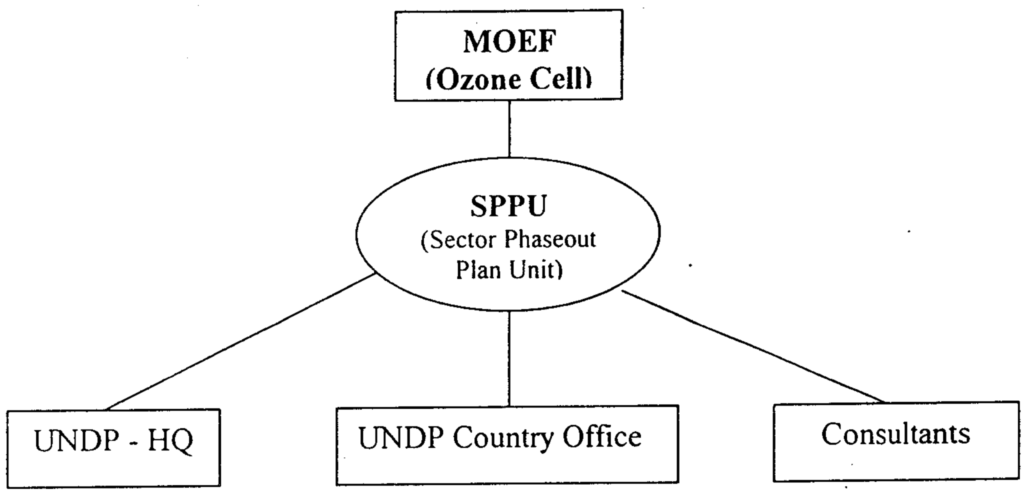
1.3 ROLES AND RESPONSIBILITIES OF STAKEHOLDERS

This section outlines the roles and responsibilities of respective stakeholders in the implementation of the Foam Sector Phase-out Plan. The major stakeholders which will be involved in the implementation, are as in the following diagram:



1.3.1. Short description / definition of the stakeholders.

A) Ministry of Environment and Forests (MOEF)

MOEF is the designated ministry responsible for implementation of Montreal Protocol in India. MOEF – through its Ozone Cell -- will carry out its responsibilities within the following institutional framework:

- Empowered Steering Committee: Chaired by the Secretary, MOEF, for coordination at the national level for meeting India's obligations under the Montreal Protocol supported by three standing committees:
- Technology and Finance Standing Committee (TFSC): For providing policy and technical guidance, direction and oversight to the overall Montreal Protocol program.
- Standing Committee for Small Scale Industry (SCSSI): Entrusted with advising on ODS phase-out and compliance by the crucial small industries sector
- Standing Committee for Monitoring and Evaluation (SCME): For advising on and monitoring of implementation.

B) Sector Phase-out Plan Unit (SPPU): To be established under the Ozone Cell (MOEF), with the assistance of UNDP, for management and coordination of the Sector Phase-out Plans. The detailed terms of reference for the staff for constituting the SPPU are attached as Annex-2. The SPPU will facilitate implementation of Sector Phase-out Plans.

C) UNDP-HQ / UNDP-CO: As the implementing agency for the Foam Sector Phase-out Plan, UNDP will be implementing the programme using the Direct Execution Modality (DEX). It's Montreal Protocol Unit in New York has been actively involved in the project preparation phase, will guide the overall implementation process, guide the UNDP Country Office whenever needed, finalize / submit the yearly progress reports and defend them at the meetings of the Executive Committee of the Multilateral Fund, to obtain the subsequent funding tranches of the programme. UNDP's Country Office located in New Delhi will liaise closely with the SPPU to carry out the implementation of the project activities.

1.3.2. Role of the Stakeholders.

The role of each of the stakeholders in each of the anticipated project implementation activities is provided in the following table. Each stakeholder's involvement is indicated as high "h", medium "m" or low "l". The stakeholder bearing responsibility for a given activities is indicated with a capital "H".

ACTIVITY	MOEF	UNDP-HQ	UNDP-CO	SPPU	Consultant
Ownership of the programme and leader of the programme, all monitoring functions	H				
Setting up operational procedure for participation of recipient enterprises	H			l	l
Overall responsibility for monitoring and supervision of implementation activities with the assistance of UNDP	H	h		h	m
Project Preparation Activities, business planning, plan visits of consultants, negotiate with MLF Secretariat and ExCom, liaise with MOEF.	m	H	l		H
Inform MLF Secretariat and ExCom about status in yearly progress report for MLF	m	H	l		H
Obtain funding from MLF Treasurer, finalization of prodoc, negotiating implementation arrangements	l	H	l		l
Drafting TOR's and managing for SPPU and consultants	l	H	l		m
Managing of SPPU activities and consultants		m	H		
Cooperation with UNDP-Experts		l	l	H	H
Recruitment International consultants		H	l		
Recruitment National consultants / payments of national personnel / F10		H	H		l
Obtain signatures for prodocs / yearly tranches	m	m	H		
Process budget revisions		m	H		
Organize/participate in supervision missions, monitoring meetings / standing committees / TPR's	h	l	H	h	m
Enforcement of the ODS Regulations in relation to this project	H			m	m
Supervision of other activities, such as public information and awareness initiatives, training programs, as needed.	m			H	m
Provide advice and resolve eligibility issues related to MLF	l	H			m
Establishing mechanism of RC participation in the Sector phase-out Plan and in determining the sequence of RC participation	l		l	H	m
Provide Technical advise to recipient enterprises on industrial conversion process					H
Carry out visits at these enterprises on a regular basis and report on progress				H	H
Preparation of specifications, terms of reference and vendor shortlists			l	H	H
Preparation of Invitations to Bid (ITBs), carrying out international/local competitive bidding exercises for equipment/services + opening of bids			H	h	H
Finalization of vendor selections, evaluation of bids/vendors			h	H	H
Submission of documentation related to procurement-preparation			l	H	
Contracts Committee (local or HQ depending on size)		H	m		
Issuance of Purchase Orders & payment to vendors / recipients			H	h	l
Arranging customs clearance of internationally procured equipment			H	l	l
Ensuring local distribution of equipment to the recipient enterprises			l	m	H
Ensuring implementation of the Local Works needed to install equipment				l	H
Ensuring production start-up with CFC-free technology, Test Trials				l	H
Monitoring and supervising enterprise-level CFC phase-out and baseline equipment disposal, including any required inspection visits to RCs				h	H
Carrying Out payments for incr. Operational costs if applicable			H	l	
Collection of official affidavits/SOC upon respective enterprise phaseout protocols	l			H	H
Arranging verification audits of Annual Implementation Programs		H	l	h	H
Providing inputs for preparation of Annual Implementation Programs / progress reports to UNDP		m	l	H	m
Review of yearly progress reports, and action plans, negotiate with MLF Secretariat and ExCom on obtaining next funding tranche, finalization of yearly prodoc corresponding to tranche.	l	H	l	h	H
Cooperating with supervision and audit verification teams or with independent reviewers appointed by ExCom, to verify the findings of the audits	h	m	l	H	m

H: high involvement and having lead responsibility for the activity concerned

h: high involvement

m: medium involvement

l: low involvement

1.3.3 Role of the Recipient Enterprises

While the recipient enterprises are not considered as a stakeholder in carrying out the implementation of the project per sé, they also play a key-role as the recipient of the project activities. The obligations and responsibilities of each of the recipient enterprises participating in the Sector Phase-out Plan will include the following:

- Designating a contact person for the project
- Undertaking to be available for interacting and cooperating with Ozone Cell/SPPU and UNDP
- Providing all documentation and declarations as may be required by MOEF for participation in the Sector Phase-out Plan in the prescribed format
- Agreeing to the specifications, terms of reference and vendor shortlists prepared by UNDP/SPPU experts
- Preparing the sites and completing all required local works for installation of equipment procured and provided to the enterprise under the terms of participation in the Sector phase-out Plan
- Ensuring the installation and commissioning of all equipment and services including all changes to the production operations for ensuring phase-out of CFCs, in cooperation with the suppliers and in accordance with the terms of reference provided
- Undertaking to irrevocable phase-out of CFCs upon completion of the project and in accordance with the agreed schedule
- Ensuring that the CFC-based baseline equipment replaced under the project is irrevocably rendered unusable with CFCs
- Undertaking to maintain production and other related records and make them available for review and verification as may be required
- Providing inputs to SPPU and UNDP for preparing project completion reports as may be required Accepting supervision/inspection teams from SPPU/MOEF, relevant government agencies and UNDP, as well as designated experts and verification/audit teams
- Complying with all laws and regulations related to the Montreal Protocol promulgated by GOI including the ODS (Regulation) Rules
- Participating in workshops/meetings as called for by SPPU/UNDP

2. OPERATIONAL PROCEDURES

2.1 ANNUAL IMPLEMENTATION PROGRAMS

2.1.1 Preparation

For each year of the duration of the Sector Phase-out Plan, UNDP, in cooperation with the SPPU, will prepare an Annual Implementation Program for the calendar-year period and following its review and clearance by Ozone Cell/MOEF, will submit it to the last ExCom meeting of the preceding year. Upon approval by ExCom, the annual grant tranche will be transferred from the MLF to UNDP. Disbursement of funds from UNDP will be subject to release of funds from MLF. The Annual Implementation Program will include:

- Review of the preceding year's Annual Implementation Program, detailing realization of CFC phase-out targets, progress of implementation of all activities and status of disbursements
- Monitoring indicators
- Details of activities proposed to be carried out
- Amounts and schedule of disbursements
- Request for funding allocation from annual grant tranche
- Confirmation by UNDP that the preceding year's targets have been satisfactorily met

2.1.2 Inputs from SPPU

SPPU will provide the following inputs to UNDP for the Annual Implementation Programs:

Reporting for the preceding year:

- Actual CFC phase-out achieved at enterprise level
- Agreed remedial actions for the current year, in the event CFC phase-out targets in the preceding year were not met
- Report on all other activities undertaken

Planning for the current year:

- CFC phase-out expected from participating enterprises
- Annual grant tranche for the year and budget estimates for each of the activities
- Projected disbursement schedules and amounts
- Monitoring Indicators

2.1.3 Verification and certification

By Ozone Cell/MOEF
Ozone Cell/MOEF will commission independent technical auditors, such as Chartered Engineers or similar authorized entities to verify and certify that all project inputs have been provided at enterprise level, the agreed CFC phase-out has been established and all other obligations have been met by the recipient enterprise(s). The terms of reference for such audit will be developed in consultation with UNDP.

By UNDP
UNDP shall carry out final inspection, verification and certification of the project inputs at enterprise level to establish completion of all activities and disposal of replaced CFC-based equipment and to establish that the agreed CFC phase-out has been achieved. UNDP shall also carry out independent verification and certification of all other activities envisaged in the annual implementation program.

2.2 PROCUREMENT

The international and local procurement of equipment and services required in the implementation of the Foam Sector Phase-out Plan, jointly by UNDP and SPPU, through an integrated Procurement Support Group comprising of designated representatives and experts from SPPU and UNDP. The procurement procedures are described in more detail in Annex-3. The respective distribution of responsibilities for procurement activities would be as below:

2.2.1 SPPU Responsibilities

- Preparation and finalization of terms of reference, scope, specifications of and vendor short-lists for equipment & services to be procured, in consultation with the respective recipient enterprises and with the support of designated UNDP technical experts
- Objective and transparent techno-commercial evaluation of bids received from the vendors and recommendation of the technically acceptable vendor offering the lowest prices

2.2.2 UNDP Responsibilities

- Issuance of Invitations to Bid to the short-listed vendors as advised by SPPU
- Opening of Bids and sending the bids to SPPU for evaluation
- Issuance of Purchase Orders/Contracts to the selected vendors
- Effecting payments to the selected vendors in accordance with the terms of the purchase orders/contracts, upon authorization by SPPU
- Arranging customs clearance and delivery of internationally procured equipment to the respective recipient enterprises

2.3 DISBURSEMENT

The disbursement of the funding for the Foam Sector Phase-out Plan is governed by the agreement between GOI and the Executive Committee (UNEP/OzL.Pro/ExCom/37/71). The flow of funds for the implementation of the Foam Sector Phase-out Plan is summarized below:

2.3.1 From MLF to UNDP

Upon ExCom approval of the Annual Implementation Program, the approved grant tranche for each year will be transferred from the MLF to UNDP subject to fund availability at MLF. This will include all project funds covering the incremental capital costs for the investment and policy & management support components, the approved incremental operating costs and agency fees.

2.3.2 From UNDP to SPPU

The approved funding tranche for each year, covering the Policy and Management Support Component in the Foam Sector Phase-out Plan, would be disbursed by UNDP to SPPU in accordance with UNDP financial rules and procedures, upon submission by SPPU to UNDP, the required requisitions for activities to be undertaken by SPPU under the Foam Sector Phase-out Plan. The salaries of SPPU staff and SPPU capital and operational expenses shall be disbursed by UNDP in accordance with the contractual terms and applicable UNDP rules and procedures.

2.3.3 From UNDP to Suppliers

UNDP will effect payments to international and local suppliers of equipment and services, procured under the Foam Sector Phase-out Plan, in accordance with the agreed contractual terms and in line with procurement procedures for the Foam Sector Phase-out Plan detailed in Annex-3, upon endorsement by SPPU.

2.3.4 From UNDP to Recipient Enterprises

All eligible reimbursements of expenses and eligible incremental operating costs as approved in the Foam Sector Phase-out Plan, shall be disbursed directly by UNDP to the recipient enterprises, upon receiving an endorsement from SPPU that the endorsed amounts are reasonable and eligible and that the required supporting documentation in accordance with the agreed terms between Ozone Cell/MOEF and the recipient enterprises has been provided and reviewed.

3. MONITORING & REPORTING

The Ozone Cell/MOEF will have the overall responsibility for monitoring the implementation of the Foam Sector Phase-out Plan. The monitoring indicators for outputs at the national and enterprise levels would be as below:

3.1 NATIONAL LEVEL MONITORING INDICATORS

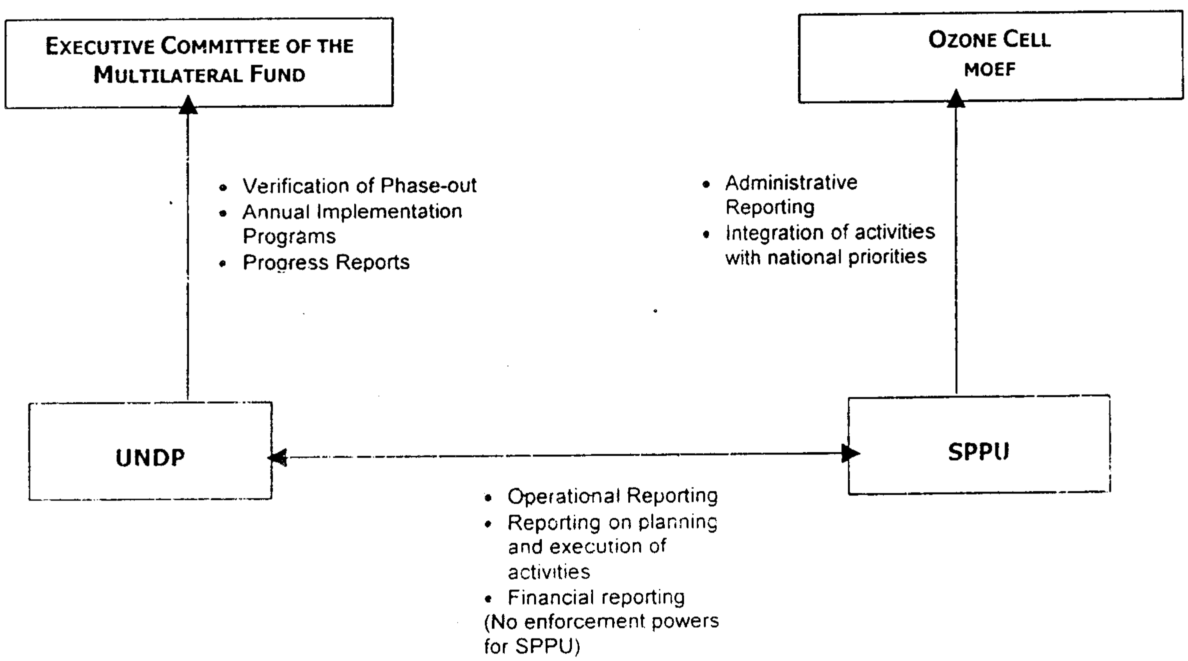
- Annual domestic production level of CFCs
- Annual domestic consumption of CFCs in the Foam Sector
- Annual maximum permissible consumption level of CFCs in the Foam Sector
- Annual CFC phase-out targets as prescribed in the Annual Implementation Program
- Annual CFC phase-out actually achieved in the Foam Sector
- Annual fund disbursements form the Sector Phase-out Plan
- Data reporting obligations under Article-7 of the Montreal Protocol
- Promulgation of any new policies and regulations pertaining to the Foam Sector phase-out Plan
- Implementation status and effectiveness of policies and regulations pertaining to the Foam Sector Phase-out Plan

3.2 Enterprise Level Monitoring Indicators

- Baseline CFC consumption figures for enterprises with ongoing (under implementation) conversion projects under the Montreal Protocol
- Baseline CFC consumption figures for enterprises participating in the Sector Phase-out Plan
- CFC phase-out targeted at enterprise levels, in the Annual Implementation Programs
- CFC phase-out achieved at enterprise level

3.3 Administrative Reporting

The following figure illustrates the proposed administrative reporting mechanism:



ANNEX-1

FORMAT FOR PARTICIPATION AGREEMENT WITH RECIPIENT ENTERPRISES TO BE COVERED UNDER THE FOAM SECTOR PHASE-OUT PLAN

Ozone Cell
Ministry of Environment & Forests
New Delhi, India

Dear Sirs,

PHASE-OUT OF CFCS IN THE MANUFACTURE OF (SUB-SECTOR) FOAM

In connection with the above we hereby confirm the following:

a) We presently consume polyurethane chemicals in our production of (sub-sector) foam. We procure these chemicals mainly from local chemical suppliers who have been helping and advising us regarding the usage of these chemicals to enable us to maintain the properties of our end products and meet our customer's requirements economically. We understand that these polyurethane chemicals contain CFCs, which have to be phased out in future, as per international agreements.

b) We have been assured by our chemical suppliers that they will be able to supply us the alternative chemicals that will give us the desired quality of end products. We understand that our present technology and process may not be suitable for working with the alternative chemicals and that we may be eligible to receive equipment suitable for handling the alternative chemicals, which may be made available to us under the supervision of MOEF/UNDP.

c) We are agreeable to participate in a group/sectoral project covering enterprises similar to us producing foam, with the aim of phasing out CFCs. Under this project, we understand that we may be eligible to receive equipment, trial materials, training, technical assistance, etc.

d). We agree to accept the equipment and selected conversion technology recommended by UNDP/MOEF as per specifications to be developed by them. We also agree that MOEF/UNDP may make any required technical decisions affecting the technology selection, to ensure that project objectives are achieved and the selected technology can be applied in accordance with established industrial standards and practices for operation and environmental & occupational safety.

e) We understand and accept that the Government of India and UNDP will make a determination of the amount of funding we will be eligible to receive, in order to effect phase-out of CFCs.

2) We confirm the following baseline information about our enterprise:

Consumption of CFC-based chemicals: ____MT (for CY 2000)
Baseline equipment/process: Hand-mixing/Low-pressure dispenser/High-pressure dispenser
Date of Establishment/Registration:
Date of commencement of commercial production:
Name of Proprietor/Partner/Managing Director:
Address of Registered Office/Proprietor/Partner:
Address of factory where CFC phase-out will be implemented:

3) We hereby undertake:

a) To bear any costs required for successful conversion to fully CFC-free technology over and above the approved funds.
b) To discontinue the use of CFCs and to dispose all redundant baseline equipment replaced under the project, upon project completion and to allow monitoring inspections by Government of India and/or UNDP or their designated representatives during project implementation and after project completion, to verify the same.
c) To assume all liabilities which may arise throughout the conversion process.

This letter may be treated as our formal application and confirmation of our baseline data, for seeking assistance from the Multilateral Fund of the Montreal Protocol for phasing out of CFCs in our manufacturing process.

(Signed)
Authorized Signatory

ANNEX-2

TERMS OF REFERENCE FOR SPPU STAFF

1. NATIONAL PROGRAMME MANAGER

The mandate of the Sector Phase-out Plan Unit (SPPU) to be constituted for implementation of the Foam Sector and Refrigeration (Mfg) Sector Phase-out Plans in India, would be to assist the Ozone Cell, Ministry of Environment and Forests (MOEF) and UNDP for implementation of the Plans, to be carried out through a combination of Investment and Policy & Management Support components, and to facilitate achievement of the CFC consumption and phase-out targets in these Sectors in India, in accordance with the respective agreements between Government of India and the Executive Committee of the Multilateral Fund (UNEP/OzL.Pro/ExCom/37/71, Annex-VII and UNEP/OzL.Pro/ExCom/38/70, Annex-X). UNDP is the designated implementing agency for these projects and will provide the required technical and infrastructural support for the implementation of these Plans.

Duties and responsibilities

The National Programme Manager will have overall operational responsibility for coordinating the implementation of these Plans and any other Sector Phase-out Plans approved for UNDP implementation. The National Programme Manager will be responsible for regular review and implementation of the Plans under the supervision of Director, Ozone Cell and guidance of the Regional Programme Coordinator, UNDP-MPU. The National Programme Manager shall work in close cooperation and coordination with UNDP India Country Office and UNDP international/national experts and is expected to discharge the following functions,

a) Manage the day-to-day functioning of the SPPU.
b) Manage and monitor activities performed by the other SPPU professional and general staff.
c) Act as an interface between UNDP, MOEF and other relevant organizations/departments on activities relating to the SPPU.
d) Assist Ozone Cell in verification of baseline CFC consumption levels and other information at the enterprise level and with the assistance and inputs of the international/national experts, determine the sequence of their participation.
e) Obtain from the participating enterprises under the Plans, any required documentation or confirmations as may be advised by MOEF and UNDP in the appropriate formats.
f) Review, on behalf of the Ozone Cell, upon request from UNDP, any documentation related to the procurement of equipment and subcontracts, such as specifications, terms of reference, shot lists of vendors, invitations to bid, evaluations of bids, etc. and endorse these documents for further processing by UNDP.
g) With the assistance of the UNDP international/national experts, ensure proper completion of projects at enterprise-level, including CFC phase-out, destruction of baseline equipment, depletion of CFC stocks and issuance of completion documentation, etc.
h) With the assistance and inputs of the UNDP international/national experts, prepare periodic reports for Ozone Cell to be submitted to various stakeholders including MOEF and UNDP, including the preparing annual implementation programmes, revisions of the project document, work plans, progress reports, etc., including verification of annual phase-out targets and any documentation needed by UNDP for obtaining release of annual funding tranches for these Plans.
i) Participate in and cooperate with UNDP's periodic missions to India, participate in UNDP's tripartite review meetings, and participate in any possible auditing/evaluation tasks and visits that may be initiated under the Plans.
j) Supervision of the public awareness and information dissemination activities, including workshops, to be carried out under the Plans
k) Assist Ozone Cell in implementation and enforcement of policies and regulations pertaining to the implementation of the Plans, as per the ODS (Regulation) Rules, 2000.
l) Ensure proper filing of all pertinent records, documentation and communications, to and from SPPU, relevant to the implementation of the Plans.
m) Manage and maintain proper records of financial transactions performed by SPPU.

n) To assist UNDP-Delhi in obtaining from MOEF any documentation as may be required, for customs clearance of equipment procured under the Plans,.
o) Perform any other tasks as may be assigned by Ozone Cell or UNDP in context of the implementation of the Plans.

Qualifications and Experience

- A Master's degree in Environment/Life Sciences, Engineering or Chemistry is required. A Doctoral or Management degree is desirable.
- Minimum fifteen years working experience in Government, Public Sector, Multilateral Organizations or NGOs is required.
- Minimum ten years experience in management and administration of environmental projects and activities.
- Thorough knowledge and understanding of the Montreal Protocol financial mechanism and the Multilateral Fund policies, guidelines and procedures.

Salary

Negotiable based on qualifications and experience

Duration

One year (renewable)

Location

New Delhi, India

2. TECHNICAL/OPERATIONS ASSISTANT

Duties and responsibilities:

Under direct supervision of the National Program Manager of SPPU, the incumbent performs the following function:

a) Assist the National Programme Manager with the day-to-day general implementation of the Foam and Commercial Refrigeration Phase-out Sector Plans.
b) Preparation of files of individual enterprises for participation in the phase-out plans.
c) Examining the documents relating to baseline equipment and technical status of the enterprises.
d) Assist NPM in verification of CFC consumption levels at individual enterprises.
e) Assisting in the preparation of various reports for stakeholders, including the Ozone Cell and UNDP.
f) Assisting in review of progress in implementation of the phase-out plans.
g) Assisting in periodic assessment of the sector phase-out programme.
h) Assisting in organizing non-investment activities (e.g. work shops, meetings, technical assistance activities).
i) Assist NPM in the preparation of the Annual Implementation Programme.
j) Perform any other duties assigned by the NPM, Director (O) of Ozone Cell and Programme Officer of UNDP within the purview of the projects.
k) Drafting of letters and technical reports.

Qualification and Experience:

- First class Master Degree in Science (Chemistry/ Physics)/BE in Chemical/Mechanical with 2 years experience in managing environmental project in private or public or government sector.
- Knowledge on environmental projects specifically polyurethane foam and commercial refrigeration and knowledge of environmental conventions are desirable. Knowledge of computer applications is essential.
- Languages : Excellent knowledge of English and Hindi.

Salary

Negotiable based on qualifications and experience

Duration

One year (renewable)

Location

New Delhi, India

3. ADMINISTRATIVE ASSISTANT

Duties and responsibilities

Under the direct supervision of the National Programme Manager of SPPU and the Ozone Cell (MoEF), the incumbent performs the following functions:-

a) Assist the National Programme Manager with general secretarial functions to support the day-to-day operational activities in the implementation of the sector phase-out plans.
b) Draft correspondence, reports, evaluations and justifications, as required on general administrative and specialized tasks, which may be of a confidential nature, within the assigned area of responsibility.
c) Assist in organizing meetings and workshops, providing travel and logistics support to participants and team members as required.
d) Distribution, draft and correct correspondence, reports, briefing and other documents.
e) Responsible for day-to-day programme correspondence, information sharing and filing.
f) Arrange periodic meetings with CPAs, Government officials, ensure documentation is complete, taking notes/minutes at meetings.
g) Answer telephone queries and forward to responsible officers.
h) Assist in organizing teleconferences and videoconferences
i) Compile and research background material, working papers and statistical data for briefing sessions; prepare presentations.
j) Perform other duties as requested from time-to-time.

Education Qualification:

University Degree. Diploma in Secretarial Practice.

Professional Experience:

At least 4-5 years secretarial and administrative experience preferably 1-2 years in environmental project of UN organization

Knowledge and skills:

Good knowledge of typing and stenography at least speed of 60 w.p.m. and 200 w.p.m., in addition to good knowledge of computing skills including MS Office. Drafting of letters is desirable

Languages:

Excellent knowledge of English and Hindi.

Salary

Negotiable based on qualifications and experience

Duration

One year (renewable)

Location

New Delhi, India

ANNEX-3

PROCUREMENT PROCEDURES

The following is a brief description of the elements of the procedural regime, which would be followed for international and local procurement of equipment and services required for the implementation of the Foam Sector Phase-out Plan:

INTRODUCTION

The procurement activities will be carried out by UNDP supported by an integrated Procurement Support Group (PSG). The PSG team will comprise of the following:

- Coordinator of the SPPU
- One designated UNDP staff experienced in procurement
- One designated UNDP international technical expert
- One designated UNDP national technical expert
- One designated UNDP program staff

The Procurement Support Group will assist the SPPU in arranging the international and local procurement of equipment and services required for executing the Foam Sector Phase-out Plan in a transparent and accountable manner. The various procurement actions will be initiated upon signature of the project document by GOI and UNDP and receipt by UNDP of the annual disbursement tranche from MLF

INTERNATIONAL PROCUREMENT

- The technical requirements of conversion to non-CFC technology at each enterprise, would be assessed by UNDP experts. Based on the same, the scope, technical specifications of the equipment and short-list of vendors would be developed by UNDP experts. A minimum of five reputed international vendors from a minimum of three countries will be short-listed. The specifications shall be clear and unambiguous to the maximum extent possible and shall incorporate the most cost-effective technical options, required for effecting CFC phase-out. The PSG will endorse the specifications and vendor short-lists.

- Concurrence of the recipient enterprises, to the specifications and vendor short-lists may be obtained by SPPU to the extent possible.

- The SPPU will formally forward the specifications and vendor short-lists to UNDP's procurement office.

- UNDP's procurement office will issue the Invitations to Bid (ITB) to the short-listed vendors, and may at its discretion to additional vendors. The vendors shall be provided a minimum of 21 days from the date of issuance of the ITB for submitting the bids. No extensions to the date for submitting the bids will be granted under any circumstances, except Force Majeure.

- On the stipulated date of submission of the Bids, the UNDP procurement office shall conduct a public opening of bids and forward the bids to the PSG.

- The PSG will then prepare a report consisting of an objective and independent techno-commercial evaluation, analysis and comparison of the bids received and recommendation of the successful bidder. The technically acceptable bidder offering the lowest prices shall be recommended. Some of the factors to be considered in such an evaluation are, the compliance of the bid with the specifications, reliability of the supplier with regard to product quality, industry reputation and financial stability, local availability of spare parts and service, etc.

- The SPPU will formally forward the bid evaluation report(s) along with recommendations to UNDP's procurement office.

- UNDP's procurement office will issue the purchase order/contract to the recommended vendor.

Local Procurement

All procedures would be similar to international procurement with the following exceptions:

- The vendor short-list will comprise of a minimum of three reputed indigenous vendors
- The vendors shall be provided a period of minimum of fifteen days from the date of issuance of the ITB, for submission of bids

ANNEX VI

PROJECT COVER SHEET

COUNTRY: INDIA **IMPLEMENTING AGENCY:** UNDP

PROJECT TITLE: Umbrella project for the conversion from carbon tetrachloride (CTC) as a cleaning solvent to trichloroethylene (TCE) at 6 plants of Steel Authority of India Limited (SAIL), (Bhilai, Bokaro, Durgapur, IISCO, Rourkela and Salem)

PROJECT IN CURRENT BUSINESS PLAN:	Yes	
SECTOR:	Solvent	
SUB-SECTOR:	Cleaning /CTC	
ODS USE IN SECTOR:		
Baseline (average 1998 - 2000)	11,505	ODP tonnes - Consumption
Current (2001))	6,662	ODP tonnes - Consumption
ODS USE AT ENTERPRISE (Average of 2000-02)	221.5	ODP tonnes
PROJECT IMPACT:	221.5	ODP tonnes
PROJECT DURATION:	18	months
PROJECT COSTS:		
Incremental Capital Cost:	US$	2,623,000
Contingency (10%):	US$	262,300
Incremental Operating Costs:	US$	564,373
Total Project Cost:	US$	3,449,673
LOCAL OWNERSHIP:	100%	
EXPORT COMPONENT:	0	
REQUESTED GRANT:	US$	3,449,673
REQUESTED AGENCY FUNDING:	US$	400,464
TOTAL COST OF PROJECT TO MULTILATERAL FUND:	US$	3,850,137
COST EFFECTIVENESS (GRANT/OD KG):	US$/kg	16.03
STATUS OF COUNTERPART FUNDING:	Committed	
PROJECT MONITORING MILESTONES INCLUDED:	Yes	
NATIONAL COORDINATING AGENCY:	Ozone Cell, Ministry of Environment and Forests	

Project summary:

The project will phase out the use of 201.3 metric tonnes (or 221.5 ODP tonnes) of carbon tetrachloride (CTC) at Steel Authority of India Limited (SAIL), specifically the following plants: Bhilai, Bokaro, Durgapur, IISCO, Rourkela and Salem. CTC is used extensively in the manufacture of steel. CTC is used as a cleaning solvent for high voltage switchgear, transportable and stationary electrical motors, and oxygen producing equipment, piping and storage vessels. The major cost items are 16 top loading vapour degreasers, 6 cold solvent cleaning stations, 7 solvent distillation units and related accessories with trichloroethylene (TCE) as solvent, amounting to US$2,258,000, site modifications of $210,000, technical cleaning process and equipment support of $155,000, and contingencies. Incremental operating costs for all plants amount to US$ 564,373.

Country studies and the country program prepared during 1993 have identified the sector as a high priority area.

Impact of the project on country's Montreal Protocol obligations:

The project will eliminate 221.5 ODP tonnes of CTC consumption from the solvent sector.

Revised by: D. Staley, UNDP Solvent Sector Expert Date: June 2004

1.0 PROJECT OBJECTIVE

This project represents the Government of Japan's bilateral contribution, through the Multilateral Fund, towards India's commitment to phase-out consumption and production of the Montreal Protocol controlled substance carbon tetrachloride (CTC) prior to 1 January 2010, in compliance with Protocol schedules. The implementation of phase-out activities at four enterprises and its subsidiaries, Steel Authority of India Limited (SAIL), Western Engineering Co. (WEC), Nissan Copper Pvt. Ltd. (NCPL) and Hind Metal and Tubes (HMT), will eliminate an aggregate consumption of up to 533 metric tons of CTC and form an integral effort towards phase-out of consumption in the metal cleaning sub-sector.

The objective of this project is to phase out CTC used at nine plants of SAIL: Alloy Steel Plant (Alloy), Bhilai Steel Plant (Bhilai), Bokaro Steel Plant (Bokaro), Durgapur Steel Plant (Durgapur), Indian Iron & Steel Company (IISCO), Maharashtra Elektrosmelt Limited (Maharashtra), Rourkela Steel Plant (Rourkela), Salem Steel Plant (Salem), and Visvesvaraya Iron and Steel Limited (Visvesvaraya). Alloy, Maharashtra and Visvesvaraya report no CTC consumption. Of the remaining 6 plants, a total of 201 metric tonnes of CTC (Bhilai-113, Bokaro-24, Durgapur-10, IISCO-10, Rourkela- 41 and Salem-3) or 221.1 ODP tonnes was used as cleaning solvent for high voltage switchgear, transportable and stationary electrical motors and oxygen producing equipment, piping and storage vessels. CTC will be replaced by trichloroethylene (TCE). Required equipment includes vapour degreasers, cold solvent spray booths, mobile spray cleaners and distillation units for solvent reclamation.

2.0 SECTOR BACKGROUND

The Government of India ratified the Montreal Protocol (MP) on Substances that Deplete the Ozone Layer on September 17, 1992. India has been classified as a country operating under Article 5, paragraph 1 of the Protocol. The Ministry of Environment and Forests (MoEF) has been empowered by the Government of India to have overall responsibility for implementation of Montreal Protocol related activities in India. The MoEF has established an Ozone Cell with operational responsibility for implementation of the Protocol-related activities in India.

The Country Program for the Phase-out of Ozone Depleting Substances was submitted for the Executive Committee's consideration in 1993. The 1993 Country Program reported net CTC production and consumption of 1,958 ODP tons and 5,097 ODP tons in 1992, respectively. These figures do not include production and consumption for feedstock applications.

Table 1: India CTC Consumption and Production Data as per Article 7 of the Montreal Protocol

(ODP tonnes)

	1989	1992	1993	1994	1995	1996	1997	1998	1999	2000
Consumption	4,758	5,097	10,600	8,790	3,112	8,776	7,876	6,270	16,099	12,147
Production	4,758	1,958	(1,036)	8,433	(21,788)	(19,787)	7,876	6,614	15,897	12,147

As a Party to the Montreal Protocol, India is required to submit its annual production and consumption data for all controlled substances under the Montreal Protocol to the Ozone Secretariat of UNEP in Nairobi (Article 7 of the Montreal Protocol). The data reported by the Ozone Cell on behalf of the Government of India, as required by Article 7 of the Protocol, particularly the data for 1998 – 2000, was used for establishing the baseline levels for production and consumption of CTC during the compliance period.. The official baseline consumption and production levels for India are 11,505 ODP tons and 11,553 ODP tons, respectively.

Table 2: Average CTC Consumption and Production (per Article 7) During 1998 – 2000

Reported Data (Article 7)	1998	1999	2000	Baseline
Consumption (ODP tonnes)	6,270	16,099	12,147	11,505
Production (ODP tonnes)	6,614	15,897	12,147	11,553

CTC is an ozone depleting substance listed in Annex B, Group II, of the Montreal Protocol. The phase-out schedule of this chemical, that is applicable to Article 5 countries, is as follow:

Consumption:	85% reduction of CTC consumption by 1 January 2005; 100% reduction of CTC consumption by 1 January 2010;
Production:	85% reduction of CTC production by 1 January 2005[1]; 100% reduction of CTC production by 1 January 2010[2].

The latest CTC consumption and production levels (2001)[3] are 42,639 ODP tons and 18,105 ODP tons, respectively. To be in compliance with the Montreal Protocol, India must reduce its consumption and production levels for non-feedstock applications to 1,725.75 ODP tons and 1,733 ODP tons, by 1 January 2005.

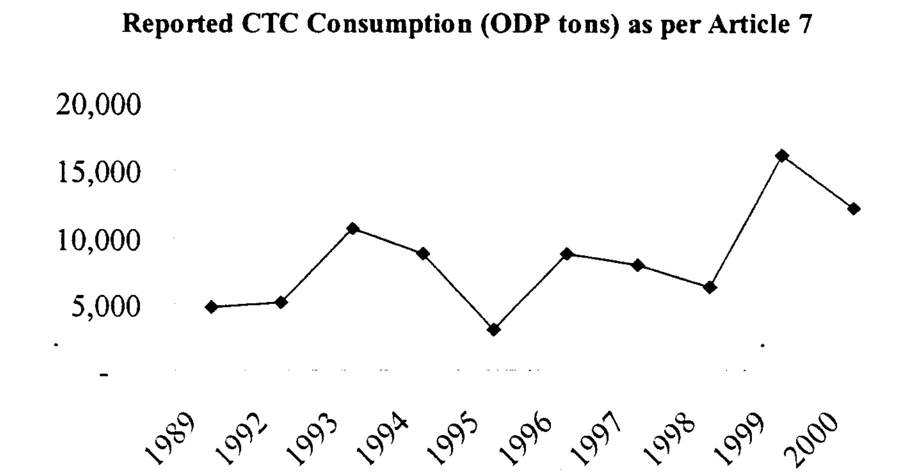


Figure 1 CTC consumption for non-feedstock applications reported by the Government of India as per Article 7 of the Montreal Protocol

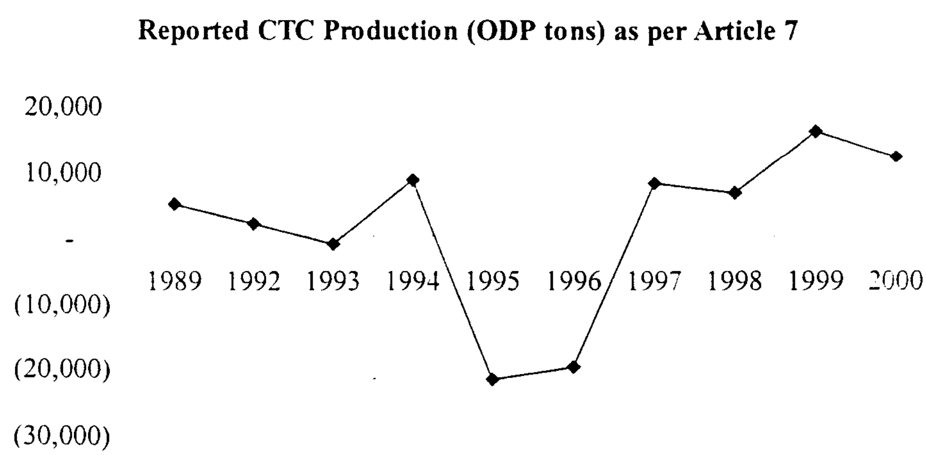


Figure 2 CTC production for non-feedstock applications reported by the Government of India as per Article 7 of the Montreal Protocol

[1] Allowance for production to meet the basic domestic needs of Article 5 parties: 10 percent of base level production.
[2] With possible essential use exemptions.
[3] Production and consumption figures include demand for feedstock and non-feedstock applications.

The definition of production as per Article 1 of the Montreal Protocol is the total production level minus the total tonnage destroyed by technologies approved by the Parties and minus the total tonnage consumed as feedstock. Based on this definition, the reported figures could vary significantly depending on the level of CTC imported for feedstock applications. However, for the purpose of this study and for the purpose of establishing a production and consumption baseline, the reported figures for 1998 to 2000 are used for the development of this CTC phase-out plan.

2.1 CTC Consumption and Production in India

The demand for CTC in India for feedstock and non-feedstock applications is more than 40,200 MT per year (average demand during the period from 1998 to 2000). CTC is used as a feedstock as well as a process agent and solvent. The demand is met by both the local production of CTC and imported CTC. The average production level of CTC during 1998 – 2000 is about 19,000 MT, which is supplemented by additional imports of 21,300 MT per year (as per survey results).

In average, about 33,800 MT of the total supply of 40,200 MT was used in the applications considered as feedstock[4] by the Montreal Protocol. Major feedstock applications in India include the use of CTC for the production of CFCs, and the use of CTC for the production of DV acid chloride, an intermediate material for the production of cypermethrin and other synthetic pytheroids. A small amount of CTC was exported in 1998 and 1999. However, export of CTC has stopped since 2000. In addition, small consumption of CTC as laboratory reagents was also identified. The average feedstock use for the production of CFC during the period from 1998 to 2000 is 27,000 MT, and 6,800 for the production of DV acid chloride[5].

The remaining amount of CTC (40,200 MT less 33,800 MT used as feedstock, laboratory reagents and export) is consumed by the process agents industry and the solvent sector in India. The average consumption of CTC in the process agents industry, between 1998 and 2000, is approximately 2,600 MT. A balance of 3,800 MT of CTC is believed to be used in the solvent sector.

In 2001, the total quantity of CTC locally produced was 16,459 MT. This quantity was supplemented by imports of another 24,661 MT. On the demand side, the total CTC requirement for feedstock applications was 32,649 MT. About 6,056 MT was consumed in the applications considered as consumption by the Montreal Protocol. There were about 2,415 MT of CTC unaccounted for by the survey. This could represent the level of inventory maintained by distributors and dealers. About 1,740 MT of the total identifiable consumption of 6,056 MT was for meeting the demand in the process agents industry. The total consumption of CTC in the solvent sector in 2001 was 4,314 MT.

Table 3: Estimated CTC Consumption and Production in 2001

	MT	Total MT
Supply		41,120
Domestic Production	16,459	
Import	24,661	
Demand		38,705
Feedstock Applications	32,649	
Consumption*	6,056	

*An estimate based on identifiable consumption

[4] Feedstock is defined as the use of controlled substances as raw materials for manufacturing of other chemicals.
[5] DV acid chloride is an intermediate chemical for production of cypermethrin and other synthetic pytheroids.

3.0 ENTERPRISE BACKGROUND

With a production capacity of 12 million tonnes of crude steel annually, Steel Authority of India Limited (SAIL) is India's largest and one of the world's leading steel producers. Having 100% Indian equity, its turnover in 2002-03 was over Rs. 190 billion (US $4 billion). SAIL has nine major units: five integrated and four special steel plants.

The five integrated steel plants are located at:

- Bhilai Steel Plant (BSP) in Bhilai, Chhattishgarh
- Bokaro Steel Limited (BSL) in Bokaro, Jharkhand
- Durgapur Steel Plant (DSP) in Durgapur, West Bengal
- Rourkela Steel Plant (RSP) in Rourkela, Orissa
- Indian Iron & Steel Company (IISCO), a subsidiary in Burnpur, West Bengal

The four alloy and special steel plants are located at:

- Alloy Steels Plant (ASP) in Durgapur, West Bengal
- Maharashtra Elektrosmelt Limited (MEL), a subsidiary in Chandrapur, Maharashtra
- Salem Steel Plant (SSP) in Salem, Tamil Nadu
- Visvesvaraya Iron and Steel Limited (VISL) in Bhadravati, Karnataka

SAIL was established in 1956 and actual production started from 1959. All plants work three shifts.

The product mix for all nine plants is shown in Table 4 as follows:

Table 4: Product Mix at SAIL (Saleable steel in thousand tonnes)

Product / Unit	Long			Flat					Semis	Track & railway	Merchant product	Alloy & special steels	Total
	Structural	Wire rods	Pipes	HR coils & plates	CR coils & sheets	Galvanised	Skelp	Various other plate & sheet					
Bhilai	250	400						950	553	500	500		3,153
Bokaro			130	490.5	433	160		384				73.5	1,671
Durgapur	207						180		861	58	280		1,586
Rourkela				2,120	1,390			270					3,780
IISCO													n/a
Alloy													n/a
Maharashtra													n/a
Salem													n/a
Visvesvaraya													n/a
Total	457	400	130	2,611	1,823	160	180	1,604	1,414	558	780	74	10,190

4.0 PROJECT DESCRIPTION

As shown, Steel Authority of India Limited produces saleable steel for a variety of applications. CTC is relied upon extensively as an industrial solvent in support of the production processes. Specific uses include cleaning high voltage switchgear, transportable and stationary electrical motors and oxygen producing equipment, piping and storage vessels. For these purposes CTC has several very useful characteristics including being non-flammable, strong cleaning power, fast evaporation rate, no post-evaporation residue, and low cost. Unfortunately, it is very toxic, believed to be carcinogenic and known to deplete the ozone layer with a high ODP.

4.1 Existing Cleaning Process

4.1.1 High Voltage Switchgear

Steel production requires the supply of high voltage electricity. The production process also creates dust that interferes with and must be removed from the various circuit breakers and electrical installations utilized. Removal is accomplished manually using a cloth or brush containing CTC. In certain situations switchgear must be cleaned while live (i.e., in use). In this case CTC solvent may be dispensed from an aerosol can. Non-flammability and no residue evaporation are benefits of CTC in this process.

4.1.2 Electrical Motor Repair

Each SAIL steel plant uses thousands of electric motors to continuously run various production shops. During the production process iron ore fines, carbon, coke dust, and mill scales are deposited over the motors and their coil windings. This soil mixes with the oils and greases already present for lubrication of moving parts, reducing insulation resistance and causing malfunction of the electrical motors. The thick soils are removed during preventive maintenance or unplanned repairs to enable the motors to function properly. Two similar processes are used to clean the electric motors depending on size. Motors that can be transported are brought to an Electrical Motor Repair Shop (EMRS). Motors too large to transport to the EMRS are either moved to a maintenance area within the production building or are partially disassembled and cleaned in place.

Transportable Electric Motors

Maintenance operations for these motors vary at each steel plant. Most plants have one or two dedicated EMRS. The size and number of motors cleaned differs as well as the exact cleaning methodology. On an annual basis, approximately 4,000 – 6,000 motors weighing less than 20 tonnes each are cleaned with CTC in the EMRS at each steel plant.

The cleaning process generally takes place in the following steps:

- *Dismantling*: motors are brought to the EMRS. Heavier motors are unloaded with overhead cranes. All motors are inspected and then dismantled into primary components such as the rotor, stator, armature, field, and coil winding.
- ***Primary non-solvent cleaning:*** gross contamination is mechanically removed by physical scraping, spraying heated water or blowing compressed air.
- ***Solvent cleaning:*** CTC is used in a variety of single use applications. Methods vary between brush application, hand wipe, mesh pad, hand pump sprayer, and compressed air atomisation. In most cases dissolved and suspended soils are removed from the part by gravity as the solvent runs onto the floor or is caught in a pan to evaporate. Spent solvent is not captured for re-use. This process is repeated depending upon the type and quantity of dirt accumulated on the part. This solvent use is totally emissive.
- *Pre-drying*: In some cases compressed air is used to facilitate solvent evaporation from the complex geometry of certain cleaned parts.
- *Final drying*: Ovens are sometimes used to complete removal of solvent and condensation from the cleaned parts, especially windings. In many cases oven drying is necessary for satisfactory functioning of the assembled motor.

Depending upon the electrical motor the cleaning cycle will vary from a minimum of one hour up to 8 hours.

Stationary Electric Motors

In addition to EMRS, cleaning of the heaviest electrical motors (as much as 190 tonnes) is done in the respective production shops when required or during annual shutdowns. It is too difficult to transport the motors to the EMRS. The same basic cleaning process followed for smaller transportable motors is followed for the large stationary electric motors. Slight differences occur only in the solvent cleaning and drying steps. Solvent is primary applied through compressed air atomisation. Brushing or wiping typically follows the spray application. Final drying at Bhilai Steel Plant is accomplished by placing a large ring of infrared light bulbs around the motor and under an asbestos blanket. In some case it is also possible to move certain parts into an oven within the particular production shop.

4.1.3 Oxygen Plants

Oxygen is required in the steel manufacturing process to convert pig iron into crude steel. All SAIL integrated steel plants have one or two oxygen plants to support this conversion process. Oxygen plants are complicated arrangements that utilize many mechanical systems. Most of these systems require periodic cleaning. CTC is currently used to clean air separation units, turbo compressors, transfer piping and storage vessels.

Smaller Parts and Hand Tools

Various parts such as pumps, gauges, valves, rotors, housings and hand tools smaller than 0.5m x 0.5m x 2m are typically manually cleaned by immersion in a simple container of ambient temperature virgin CTC. In most cases parts are immediately re-installed.

Large Systems

It is not efficient to completely disassemble air separation units and transfer piping systems for maintenance operations. In this case ambient temperature virgin CTC is circulated throughout a controlled portion of the system and drained. After forced circulation of solvent, compressed dry air or nitrogen is used to accelerate evaporation of remaining CTC.

Gaseous Storage Vessels

Each oxygen plant has many tanks for storage of various gasses created during the separation process. In most cases the tanks hold $100m^3$ of gas and are approximately 3 meters in diameter and 15 meters in length. Orientation of the tanks is both horizontal and vertical. Further clarification is required regarding the need to clean small portable oxygen storage vessels. Regulations require hydrostatic testing of the large high pressure holding tanks every four or five years. The test process necessitates CTC cleaning as described below.

The test and cleaning process vary between plants. The general steps are as follows:

- ***Empty and inspect***: Tank contents are emptied and inside surfaces are visually inspected.
- ***Primary non-solvent cleaning:*** Corrosion is mechanically removed manually with wire brushes or mesh pads or by sand blasting.
- ***Inspect:*** Sonic non-destructive inspection (NDI) is performed to determine wall thickness.
- ***Hydrostatic test:*** Tank is readied and filled with water. Reciprocating pumps increase pressure to between 1.2 and 1.5 working pressure (from 30 kg/cm^2 to ~45kg/cm^2).
- ***Inspect:*** Sonic non-destructive inspection (NDI) is performed to determine wall thickness and ensure deformation is elastic not plastic.
- ***Empty and dry:*** Water is drained and inside is dried with dry compressed air or nitrogen.
- ***Solvent cleaning:*** Manual wipe cleaning is performed on inner tank walls. A variation was noted at some plants where tank orientation is vertical. In this case CTC is sprayed from the top flange opening and allowed to gravity wash down the inner walls.
- ***Cleanliness confirmation:*** Some oxygen plants performed analysis to ensure cleanliness standards were met. Cleanliness inspection methods are different at all plants, ranging from none to spectrometric. Standards also vary from concentration of soil in spent solvent to an acceptable change in contamination level when comparing virgin to spent solvent.
- ***Dry:*** Inside is again dried with dry compressed air or nitrogen.
- ***Recharge:*** Tank is readied and gaseous oxygen (GOX) is gradually reintroduced and brought to working pressure.

4.2 Solvent Consumption

CTC consumption at the nine major units can be seen in Table 5:

Table 5: CTC Consumption in Metric Tonnes

Plant \ Time	1999-2000	2000-2001	2001-2002	3 year average
Bhilai	124	120	95	113
Bokaro	20	21	31	24
Durgapur	11	11	9	10
Rourkela	40	39	43	41
IISCO	11	11	9	10
Alloy	0	0	0	0
Maharashtra	0	0	0	0
Salem	3	3	3	3
Visvesvaraya	0	0	0	0
Total	209	205	190	201.3

The baseline for CTC use is therefore the average of the three years, that is, 201.3 metric tonnes/yr (221.5 ODP tonnes/yr).

4.3 Existing Cleaning Equipment

4.3.1 High Voltage Switchgear
No equipment is used in this cleaning application. All cleaning is performed manually.

4.3.2 Electrical Motor Repair
No major dedicated CTC cleaning equipment exists for this application. Overhead cranes, ovens and compressed air all serve other maintenance or production functions as well as their cleaning support role. Minor low value assets such as solvent containers, exhaust fans, aerosol spray guns, and heat lamps are also utilized in a variety of ways to facilitate solvent application and removal.

4.3.3 Oxygen Plants
No major CTC cleaning equipment exists for this application. Small parts are immersed in rudimentary containers and large systems are simply flushed and dried. Vessel cleaning is accomplished by manual wiping. For some of the vertical tanks a spray wand is used to apply CTC to the inside top of the tank. An exception may be the one small solvent distillation unit manufactured at Bhilai to distil and reuse CTC at the oxygen plant.

5.0 Alternatives, Proposed Cleaning Processes, and Requirements

5.1 Alternatives

Many alternatives exist for most solvent cleaning applications. The ultimate selection requires careful consideration of the various advantages and disadvantages between possible options. Table 6 compares the most likely alternatives by assigning each a score for the various considerations. The analysis can be more sophisticated if weighting factors are assigned to each consideration. For this discussion each consideration column is weighted evenly. Safety was the most difficult column to assess as scores for the different alternatives had to be considered in light of flammability, reactivity with high-pressure oxygen and the overall cleaning process. For example, CTC is perhaps the safest solvent from a flammability or oxygen exposure perspective but the current process of entering storage vessels to manually clean is extremely dangerous. Consideration of all of these safety aspects results in a score of 2 for safety for CTC as an alternative.

Table 6: Alternative Comparison

Considerations	ODP	Ability to clean electricals [a]	Ability to clean O2 systems [b]	Simple cleaning process	Cost	Safety [c]	Worker chronic health	Other environmental [d]	Total	Usability [e]
Current Process (carbon tetrachloride)	0	3	3	4	4	2	0	0	16	0
Alternative Process										
Chlorinated	3	3	4	3	3	3	2	2	23	23
Aqueous	4	1	2	0	2	2	3	2	16	0
Aliphatic & Aromatic hydrocarbons	4	2	2	1	3	0	3	2	17	0
Petroleum distillate specialty blends	4	3	3	2	1	1	3	2	19	19
HCFC 225cb	2	1	1	3	0	3	3	1	14	0
HCFC 141b	1	0	2	3	2	3	3	1	15	0
HFCs and HFE	4	1	1	3	0	3	4	1	17	0
n-propyl bromide	2	1	3	3	2	2	1	2	16	16
PFCs	4	·1	1	1	0	4	4	1	16	0

0 = Worst, 1 = Poor, 2 = Average, 3 = Good, 4 = Best

a - Ability to clean soils from high voltage switchgear and electric motors compared to CTC

b - Ability to clean soils from oxygen systems compared to CTC

c - Safety considers workers during cleaning and ensuing operations (over exposure & flammability)

d - Other environmental = VOC, GWP, and Groundwater

e - Usability = This column reflects 0 if there are any zeros in the row

5.1.1 Carbon Tetrachloride

The current cleaning processes generally speaking are very simple. In addition CTC is inexpensive. However, CTC has many critical disadvantages including high ODP, high toxicity, and high global warming potential. Like other chlorinated solvents CTC is heavier than water so if released onto the ground it can quickly cause significant environmental impact. Although CTC is also perhaps the safest solvent when considering direct exposure to GOX, current cleaning processes reduce the safety of this solvent. It is extremely dangerous for persons to enter storage vessels to perform manual degreasing with almost any solvent. Current cleaning practices are also not economical. Almost no attempt is made to collect and recycle CTC. So although the solvent cost per kilogram is low, single pass use of solvent drives total cleaning cost to be much higher than necessary.

5.1.2 Non-Ozone Depleting Chlorinated

Some chlorinated solvents have more cleaning power than CTC. Also, there are many alternative chlorinated solvent-cleaning processes that would significantly reduce solvent emissions and increase recycling. New processes are more complicated than existing cold cleaning manual methods. Worker safety and health concerns are also reduced with lower exposure to a less toxic solvent. Although VOC and GWP for the chlorinated solvents are low, there is still a concern for groundwater contamination.

5.1.3 Aqueous

Aqueous cleaning advantages include non-ozone depleting and a relatively low worker health risk. Disadvantages include the significantly complicated aqueous cleaning process. Challenges with detergent make up, mechanical agitation (e.g., ultrasonics or spray) pure rinse water, wastewater treatment, and drying all contribute. Risk is also high for problems with exposure to oxygen since complete rinsing can be difficult with complex geometries.

5.1.4 Aliphatic & Aromatic Hydrocarbons

Although non-ozone depleting, the choice of which non-halogenated hydrocarbon to use is a compromise. Faster evaporation means higher flammability. To increase safety by using a solvent that is non-flammable but only combustible will increase drying time. When making a solvent decision inside this group of alternatives it is also necessary to consider possible residue issues. The largest drawback is the obvious flammability of hydrocarbon residues in oxygen systems. Hydrocarbons are a risky proposition for this application.

5.1.5 Petroleum Distillate Speciality Blends

Non-halogenated hydrocarbons can be blended to emphasise the advantages and minimize most disadvantages found in pure solvents. The prime disadvantage in this case becomes the high cost of these speciality blends. The safety risk is still present for use in cleaning oxygen systems.

5.1.6 HCFCs

Although relatively safe and acceptable for worker health; ODP, GWP, lower cleaning power and high cost make HCFCs the least acceptable alternative.

5.1.7 HFCs and HFE

Cost and poor cleaning ability (even after blending) rule out this alternative. Low toxicity is the largest advantage.

5.1.8 n-Propyl Bromide

Strong cleaning ability and low cost are attractive features of nPB. ODP and expected high toxicity are disadvantages. Potential for future regulation under the Montreal Protocol also deserves consideration.

5.1.9 PFCs

Expensive, high GWP, slow drying and poor cleaning ability but residual is completely safe to GOX exposure.

5.2 Further Consideration of Chlorinated Solvent Alternatives

After reviewing the considerations for the various possible options it seems clear that non-ozone depleting chlorinated solvents will provide the best overall solution. Table 7 provides more detailed information to assist with the final selection of the optimal chlorinated solvent for the three cleaning applications at SAIL.

Table 7: Non-ozone Depleting Chlorinated Solvent Comparison

	Formula	ODP	GWP	Boiling Point °C	Evaporate Rate (nBA=1)	Latent Heat (cal/gm)	Flash Point °C	Flammable limits (vol % @ 25 °C)	Kauri-Butanol Value *	Toxicity
Current Process (carbon tetrachloride)	CCl_4	1.1	1,400	77	7.5	46.4	None	None	113	High
Alternatives										
Methylene chloride	CH_2Cl_2	0	9	40	14.5	78.9	None	14-22	136	Med
Perchloroethylene	CCl_2CCl_2	0	~ 9	121	2.1	50.1	None	None	90	Med
Trichloroethylene	$CHClCCl_2$	0	< 9	87	6.4	56.4	None	8-10	129	Med

* Solvent cleaning power is expressed in terms of the Kauri Butanol value (higher number = higher power)

5.2.1 Methylene Chloride

Methylene chloride (MC) has the lowest boiling point, fastest evaporation rate and highest cleaning power of the three non-ozone depleting chlorinated solvents. Fast evaporation makes it a poor choice for cold solvent (ambient temperature) manual cleaning. Heightened awareness of solvent conservation is required when using MC for this type of cleaning. A final concern is worth noting about small mass parts manually cleaned with MC. In humid

5.3 Proposed Cleaning Processes and Requirements

5.3.1 High Voltage Switchgear

No new equipment is proposed in this cleaning application. The following are required:

1) A simple conversion to TCE solvent.
2) Personal protective equipment (PPE) is necessary to comply with national worker exposure limits. For this application gloves and protective eyewear will suffice.
3) TCE packaged in aerosol cans for difficult to reach locations.

Live circuit cleaning should not be performed with TCE as it does have a very narrow range of flammability (8.0 to 9.7 @ 25°C). Under certain circumstances (e.g., ignition by a high-energy source such as an electric arc or hot wire ignition), trichloroethylene can form combustible vapour-air mixtures. If circuits must be cleaned live, PCE would be a more safe (non-flammable) solution. In this application PCE would perform similarly to CTC in use today.

5.3.2 Electrical Motor Repair

Transportable Electric Motors

Significant change is required to replace CTC cleaning processes in use today in the EMRS. The following types of items are needed at the SAIL steel plants. See Table 8 for specific quantities required at each plant:

1) 1.0m x 1.0m x 1.5m basket batch vapour degreasers for high volume small motors.
2) 1.0m x 1.5m x 2.5m basket batch vapour degreasers for medium size motor components.
3) Integral solvent distillation unit for each degreaser.
4) Dedicated hoist for each degreaser to load and unload parts baskets.
5) 3.0m x 3.0m x 3.0m cold solvent cleaning stations for the largest transportable motor components. Stations include cleaning bench, spray wand, solvent supply container, recirculation pump and induced draft ducted ventilation. Oven drying will still be required for certain large component parts cleaned at these stations. Drying of these parts will continue as it is done today with existing ovens.
6) Solvent transfer pump to transfer spent solvent from cleaning station to container and from container to central distillation unit.
7) Shop modifications that are required to provide a foundation with sealed containment under all equipment holding TCE, utilities, ventilation ducting, and existing equipment rearranges.
8) Safety shower and eyewash station.
9) PPE to include gloves, apron, safety glasses, and half mask respirator.

Stationary Electric Motors

As today the cleaning of the largest stationary electric motors will not utilize any capital-intensive cleaning equipment. The following types of items are needed at the SAIL steel plants. See Table 8 for specific quantities required at each plant:

1) A simple conversion to TCE solvent.
2) Manual spray wand
3) High volume extraction fan
4) PPE to include gloves, apron, safety glasses, and half mask respirator.

5.3.3 Oxygen Plants

Alternative processes required for this application vary. They range from a simple exchange of solvent from CTC to TCE up to a new mechanical process to replace manual cleaning of inner walls of the GOX storage vessels. The following types of items are needed at the SAIL steel plants. See Table 8 for specific quantities required at each plant:

1) 1.0m x 1.0m x 1.5m basket batch vapour degreasers for smaller items such as pumps, gauges, valves, rotors, housings and hand tools.
2) Integral solvent distillation unit for each degreaser.

3) Dedicated hoist for each degreaser to load and unload parts baskets.
4) Shop modifications to provide sealed containment under degreaser, utilities, and existing equipment rearranges.
5) Mobile spray apparatus to remotely clean the inner walls of the GOX storage vessels.
6) Reclamation distillation unit. Large quantities of virgin solvent are used in single pass (fill and empty) operations in the oxygen plants. In addition, spent solvent will be produced in the spray cleaning stations of the EMRS. Location of still will most likely be at each oxygen plant.
7) Shop modifications that are required to provide a foundation with sealed containment under all equipment holding TCE, utilities, and existing equipment rearranges
8) Safety shower and eyewash station.
9) PPE to include gloves, apron, safety glasses, and half mask respirator, and self-contained breathing apparatus where tanks need entry.

Table 8: Equipment Requirements

Cost Item (US$ in thousands)	Required Cleaning Equipment													
	Electrical Motor Repair Shop (EMRS)						Stationary Motors		Oxygen Plant					
	1.0m x 1.0m x 1.5m basket VD* with still	1.0m x 1.5m x 2.5m basket VD* with still	Hoist	Cold Solvent Cleaning Station	Safety shower & eyewash	Shop modi-fications (civil work)	Exhaust fans	Spray wands	1.0m x 1.0m x 1.5m basket VD with still	Hoist	Mobile spray apparatus	Still and transfer pumps	Safety shower & eyewash	Shop modi-fications (civil work)
Plant														
Bhilai	1	1	2	2	2	2	12	12	2	2	1	2	2	2
Bokaro	1	1	2	1	2	1	8	8	1	1	1	1	1	1
Durgapur	0	1	1	1	1	1	8	8	1	1	1	1	1	1
Rourkela	1	1	2	1	1	1	12	12	2	2	1	2	2	2
IISCO	0	1	1	1	1	1	8	8	1	1	1	1	1	1
Alloy	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maharashtra	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Salem	1	0	1	0	1	1	2	2	0	0	0	0	0	0
Visvesvaraya	0	0	0	0	0	0	0	0	0	0	0	0	0	0

* VD = Vapour Degreaser

5.4 Additional Considerations

5.4.1 Chemical Supply

Research by UNDP indicates that TCE availability in India is good and therefore procurement should not be difficult. However, availability of the chosen solvent alternative requires verification by each plant to ensure distribution at their specific location. This should include both a primary and secondary source to meet each plant's requirements.

5.4.2 Single Solvent Solution

The most simplistic approach for choosing an alternative to CTC is to select a single solvent. As was previously discussed, some properties of other alternatives may be more optimal for a portion of the total cleaning requirement at a steel plant. However, with multiple solvents a disciplined material management system is required to ensure potentially dangerous mistakes do not occur by inadvertently using the wrong solvent. This same argument can be made when considering using stabiliser-free TCE as a cost cutting measure. Stabilised TCE is 50% more expensive and is not required for applications that are completely emissive (e.g., high voltage switch gear). However, it is a must for vapour degreasing and oxygen systems cleaning. Accidental use of the wrong solvent could be very catastrophic so is not worth the risk. In addition, the use of non-stabilised TCE requires closer inventory monitoring as it has a shorter shelf life. Stabilised chlorinated solvents last two years or more if sealed and uncontaminated. Shelf life of non-stabilised solvent is closer to six months.

5.4.3 Cleaning Complexity

It is likely that SAIL will have very positive experiences after implementation of the alternative cleaning processes. Less solvent will be required. Parts will likely be cleaner because of better processes with a stronger solvent and worker exposure will be dramatically decreased. As usual all of these benefits come with a cost. Cleaning at SAIL will become more complex. Initial and maintenance training will be required. In addition to learning how to operate new cleaning equipment, understanding maintenance of solvent chemistry will be required.

Correct Stabiliser
Only special metal-cleaning grades of TCE should be purchased; they will be specially stabilised for this application. The stabiliser systems for nonferrous metals, such as aluminum and copper can be different from those for ferrous metals.

Stabiliser Maintenance
TCE has a slight tendency to create hydrochloric acid when heated in the presence of water. It is therefore important to maintain an adequate level of stabiliser in order to prevent corrosion of metals. This includes both the parts being cleaned and the cleaning equipment itself. Periodic solvent sampling is required to monitor the solvent chemistry. Stabiliser concentrates are available which can be added as needed to maintain a correct chemistry. Under no circumstances should alkali be used to neutralise acids in TCE. Periodically over the course of a year the solvent contents of the vapour degreaser will need to be changed completely. Many variables affect the amount of time between changes. The manufacturer/supplier of TCE should be consulted for detailed discussion of surfaces to be cleaned and correct maintenance levels to ensure optimum results in terms of the stabiliser system. Cost of stabiliser was considered in Annex 1.

5.4.4 Independent Progress

In some plants encouraging progress has been made in an attempt to find alternatives to CTC cleaning. For example:

- Alternative petroleum distillate speciality blend solvents have been tried at Bokaro and Rourkela for cleaning electric motors. Cleaning is successful but cost of solvent is five times CTC.
- Rourkela designed and built a cleaning station to utilize the speciality solvent. This allows recycle of the solvent and significantly lowers cost per unit cleaned.
- Rourkela and Bhilai have successfully used TCE to clean air separation units and GOX storage vessels respectively.
- Bhilai researched a mechanical method to replace the dangerous practice of manually cleaning horizontal GOX storage vessels.

This information has been useful in the preparation of this document and will help to implement the best alternatives at SAIL.

5.4.5 Spray Coating

In some cases special coatings are applied to sheet steel. Brochures for this process refer to certain coatings being chlorinated. It was not possible to determine if the coatings contained halogenated solvents that may be ozone depleting. It is recommended that SAIL review all purchased materials to ensure that supplies will not be unknowingly modified or become unexpectedly unavailable after ozone-depleting chemicals are phased out.

6.0 Safety, Health and Environment

Compliance with safety, health and environmental regulations are ultimately of course the responsibility of SAIL. However, it should be noted that an effort was made to research applicable national regulations. The proposed implementation plan described in this project document provides guidance and suggests new processes that will meet all known regulations.

6.1 Safety

CTC is a safe solvent when used correctly. It will not burn and does not react to high-pressure GOX. However, it must be pointed out that the current practice of persons entering large storage vessels for manual cleaning is extremely dangerous. Due to carbon tetrachloride's volatility, inhalation is the principal hazard. However, like all chlorinated solvents it has a vapor density much greater than air so CTC (and MC, PCE, TCE) displaces air within the vessel. This can easily result in asphyxiation (suffocation) because there is no oxygen available. The initial effects of an excessive inhalation exposure are dizziness, loss of coordination, and symptoms of anesthesia. These symptoms may be accompanied by nausea. Excessive exposure may also cause systemic injury (kidney and liver damage). Extremely high vapor levels may increase myocardial irritability (irregular heartbeats) and potentially death.

If at all possible, vessel cleaning should be delayed until this project is implemented. If manual cleaning must proceed before project completion, a system such as self-contained breathing apparatus (SCBA) must be employed with careful monitoring from outside the tank. SCBA means supplying oxygen from outside the vessel. It is a dangerous mistake to use half mask respirators in this application. These mask only filter solvent vapour they do not supply oxygen. It is critical to understand the difference.

6.2 Health

TCE as an alternative to CTC will be a significant improvement from a worker exposure perspective. Not only is TCE less toxic than CTC but correct use of PPE and improved cleaning processes will drastically reduce worker exposure. This will make TCE much more acceptable from both an acute and chronic worker exposure point of view.

Training will be provided during implementation to explain the details on how to minimise TCE exposure using PPE. However, the following types of PPE should be employed as soon as feasible to limit CTC exposure in the interim.

Operators should be equipped with the following:

- Gloves: Viton fluoroelastomer, nitrile rubber, neoprene, or polyvinyl alcohol (PVA).
- Apron: Polyvinyl alcohol, neoprene, or nitrile.
- Eye Protection: Safety glasses or their equivalent. Goggles where liquid splash contact is likely.
- Half mask carbon filter respirator should be available for handling in case of spills
- Self-contained breathing apparatus must be provided where persons are exposed to oxygen deprived situations. TCE has heavy vapours that will collect in low poorly ventilated areas. When persons enter confined spaces such as GOX storage vessels, SCBA must be worn.

6.3 Environment

6.3.1 Air

The use of vapour degreasers, solvent recycling and solvent reclamation distillation units will greatly reduce air emissions from pre-conversion levels. However, several high emission cold solvent cleaning applications will remain such as high voltage switches, large transportable motor components, and stationary electric motors. Efforts should continue to reduce solvent loss in these cleaning applications.

6.3.2 Water

It is never acceptable to introduce halogenated industrial solvents to sanitary or storm water sewer systems as a means of disposal.

6.3.3 Soil

Halogenated industrial solvent should never be allowed to spill onto bare earth, asphalted roads or unsealed concrete. Their relative density allows them to sink below groundwater. This causes toxic contamination of community drinking water drawn from wells and hinders removal efforts.

6.3.4 Disposal

Evaporation served as the primary means of disposal for CTC. In addition to the environmental impact, this method is very wasteful from a financial perspective. Recycling and the use of reclamation stills will dramatically reduce cleaning costs but it will also introduce a more concentrated waste stream known as still bottoms. The disposal of still bottoms should be well planned. In some cases the solvent vendor will provide disposal services for a nominal fee. For SAIL a unique opportunity exists. In many parts of the world burning still bottoms in high temperature cement or limestone kilns, fitted with electrostatic precipitators and wet scrubbers, is acceptable. It may be possible for SAIL to attain permission for this disposal method.

7.0 Project Costs

The project costs refer to all costs including incremental operating costs. As shown in Table 9, the total project cost of US$ 3,449,673 was calculated as the incremental capital cost of US$ 2,885,300 plus net incremental operating costs of US$ 564,373 for 4 years discounted at 10%.

7.1 Incremental Capital Cost

As given in Annex 1(a to f), the total incremental capital cost is US$ 2,885,300. The major components of this cost included technical cleaning process support, equipment support, and the purchase and installation of equipment to permit the conversion to TCE solvent and 10% contingency.

7.1.1 Cleaning Process and Equipment Support

SAIL has two primary cleaning application, electrical motors and oxygen systems. As previously explained the change from CTC to TCE needs careful study and process standardisation. Material compatibility testing will be required to ensure TCE is not too aggressive for electrical components such as motor winding insulation. The ability to remove all traces of TCE from the different oxygen system components must be ensured. A standardised method must be developed and instituted to measure whether all TCE has been removed. If these conditions cannot be met then another solution will be required for large portions of the oxygen system that are cleaned in place. Standardised testing procedures need to be established and instituted to meet existing cleanliness standards.

Pre-commissioning of complex equipment should be carried out at the site of the Original Equipment Manufacturer (OEM) prior to shipment. Prior to shipment of equipment, batches of actual work-pieces from the factory should be sent to OEM to clean with the proposed alternative and returned to the factory to evaluate if it meets the cleanliness requirements. If the pieces are too heavy to transport, then the work pieces are to be simulated. An expert from the OEM should be present during the installation and start-up at the SAIL plants. The existing engineers, operators and maintenance personnel will be trained in operating and maintaining the new equipment.

7.1.2 Technical Consultancy

Technical consultancy will be required to research, propose and document alternative selection. Equipment specifications will be required for the purchase of custom cleaning equipment described in Table 8. Also, staff training is required in safety, health and environmental aspects of TCE use.

7.1.3 Equipment to be Purchased and Installed

Equipment to be purchased is outlined in Table 8. The project includes funding to prepare the sites for equipment installation. Scope of this work includes providing a foundation with sealed containment, utilities, and existing equipment rearranges.

7.2 Incremental Operating Costs/Savings

If the project were not undertaken, the annual operating cost would be US$ 270,140. The annual operating cost of the implemented project will be US$ 448,176 resulting in annual incremental operating cost of US$ 178,036. Given an equipment lifetime of 10 years and discount rate of 10%, the net present value of the first 4 years of incremental operating costs is US$ 564,373. The details are provided in Annex 2 (a to f).

7.3 Revenues

This project provides SAIL with US$ 178,036 in annual incremental operating costs per year.

7.4 Local Ownership Ratio
SAIL is 100% Indian owned therefore, the total proposed Multilateral Fund financing is equal to the total project incremental cost of US$ 3,449,673.

7.5 Exports
Exports are nil.

7.6 Proposed MLF grant
The proposed MLF grant for this project is calculated as follows:
To the total incremental capital cost of US$ 2,885,300 was added the net present value of the incremental operating costs over the first 4 years of the project, which is US$ 564,373. The sum was then multiplied by the 100% Indian ownership ratio of SAIL, to yield the resultant grant of US$ 3,449,673. Exports to non-Article 5 countries are less than 10% so the grant remains at US$ 3,449,673.

7.7 MLF Grant Calculation

Table 9: Total Project Grant

Plant \ Cost	ICC	ICC contingency	ICC total	IOC	NPV of 4 years IOC	Total Project Cost
Bhilai	682,400	68,240	750,640	25,577	81,079	831,719
Bokaro	471,350	47,135	518,485	40,646	128,848	647,333
Durgapur	361,100	36,110	397,210	31,796	100,793	498,003
Rourkela	615,400	61,540	676,940	44,876	142,257	819,197
IISCO	361,100	36,110	397,210	31,796	100,793	498,003
Alloy	0	0	0	0	0	0
Maharashtra	0	0	0	0	0	0
Salem	131,650	13,165	144,815	3,345	10,603	155,418
Visvesvaraya	0	0	0	0	0	0
Total	2,623,000	262,300	2,885,300	178,036	564,373	3,449,673

7.8 Financing Plan
MLF funding is a grant and is limited to the incremental capital and incremental operating costs as calculated above. Funding for this project will be financed from the bilateral contributions of the Government of Japan to the MLF.

8.0 Project Implementation

The project will be carried out at SAIL.

8.1 Required Regulatory Action
No regulatory action, other than routine permitting, will be required to implement this project.

8.2 Direct Project Impacts
The project will eliminate annually 201.3 metric tonnes/yr (221.5 ODP tonnes/yr) in six of the nine plants at SAIL. No consumption is reported at Alloy and Visvesvaraya plants.

8.3 Project Management and Implementation

Ozone Cell, Ministry of Environment and Forest will administer the Project. An amount has been allocated to facilitate management coordination, monitoring and performance verification responsibilities of SPPU and MoEF. As designated by the Government of Japan, with the concurrence of the Government of India, UNDP will implement this project under Direct Execution (DEX) modality. In close coordination with the Ozone Cell and the