baseline study, methodology, monitoring and verification, project design document preparation, validation and registration thereof
- Owning and transacting a portion of the emission reductions allocated from the project as separately agreed to by GFL

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Contact information:

Ineos Fluor Limited
PO Box 13, The Heath
Runcorn
Cheshire WA7 4QF
United Kingdom

Registered in England No. 4041123

Contact Person:	Dr. Andrew A Lindley
Telephone:	+ 44 1928 513 145
Telefax:	+ 44 1928 511 418
E-mail:	Andrew.lindley@ineosfluor.com

(b) Cooperatieve Centrale Raiffeisen Boerenleenbank B.A. (Rabobank), Netherlands

Role (subject to detailed contract between GFL and Rabobank):

- Acting as intermediary for the benefit of the State of the Netherlands for the purchase of Emission Reductions

Contact information:

Rabobank International
Croeselaan 18, 3521
CB Utrecht
P.O.Box 17100,
UC R 315
3500 HG Utrecht, The Netherlands

Contact Person:
Ms Caroline van Tilborg
Head of Carbon Procurement Dept.

Telephone: + 31 30 216 4969
Telefax: + 31 30 216 1949

(c) Sumitomo Corporation, Japan

Role (subject to detailed contract between GFL and Sumitomo):

- Providing operations and maintenance assistance through Daikin Industries, Japan, who have rich experience in operating and maintaining similar plants in Japan
- Transaction Facilitator for part / whole of Emission Reductions intended by GFL to be sold in Japan

Contact information:

Sumitomo Corporation, Japan
1-8-11, Harumi, Chuo-ku, Tokyo, 104-8610, Japan

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Title and Section: Manager, Global Environment Department
Telephone: +81 3 5166 3162
Telefax: + 81 3 5166 6310

(d) Gujarat Fluorochemicals Limited (GFL) intends to appoint a bank / financial institution to act as a trustee / custodian, on behalf of GFL, for whole / part of the emission reductions generated by the project, as may be decided by GFL to be placed in trust / custody of the bank / financial institution. On such appointment, GFL may decide to add the name of such bank / financial institution as a Project Participant in accordance with the procedures in this regard.

A.3.2 Parties

Republic of India, the host country, is a party to the Kyoto Protocol and has acceded to the Kyoto Protocol in 2002.

The United Kingdom ratified the Kyoto Protocol on 31 May 2002.

The Netherlands ratified the Kyoto Protocol on 31 May 2002

Japan ratified the Kyoto Protocol on 4 June 2002

A.3.2 Promoters details & background

A.3.2.1 Gujarat Fluorochemicals Limited (GFL) or its associate companies will be the promoter of the CDM project. The thermal oxidation facility will be installed at the existing site of GFL's HCFC 22 plant.

Gujarat Fluorochemicals Limited (GFL) has been promoted by INOX Group, who is in the business of industrial gases, refrigerant gases, family entertainment centres, IT enabled services etc. A profile on INOX group is provided in Annex 1.

A.3.2.2 Details of main business

Gujarat Fluorochemicals Limited (GFL) is a producer of Refrigerant gases mainly $CHClF_2$ (HCFC 22) from chloroform ($CHCl_3$) and hydrofluoric acid (HF). HF is produced in the complex by the reaction of fluorspar (CaF_2) and Sulphuric acid (H_2SO_4). Fluorspar, chloroform and sulphuric acid are the feedstock for the main business and CHF_3 (HFC 23) is inevitably generated as a by-product of production of HCFC 22. A block diagram showing the process steps is given in Annex 8 along with other information.

(a) Process used

The main facility for the production utilizes following reaction:

- $CaF2 + H2SO4 \rightarrow CaSO4 + 2HF$
- $2 HF + CHCl3 \rightarrow CHClF2 (HCFC 22) + 2 HCl$
- $3 HF + CHCl3 \rightarrow CHF3 (HFC 23) + 3 HCl$

(b) Abbreviation:

- CaF2 – Fluorspar
- H2SO4 – Sulphuric Acid / Oleum
- CaSO4 – Gypsum
- HF – Hydrofluoric Acid
- CHCl3 – Chloroform
- HCl – Hydrochloric Acid

(c) GFL uses the following feedstock:

? Fluorspar (mainly CaF2)
? Chloroform (CHCl3)
? Sulphuric Acid / Oleum (H2SO4)

(d) Principal products produced on the site:

? Chlorofluorocarbons - HCFC – R22
? Hydrofluoric Acid – HF

(e) By-products

- ❑ Gypsum (CaSO4)
- ❑ HFC 23 (CHF3)
- ❑ Hydrochloric Acid (HCl)

(f) Production capacity

The plant used to manufacture HCFC 22 is a swing plant (the plant cannot produce R 11 / R 12 and HCFC 22 at the same time), which is currently also used to produce CFC 11 (R 11) and CFC 12 (R 12). The plant has instantaneous installed capacity in excess of 60 TPD HCFC 22 (up to 75 TPD). This is equivalent to around 20,700 TPA or higher based on operating days / year of 345 or higher and using at least 60 TPD instantaneous installed capacity.

The production in the calendar years 2004 and 2005, as per GFL's business plan, would be 15,000 TPA and 18,500 TPA respectively.

The production of HCFC 22 has been below capacity due to limited availability of Anhydrous HF (hydrofluoric acid) and the need to produce other refrigerant gases (R11 & R 12).

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Two projects to improve the availability of Anhydrous HF were conceived and initiated prior to any involvement in CDM and represent a business-as-usual initiate to fully utilise the plant capacity. One of these two projects is already commissioned and the 2nd project is being commissioned (October / November 2003).

The utilisation of the plant to make CFC 11 and CFC 12 reduces HCFC 22 production, due to two factors: the unavailability of the plant while making CFC 11 and CFC 12; and the time required to switch from CFC 11 / CFC 12 to HCFC 22 and vice-versa. The National plan to phase out CFCs by 2010 will gradually reduce the production of CFC 11 and CFC 12 at GFL and will gradually allow more days for the production of HCFC 22.

The lowest ratio of HFC 23 to HCFC 22, for the last 3 completed years is 2.9% as per Annex 5

A.3.3 Current status of the project activity

The CDM project for thermal oxidation of HFC 23 is in the pre-feasibility stage. Following pre-project work has been completed:

- Physical conditions at which HFC 23 will be delivered to the thermal oxidation facility have been firmed up.
- Disposal scheme for combustion gases has been finalized.
- Process licensors / engineering contractors have been contacted and budgetary proposals received and under discussions and negotiation.
- Preliminary estimates of cost of installation & its operating cost have been prepared.
- Study on probable locations for the thermal oxidation facility on the existing layout has been carried out and most probable location has been marked.
- Appointment of PricewaterhouseCoopers for preparation of draft PDD and Host Government Approval (HGA).
- Appointment of M/s. SGS as 'Operational Entity' for validation.
- Draft PDD submitted to Government of India for HGA.
- Monitoring plan for the input to / output to the project activity including emissions has been prepared
- Methodologies for baseline emission and project emissions are based on existing approved methodology and reduction in GHG emission has been quantified.

The project start date is expected to be December 2003 (based on the host government approval being received by December 2003) with project completion date expected in September 2005, being about twelve months from project registration.

A.4 Technical description of the project activity

A.4.1 Location of the project activity

A.4.1.1 Host country party (ies)

India

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A.4.1.2 Region / State / Province etc.

Gujarat / District Panchmahals, Taluka Ghoghamba

A.4.1.3 City / Town / Community etc.

Ranjitnagar

A.4.1.4 Details of physical location including information allowing the unique identification of this project activity

(a) Address

The thermal oxidation project will be located at the existing 'HCFC 22 Complex' of GFL located at the following address:

Gujarat Fluorochemicals Limited
Survey No. 16 / 3, 26, 27
Ranjitnagar
Taluka Ghoghamba
District Panchmahals
Gujarat, India

(b) Physical Location of the Project

The location map of the Gujarat Fluorochemicals Limited is attached as Annex 7. Nearest airport and railway station is Vadodara (60 km), which is at a driving time of an hour.

(c) Latitude and longitude

- Latitude — Between 22^0 25' and 22^0 35'
- Longitude — Between 73^0 30' and 73^0 45'

A.4.2 Category (ies) of the project activity

The project is principally categorized in: Category 11: **"**Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride**"** (overlapping to Category 1: "Energy Industries", Category 3: "Energy Demand", Category 5: "Chemical Industry" and Category 13: "Waste Handling and Disposal") in the scope of the project activities listed in the *Sectoral* scope for accreditation of the operational entities.

The methodology AM 0001, applied to this project, has its category 11.

A.4.3 Technology to be employed by the project activity

A.4.3.1 HFC, its composition & quantity to be thermally oxidised

(a) Source of HFC 23

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As explained earlier, HFC 23 is inevitably generated as a by-product from the production facility for HCFC 22. Since there is no known market for HFC 23 in India, it is being vented into the atmosphere since inception of the plant in 1989. A block diagram showing the source of HFC 23 emission from the plant is given as Annex 9.

(b) Composition of HFC stream to be thermally oxidised

The typical composition of HFC 23 stream from vent of Column No. C-209 (within the HFC 22 plant) is given below, which could vary due to variations in the HCFC22 plant and the incinerator is designed to handle the variations:

Component	Unit	Average Range
HFC 23	Wt. %	90-92
HCFC 22	Wt. %	7-8
Air	Wt. %	1-2

(c) Quantity of HFC 23 stream to be thermally oxidised

The quantity of HFC 23 stream, with composition as given in A.4.3.1 (b), to be thermally oxidized is at 2.9% of HCFC 22 production (lowest ratio of last 3 calendar years) as per measurement of HCFC 22 production and laboratory analysis by Gas Chromatograph (GC), regularly calibrated as per the standard calibration procedure in the ISO 9002 Quality System being followed at GFL as defined in Section D.6 and Annex 5

A.4.3.2 Proposed technology

The specific equipment for the project activity will be decided after complete technical scrutiny and negotiations with equipment manufacturers. The description of typical technology for the proposed thermal oxidation system is given below.

It is proposed to deploy single stage combustion process where the fluorocarbon waste gases (HFC 23) are thermally oxidized at around 1,200 ^{0}C to gaseous products of combustion, viz., carbon dioxide and water vapour along with hydrogen fluoride, hydrogen chloride besides air (nitrogen and oxygen). The combustion gases are cooled to around 50^0 to 90^0 C by absorption of combustion gases in excess water (direct contact) to form weak acids (HF and HCl). The remaining gases (not absorbed in cooling water) are passed through a scrubber where caustic soda solution is passed counter-currently to rising un-absorbed gases to remove remaining HF and HCl. The composition of flue gases from the stack in project activity is given in Section A.4.3.8. The weak acids formed in cooling water tank are recovered and/or neutralised by hydrated lime [Ca (OH) 2] to form CaF2 and CaCl2 followed by settling / precipitation. The settled CaF2 and CaCl2 solids are removed and processed to remove water then by drying to obtain dried solids, which can be used for land filling for safe disposal. A block diagram showing the process scheme is given in Annex 10.

In the proposed thermal oxidation system, HFC 23 gas is subjected to a very high temperature of around 1200 ^{0}C to ensure almost complete decomposition of HFC 23 gases and prevent formation of dioxins. Based on the experience of Ineos Fluor and as guarantees offered by the

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process licensors and plant suppliers, more than 99.999% of feed HFC 23 (along with HCFC 22, reference section A.4.3.1 (b) above) is decomposed. The emission of HFC 23 from the thermal oxidation system is almost 'Zero' (less than 0.001%).

The composition and physical conditions of the HFC 23 gas stream to be thermally oxidised is already defined in A.4.3.1 (b) to (d).

The technology proposed in this document, for the decomposition of HFC 23, is a proven technology. The decomposition plant will be very reliable and capable of delivering almost complete destruction of HFC 23 and HCFC 22 (HCFC 22 is carried over with HFC 23 from the HCFC plant). No credit is being claimed for HCFC 22.

Since HFC 23 is non-toxic and its emissions are not regulated in India, the installation of thermal oxidation facility is voluntary involving significant capital and operating cost. The installation, however, would bring in the following direct / indirect benefits:

- Better environment due to significantly lower release of GHG.
- Transfer of environment technology to the country.
- Development of environmental technology skills in the country.
- Direct and indirect employment.

The process description of each section of the complete thermal oxidation facility is described below section wise.

(a) Thermal oxidation chamber (furnace)

The thermal oxidation chamber is the heart of the system. LPG / any other fuel along with air (O_2 and N_2) and steam is fed to the thermal oxidation chamber (furnace) where LPG / any other fuel is oxidised to carbon dioxide (CO_2) and water vapour. HFC 23 (containing low levels of HCFC 22, 7-8%) is simultaneously supplied to the thermal oxidation furnace, where it is oxidised to CO_2, HF and HCl as per the following reactions:

- CHF_3 (=HFC 23) + H_2O + ½ O_2 → CO_2 + 3 HF
- $CHClF_2$ (=HCFC 22) + H_2O + ½O_2 → CO_2 + 2 HF + HCl
- CH_4 (natural gas, methane) + 2 O_2 → CO_2 + 4 H_2O

The purpose of firing LPG / any other fuel is two fold, one to provide additional hydrogen and other to minimise formation of free chlorine among the combustion products.

As can be seen from the above reactions, steam, like LPG / any other fuel, is an additional source of hydrogen and is necessary to ensure complete conversion of halogens in HFC 23 and HCFC 22 to the respective hydrogen halides. Steam also controls the temperature of the thermal oxidation chamber.

The thermal oxidation furnace is equipped with a versatile burner, which has multi gas injectors. This is a special burner, which is capable of burning a wide range of both types of wastes, viz., gaseous and liquids wastes with low calorific values with large variation of excess air.

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The burner is the most important component of the thermal oxidation furnace. This burner has a special design to ensure intense mixing of HFC 23 air and fuel during combustion of the final mixture. This ensures almost complete decomposition of HFC 23 (and HCFC 22 contained therein), i.e., more than 99.999% combustion efficiency.

The thermal oxidation chamber is lined with a special refractory lining to protect the shell of the chamber (furnace) from the high temperature of the combustion. The shell temperature is maintained above the acid dew point (of HF and HCl) to prevent condensation and thus acid dew point corrosion.

The residence time is of utmost importance in the design of combustion temperature and burner and the entire operation of combustion to ensure complete combustion and at the same time not to allow stranded combustion products within the chamber, causing poor combustion and heat transfer. The oxidation chamber is designed with an optimum residence time, typically more than 2 seconds.

(b) Cooling system

The oxidised gases (combusted gases) from the thermal oxidation chamber enter the cooling system, which always maintains a liquid level. Here the oxidised gases come in direct contact with liquid (water). To ensure that no part of the gas is left without contacting water, the gases are introduced into the liquid level at a depth through a down comer. Since the gases are entering at a very high temperature of 1,200 ^{0}C, the down comer walls are to be prevented, which is done by continuous flow of water onto the walls of the down comer. This also prevents build-up of deposits (condensation of oxidised solid reaction products entrained in gases) on the walls of the down comer.

The make-up water is sprayed into the cooling tank from the top through a series of nozzles. This helps in maintaining the temperature of the cooling system in general and down comer (and its walls) in specific. With this system, the oxidised gases are cooled and the unabsorbed gases leave the system counter-current to the spray water (make-up water flowing downwards) at 50-90 ^{0}C. The water is sprayed at such a rate that the temperature of the combustible gases is brought down to the desired level (50- 90 ^{0}C) within milliseconds of entering the down comer. This helps in freezing the undesired gas phase reactions and thus eliminates the formation of dioxins.

The oxidised gases enter the cooling tank at a pressure. Their absorption by water creates a high degree of turbulence in the cooling tank, which ensures rapid cooling of oxidised gases and almost complete absorption of HF and HCl in the sprayed water.

The spray water forms dilute acids in the cooling system due to absorption of HF and HCl. Dilute acids so formed in the cooling system overflow to the collection system located at the bottom of the down comer. The rate at which the make-up water into the cooling tank is adjusted so that the concentration of acids in the overflow is maintained at the desired level.

It is not economical to recover waste heat from flue gas, as these are very corrosive in nature. Gas-to-Gas exchange would require a very large heat exchanger with very low heat transfer co-efficient, which would be very expensive to manufacture and maintain.

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(c) Caustic scrubbing system

The caustic scrubbing system is installed to control emission of unabsorbed gases. This is achieved by neutralisation of residual HF, HCl and free Chlorine with caustic soda solution.

The unabsorbed gases from the cooling system pass through packed column (s). In this packed column, the unabsorbed gases flow upwards while caustic soda solution flows downwards absorbing the residual HF, HCl and any free Chlorine in the gases. The packed column ensures sufficient mass transfer area between the unabsorbed gases and down coming caustic solution.

The treated gases coming out of the top of the caustic scrubber carrying mist (entrained water vapours), which are removed by passing these through a demister. The water drops are removed before the treated gases are discharged to the atmosphere.

The used caustic solution flowing to the bottom of the scrubber bottom is continuously collected in the sump at the base of the scrubber from where major part is re-circulated to the top of the scrubber along with fresh make-up of caustic solution. A minor part joins the feed (dilute acid from cooling system) to the neutralisation tank. A pH meter is installed in the caustic solution recycle stream to automatically control the rate of fresh make-up of caustic solution. The level of the liquid in the scrubber sump decides the rate at which the minor part of the used caustic solution is taken to the neutralisation tank.

(d) Neutralisation and settling system

The dilute acid stream (HF and HCl) produced in the cooling tank is transferred to the neutralisation tank where these are recovered and/or neutralised with hydrated lime (calcium hydroxide) resulting in settling / precipitation of solids (CaF2 and small quantities of CaCl2). The solids are pumped to a buffer tank from where these are fed to a filter, where these are dehydrated. Part of the water is removed from solids. Part of the filtrate is recycled back to the neutralisation tank and the balance is transferred to the Effluent Treatment Plant / Water recovery system. Balance water is removed in the dryer / lagoon. Dried solids are used as landfill for safe disposal.

(e) Exhaust stack

The scrubbed gases from the caustic scrubber are discharged to atmosphere via an exhaust stack. Discharge to atmosphere is at an elevation as per local statutory regulations.

(f) Utilities

The thermal oxidation system will require the following utilities:

- Water treatment plant for process water.
- Cooling water system, comprising of cooling water, sump and cooling water pumps.
- Air compressor.

(g) Effluent treatment cum water recovery plant

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The thermal oxidation system would have an 'Effluent Treatment Cum Water Recovery' system, where filtrate overflow from solids precipitator / settler and aqueous solution from bottom of caustic scrubber will be treated to reduce BOD / COD / TDS and SS to the norms prescribed by the local and national authorities. The water discharged from the plant will be recycled to the thermal oxidation system to the extent possible. The balance treated water, if any, and which meets the local and national standards for discharge of liquid effluents, will be discharged.

A.4.3.3 HFC23 flow rate and composition

HFC 23 flow rate (please also refer to A.2.2)

- HFC 23 — 2.9% of HCFC 22 production

Composition of HFC 23 stream

- Please refer to section A.4.3.1 (b).

A.4.3.4 Process design basis

• Gas flow	Approx. 660 MTY based on installed capacity of HCFC 22 as in A.3.2.2 (f), generation of HFC 23 @ 2.9% of HCFC 22 production and HFC 23 stream composition as in A.4.3.1. The capacity of the Incinerator would be accordingly designed to match the instantaneous capacity to take care of stoppages, interruption etc.
• Thermal oxidation temperature	~ 1,200 ^{0}C
• Gas residence time	More than 2 seconds
• Cooling system operating temperature	50 ~ 90 ^{0}C

A.4.3.5 Block diagram

A block diagram showing the process scheme of the thermal oxidation facility is given in Annex 10.

A.4.3.6 Input-output diagram for the thermal oxidation system

Input-output diagram for the thermal oxidation system shows feed, fuel, air, steam, hydrated lime and caustic soda solution entering the system and products (CaF2, CaCl2), vent gases and air, alkaline effluent etc. being discharged from the system. The input-output diagram is attached as Annex 11. This diagram will be finalised during the execution stage of the project

A.4.3.7 Products of combustion / effluents and emissions (preliminary) will be as below:

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a.	Acid effluent from cooling system of the thermal oxidiser chamber to the neutralisation system		Components	HF and HCl
b.	Alkaline effluent from the caustic scrubbing system		Components	NaF / NaCl / NaOCl
c.	Flue gas temperature		46 ^{0}C or less	
d.	Flue gas composition at stack (typical)			
	Main components	N2	70 -72 % Vol.	
		O2	4.5 - 5 % Vol.	
		CO2	16.5 -17.5 % Vol.	
	Others	HF	≤ 1 mg/Nm3	
		HCl	≤ 10 mg/Nm3	
		CO	≤ 50 mg/Nm3	
		Total Organics (C)	≤ 10 mg/Nm3	
		NOx (as NO2)	≤ 200 mg/Nm3	
		Dioxins	≤ 0.1 ng/Nm3	
		SO2	≤ 50 mg/Nm3	
		H2O	Balance	

The thermal oxidation system based on best available technology results in an emission, at the discharge of stack, that meets the above criterion (giving other components in flue gases), which is also in accordance with EU Directive 2000 / 76 / EC as well as meet the ambient air quality stipulated by the Ministry of Environment and Forests, India.

A.4.3.9 Combustion efficiency

A combustion efficiency of more than 99.999% with regard to destruction / oxidation of HFC 23 and related halogenated hydrocarbons is achieved in the proposed thermal oxidation system. The system employs an excellent burner system, where very high combustion efficiency is achieved through the special burner design and the combustion chamber (furnace) of the burner. Air is introduced tangential to the air compartment of the burner. The internal of the air compartment of the burner is so designed that it imparts a whirling motion to the combustion air. This also compresses the combustion air by the time it is ready to exit the air compartment. When the combustion air exits the air compartment and enters the combustion chamber through a nozzle placed centrally, it expands. LPG and HFC 23 are fed through the inlet to the combustion chamber placed along its axis. The inlet also terminates at around the centre of the combustion chamber.

There is an intense mixing of HFC 23, LPG and air due to latter's expansion and burning of the mixture at the centre of the combustion chamber. The mixture of HFC 23, LPG and air is ignited at the tip of the nozzle, due to the prevailing temperatures (1,200 ^{0}C). At the start of the thermal oxidation chamber, a pilot burner is used to ignite the mixture (or LPG alone).

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The burning mixture expands into the chamber, which causes a pressure drop at the centre of the chamber. This pressure drop creates a rush of combustion mixture towards the centre thereby causing an intense mixing of HFC 23, LPG and air and results in a highly efficient and clean combustion.

A.4.3.10 Collection, storage & transportation of HFCs

As shown in Annex 9, HFC 23 (typically along with 7-8% of HCFC 22 and 1-2% Air) is emitted from the vent of Column No. G-209 of the HCFC 22 plant, during purification of HCFC 22. Presently, GFL is implementing a project for recovery of Anhydrous Hydrofluoric Acid (AHF) from by-product Hydrochloric Acid (HCl) and also to enhance the quality of HCl gas. Because of this project, HFC 23 route within the plant will be through the AHF recovery equipment but will ultimately be emitted from the vent of Column No. C-209 in the HCFC 22 plant, as at present.

A provision to store HFC 23 in a buffer tank within the Project Activity is being proposed, from where it can be pumped directly to the thermal oxidiser via a flow meter.

A.4.3.11 Material of construction

The thermal oxidation system produces highly corrosive products of combustion. The system uses special materials like high Cr-Mo steel or composite materials like Hastelloy, where high temperature and corrosion conditions exist. Wherever ambient temperatures exist, use of plastics like FRP or PP is made.

A.4.4 Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and / or sectoral policies and circumstances.

If the proposed thermal oxidation facility were not installed, all of HFC 23 would continue to be emitted to the atmosphere, as there is no capture or storage facility and no HFC 23 has been captured for sale. HFC23 has a GWP of11700 while on decomposition the principal GHG shall be CO2, which has a GWP of 1. The proposed thermal oxidation facility would result in almost complete destruction of HFC 23 and therefore reduction in the emission of HFC 23. This results in conversion of high GWP emission to low GWP emission resulting in GHG emission reduction. The net reduction in emission of GHG from the existing GFL's complex would be an amount equal to the quantity of HFC 23 actually oxidised thermally minus GHG emissions caused by the Project Activity.

The carbon dioxide equivalence of the HFCs is given by "quantity of decomposed HFCs multiplied by the GWP associated with that HFC". This relationship will be used to calculate the reduction in GHG emission by the installation of thermal oxidation facility. The quantity of HFC decomposed can be monitored on regular and continuous basis.

The 'Additionality criteria' from environmental angle of GHG emission reduction is well demonstrated by the introduction of this new technology of thermal oxidation of HFC 23 to reduce GHG emissions in the plant, which have been occurring since 1989.

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Considering that there is no regulation on emission of HFC 23 in India, it would be correct to adopt the baseline condition as that condition where the entire HFC 23 is being vented to the atmosphere and calculate the total estimate of anticipated reduction in the CO2 (Carbon Dioxide) equivalent. This anticipated reduction will be based on the quantity of HFC thermally oxidised.

Further, it may be noted that under the Montreal Protocol, the phase out regulation for HCFC 22 in India is set out for the year 2040. This implies that HCFC 22 can be produced in India till the year 2040. In other words, HFC 23, a by-product generated in the production of HCFC 22 shall also be produced and emitted to the atmosphere till the year 2040.

Lowest of the three production ratios of HFC 23, as a by-product of HCFC 22, divided by the production of main product, HCFC 22 for the last three (3) years at GFL can be used to establish a production norm for HFC 23, called the cut-off rate. Fixing of cut-off rate ensures a cap on the decomposition of HFC 23 and therefore avoids unfair benefits of obtaining credit by decomposing extra HFC 23 than the cut-off rate of HFC 23. This would also ensure that HCFC 22 plant is run at its best efficiency.

The international norm of HFC 23 generation is 3-4% of HFC 23 / HCFC 22 production against which the value considered by Gujarat Fluorochemicals Limited is only 2.9%. The generation norm @ 2.9% is conservative as confirmed by recent measurements using a mass flow meter.

The ratio of generation of HFC 23 to HCFC 22 based on laboratory analysis of and measurement of HCFC 22 production, for the last 3 years is summarised in Annex 5:

The thermal oxidation, which would result in reduction in GHG such as HFC 23, releases other GHGs, such as CO2, which would be emitted by the thermal oxidation of HFCs and burning of fuel in thermal oxidiser, directly (due to thermal oxidation process) or in-directly (leakages) in production of electric power, steam, Caustic Soda, Hydrated Lime etc. A list of all possible emissions from the project activity is given below.

Due to thermal oxidation (Direct)	• HFC 23 leakage, i.e., release of un-decomposed HFC 23 from the thermal oxidation system. • CO2 emission due to oxidation (burning) of HFC 23. • CO2 emission due to oxidation (burning) of LPG / any other fuel.
Leakages (In-direct)	• CO2 emission due to generation of that quantity of power that is consumed by the system. • CO2 emission due to generation of that quantity of steam that is consumed by the system. • CO2 emission due to production of that quantity of hydrated lime that is consumed by the system. • CO2 emission due to production of that quantity of caustic soda that is consumed by the system. This only includes equivalent CO2 to the energy consumed by the caustic soda plant. • CO2 emission due to disposal of solid waste.

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Process water, cooling water, Effluent Treatment cum Water Recovery plant, Solid waste treatment and compressed air system are part of the thermal oxidation system. CO2 emission from these facilities is equivalent to the power consumed in operating these facilities. Hence, CO2 equivalent of power consumed to operate these systems will be calculated based on the power consumed by these units and the same is clubbed with the total power requirement of the project activity, i.e., the thermal oxidation system.

No other reagents or chemicals, other than those described above are used in the thermal oxidation system. No component of the system is a consumable, consumption of which would produce CO2 on regular basis.

These are the only emission sources from the Project Activity emitting CO2. The emission due to these GHG is subtracted from the reduction in emission due to thermal oxidation of HFC.

A.4.5 Public funding of the project activity

The project is proposed to be financed by the project sponsors, who propose to undertake the CDM Project Activity as the project proponent. At present, no public funding is envisaged. In case public funding is sought, the proponent shall duly ensure that it is additional to any ODA.

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B. BASELINE METHODOLOGY

B.1 Title and reference of the methodology applied to the project activity

Approved methodology AM 0001 – Incineration of HFC 23 waste streams.

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

B.2.1 Since the objectives and outcomes of this Project Activity are similar to those delineated in the PDD of Ulsan Chemical Co., Ltd., Korea project, (Related F-CDM-Nmpu document ID number (s) – F-CDM-Nmpu0007), the baseline methodology is considered applicable.

Moreover the applicability conditions as delineated here below also do not violate any of the applicability conditions of the approved Methodology AM 0001 (Related F-CDM-Nmpu document ID number (s) – F-CDM-Nmpu0007).

B.2.2 The applicability conditions, which apply to India, are clearly met by the methodology proposed as elaborated as under:

(a) There are no regulations in India on the production of HCFC 22, the main product of Gujarat Fluorochemicals Limited. HFC 23 being a by-product of HCFC 22, there are no restrictions on production of HFC 23.

(b) There are no regulations in India on emission of HFC 23.

(c) A cut-off rate of 2.9% is already set to ensure no unfair claim of credit by decomposition of excess HFC 23 than permitted under this CDM project. Even if the entire HFC 23, which is produced in the HCFC 22 plant is thermally oxidised, credit for the only that quantity of HFC 23 will be available that is equal to or less than the cut-off rate as defined above. The cut-off rate, in keeping with the recommendations of the Meth Panel, is set as the lowest of HFC 23 / HCFC 22 ratio for the last 3 years (2000, 2001 and 2002) achieved by GFL at their HCFC 22 plant. The ratio is found to be 2.9 i.e., 2.9 kg of HFC 23 per 100 kg of HCFC 22 (reference Annex 5).

(d) No credit is given for HFC 23 that is recycled in the normal operation of HCFC 22 plant if that quantity of HFC 23 is also thermally decomposed. In the main HCFC 22 plant, there is no possibility of recycling HFC 23 and hence the calculation for credit does not consider HFC 23 recycle.

(e) The possibility that the HFC23 that is decomposed in the thermal oxidation facility, is diverted from alternative uses is not valid as GFL proposes to decompose HFC23 generated only at its own facility and all the HFC generated at its facility since commencement of commercial operation of the plant has been vented to the atmosphere.

(f) To the best of knowledge, there is no known market for HFC 23 in India.

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B.2.3 Furthermore, applicable conditions are so designed that all government regulations and controls will be adhered to and any unfair practices to claim higher than due credit is avoided.

It would be fair to conclude that the proposed methodology is not only justified but also very applicable and suitable under the required conditions.

B.3 Description of how the methodology is applied in the context of the project activity

B.3.1 According to the approved methodology, it is applied by measuring the actual amount of HFC23 fed into the oxidizer. As explained elsewhere in this report, HFC 23 is a by-product in the production of HCFC 22 from Chloroform and HF (HF is generated within the complex by the reaction of Fluorspar and Sulphuric Acid). At present, the waste stream of HFC 23 (typically consisting of 90-92% HFC 23, 7-8% of HCFC 22 and balance air) is the only feed for the proposed thermal oxidation system.

The amount of HFC 23 that is fed to the thermal oxidation system is measured at the point of entry into the oxidiser. In this case since HFC 23 is the only HFC in the feed, it is easier to monitor and measure the feed and calculate the equivalent CO2 emission. As the feed is a mixture (HFC 23 – 90-92%, HCFC 22 – 7-8% and Air – 1-2%), the composition of HFC 23 stream will also be monitored so that credit is claimed only for HFC 23 and not for HCFC 22 or air, which are part of HFC 23 stream.

Though the approved methodology adopts a formula where the cut off value on the baseline emissions of HFC 23 is calculated as "HCFC 22 production in that year × cut-off rate - HFC 23 average yearly sales volume from the year 2001 to the year 2003", to the best of knowledge, there is no known market that we are aware of for HFC 23 in India and hence the cut-off value on the baseline emission is calculated as 'HCFC 22 production x cut-off rate'.

B.3.2 The economic / financial and investment additionality is clearly established since India has no regulation, which requires limiting the emission of HFC 23, it is not mandatory for GFL to install the thermal decomposition facility. The facility, if installed, will involve economic/financial commitment for Gujarat Fluorochemicals Limited, in the form of substantial capital and operating (recurring) costs. Gujarat Fluorochemicals has no direct economic/financial incentive for incurring these costs and has in the past been operating without the project. The possibility that in future some domestic regulation on the emission of HFC23 may be promulgated has been built into the methodology.

B.3.3 The GHG emission reduction achieved by this project activity is the quantity of waste HFC 23 actually destroyed less the GHG emissions generated by the destruction process less leakage due to the destruction process.

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B.3.4 The GHG emission reduction, E_R, achieved by the Project Activity for a given year is equal to the quantity of HFC 23, Q_{HFC23}, from HCFC 22 production facility destroyed by the project activity less the baseline HFC 23 destruction, $Q_{BL\ HFC\ 23}$, during that year multiplied by the Global Warming Potential (GWP) value for HF 23 less the GHG emissions generated by the thermal oxidation process, E_{TOP}, less GHG leakage, E_L, due to the thermal oxidation process, as per the equation given below:

$$E_R = (Q_{HFC\ 23} - Q_{BL\ HFC\ 23}) \times GWP_{HFC\ 23} - E_P \text{ where } E_P = E_{TOP} + E_L$$

Abbreviation:

GHG emission reduction measured in tonnes of CO2 equivalent	E_R
Quantity of waste HFC 23, in metric tonnes, destroyed during the year measured	$Q_{HFC\ 23}$
Baseline quantity of HFC 23, in metric tonnes, destroyed during the year	$Q_{BL\ HFC\ 23}$
Sum of GHG emissions due to thermal oxidation process and leakages in metric of CO2 equivalent	E_P
GHG emissions due to thermal oxidation process in metric of CO2 equivalent	E_{TOP}
GHG emissions due to GHG leakages, in metric tonnes of CO2 equivalent	E_L

The project activity converts 1 tonne of HFC 23 to tonnes of CO2 equivalents. The approved GWP value for HFC 23 is 11,700 tonnes CO2 / tonne HFC 23

The thermal oxidation process uses fuel (LPG), steam, electric power, caustic soda and hydrated lime. The steam and electric power would be purchased from the existing facilities at GFL complex and hence the emissions associated with steam and electric power are included are included in the leakage calculations. Similarly emissions associated with caustic soda and hydrated lime is included in the leakage calculations, as these will also be purchased. The emissions due to thermal oxidation process, E_{TOP}, are the emissions due to the use of LPG (CO2 released due to burning of LPG), the emissions due to HFC 23 not destroyed and GHG emissions of the thermal oxidation process (CO2 released due to burning of HFC 23. This can be written as:

$$E_{TOP} = Q_{HFC\ 23} \times F_{HFC\ 23\ NO} \times GWP_{HFC\ 23} + Q_{HFC\ 23} \times F_{HFC\ 23} + Q_{LPG} \times F_{LPG}$$

Fraction of HFC 23 not thermally oxidised	$F_{HFC\ 23\ NO}$
GWP of HFC 23	$GWP_{HFC\ 23}$
Emission factor for thermal oxidation of HFC 23	$F_{HFC\ 23}$
Quantity of LPG used for thermal oxidation during the year, measured in M3	Q_{LPG}
Emission factor for burning of LPG	F_{LPG}

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Though the fraction of HFC 23 not destroyed is typically very small (0.001% as per guaranteed combustion efficiency of 99.999%), the monitoring plan provides for its periodic measurement at stack. Though HFC 23 can also leak to atmosphere through water, but the possibility is infinitesimally small and ignored as per AM 0001.

B.3.5 Baseline

The baseline is the quantity of the HFC 23 stream required to be destroyed by the applicable regulations of the host country. If the host country regulations require total amount of HFC 23 that is generated to be destroyed then the this quantity would be:

$Q_{BL\ HFC\ 23} = Q_{HFC\ 23} \times Z_y$

Actual quantity of HFC 23 in MT per year to be decomposed in thermal oxidation facility	$Q_{HFC\ 23}$
Fraction of waste stream, HFC 23, required to be destroyed by the regulations of the country in the year y.	Z_y

In the absence of any regulations requiring destruction of HFC 23 waste, Z y for India = 0 and HFC 23 waste is typically released to the atmosphere. Hence the baseline destruction for this project is ‘0.

In order to exclude the unfair practice of manipulating the production to increase the quantity of waste HFC 23 to be destroyed, the quantity of waste HFC 23 ($Q_{HFC\ 23}$) for calculation of baseline emission reduction is limited by the cut-off norm for the generation of HFC 23 to HCFC 22 production, as described earlier, by the following equations.

$Q_{HFC\ 23}$, if $Q_{HFC23} < \%$ Cut-off x $Q_{HCFC\ 22}$ production in that year or

% Cut-off x $Q_{HCFC\ 22}$, if $Q_{HFC23} > \%$ Cut-off x Q_{HCFC22}

The baseline emission reduction (E_B) can be defined as -

$E_B = Q_{HFC\ 23} \times GWP_{HFC\ 23}$, if $Q_{HFC23} < \%$ Cut-off x $Q_{HCFC\ 22}$ production in that year

$E_B = \%$ Cut-off x $Q_{HCFC22} \times GWP_{HFC23}$, if $Q_{HFC23} > \%$ Cut-off x Q_{HCFC22} production in that year

As per IPCC SAR, whose GWP are applied for conversion factors of the Kyoto Protocol for the 1^{st} Commitment Period, value of GWP for HFC 23 is 11,700.

B.3.6 Leakages

Leakage is emissions of GHGs due to the project activity that occur outside the project boundary. The sources of leakages due to the thermal oxidation process are the following:

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a) GHG (CO2 and N2O) emissions associated with the production of purchased electric power and steam.
b) CO2 emission associated with the production of hydrated lime used in thermal oxidation system.
c) CO2 emission associated with the production of caustic soda used in thermal oxidation system.
d) CO2 emissions due to transport of solids for safe disposal to landfills.

$$E_L = Q_{Power} \times F_{Power} + Q_{Steam} \times F_{steam} + Q_{Ca(OH)_2} \times F_{Ca(OH)_2} + Q_{NaOH} \times F_{NaOH} + Q_{Solid\ Waste} \times F_{Solid\ Waste}$$

Where Q_{Power}, Q_{Steam}, $Q_{Ca(OH)_2}$, Q_{NaOH} and Q_{Solid} are the quantities of Electric power, steam, hydrated lime, caustic soda and solid wastes respectively purchased (used) for thermal oxidation and F_{Power}, F_{Steam}, $F_{Ca(OH)_2}$, F_{NaOH} and $F_{Solid\ Waste}$ are their GHG emission factors.

B.3.7 Leakage in the Baseline Emission

a) Indirect emissions in one step upstream and one step downstream activities have been considered.

b) All equipment proposed is new and is not transferred from any other project involving emission reductions. Life Cycle emissions have not been considered in accordance with the approved methodology.

c) The cut off rate ensures that operational inefficiency is not rewarded.

d) The HFCs combusted have not been diverted from alternative uses.

B.4 Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity

Since India has no regulation, which requires limiting the emission of HFC 23, the thermal decomposition facility is not required to be installed. In the absence of installation of the facility, HFC23 is being vented to the atmosphere. With the CDM project activity a high GWP gas is destroyed resulting in net GHG emission reduction.

The economic/financial/investment barrier Additionality criteria is clearly demonstrated since installation of the facility, will represent substantial initial investment and recurring expense to Gujarat Fluorochemicals Limited, in the form of capital and operating costs. In the absence of a regulatory requirement or financial/economic incentive, there is no rationale for implementation of the project barring the desire to contribute to mitigation of climate change impacts.

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Further the project takes into account the fact due to some mal-operation or problem with the HCFC 22 plant or any other reason, more HFC 23 is generated than the ratio achieved in the past, a 'cut-off rate' already exists because of which no additional or extra credit is earned by increasing the generation of HFC 23 beyond the cut-off level and oxidising it in the thermal oxidation system. Actual emissions can be checked by the concerned entity during the time of inspection / verification as per Monitoring and Verification Plan. Thus, the carbon credit based on actual emissions, will be computed only limited to the cut-off rate, thereby ensuring there is no unfair claiming of credit.

It is absolutely clear that with no regulations in existence in India for the control of HFCs emissions, GFL proposes to install the thermal oxidation facility only to eliminate or reduce the generation of GHG as there are no returns from this project and therefore the estimated investment and operating cost do not justify such a project.

B.5 Description of how the definition of the project boundary related to the baseline methodology is applied to the project activity

In the approved methodology, the approved project boundary definition is the same that has directly been applied herein. The application of applying the Project Boundary is very clearly explained in section B.3. The facility to decompose the HFC 23, which starts from the C 209 vent (in the HCFC 22 plant) for HFC 23 and includes the following:

- HFC 23 at the inlet of HFC 23 tank located in the Project Activity.
- Flue gas discharge at the outlet of stack.
- Hydrated lime, caustic soda, electric power, steam and raw water at the battery limit of the thermal oxidation system.
- Dried solids after dryer / lagoon.
- Recovered water from water recovery / effluent treatment plant.
- Air compressor.

The boundaries exist physically on hardware and are clearly defined for each input and output of the project activity. The boundaries, therefore, are not subject to change within the scope of this CDM project and will be not be different for the baseline methodology and actual operation.

B.6 Details of baseline development

B.6.1 Date of Completing the Final Draft of this Baseline Section *(DD / MM / YYYY)*

03 / 11 / 2003

B.6.2 Name of person / entity determining the baseline

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PricewaterhouseCoopers have assisted the Project Promoters in developing the Project Design Document and design the project in order to be compatible with Host Government Approval criteria. PricewaterhouseCoopers (PwC), formed by the global merger of Price Waterhouse and Coopers & Lybrand in 1998, is the world's largest financial and professional services organisation with 125,000 people in 142 countries and 867 offices worldwide. The contact details of PricewaterhouseCoopers are provided hereunder.

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C DURATION OF PROJECT ACTIVITY / CREDITING PERIOD

C.1 Duration of the project activity

C.1.1 Starting date of the project activity

The emission reductions from the Project Activity are expected to commence by around October 2005, i.e., about twelve months from the registration of the Project.

C.1.2 Expected operational lifetime of the project activity

15 y – 0m

C.2 Choice of the crediting period and related information

C.2.1 Renewable crediting period (at most seven (7) years per period)

C.2.1.1 Starting date of the first crediting period (DD / MM / YYYY)

Not opted for

C.2.1.2 Length of the first crediting period

Not opted for

C.2.2 Fixed crediting period (at most ten (10) years)

C.2.2.1 Starting date (DD / MM / YYYY)

01 / 10 / 2005

The starting date of the first crediting period would be the date of commissioning of the thermal oxidation system expected to be by October 2005 (assuming project registration by end September 2004).

C.2.2.2 Length (max 10 Years)

10y – 0m

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D MONITORING METHODOLOGY AND PLAN

D.1 Name and reference of approved methodology applied to the project activity:

D.1.1 **Title**

The Monitoring methodology for thermal oxidation (decomposition) of HFC 23 in a non-Annex I Party where regulations do not restrict HFC 23 emissions.

D.1.2 Monitoring Methodology

The monitoring methodology is same as 'Approved Monitoring Methodology AM 0001' for 'Incineration of HFC 23 Waste Streams' for Ulsan Chemical Co. Ltd, Korea (Related F-CDM-Nmpu document ID number (s) – F-CDM-Nmpu0007).

The monitoring methodology is based on direct and continuous measurement of the actual amount of HFC 23 destroyed and of the energy and chemicals used in the destruction process as shown in Figure D.1. The energy and chemicals used would comprise of energy - LPG fuel, steam & electric power and chemicals – caustic soda and hydrated lime.

Since the emission reduction are dominated by the amount of HFC 23 destroyed, the correct measurement of HFC 23 is very important. To accurately measure the quantity, two (2) mass flow meters, in series but read simultaneously, each of which is calibrated periodically, will be employed. One flow meter already exists in the HCFC 22 plant. The periodicity of re-calibration with help of zero check shall be weekly.

Besides, quantity of HFC 23, monitoring of the following is additionally carried out:

a) Purity of HFC 23 waste stream is checked daily by sampling and using Gas Chromatograph. The relevant instrument reading will be recorded manually before transferring to computer. Chromatograms shall be printed and the GC shall be calibrated once weekly using a secondary standard. The purity along with the quantity (as determined by flow meter) determines the actual quantity of HFC 23 (out of HFC 23 waste stream consisting of HCFC 22 and Air) fed to the thermal oxidiser.

b) Amount of waste generated. The output of HFC 23 from the HCFC 22 plant will be checked periodically by comparing the amount of HCFC 22 produced to the quantity of HFC 23 destroyed.

The quantities of gaseous effluents (CO, HCl, HF, Cl2, Dioxin and NOx) and liquid effluents, if any (pH, COD, BOD, SS, Phenol) shall be measured every six months to ensure compliance with local environmental stipulations.

D.1.3 The 'Baseline Methodology' and the 'Formulae' for calculation of 'Baseline Emission Reduction' were described in Section-B of this 'Project Design Document'. The formulae derived for the calculation of 'Baseline Emission Reduction' was:

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$E_B = Q_{HFC\ 23} \times GWP_{HFC\ 23}$ if $Q_{HFC23} < \%\ \text{Cut-off} \times Q_{HCFC\ 22}$ production

$E_B = \%\ \text{Cut-off} \times Q_{HCFC22} \times GWP_{HFC23}$ where $Q_{HFC23} > \%\ \text{Cut-off} \times Q_{HCFC22}$

Baseline Emission reduction due to project activity **Equation 1**
$E_B = Q_{HFC\ 23} \times GWP_{HFC\ 23}$

D.1.4 The 'Baseline Methodology' assumes that the HFC 23, being released to atmosphere at present, will be completely oxidised in the Thermal Oxidation system. When HFC 23 is oxidised in the Thermal Oxidation system, there will be GHG emissions due to Thermal Oxidation Process (direct) from within the battery limit (B/L) of the system and leakages (indirect emission due to thermal oxidation process) from outside the battery limit of the system.

The actual reduction in emission due to oxidation of HFC 23 in the Thermal Oxidation system can be calculated by the following formula: These are explained as below:

Actual Emission Reduction = Baseline Emission Reduction – Sum of GHG emissions due to thermal oxidation process and leakages.

Example of GHG emissions due to thermal oxidation process are CO2 released due to oxidation (burning) of HFC 23 and fuel in the thermal oxidiser and un-oxidised HFC 23 in flue gases while leakages GHG emission are due to CO2 released outside the project boundary in generating electric power and steam, which are consumed by the project activity and CO2 released due to generation of energy for and otherwise in production of hydrated lime and caustic soda, which are used by the project activity. As already explained in Section B, process water, cooling water, compressed air, effluent treatment and solid waste treatment will be required within the thermal oxidation system and CO2 emission on account of these activities because of power consumption in these units has been clubbed with the power requirement of the thermal oxidation system. An exhaustive list covering all possible and measurable quantities are listed below. The detailed equations are given in section E:

Thermal Oxidation Process (Direct)	• Release of un-decomposed HFC 23 from the thermal oxidation system. • CO2 emission due to oxidation (burning) of HFC 23. • CO2 emission due to oxidation (burning) of LPG fuel.
Leakage (Indirect)	• CO2 emission due to generation of that quantity of power that is consumed by the system including power consumed in operating water treatment plant, cooling water system, air compressor and effluent treatment plant. • CO2 emission due to generation of that quantity of steam that is consumed by the system. • CO2 emission due to production of that quantity of hydrated lime that is consumed by the system.

- CO2 emission due to production of that quantity of caustic soda that is consumed by the system. This only includes equivalent CO2 to the energy consumed by the caustic soda plant.
- CO2 emission due to disposal of solid waste.

D.1.5 Reduction in emission by the system due to oxidation of HFC 23

Reduction in GHG emissions, which would have taken place if entire HFC 23 coming out as a by-product of HCFC 22, were to be released to atmosphere. This will be represented by the Formula 1 as given in D.1.3 above.

D.1.6 Other factors

The above equation has been derived on the following basis:

a. Regulation on emission of HFC 23 in India

At present, there are no regulations on emission of HFC 23 and hence the fraction of waste HFC 23, Z y, to be destroyed has been taken as '0'.

b. HFC 23 is produced at more than the normal rate of by-production, in which case the cut-off rate will apply.

HFC 23 forms as a by-product in the production of HCFC 22, the main product. Though HCFC 22 plant envisages minimum production of HFC 23 yet a certain quantity of HFC 23 is always produced.

The IPCC GHG Inventory Good Practice Guidance Report sets the cut-off value for HFC 23 production as a by-product of HCFC 22 as 4% (always expressed as percentage of HCFC production). However, as explained in A.2.2, HFC 23 is 2.9% of HCFC 22 production in the GFL plant (the lowest % achieved in last three years). Therefore the amount to be incinerated in the project activity will be equivalent to 2.9% of HCFC 23 production in that year.

Therefore, no credit will be allowed for amounts of HFC 23 produced and thermally oxidised at value more than the cut-off value The method for calculating the cut-off value is explained in Section B of this PDD. Since Gujarat Fluorochemicals does not sell any HFC 23 and to best of our knowledge there is no known market for HFC 23 in India. Hence, there is no difference between the production and quantity that is thermally oxidised.

c. HFC 23 recycled

There is no recycle of HFC 23 at Gujarat Fluorochemicals Limited (there is no possibility in HCFC 22 plant) and hence no factor is considered necessary to account for this operation. Operational Entity can verify this at the time of inspection.

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D.1.7 Other products / effluents from thermal oxidation system

a. Solid
Solids (CaF_2 and $CaCl_2$) obtained after the settling / precipitation tank, filter and dryer (Lagoon) are used as landfill for safe disposal.

b. Liquid effluents
Bleed stream of aqueous effluent from the bottom of caustic scrubber and filtrate from the solid precipitation tank are the liquid effluents, which will be treated before discharge, if any, to meet the national and local discharge regulations.

c. Flue gas
The main components of flue gas coming out of the top of caustic scrubber are CO_2 and Nitrogen. The flue gas also contains CO, HF, HCl, Cl_2, NOx and traces of dioxins (formed as a result of high temperature oxidation of halogenated, nitrogen and other hydrocarbons. However, the technology adopted here ensures that dioxins will be less than 0.1 ng / NM^3 of flue gas in accordance with EU Directive 2000 / 76 / EC as well as meet the ambient air quality stipulated by the Ministry of Environment and Forests, India.

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

The objectives and outcomes of the proposed project activity being identical to the Ulsan Chemical Co., Ltd. PDD, which is already approved by the Meth EB for a similar project (Approved Monitoring Methodology AM 0001). This monitoring methodology AM 0001 can be used for the project activities that thermally oxidise (incinerate) HFC 23 waste in excess of any regulatory requirements from sources of a HCFC production facility in a non-Annex I Party. The GFL project meets these requirements.

D.2.1 This PDD for the Thermal Oxidation System under CDM has tried to cover all possible sources of GHG emission that may result directly or indirectly due to various reactions taking place in the system and emitting GHG to the extent that deemed CO_2 release for the production of hydrated lime and C. soda, which are used in the project activity, is also considered.

D.2.2 Further applicable conditions are so designed that all government regulations and controls will be adhered to and any unfair practices to claim higher than due credit is avoided.

D.2.3 Gujarat Fluorochemicals Limited already adheres to the provisions of the Montreal Protocol, to which India is a signatory.

D.2.4 There are no other possible sources of GHG emission from this project activity during the operation stage. The single biggest factor for determining the GHG reduction is the quantity of HFC 23 fed to the Thermal Oxidation system and that has to be measured very correctly and carefully.

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D.2.5 The following indirect CO_2 emissions are not considered, as these are very insignificant and not measurable. This is in accordance with the approved AM0001.

- CO_2 released in the manufacture of packing material for absorption tower (caustic scrubbing tower) as this packing material is not a consumable item. This packing material requires change only when broken.
- CO_2 released in the fabrication / manufacture of equipment and machinery used in the project activity.
- CO_2 equivalent of N_2O released from the project activity, which is insignificant in comparison to the GHG emission reductions.

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D.3 Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID Number *(Please use numbers to ease cross-referencing to Table D.6)*	**Data Type**	**Data Variable**	**Data Unit**	**Measured (m), Calculated or estimated (e)**	**Recording Frequency**	**Proportion of Data to be Monitored**	**How will the data be archived? (Electronic / paper)**	**For how long the is the archived data to be kept?**	**Comment**
$Q_{HFC\ 23\text{-}Leak}$	Mass	Un-oxidised HFC 23 in Flue Gas	MT-HFC 23	m	Every 6 months	100 %	Paper & Electronic Copy	10 years	Analysis of flue gases to check leaked HFC 23
$Q_{CO2\text{-}HFC\ 23}$	Mass	CO2 generated by oxidation of HFC23	Kg-CO2	C	Monthly	100 %	Paper & Electronic Copy	10 years	-
Q_{Fuel}	Mass	Fuel fed to Thermal Oxidiser	Kg	m	Monthly	100 %	Paper & Electronic Copy	10 years	Fuel meter
$Q_{CO2\text{-}Fuel}$	Mass	CO2 from burning of fuel	Kg-CO2	C	Monthly	100 %	Paper & Electronic Copy	10 years	-
$Q_{CO\text{-}Flue\ Gas}$	Mass	CO in Flue Gas	g – CO	m	Every 6 months	100 %	Paper & Electronic Copy	10 years	-
$Q_{HF\text{-}Flue\ Gas}$	Mass	HF in Flue Gas	g – HF	m	Every 6 months	100 %	Paper & Electronic Copy	10 years	-
$Q_{HCl\text{-}Flue\ Gas}$	Mass	HCl in Flue Gas	g-HCl	m	Every 6 months	100 %	Paper & Electronic Copy	10 years	-

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D.3 Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID Number *(Please use numbers to ease cross-referencing to Table D.6)*	**Data Type**	**Data Variable**	**Data Unit**	**Measured (m), Calculated or estimated (e)**	**Recording Frequency**	**Proportion of Data to be Monitored**	**How will the data be archived? (Electronic / paper)**	**For how long the is the archived data to be kept?**	**Comment**
$Q_{Cl2\text{-}Flue\_Gas}$	Mass	Cl2 in Flue Gas	g- Cl2	m	Every 6 months	100 %	Paper & Electronic Copy	10 years	-
$Q_{NOx\text{-}Flue\ Gas}$	Mass	NOX in Flue Gas	g-NOx	m	Every 6 months	100 %	Paper & Electronic Copy	10 years	-
$Q_{Dioxins\text{--}Flue\ Gas}$	Mass	Dioxins in Flue Gas	g- Dioxins	m	Every 6 months	100 %	Paper & Electronic Copy	10 years	-

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D.4 Potential sources of emissions which are significant and reasonably attributable to the project activity, but which are not Included in the project boundary, and identification if and how data will be collected and archived on these emission sources.

ID Number *(Please use numbers to ease cross-referencing to Table D.6)*	**Data Type**	**Data Variable**	**Data Unit**	**Measured (m), Calculated or estimated (e)**	**Recording Frequency**	**Proportion of Data to be Monitored**	**How will the data be archived? (Electronic / paper)**	**For how long the is the archived data to be kept?**	**Comment**
Q_{Power}	Energy	Power consumption	KWh	m	Monthly	100 %	Paper & Electronic Copy	10 years	Metered Note 2
Q_{Steam}	Mass	Steam consumption	MT	m	Monthly	100 %	Paper & Electronic Copy	10 years	Metered (Note 2)
$Q_{Ca(OH)2}$	Mass	Hydrated Lime consumption	MT	m	Monthly	100 %	Paper & Electronic Copy	10 years	Weighed
Q_{NaOH}	Mass	C. Soda consumption	MT	m	Monthly	100 %	Paper & Electronic Copy	10 years	Weighed
$Q_{Solid\ Waste}$	Mass	Solid Waste from Project Activity	MT	m	Monthly	100 %	Paper & Electronic Copy	10 years	Weighed
C_{Fuel}	Number	No. of Carbon atoms per Molecule of Fuel	No.	c	Yearly or Whenever change in specification	100 %	Paper & Electronic Copy	10 years	-
M_{Fuel}	Mass	Molecular weight of Fuel	No.	c	Yearly or Whenever change in specification	100 %	Paper & Electronic Copy	10 years	-

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D.4 Potential sources of emissions which are significant and reasonably attributable to the project activity, but which are not included in the project boundary, and identification if and how data will be collected and archived on these emission sources.

ID Number *(Please use numbers to ease cross-referencing to Table D.6)*	**Data Type**	**Data Variable**	**Data Unit**	**Measured (m), Calculated or estimated (e)**	**Recording Frequency**	**Proportion of Data to be Monitored**	**How will the data be archived? (Electronic / paper)**	**For how long the is the archi ved data to be kept?**	**Comment**
F_{Power}	Mass / Energy	CO2 generated per unit of Power	MT – CO2 / kWh	e	Yearly	100 %	Paper & Electronic Copy	10 Years	-
F_{Steam}	Mass / Mass	CO2 generated per Mt of Steam	MT-CO2 / MT	e	Yearly	100 %	Paper & Electronic Copy	10 years	-

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D.5 Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHG within the project boundary and identification if and how such data will be collected and archived.

ID Number *(Please use numbers to ease cross-referencing to Table D.6)*	**Data Type**	**Data Variable**	**Data Unit**	**Measured (m), Calculated or estimated (e)**	**Recording Frequency**	**Proportion of Data to be Monitored**	**How will the data be archived? (Electronic / paper)**	**For how long the is the archived data to be kept?**	**Comment**
$Q_{HCFC\ 22}$	Mass	HCFC 22 production	MT – HCFC 22	m	Monthly	100 %	Paper & Electronic Copy	10 years	Reference data to check cut-off condition & rough estimation of $Q_{HFC\ 23}$
$Q_{HFC\ 23}$	Mass	HFC 23 fed to Thermal Oxidiser	MT – HFC 23	m	Monthly	100 %	Paper & Electronic Copy	10 years	Metered (Note 3)
Composition of HFC 23	Ratio	Composition of HFC 23 fed to Thermal Oxidiser	% v / v	m	Monthly	100 %	Paper & Electronic Copy	10 Years	Using GC (Note 4)

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D.6 Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored.

Extensive quality control procedures are planned for the following parameters, even though the uncertainty levels are low since minor variations in these parameters can materially impact the total emission reduction estimation.

Data	**Uncertainty Level of data (High / Medium/ Low)**	**Are QA / QC Procedures planned for these data?**	**Outline explanation why QA / QC procedures are or are not being planned?**
$Q_{HFC\ 23}$ (Table D.5)	Low	Yes. The existing QA & QC organisation will be extended to form separate cell for the thermal oxidation project and QA & QC procedures as per UK standards, which is equivalent to JIS Standards, in terms of equipment and analytical method will be set. The measurement will be done using two flow meters in series to be read simultaneously with weekly re-calibration frequency with help of zero check. ASTM or other equivalent standards shall be used.	QA & QC procedures exist & implemented (GFL has quality system to ISO 9002) to – 1. Well defined procedures and instructions to provide consistent results to successfully implement & operate the CDM project, 2. Fix clear job responsibilities 3. Provide requisite tools & training to achieve the objectives.
$Q_{HFC\ 23\_Leak}$ (Table D.3)	Low	Yes. Shall be measured for the flue gases at the stack of the thermal oxidiser. ASTM or other equivalent standards shall be used.	- Do -
Composition of HFC 23	Low	Yes. The measurement shall be done using Gas Chromatograph. ASTM or other equivalent standards shall be used. The GC will be calibrated once a week using secondary working standard gas prepared from the certified reference gas.	- Do -

Note1: GFL would nominate a senior technically qualified person who would be in charge of the thermal oxidation system. The person would be appointed before commissioning the oxidation system and he would be responsible for monitoring, review and reporting emission data and reductions.

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Note2: The Electric Power Meter and the Steam Meter would have the facility of recording the monthly readings, directly into a computer system to minimise the errors that may be associated with human recording and transfer to written / electronic records.

Note 3: A computer system (reference Note 2 of D.4 above) will be used to record data automatically from the Mass Flow Meters employed to measure HFC 23 feed to the thermal oxidation system. The paper records would be maintained as back up.

Note 4: The Chromatographs will be printed to establish the authenticity of the data recorded.

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Data	Uncertainty Level of data (High / Medium/ Low)	Are QA / QC Procedures planned for these data?	Outline explanation why QA / QC procedures are or are not being planned?
Q_{Fuel} (Table D.3)	Low	Yes. Measurement using LPG / ANY OTHER Meter. ASTM or other equivalent standards shall be used.	- Do -
Q_{Power} (Table D.4)	Low	Yes. Measurement shall be by Electric Power Meter. ASTM or other equivalent standards shall be used.	- Do -
Q_{Steam} (Table D.4)	Low	Yes. Measurement shall be by a meter. ASTM or other equivalent standards shall be used.	- Do -
$Q_{HCFC\ 22}$ (Table D.5)	Low	Shall be obtained from HCFC 22 production records at GFL. ASTM or other equivalent standards shall be used.	- Do -

As already explained elsewhere in this section, since baseline emission is calculated as $Q_{HFC\ 23}$ x $GWP_{HFC\ 23}$ (11,700), factors other than Q HFC 23 are very small in comparison. Hence, the most important monitoring & measurement are the following:

1. $Q_{HFC\ 23}$ Stream
2. Composition of HFC 23 Stream to calculate $Q_{HFC\ 23}$
3. $Q_{HCFC\ 22}$ (Production)
4. $Q_{HFC\ 23\_Leak}$

The frequency of re-calibration of mass flow meter for Q HFC 23 therefore shall be weekly whereas for other meters, it shall be as per the Quality System (to ISO 9002 Standards) at GFL.

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D.7 Name of person / entity determining the monitoring methodology

PricewaterhouseCoopers have assisted the Project Promoters in developing the Project Design Document and design the project in order to be compatible with Host Government Approval criteria. PricewaterhouseCoopers (PwC), formed by the global merger of Price Waterhouse and Coopers & Lybrand in 1998, is the world's largest financial and professional services organisation with 125,000 people in 142 countries and 867 offices worldwide. The contact details of PricewaterhouseCoopers are provided hereunder.

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E CALCULATION OF GHG EMISSION BY SOURCES

E.1 Description of formulae used to estimate anthropogenic emissions by sources of greenhouse gases of the project activity with the project boundary

Due to thermal oxidation process (TOP)

a. CO_2 equivalent of fraction of HFC 23 remaining un-oxidised in the flue gases from the Thermal Oxidation system = $Q_{HFC\ 23\_} \times F_{HFC\ 23\ NO} \times GWP_{HFC\ 23}$. **Equation 2**

b. CO_2 released due to thermal oxidation of HFC 23 to CO_2 = $Q_{HFC\ 23}$ X $F_{HFC\ 23}$ [Note 1] **Equation 3**

c. CO_2 released from burning of fuel = Q_{Fuel} X $F_{LPG\ /\ ANY\ OTHER}$ [Note 2] **Equation 4**

The total GHG emissions due to thermal oxidation process (E_{TOP}) are given by the sum of above 3 ~~4~~ emissions:

$$E_{TOP} = Q_{HFC\ 23\_} \times F_{HFC\ 23\ NO} \times GWP_{HFC\ 23} + Q_{HFC\ 23} \times F_{HFC\ 23} +.\ Q_{Fuel} \times F_{LPG}\ OR$$

$$E_{TOP} = Q_{HFC\ 23\_} \times F_{HFC\ 23\ NO} \times 11{,}700 + Q_{HFC\ 23} \times (44/70)\ +.\ Q_{Fuel} \times (44 \times C_{Fuel} / M_{Fuel})$$

The units of each variable are kept common.

E.2 Description of formulae used to estimate leakage, defined as: the net change of anthropogenic emissions by sources of greenhouse gases, which occurs outside the project boundary, and that is measurable and attributable to the project activity:

The above are indirect emissions associated with generation of utilities used in the project activity and are described below:

a. Equivalent of Power consumed by the Thermal Oxidation System = Q_{Power} X F_{Power} (CO_2 generated per unit of Power Consumed) [Note 1] **Equation 5**

CO_2 deemed to have been released if the power, which will be consumed by the system, were to be generated within the battery limit of the system.

[Note 1] $F_{HFC\ 23}$ = Mol. Wt. of CO_2 x No. of Carbon Atoms in HFC 23 / Mol. Wt. of HFC 23 = 44 x 1/70 = 0.6285 t CO_2 / t of HFC 23

[Note 2] $F_{LPG\ /\ ANY\ OTHER}$ = Mol. Wt. of CO_2 x No. of carbon atoms in one molecule of Fuel (C) / Mol. Wt. of Fuel (M) = 44 x C_{Fuel} / M_{Fuel} = 44 x 3.6 / 52.4 Kg CO_2 / Kg of LPG = 3.00 MT CO_2 / MT LPG

[Note 1] F_{Power} = The value of CO_2 generated per unit of power is obtained based on Diesel Generating sets of GFL operating on SKO within the HCFC 22 comp lex.

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b. Equivalent of Steam used by the Thermal Oxidation System $= Q_{Steam} \; X \; F_{Steam}$ (CO2 generated per MT of Steam Consumed) [Note 2]. **Equation 6**

CO2 deemed to have been released if the steam, which will be consumed by the system, were to be generated within the battery limit of the system.

c. Equivalent of hydrated lime used by the Thermal Oxidation System, GHG emission $= Q_{Ca(OH)2} \; X \; F_{Ca(OH)2}$ [Note 1]. **Equation 7**

CO2 deemed to have been released when hydrated clime is produced from limestone [CaCO3] as below:

CaCO3 -> CaO + CO2
CaO + H2O -> Ca (OH) 2

d. Equivalent of caustic soda used by the Thermal Oxidation System, GHG emission $= Q_{NaOH} \; X \; F_{NaOH Power} \; x \; F_{Power}$ **Equation 8**

CO2 deemed to have been released when power required to produce caustic soda is generated with the Project Activity.

The value of $F_{NaOH\text{-}Power}$ is 3,000 kWh / MT of caustic soda (100%), a standard figure for the caustic soda industry. F_{Power} has been used in equation 5 above and the same figure can be used for this equation.

e. Equivalent of Fuel used in transporting Solid Waste to landfill site, GHG emission $= Q_{Solid\ waste} \; x \; F_{Transport} \; x \; F_{Transport\ Fuel}$ [Note 2] **Equation 9**

The total leakages (indirect emissions) due to destruction of HFC 23 (E_L) are given by the sum of above 5 emissions:

E L = GHG due to usage of Power + Steam + hydrated lime + caustic soda + transport fuel for destruction of HFC 23.

$$E_L = Q_{Power} \; X \; F_{Power} + Q_{Steam} \; X \; F_{Steam} + Q_{Ca\ (OH)\ 2} \; x \; 44 / 74 + Q_{NaOH} \; x \; F_{NaOH\text{-}Power} \; x \; F_{Power} + Q_{Solid\ waste} \; x \; 0.009 \; x \; F_{Fuel\ Transport}$$

E.3 The sum of E.1 and E.2 representing the project activity emission (E_P)

$E_P = E_{TOP} + E_L$ OR

[Note 2] F_{Steam} = the value of CO2 generated per unit of steam is calculated from the average fuel consumed by the boiler producing steam, in this case GFL.
[Note 1] $F_{Ca(OH)2}$ = Mol. Wt. of CO2 / Mol. Wt. of Ca (OH) 2 = 44/74 = 0.595 t CO2 / t $Ca_{(OH)2}$
[Note 2] $F_{Transport}$ = 0.009 MT / Tonne of solid waste and $F_{Transport\ Fuel}$ = CO2 released per MT of Transport Fuel, which is same as that released when SKO is used.

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$EP = Q_{HFC\ 23}$ x $F_{HFC\ 23\ NO}$ x 11,700 + $Q_{HFC\ 23}$ X (44/70) + Q_{Fuel} X (44 x C_{Fuel} / M_{Fuel}) + Q_{Power} X F_{Power} + Q_{Steam} X F_{Steam} + $Q_{Ca\ (OH)\ 2}$ x 44 / 74 + Q_{NaOH} x $F_{NaOH\text{-}Power}$ x F_{Power} + $Q_{Solid\ waste}$ x 0.009 x $F_{Fuel\ Transport}$

E.4 Description of formulae used to estimate the anthropogenic emissions by sources of greenhouse gases of the baseline

As estimated under Section D.1.3, the baseline emission reduction is given by the following equation:

$E_B = Q_{HFC\ 23}$ x $GWP_{HFC\ 23}$

The value of $GWP_{HFC\ 23}$ is equal to 11,700. The above equation, therefore, is simplified to -

$E_B = Q_{HFC\ 23}$ x 11,700

E.5 Difference between E.4 and E.3 representing the net emission reductions of the project activity:

$E_R = E_B - EP$

Using equation 1 to 9, the above equation can be written in terms of directly measurable quantities, as below:

$E_R = Q_{HFC\ 23}$ x 11,700 - ($Q_{HFC\ 23}$ x $Q_{HFC\ 23\ NO}$ x 11,700 + $Q_{HFC\ 23}$ x 44/70 + Q_{Fuel} x 44 x C_{Fuel} / M_{Fuel} + Q_{Power} x F_{Power} + Q_{Steam} x F_{Steam} + $Q_{Ca\ (OH)\ 2}$ x 44 / 74 + Q_{NaOH} x $F_{NaOH\text{-}Power}$ x F_{Power} + $Q_{Solid\ waste}$ x 0.009 x $F_{Fuel\ Transport}$

E.6 Table providing values obtained when applying formulae above:

E R = 290 x 11,700 – (290 x 0.001x 11,700 / 100 + 290 x 44 / 70 + Q Fuel x 44 x 3.6 / 52.4 + Q_{Power} x 0.691 [Note 1] + Q_{Steam} x 0.251[Note 2] + Q Ca (OH) 2 x 44 / 74 + Q NaOH x 3,000 x 0.691 + Q Solid Waste x 0.009 x 3 [Note 3]

The amount of HFC 23 decomposed in a year would depend upon HCFC 22 production in a particular year. The value of emission reduction based on the production of HCFC 22 at about 10,000 MTY in calendar year 2003 is calculated below. The reduction in GHG emission (equivalent CO2) is calculated at HFC 23 amount equal to 2.9% of HCFC 22 production

Illustration for 10000 MT of production of HCFC22

	MT CO2
Emission reductions due to project activity. E_B	**3,393,000**

[Note 1] Kg of CO2 released per kWh of Power consumed is 0.691 or 0.00069 MT of CO2 released per kWh of power consumed at GFL.
[Note 2] At GFL, 0.251 MT of CO2 is released per MT of Steam production.
[Note 3] CO2 released per MT of Fuel used is 3 MT.

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Increase in emission from project activity, E_P	**1075**
$E_R = E_B - E_P$	**3,391,925**

From above calculations, it also justified that $Q_{HFC\ 23}$ is the most important quantity to determine reduction in emission. Other quantities are too small and insignificant. However, the monitoring of other emissions help in indirectly monitoring the performance of Thermal Oxidation System and hence in maximising the reduction in emissions.

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F ENVIRONMENTAL IMPACTS

F.1 Documentation on analysis of the environmental aspects, including transboundary impacts

An 'Environmental Impact Assessment Study' for the proposed project has been undertaken and shall be available before start of project construction.

F.2 If impacts are considered significant by the project participants or the host party: *Please provide conclusions and all references to support documentation of an Environmental Impact Assessment that has been undertaken in accordance with the procedures as Required by the Host Party.*

Executive Summary of EIA report shall be included on conclusion of the EIA.

Environmental Impact information for a similar project in the UK

Experience for the plant in the UK, which has been destroying HFC23 and HCFC22 mixtures since 1999, suggests that dioxin levels rarely exceed 0.005 ng (I-TEQ)/m^3, which is only 5 % of the consented level of 0.1 ng (I-TEQ)/m^3.

Prediction of dioxin concentrations based on dispersion modelling of the plant emissions.

The plant is located in Halton Borough, UK. Extensive dispersion modelling was carried out in the Halton Borough, UK of the four new incinerators to be constructed between 1996 and 2000, the smallest of which was the HCFC22 plant vent thermal oxidiser. The results of this modelling are shown in the table below.

Parameter	Halton, UK (Commutation of 4 new incinerators)	1300 tpa HFC 23 incinerator	1300 tpa HFC 23 incinerator as a fraction of the Halton incinerators
Dioxin Mass Release[1] (g/s)	12.8×10^{-9}	0.01×10^{-9}	Less than 1 thousandth
Maximum annual average increase in the Predicted	1.2×10^{-15}	$\sim 0.001 \times 10^{-15}$	Less than 1 thousandth

[1] Assumes that the incinerator producing dioxins at 0.1 ng (I-TEQ)/m3, operating experience suggests that for HFC destruction incinerators the levels measured are less than 10 % of this limit (A ng is 1×10^{-9} grams)
[2] The long-term concentration parameter is likely to be more significant for dioxins because of their health effect is thought to be chronic (Long Term) in the small doses. This because the main pathway to humans is via contaminated food eaten over a lifetime.
N.B. Average concentration use the average meteorological data available for the location

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Concentration[2] (g/m^3)			
Percentage increase in local air quality[3]	0.3 %	Unknown, but unlikely to be greater than 0.1 %	-

Source of Halton Borough data is a report by DNV entitled "Cumulative Effects of Incinerators in Halton Borough"

The conclusion of the DNV report and an independent Environment Agency of England and Wales report was that the environmental and health effects of the dioxin releases from these incinerators was insignificant and was vastly outweighed by the benefit generated by incineration the vent gases.

[3] The average total daily intake of dioxins for the general adult in the UK population in 1996 of 125 pg I-TEQ/person/day corresponds to 2 pg (TEQ) per kg of bodyweight per day, for an adult weighing 60 kg.

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G STAKEHOLDERS COMMENTS

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

GFL identified local communities, shareholders, employees and labour as the most important stakeholders with an interest in the proposed project activity.

Accordingly, GFL sent out a notice to representatives of various stakeholder groups, with a brief on the project, informing them of the proposed meeting on 13th June 2003 at GFL plant and GFL Office at Vadodara, requesting each stakeholder group to send representatives to the said meeting at the appointed hour.

The meeting with representatives of local communities was proposed in the Plant premises while that with Shareholders, Employees and representative of the labour union was proposed in the HO at Vadodara.

Three representatives from Shareholders, Employees, the Labour Union Leader and Sarpanches of three of the villages in the vicinity of the proposed project activity were conducted at the appointed hour. The meeting of the shareholders and employees was conducted together while that with the labour union leader was conducted separately.

The stakeholder meeting process involved:

a) Welcome to the representatives by Mr. Deepak Asher, VP Corporate Finance
b) Election of a Chairperson for the meeting by the stakeholder group representatives from amongst themselves.
c) Introduction of the project by Mr. Deepak Asher on request from the Chair.
d) Open house discussion on the merits of the project with permission of the Chair.
e) Summation of the concerns expressed by the stakeholder groups and the commitments to address the concerns made by GFL by the Chairperson.
f) Preparation and circulation of draft Minutes of the Meeting and signing of the MOM.

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G.2 Summary of comments received

Comments were received from Sarpanches of Villages Ranjitnagar, Nathkua and Jeetpura located 1.75 Km SE of the site, 2 Km SW of the site and 1.5 Km NW of the site respectively. The principal concerns pertained to:

a) to any potential adverse environmental impact of the proposed project.
b) the increasing scarcity of water in the region and the potential role of GFL in mitigation of the hardships on this account;
c) how GFL planned to achieve zero discharge and whether there would be solid waste generation and how these shall be disposed;
d) employment potential of the project.

Three shareholders based in Vadodara desired to know:

a) why the company was proposing a major capital investment even though it is not required by regulations and whether Bottom-line is likely to be significantly impacted on account of the proposed investment and the O&M expenditures;
b) if R23 has any alternative uses and whether it can be sold so as to mitigate GHG emission without the proposed investment;
c) if there was a possibility of past venting of R23 to the atmosphere posing any liability to GFL;
d) if new employees would be required or existing employees shall have to be re-skilled;

Representatives of employees desired to know if the proposed project would result in deterioration of the work environment on account of the several toxic gases (HCl & HF) likely to be generated on account of the project.

The Labour Union leader:

a) stated that in whatever the firm does it must not in pursuit of profits compromise on principles of sustainable development;
b) enquired what would be the employment generation potential of the project and the skill levels;
c) enquired if there were any specific restrictions on emissions from such incinerators;
d) enquired as to what are the likely occupational health and safety impacts of the project;

Detailed MOM delineating the above concerns and GFL responses has been included at Annex 13.

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

GFL clarified to the Sarpanches:

a) that the proposed project design would adhere to the best environmental performance standards prescribed anywhere in the world though the current designs being explored conform to the EU Directives. Moreover, prior to implementation of the project an EIA would be conducted and a suitable EMP drawn up and implemented to ensure minimal adverse environmental impacts.
b) GFL clarified that though the proposed system requires about 60 M3/day of water nearly 45m3/day of water would be recycled and only 15 m3/day of water shall be drawn from external sources a makeup water. Moreover, as regards general water scarcity in the region, GFL has in the past contributed to construction of water management structures and shall continue these initiatives to improve water management in the region. Moreover, in this direction GFL had commissioned a study by Gujarat Industrial and Technical Consultancy Organization on the groundwater situation and to identify sites for construction of check dams.
c) GFL clarified that the wastewater shall be neutralized, treated in BOD/COD reactors, thickeners and recycled. While the solid waste that is generated shall be disposed of in an approved secure landfill site at Nandesari.
d) GFL specified that nearly 30 to 40 new jobs are likely to be created on account of the project activity and nearly 90% of these new jobs would involve unskilled labour. Moreover, GFL assured the Sarpanches that where possible employment would be offered to local people.

GFL in response to the Shareholder's queries clarified that:

a) the company shall receive additional revenue on account of transfer of CERs to Annex 1 countries that have commitments under Kyoto Protocol. This may have a positive impact on the bottom line.
b) though there are some uses of R23 but there are no known transactions taking place in India;
c) there are no regulations in India restricting R23 emissions as it is non toxic hence past emissions are not likely to pose any liabilities while avoidance of future emissions may be rewarded;
d) the about 30 to 40 new employees would be recruited on account of the project activity.

In response to employees concern pertaining to degradation of the work environment, GFL clarified that the technology supplier has assured that there shall be no leakage of HF and HCl. Moreover, GFL proposes to monitor the presence of these potential hazardous materials in the work environment.

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In the discussion with Mr. Raj Kumar Singh, General Secretary of AITUC which represents the work force, the GFL emphasized that

a) that the technology shall conform to applicable emission standards as prescribed in the European Union directives as there are as yet no standards/guidelines pertaining to emissions from similar operation in India;
b) nearly 30-40 new employment opportunities shall be created and of these nearly 90% is expected to be unskilled labour requirements;
c) the process is a closed system and the possibility of escape of toxic gases to the atmosphere is unlikely. Secondly, GFL shall in accordance with the requirements of the Factories Act, 1948-monitor presence of these gases in the work environment.

Detailed MOM delineating the above concerns and GFL responses has been included at Annex 13.

GFL also informed the stakeholders that the Project Activity contributes to the **sustainable development** of the region and country by facilitating and catalysing sustainable operations of GFL, thereby creation of sustainable shareholder, economic, social and environmental value. These are detailed in **Annex 12 to this PDD**.

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ANNEX 1

Information on participants in the project activity

A. Gujarat Fluorochemicals Limited

Organisation:	**Gujarat Fluorochemicals Limited**	
Street / P.O. Box:	Survey 16/3, 26, 27	
Building:	-	
City:	Ranjitnagar	
State / Region:	Gujarat / Taluka Ghoghamba / District Panchmahals	
Postfix / Zip:	380	
Country:	India	
Telephone:	(02678) 248 107, 152, 153	
Fax:	(02678) 248 153	
E-Mail:	Deepak_asher@yahoo.com	vksoni@gfl.co.in
URL:	-	-
Represented by:		
Title:	Vice President (Corporate Finance)	Head of Projects
Salutation:	Mr.	Mr.
Last Name:	Asher	Soni
Middle Name:	-	Kumar
First Name:	Deepak	Vijay
Department:	Corporate Finance	Projects
Mobile:	98795 07950	9818181419
Direct FAX:	+ 91 (265) 2310 312	+ 91 (11) 2332 5128
Direct Tel.:	+ 91 (265) 2330 057	+ 91 (11) 2332 4509
Personal E-Mail	Deepak_asher@yahoo.com	vksoni@gfl.co.in

A brief profile of INOX Group is enclosed.

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B. Ineos Fluor Holdings Limited, United Kingdom

Organization:	Ineos Fluor Holdings Limited; subsidiary Ineos Fluor Limited	
Street/P.O.Box:	PO Box 13, The Heath	
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FAX:	+44 1928 511418	
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URL:	http:/www.ineosfluor.com	
Represented by:		
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Salutation:	Dr.	
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Middle Name:	A	
First Name:	Andrew	
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C Rabobank, Netherlands

Organization:	Rabobank International	
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State/Region:	Utrecht	
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Represented by:		

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Personal E-Mail	-

D. Sumitomo Corporation, Japan

Organization:	Sumitomo Corporation, Japan	
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State/Region:	-	
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FAX:	+81 – 3 – 5166 – 6443	+ 81 – 3 – 5166 – 6310
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URL:	-	
Represented by:		
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First Name:	Hidefumi	
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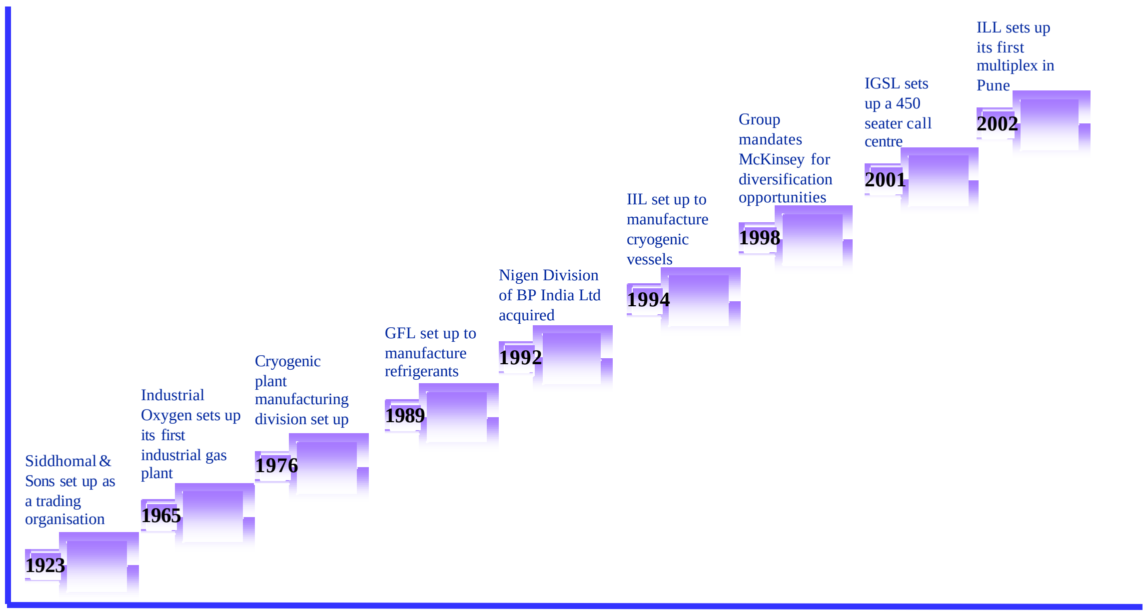
1. THE INOX GROUP

1.1 History and Background

The Group was set up in 1923 by Mr. Siddhomal Jain as a trading organisation. The Group has since then diversified its operations into various manufacturing and recently service oriented industries and grown into a Rs. 3.97bn (US$ 83m) enterprise.

Figure - Group Milestones



The Group's business interests and geographical presence are given in table below.

Business Interests **Geographical Presence**

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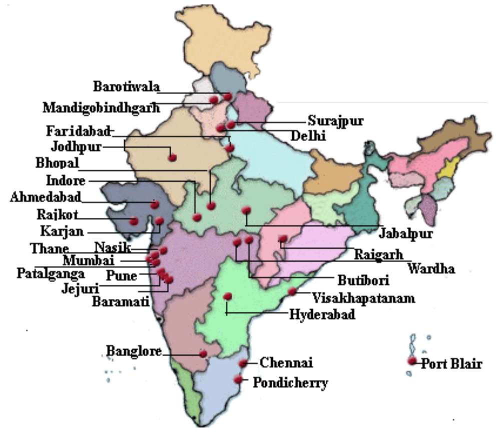
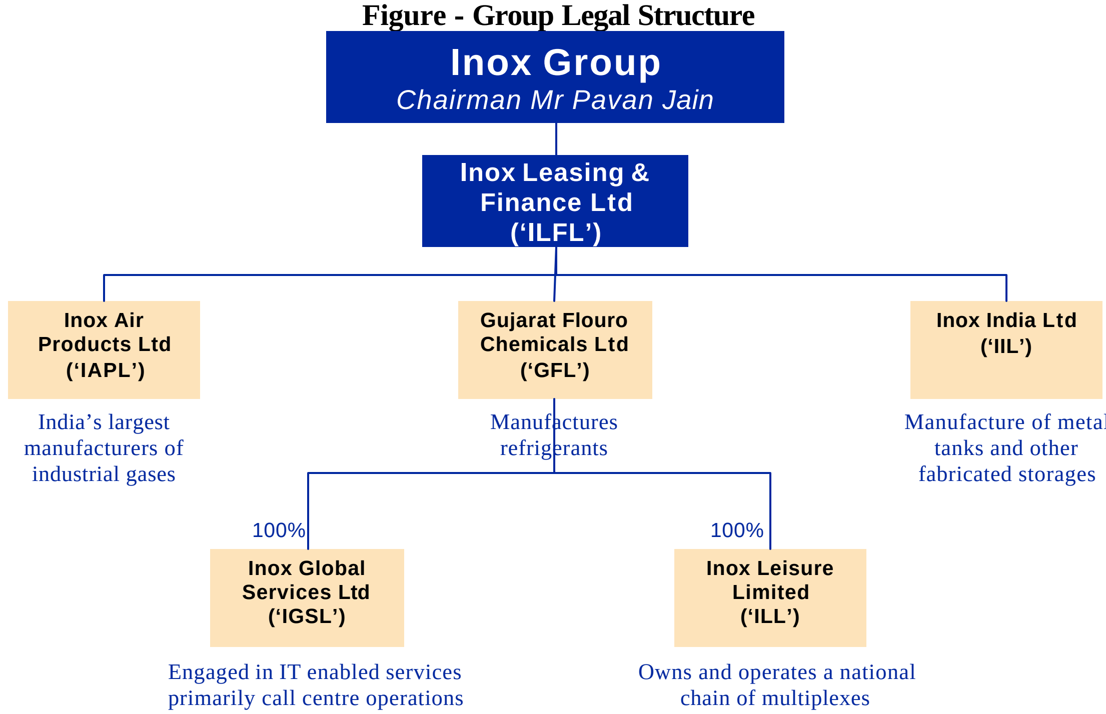
- Industrial Gases
- Speciality gases
- Cryogenic tanks and vacuum insulated tanks
- Welded cylinders and disposable gas cylinders
- Refrigerants
- Air separation plants and nitrogen PSA
- IT enabled services
- Multiplexes, leisure and entertainment



1.2 Group Structure

The Inox Group is spearheaded by Inox Leasing and Finance Limited, which is the holding company of the Group. The Inox Group structure is as follows.

Figure - Group Legal Structure



Source: Company

1.3 Key Management

The Inox Group is promoted by Mr. Pavan Jain and Mr Vivek Jain. Mr Deepak Asher is the Chief Financial Officer and looks after the Group's corporate finance activities. Their brief profiles are given below.

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1.3.1 Mr Pavan Kumar Jain

Mr Pavan Kumar Jain, aged 50, is a Chemical Engineer from IIT, New Delhi with over 30 years of business experience in various capacities, of which the last 20 have been as Managing Director of IAPL. Under his stewardship, IAPL has grown from a single plant business, to one of the largest players in the industrial gas business in the country.

1.3.2 Mr Vivek Kumar Jain

Mr Vivek Kumar Jain, aged 45, is a graduate in Economics from St Stephens, New Delhi, and a Post Graduate in Business Administration, with specialisation in Finance, from the Indian Institute of Management, Ahmedabad. Mr Vivek Kumar Jain has more than 20 years of business experience in different businesses and was instrumental in starting GFL and bringing it to its present position of being the largest manufacturer of refrigerants in the country.

1.3.3 Mr Deepak Ranjit Asher

Mr Deepak Ranjit Asher, aged 44, is commerce and law graduate. He is a fellow member of the Institute of Chartered Accountants of India and an associate member of the Institute of Cost and Works Accountants of India. Deepak is the Vice President of GFL, on the board of ILL and ILFL and currently handles all Corporate Finance activities for the Group. He is the chairman of the Multiplex Association of India, member of the FICCI Entertainment Committee and has nearly 20 years of work experience.

1.4 Brief Financial Overview

The Group's turnover and assets have been consistently growing at 11.6% and 11.7% between 1996 and 2002. However, its cash profits declined in 2001 due to losses in investment and treasury activity, though operating profits maintained their growth. Cash profits bounced back in 2002.

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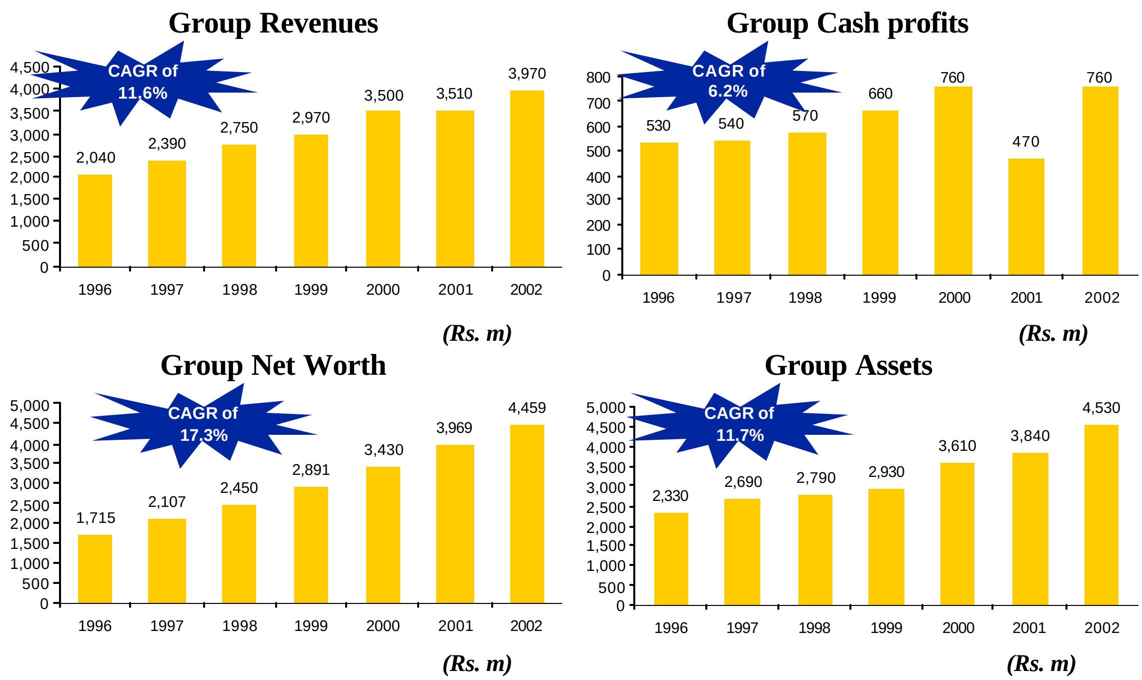
Figure – Group Financial Overview



1.5 International Affiliations

- Joint Venture with Air products, UK for industrial and speciality gases
- Technical collaboration with Stauffer Chemicals, Pennwalt Corporation and Stearns Catalytic Corporation, US for hydrogen fluoride and refrigerants
- Technical collaboration with Nippon Sanso Corporation, Japan for cryogenic systems
- Direct license from Carbotech Industries, Germany for Nitrogen PSA plant
- Technical collaboration with Permea Inc, USA for Nitrogen PSA plant

1.6 Operations

The various companies comprising the Inox Group include the following:

1.6.1 Inox Leasing & Finance Limited ('ILFL')

Set up in 1966, ILFL is a Non Banking Financial Services company engaged primarily in secondary market operations and leasing of properties. It is the holding company of the Group and it registered a turnover of Rs. 39.1m (US$ 0.8m) for the year ended March 31, 2002.

1.6.2 Inox Air Products Limited ('IAPL')

Originally incorporated as a private limited company in 1963, IAPL (formerly Industrial Oxygen Ltd) became a public limited company in 1993. IAPL is one of India's largest industrial gas manufacturers with factories at 22 locations. In 1999, UK based Air Products acquired 24% stake in IAPL from the Jain family and subsequently raised its stake to 50% by way of acquisition from the

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public. At present, the promoters (the Jain family) and Air Products have 50% stake each in the company's equity. During the year ended March 31, 2002 IAPL registered sales of Rs. 2,091m (US$ 43.5m) for FY02 and a net profit of Rs. 76.7m (US$ 1.6m).

1.6.3 Gujarat Fluorochemicals Limited ('GFL')

Incorporated in 1987, GFL is the largest manufacturer of refrigerant gases in India. GFL primarily manufactures two grades of refrigerant gases namely – Chlorofluoro Carbons ('CFCs') and Hydro Clorofluoro Carbons ('HCFCs'). GFL is a public limited company listed on the Mumbai, National Ahmedabad and Delhi exchanges. Consequent to the implementation of the Montreal Protocol by developing countries, GFL started phasing out CFC production in terms of its obligations under the protocol. The company has begun to shift its focus to HCFC production and exports. GFL registered sales of Rs. 1,335m (US$ 27.8m) and a net profit of Rs. 305m (US$ 6.4m) for the year ended March 31st 2002.

1.6.4 Inox Global Services Limited ('IGSL')

Set up in 1988 as part of the diversification strategy of GFL, IGSL is in the IT enabled services business. It has set up a 150-seat call centre and remote transaction processing facility in Gurgaon.

1.6.5 Inox Leisure Limited ('ILL')

ILL was incorporated in 1999 and is a wholly owned subsidiary of GFL. The Company is in the process of setting up a national chain of multiplexes and is already operating multiplexes in Vadodara and Pune.

1.6.6 Inox India Limited ('IIL')

Inox India Ltd is engaged in manufacture of cryogenic vessels and storage tanks. During the year ended March 31, 2000, Inox India Ltd registered a total income of Rs. 501.6m (US$ 10.5m) and a profit of Rs. 51.1m (US$ 1.1m).

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ANNEX 2

INFORMATION REGARDING PUBLIC FUNDING

The project is proposed to be financed by the project sponsors, who propose to undertake the CDM Project Activity as the project proponent. At present, no public funding is envisaged. In case public funding is sought, the proponent shall duly ensure that it is additional to any ODA.

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ANNEX 3

NEW BASELINE METHODOLOGY

Approved baseline methodology AM 0001 is being used in this PDD. Hence this section is not applicable.

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ANNEX – 4

NEW MONITORING METHODOLOGY

1. Proposed New Monitoring Methodology

Approved baseline methodology AM 0001 is being used in this PDD. Hence this section is not applicable.

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ANNEX – 5

TABLE: BASELINE DATA

(Please provide a table containing the key elements used to determine the baseline (variables, parameters, data sources etc.). For approved methodologies you may find a draft table on the UNFCCC CDM web site. For new methodologies, no pre-defined table structure is provided)

S. No.	Key Elements	Value	Reference
1.	% Cut-off HFC 23 (ratio of HFC 23 generation to HCFC 22 production)	2.9 wt.%	Section A.2.2 and the Baseline Calculation given below
2.	GWP $_{HFC\ 23}$	11,700	Attached GWPs (100-year time horizon) in the SAR and TAR of the IPCC)
3.	CO2 Emission Factors	T CO2	
3.1	CO2 intensity of Fuel used in thermal oxidiser (LPG in this case)	3.00 / t LPG	E .1 (c)
3.2	CO2 intensity of Electricity	0.00069 / kWh	E.6
3.3	CO2 intensity of Steam based on boiler efficiency and fuel used.	0.251 / t Steam	E.6
3.4	Hydrated Lime	0.595 / t Ca (OH) 2	E.2 (c)
3.5	Caustic Soda	3,000 x 0.691 / t C. Soda	E.2 (d)
3.6	Fuel Transport	0.009 x 3 / t Transport Fuel	E.2 (e)
3.7	HFC Burning	0.6255 / t HFC 23	E.1 (b)

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Baseline Calculation

The reduction claimed by GFL in GHG emissions is subject to a cut-off ratio, designed to ensure that no unfair claim of credit can be made by the destruction of HFC23 in excess of that permitted under the CDM project. The cut-off ratio limits the ratio of HFC23 to HCFC22 allowed for the purposes of determining the destruction of HFC23 and is arrived at the lowest of actual values for last 3 years in terms of the approved methodology AM0001.

GFL has computed the cut off ratio based on the chloroform material balance for each of the last 3 years. This approach is being adopted due to the following reasons relevant to GFL:

- ✓ The chloroform mass balance is known to be reliable, and is more accurate in GFL's case. It is also regularly used by other companies including Ineos Fluor, our technology sponsor
- ✓ Chloroform consumption and HCFC22 production quantities are computed from weighbridge measurements and have a higher inherent accuracy
- ✓ The chloroform mass balance is not dependant on HCl quantity since the concentration of HFC 23 in HCl is in ppm and hence any error in computing this loss would have an insignificant impact on the cut off ratio
- ✓ Chloroform mass balance uses values for chloroform receipts and stocks as well as for HCFC 22 production which are subject to both internal and statutory audits
- ✓ The chloroform balance method uses vent GC analysis which is analysed every shift

This method leads to the lowest ratio of 2.9% for the last 3 years.

Year	2000	2001	2002	2003*
Chloroform balance ratio	3.74%	2.90%	3.15%	3.66%

** Based on 9 months, other data indicates there would not be any significant change in the remainder of the year*

GFL proposes to use the ratio of 2.90% (lowest ratio for last 3 years) as cut-off value as per AM 0001

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GWPs (100-year time horizon) in the SAR and Tar of the IPCC

Gas	Chemical Formula		TAR	SAR	TAR / SAR
Carbon Dioxide	CO_2		1	1	1.00
Methane	CH_4		23	21	1.10
Nitrous Oxide	N_2O		296	310	0.95
Hydro fluorocarbons (HFCs)					
HFC-23	CHF_3		12,000	11,700	1.03
HFC-32	CH_2F_2		550	650	0.85
HFC-41	CH_3F		97	150	0.65
HFC-125	CHF_2CF_3		3,400	2,800	1.21
HFC-134	CHF_2CHF_2		1,100	1,000	1.10
HFC-134a	CH_2FCF_3		1,300	1,300	1.00
HFC-143	CHF_2CH_2F		330	300	1.10
HFC-143a	CF_3CH_3		4,300	3,800	1.13
HFC-152	CH_2FCH_2F		43		
HFC-152a	CH_3CHF_2		120	140	0.86
HFC-161	CH_3CH_2F		12		
HFC-227ea	CF_3CHFCF_3		3,500	2,900	1.21
HFC-236cb	$CH_2FCF_2CF_3$		1,300		
HFC-236ea	CHF_2CHFCF_3		1,200		
HFC-236fa	$CF_3CH_2CF_3$		9,400	6,300	1.49
HFC-245ca	$CH_2FCF_2CHF_2$		640	560	1.14
HFC-245fa	$CHF_2CH_2CF_3$		950		
HFC-365mfc	$CF_3CH_2CF_2CH_3$		890		
HFC-10mee	$CF_3CHFCHFCF_2CF_3$		1,500	1,300	1.15
Fully fluorinated species					
Sulphur hexafluoride		SF_6	22,200	23,900	0.93
Perfluoromethane	PFC	CF_4	5,700	6,500	0.88
Perfluoroethane		C_2F_6	11,900	9,200	1.29
Perfluoropropane		C_3F_8	8,600	7,000	1.23
Perfluorobutane		C_4H_{10}	8,600	7,000	1.23
Perfluorocyclobutane		c-C_4F_8	10,000	8,700	1.15
Perfluoropentane		C_5H_{12}	8,900	7,500	1.19
Perfluorohexane		C_6H_{14}	9,000	7,400	1.22
Ethers and Halogenated Ethers					
	CH_3OCH_3		1		
HFE-125	CF_3OCHF_2		14,900		
HFE-134	CHF_2OCHF_2		6,100		
HFE-143a	CH_3OCF_3		750		
HCFE-235da2	$CF_3CHClOCHF_2$		340		
HFE-245fa2	$CF_3CH_2OCHF_2$		570		
HFE-254cb2	$CHF_2CF_2OCH_3$		30		
HFE-7100	$C_4H_9OCH_3$		390		
HFE-7200	$C_4H_9OC_2H_5$		55		

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H-Galden 1040x	CHF2OCF2OC2F4OCHF2	1,800		
HG-10	CHF2OCF2OCHF2	2,700		
HG-01	CHF2OCF2CF2OCHF2	1,500		

SAR: IPCC the Second Assessment Report
TAR: IPCC the Third Assessment Report

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ANNEX 6

Details of Main Business of Gujarat Fluorochemicals Limited (GFL)

Gujarat Fluorochemicals Limited (GFL) is engaged in the production of Chlorofluorocarbons (HFCs and HCFCs) used as 'Refrigerant Gases', Hydrofluoric Acid (HF) and By-products.

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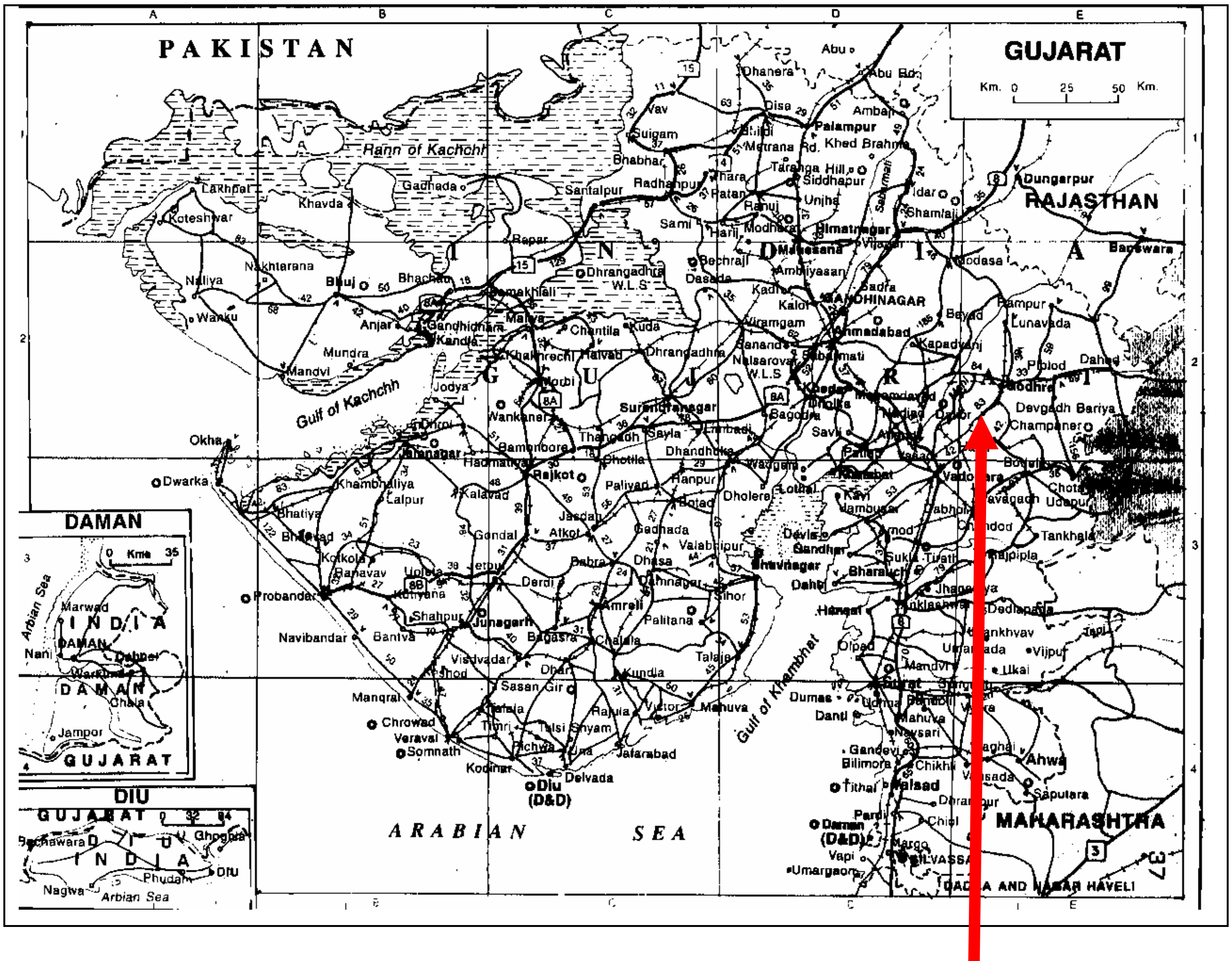
ANNEX 7

LOCATION MAP of GUJARAT FLUOCHEMICALS LIMITED



Map of Gujarat and Panchmahals

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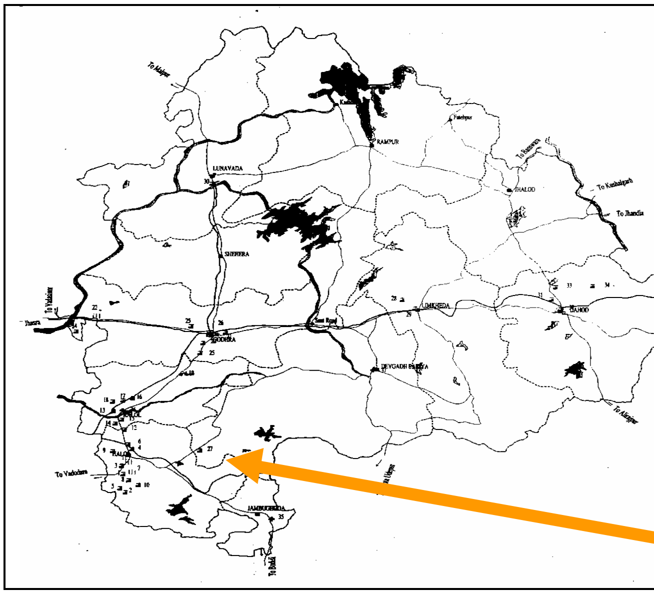
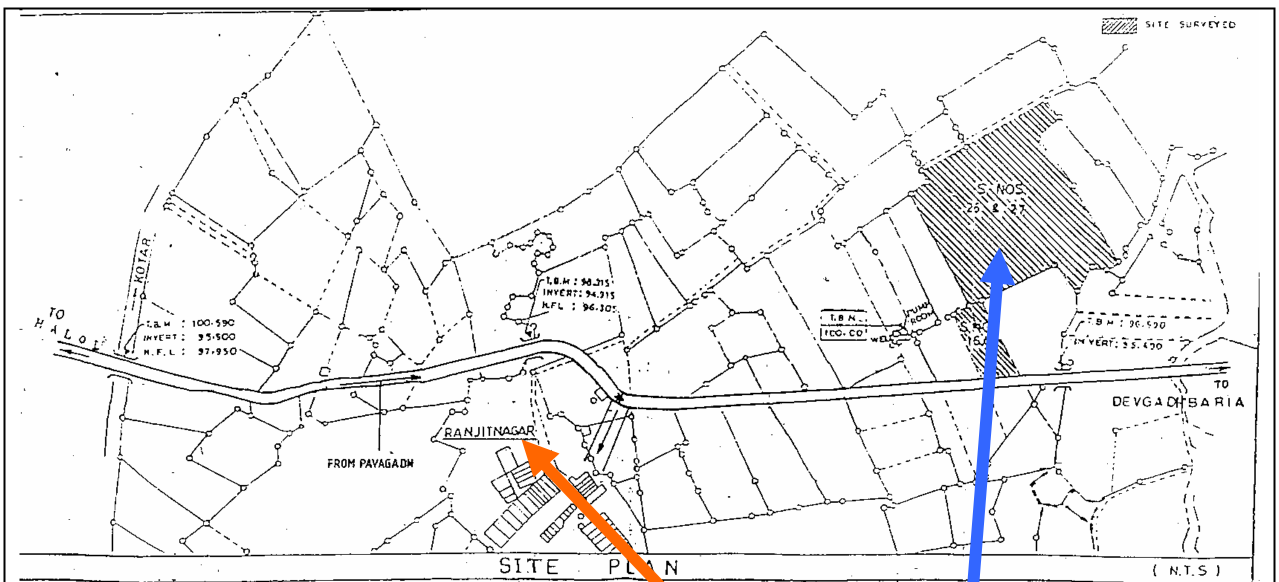


Map of District Panchmahals and Ranjitnagar



Map of Ranjitnagar and Plant Site

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Photograph of GFL's HCFC 22 Plant at Ranjitnagar, Gujarat

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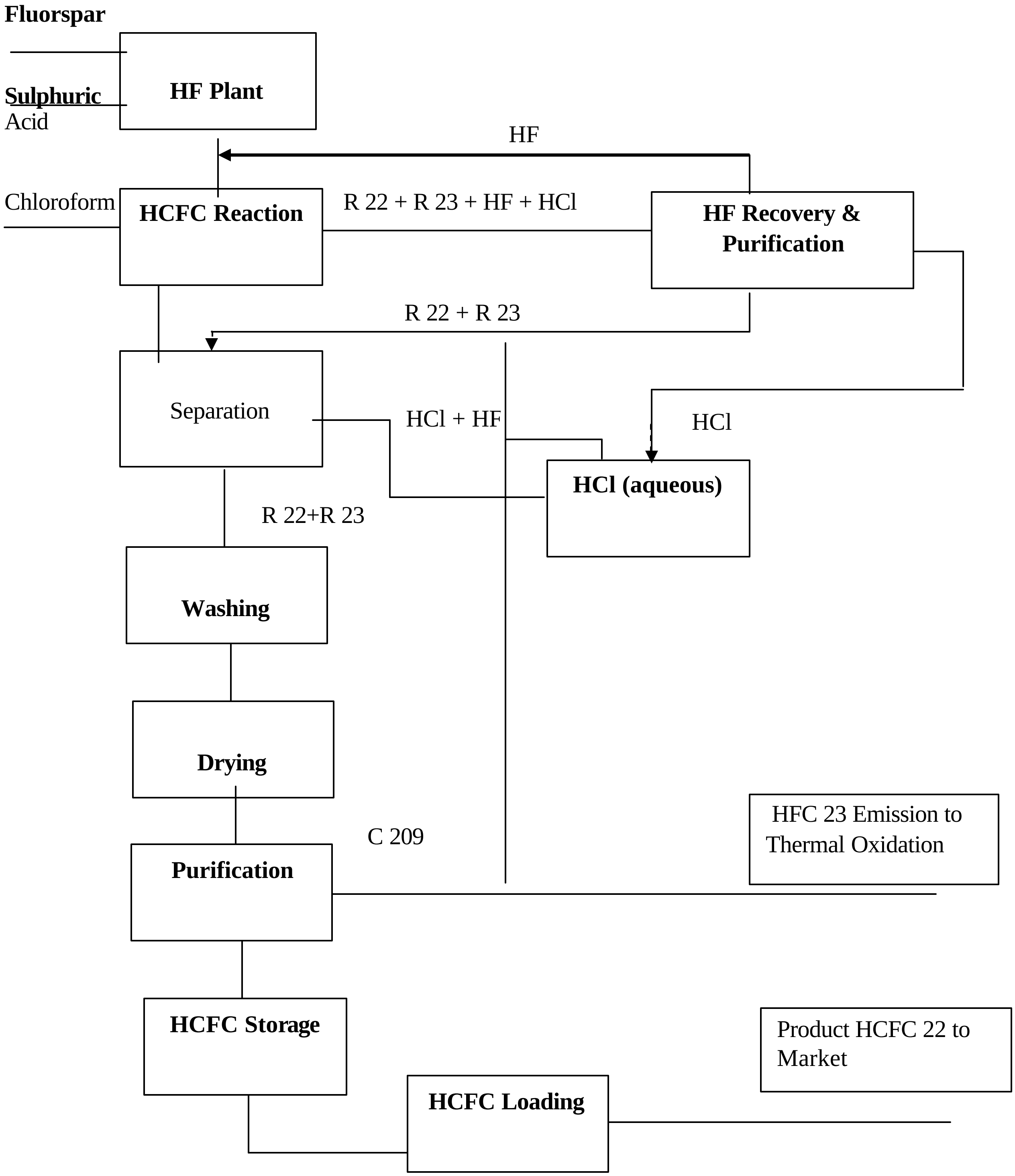
ANNEX 8

BLOCK FLOW DIAGRAM – HCFC 22 PLANT



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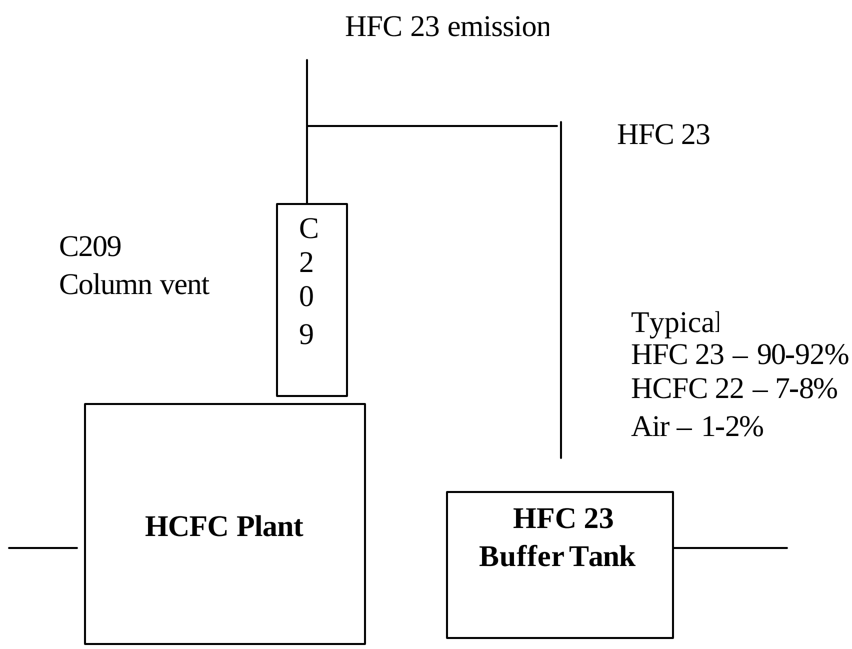
ANNEX 9

DIAGRAM SHOWING SOURCE OF HFC 23 EMISSION



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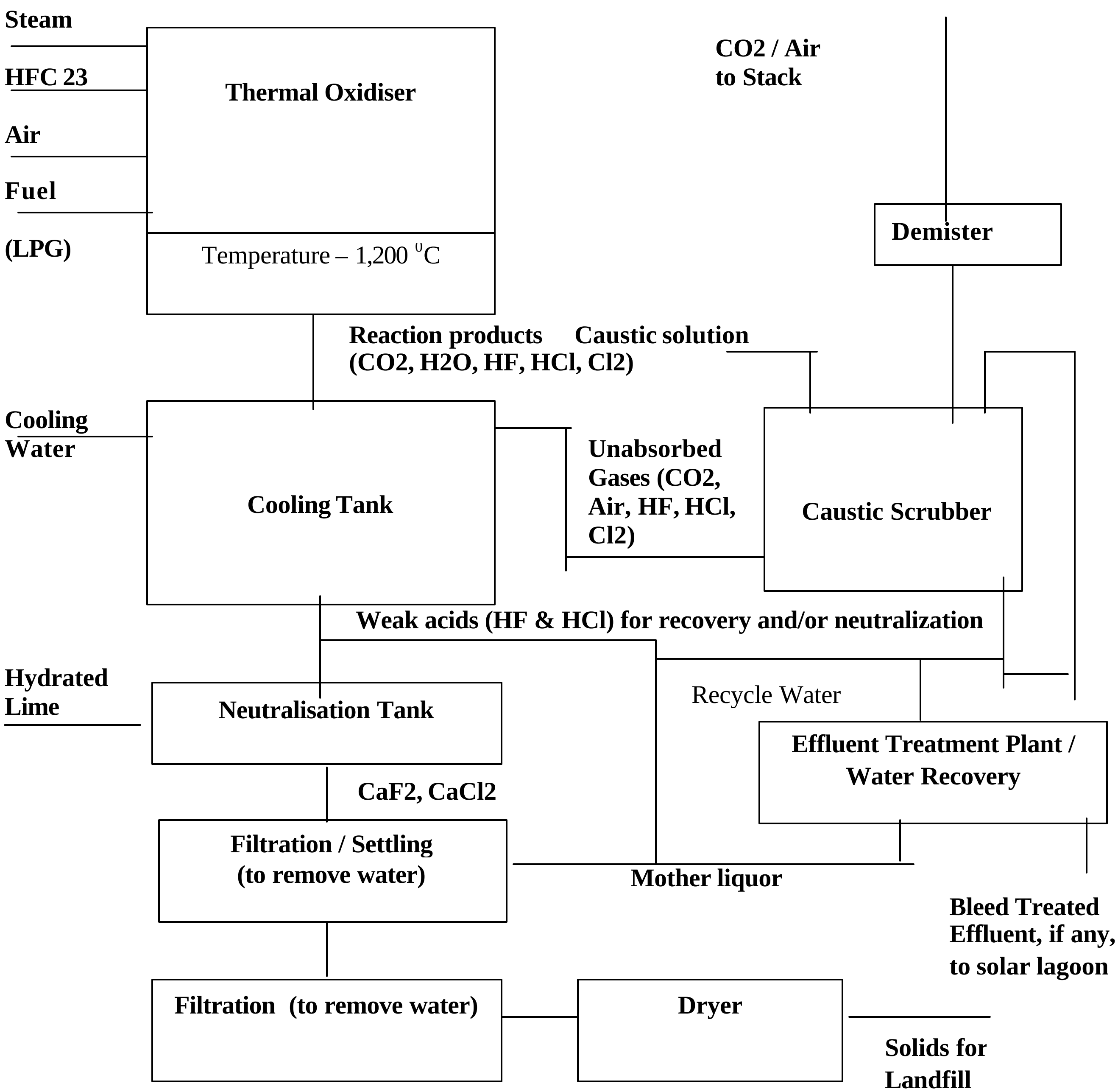
ANNEX 10

BLOCK DIAGRAM FOR PROPOSED SCHEME FOR THERMAL OXIDATION



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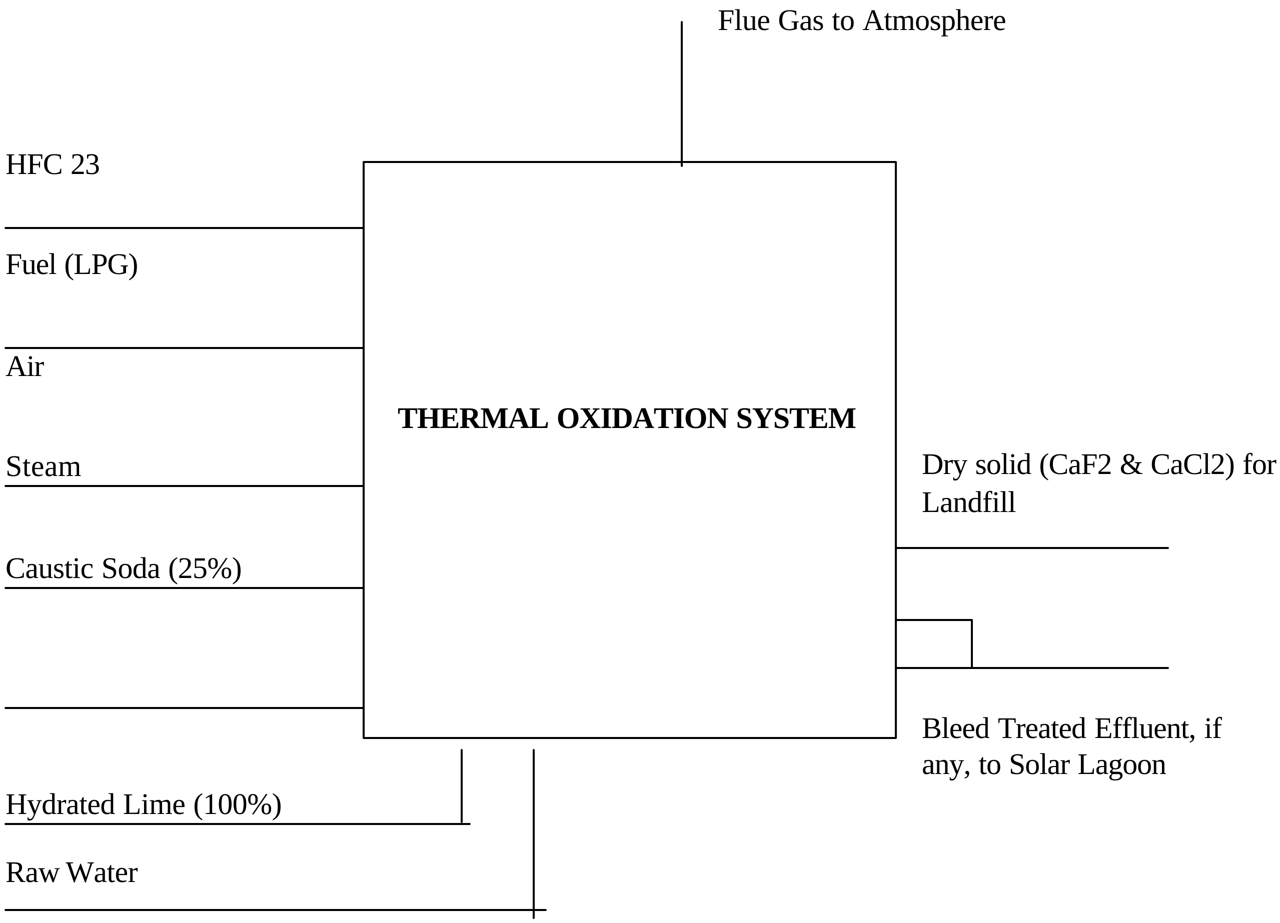
ANNEX 11

INPUT – OUTPUT DIAGRAM FOR THERMAL OXIDATION SYSTEM



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ANNEX 12

Project's contribution to Sustainable Development

The Project Activity contributes to the sustainable development of the region and country by facilitating and catalysing sustainable operations of GFL, thereby creation of sustainable shareholder, economic, social and environmental value.

The strategic objectives identified by the project to achieve the stated goals include improved management of natural resources in the vicinity of the project activity, increased rural incomes, reduced vulnerability and empowerment of the vulnerable sections of society.

More specifically, the project shall contribute to the sustainable development of the region and country by addressing the following broad issues:

1.0 Policy and Development

a) The Project Activity is proposed in rural area (as is the GFL unit) thereby creating employment opportunities in the rural areas in construction, operation and maintenance. Creation of employment opportunities in rural areas has long been recognized as a major concern for sustainable development and to stem the mass exodus from rural to urban areas. This concern has formed the cornerstone of most of Government of India's rural development programs. To that extent, the activity directly addresses a core national concern.

b) The Project Activity is line with Government of India's (GOI's) commitment to participate in global initiatives to reduce GHG emissions in light of which, GOI has become a party to the Kyoto Protocol.

2.0 Environment

a) The Project Activity shall result in significant reductions in GHG emissions as discussed in the report.

b) The sponsors are carrying out an Environment Impact Assessment for the proposed Project Activity and implement an Environment Management Plan to effectively mitigate adverse environmental impacts of the project, if any.

c) The project is proposed in the existing plant premises and no new land is proposed to be procured and diverted to the project.

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d) The sponsors, in light of the water scarcity in the region have in the past contributed to construction of water management structures like check dams etc and propose to utilize part of the CDM revenues towards facilitating improved management of water resources by local communities, as one of the activities.

e) The sponsors, in light of the increasing incidence of cattle rearing as an income activity in the vicinity, shall use part of the income from CDM to facilitate improved management of cattle fodder by the local community.

f) The sponsors shall devote part of the income from the proposed project activity to create a green belt on their premises and if permitted, undertake afforestation in village wastelands.

3.0 Socio-economic

3.1 Present State of the Area

The project is located at Village Ranjitnagar, Taluka Devgadhbaria, District Ghoghamba, Gujarat State, India, which is recognised as **an industrially backward area**. The area in the immediate vicinity of the project (around 5 kilometres radius) consists of around 10 small villages, with an aggregate population of around 50000. The nearest town, Halol, with a population of around 50000, is more than 15 kilometres away. Per-capita income levels are low and most of the population lives below the poverty line and suffers from lack of basic amenities such as water (drinking and irrigation), energy and shelter. There is only one primary school in the vicinity of the project. Most of the population is illiterate, and even amongst those who are literate education levels are very low. The primary occupation of the inhabitants of the local areas is agriculture. Very few of the inhabitants own agricultural land, and most of the population works as unskilled agricultural labour. Agricultural practices are obsolete and inefficient due to lack of knowledge in proper techniques resulting in poor soil productivity and crop yield.

The state of Gujarat, where the project activity is proposed, is not rated particularly progressive on several social factors. This is reflected in the states sex ratio, which stands at 921 as compared to national sex ratio of 933, particularly the female literacy rate of 48% as compared to the corresponding rate of 50% for India.

Panchmahals District where the project is proposed has a sex ratio of 939, which is better than the national and state average but the literacy rate of 64% and 38% for male and female respectively are lower than the national average. The sex ratio in rural Panchmahals is 942 while the literacy rate is 62% and 34% for male and female respectively. While on sex ratio the proposed site is better than state and national averages, the literacy rates are worse than the national and state averages while its mixed when compared to the state rates.

There are no industries in the area. The few persons who are employed in industries have to travel around 20 kilometres to work and are engaged in menial labour. Sanitation and hygiene conditions are also very poor. Medical and veterinary facilities are almost non-existent because of which humans and animals live in generally poor health.

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The average rural main employment rate at 31% for the district is lower than the average for Gujarat, which is at 33.66% and lower than the national average of 31.03% also. It is pertinent to mention that where only 33.58% of rural main workers in Gujarat are Agricultural labourers a higher 43% of the rural main workers in the district are agricultural labourers. This occupation besides being periodic employment presents significant income insecurity on account of numerous risks. Thus secure employment or stable income opportunity on account of the in the rice husk based farm contributes significantly to enhanced income security in the region.

3.2 Sustainable development activities

Against this backdrop, Gujarat Fluorochemicals Limited (GFL) can undertake the illustrative list of initiatives given below to uplift the conditions of the area around the plant by providing basic facilities of life and contribute towards sustainable development. GFL already has past track record of demonstrating social responsibility through similar initiatives and sees this project as another opportunity to illustrate the benefits of such community driven activities.

3.3 GFL's commitment to sustainable development

GFL has expressed its strong commitment to the sustainable development activities by committing a total fund of Rs. 7 Crores (Euro 1.375 Million) approximately for the life of the entire CDM project out of the revenues received if the project is approved and once there is revenue stream from sale of CERs. These funds will be used for selected community development activities such as education; vocational training; employment; agriculture; sanitation, hygiene & environment; water management; medical and animal health, which will contribute significantly to the well being of the local population and poverty alleviation. Towards water management, for example GFL has estimated that under the Panam River Basin Plan (Sardar Patel Jal Plan) the community contribution for check dam construction shall work out to Rs. 50 lacs half of which is proposed to be provided as a catalytic fund by the project promoters.

In addition the 'capital spend' on the CDM project will have multiplier effect on sustainable development of the area by coming up of ancillary units and service industries dependent on the CDM project.

a) GFL also commits to employ 30-40 direct employees and generate indirect employment for several folds more in related and dependent areas.

b) Increased income security shall contribute to the empowerment of the most vulnerable sections of the society. The setting up of the unit shall provide some amount of income security to agricultural labourers in the regions.

c) Since agricultural labourers and marginal labourers are comprised primarily of persons from the vulnerable sections of society, this employment opportunity, though small, shall contribute to empowerment of vulnerable sections.

d) It is expected that the project activity shall result in widening of the skill base of the local community. Several O&M work is proposed to be outsourced to local contractors and the local labour and workmen shall thus acquire new skills through a type of "on the job training".

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e) The exposure to, together with an increased income potential in construction, operation and maintenance of an operating facility, shall result in capacity development of all persons involved in these phases of the project.

f) It is pertinent to mention that since most of the labour shall be drawn from the pool of agricultural and marginal labourers, which are comprised primarily of the vulnerable sections of the society, this capacity development shall result in empowerment of the vulnerable section.

g) The increased activity and income on account of the project shall result in several redistribution benefits and cropping up of allied services.

3.4 Monitoring GFL's commitment

The sustainable development initiatives can be coordinated through the government-appointed administrative functionary in charge of the area, like the District Collector, and can be delivered to the local community through elected bodies of local self-government, like the village panchayats. GFL also suggests creation of an escrow account in which the annual committed fund will be put and the expenses from this account will be subject to external audit.

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ANNEX 13

Minutes of Meeting of Stakeholders Consultation

MINUTES OF MEETING

GUJARAT FLUOROCHEMICALS LIMITED
PROPOSED R23 INCINERATION PROJECT

GFL'S VADODARA OFFICE
13TH JUNE, 2003, 7.00 PM

Persons Present

From GFL	**From PricewaterhouseCoopers**
Deepak Asher	Dr Ram Babu
Rajendra Gujjar	Mr Samir Singh
From Shareholders	**From Employees**
Narendra Hindocha	Bhavin Desai
Pavan Logar	Tarang Sheth
Janak Patel	Mukesh Dave
	SG Patel

Business Discussed

Mr Deepak Asher thanked the participants for agreeing to attend the meeting at short notice. He then explained the project brief to all present.

Mr Asher explained that in the process of manufacture of HCFC22, an inert by-product, HCFC23, is generated in very small quantities (app 3%). Since HCFC23 is absolutely inert and harmless, almost all companies in the world vent this out into the atmosphere. Of late, some concerns have been expressed about the global warming potential of HCFC23. The company is therefore considering implementing a project to incinerate HCFC23. Mr Asher clarified that the company was considering implementation of this project voluntarily, though there was no regulatory or other requirement for it to do so.

Mr Asher explained how the incineration would be done, through a state-of-the-art thermal oxidization plant. This project would be executed, implemented and operated with all necessary regulatory permissions and consents, and would meet with all environmental regulations and standards in this regard, including the Euro II standards.

Mr Asher also explained that the company was amongst the first HCFC22 manufacturers in the world to consider implementation of such a project. The project, he said, could potentially lead to increased employment opportunities, and some technology transfer to the company. As a part of the project implementation, the company was also considering allocating a budget for local community development.

He then asked the various persons present if they had any questions or concerns in this regard, or needed any clarifications. The following questions were raised, discussed and clarified in the meeting:

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	Question / Concern / Suggestion	Clarification
(i)	Though the regulations in India permit venting of R23, why is the company proposing incineration of the same by incurring a high capital and operating cost? Would it not impact bottom line?	The company would receive additional revenue from the project through transfer of certified emission reductions. This would positively impact the bottom line of the company.
(ii)	Can we use R23 in any other manner? Or sell R23?	Though there is a limited specific application for R23, there is no known commercial market, as a result of which no producer in India has been selling any R23.
(iii)	Would there be any liability on the company for past R23 emissions?	R23 is a non-toxic, non-flammable inert and harmless gas and hence there are no regulations controlling R23 emissions. Hence, there is expected to be no liability on account of past emissions.
(iv)	Would new employees be required for this project? Would present employees need to be re-skilled / retrained?	Around 30 – 40 new employees would need to be recruited for this project. A large part of the incremental labour requirement would be unskilled.
(v)	During the incineration, would there be any harmful emissions / leakages, affecting worker health?	The system operated as zero emission standard, as guaranteed by the technology supplier. All regulatory norms for environment protection, safety and health shall be followed. We shall also continue to regularly monitor the environment and labour health.

These queries were adequately responded to by Mr Asher, as well as Dr Ram Babu. The person present expressed satisfaction over the explanations given, and wished the project and the company success in its efforts in improving the local and global environment.

Mr Asher concluded the meeting with a vote of thanks to all the invitees.

Minutes attested by

Sd/-
Deepak Asher

Sd/-
Dr Ram Babu

Sd/-
Rajendra Gujjar

Sd/-
Mr Samir Singh

Sd/-
Narendra Hindocha

Sd/-
Bhavin Desai

Sd/-
Pavan Logar

Sd/-
Tarang Sheth

Sd/-
Janak Patel

Sd/-
Mukesh Dave

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Sd/-
SG Patel

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MINUTES OF MEETING

GUJARAT FLUOROCHEMICALS LIMITED
PROPOSED R23 INCINERATION PROJECT

GFL'S VADODARA OFFICE
13TH JUNE, 2003, 8.00 PM

Persons Present

From GFL	From PricewaterhouseCoopers
Deepak Asher	Dr Ram Babu
DK Sachdeva	Mr Samir Singh
From Labour Union	
Rajkumar Singh	

Business Discussed

Mr Deepak Asher thanked Mr Rajkumar Singh, General Secretary, AITUC, which represents the work force engaged at GFL's plant, for being able to attend the meeting at short notice. He then explained the project brief to Mr Singh.

Mr Asher explained that in the process of manufacture of HCFC22, an inert by-product, HCFC23, is generated in very small quantities (app 3%). Since HCFC23 is absolutely inert and harmless, almost all companies in the world vent this out into the atmosphere. Of late, some concerns have been expressed about the global warming potential of HCFC23. The company is therefore considering implementing a project to incinerate HCFC23. Mr Asher clarified that the company was considering implementation of this project voluntarily, though there was no regulatory or other requirement for it to do so.

Mr Asher explained how the incineration would be done, through a state-of-the-art thermal oxidization plant. This project would be executed, implemented and operated with all necessary regulatory permissions and consents, and would meet with all environmental regulations and standards in this regard, including the Euro II standards.

Mr Asher also explained that the company was amongst the first HCFC22 manufacturers in the world to consider implementation of such a project. The project, he said, could potentially lead to increased employment opportunities, and some technology transfer to the company. Mr Asher assured Mr Singh that, other things being equal, preference would be given to the local residents in filling up these employment opportunities. As a part of the project implementation, the company was also considering allocating a budget for local community development.

He then asked Mr Singh if he had, on behalf of the work force, any questions or concerns in this regard, or needed any clarifications.

The following questions were raised, discussed and clarified in the meeting:

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	Question / Concern / Suggestion	Clarification
(i)	Are there any specific regulations restricting the emissions from such incinerators? Would your project adhere to such regulations?	Our incinerator technology would be state-of-the-art, adhering to the applicable environment standards of Europe. There are no standards / guidelines for similar operations in India.
(ii)	How many new jobs would be created, and what are the skill levels required?	Approximately 30 – 40 persons would be employed for the proposed operations. We expect 80% - 90% of this requirement to be in the unskilled category.
(iii)	What is the impact on occupational health and safety?	The system operated as zero emission standard, as guaranteed by the technology supplier. All regulatory norms for environment protection, safety and health shall be followed. We shall also continue to regularly monitor the environment and labour health.

These queries were adequately responded to by Mr Asher, as well as Dr Ram Babu. The person present expressed satisfaction over the explanations given, and wished the project and the company success in its efforts in improving the local and global environment. In fact, Mr Singh commended the company for its performance so far, the manner in which it has conducted employee relations, and for being amongst the first companies to conceive of and implement a project of this type. He wished the company all the very best in speedy implementation of this project.

Mr Asher concluded the meeting with a vote of thanks to Mr Singh.

Minutes attested by

Sd/-
Deepak Asher

Sd/-
Dr Ram Babu

Sd/-
DK Sachdeva

Sd/-
Mr Samir Singh

Sd/-
Mr Rajkumar Singh

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MINUTES OF MEETING

GUJARAT FLUOROCHEMICALS LIMITED
PROPOSED R23 INCINERATION PROJECT

GFL'S RANJITNAGAR PLANT
13TH JUNE, 2003, 2.00 PM

Persons Present

From GFL	From PricewaterhouseCoopers
Deepak Asher	Dr Ram Babu
DK Sachdeva	Mr Samir Singh
From Local Community	
Mr Mahendrasingh Solanki	Sarpanch, Nathkua
Mr. Dipsingh Rathwa	Sarpanch, Ranjitnagar
Mr Vitthalbhai Parmar	Sarpanch, Jeetpura
Mr. Shailesh Patel	Dy Sarpanch, Ranjitnagar

Business Discussed

Mr DK Sachdeva thanked the invitees for attending the meeting on behalf of the local community, in response to an invitation / notice sent by the company on 3rd June. He then explained the project brief to Mr Singh.

Mr Sachdeva explained that in the process of manufacture of HCFC22, an inert by-product, HCFC23, is generated in very small quantities (app 3%). Since HCFC23 is absolutely inert and harmless, almost all companies in the world vent this out into the atmosphere. Of late, some concerns have been expressed about the global warming potential of HCFC23. The company is therefore considering implementing a project to incinerate HCFC23. Mr Sachdeva clarified that the company was considering implementation of this project voluntarily, though there was no regulatory or other requirement for it to do so.

Mr Sachdeva explained how the incineration would be done, through a state-of-the-art thermal oxidization plant. This project would be executed, implemented and operated with all necessary regulatory permissions and consents, and would meet with all environmental regulations and standards in this regard, including the Euro II standards. A full environmental impact assessment would be done before implementation of the project.

Mr Sachdeva also explained that the company was amongst the first HCFC22 manufacturers in the world to consider implementation of such a project. The project, he said, could potentially lead to increased employment opportunities, and some technology transfer to the company. Mr Sachdeva assured the invitees that, other things being equal, preference would be given to the local residents in filling up these employment opportunities. As a part of the project implementation, the company was also considering allocating a budget for local community development.

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He then asked the invitees if they had, on behalf of the community, any questions or concerns in this regard, or needed any clarifications.

	Question / Concern / Suggestion	Clarification
(i)	How much water would you draw from the region?	The proposed plant would recycle the wastewater, and hence, would require only 15 m^3 per day
(ii)	As you know, the ground water level in the region is falling. You are, of course, contributing to the check-dam and ground water recharge programs in the region. Now that you are proposing the draw additional water, would you increase your participation in the check-dam program?	In fact, we already are contributing to the check-dam program currently under implementation, and we would be happy to consider a more significant contribution to the check-dam and water recharging programs of the community.
(iii)	How much more employment is likely due to the proposed activity? Will there be a preference for the local population?	Approximately 30 – 40 persons would be employed for the proposed operations. We expect 80% - 90% of this requirement to be in the unskilled category. We would prefer the local population for the unskilled jobs generated.
(iv)	How do you propose to achieve zero-discharge? Will there be solid waste? What will you do with this?	Wastewater arises out of scrubbing of vent gases. This is neutralized with hydrated lime and allowed to settle. After scrubbing, the calcium chloride and fluoride are removed and dried. The resultant wastewater will be treated in the ETP and recycled for the process. The solid waste comprising of calcium fluoride and chloride will be sent to a GPCB approved hazardous waste disposal site at Nandesari, near Vadodara.

These queries were adequately responded to by Mr Asher, as well as Dr Ram Babu. The person present expressed satisfaction over the explanations given, and wished the project and the company success in its efforts in improving the local and global environment. The invitees also mentioned that based on the past track record of the company, they have full faith in the company's assurances, that it would implement this project in a socially and environmentally responsible manner. In fact, the invitees commended the company for being amongst the first companies to conceive of and implement a project of this type. They wished the company would get all required approvals expeditiously and expressed full support for the speedy implementation of this project.

Mr Sachdeva concluded the meeting with a vote of thanks to the invitees.

Minutes attested by

Sd/- DK Sachdeva	Sd/- Dr Ram Babu
Sd/- Deepak Asher	Sd/- Mr Samir Singh

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Sd/- Mr Mahendrasingh Solanki	Sd/- Mr Dipsingh Rathwa
Sd/- Mr Vitthalbhai Parmar	Sd/- Mr Shaileshbhai Patel

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