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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Thirty-second Meeting
Ouagadougou, 6-8 December 2000

THE EXECUTIVE COMMITTEE'S SUBGROUP ON PRODUCTION SECTOR

This document consists of the following:

Part I: Report of the Sub-Group on the Production Sector (pending)

Part II: Umbrella Project for the Closure of Two Halon Plants in India, SRF and NFI

PART II

UMBRELLA PROJECT FOR THE CLOSURE OF TWO HALON PLANTS IN INDIA, SRF AND NFI

The World Bank has submitted, on behalf of the Government of India, the attached project proposal for the review and consideration by the Sub-Group on the Production Sector as well as the Executive Committee.

UMBRELLA PROJECT FOR THE CLOSURE OF TWO HALON PLANTS IN INDIA, SRF AND NFI

Background Information Note from the Secretariat

Introduction

1. The World Bank has submitted a project proposal in the amount of US $4,987,237 for the "closure" of India's halon production (attached). The proposal uses information and data included in the report of the technical audit of India's halon production which was circulated to members of the Sub-group in October 1999. The report could be made available to members of Sub-group upon request. The audit was preceded by a strategy funded by Multilateral Fund and submitted by UNDP to 28th Meeting of the Executive Committee.

2. The proposal should be considered in the light of:

(a) Technical audit of the Indian Halon production

The audit report provided the following information:

Plant	Year of start-up	Halon products	Capacity (in MT)	Production (best year)	Status
SRF	1994	1211, 1301	500	109 (1998)	Closed 1998
NFI	1990	1211	300	95 (1995)	Closed 1995

(b) Indian Halon Phase out Strategy

The Strategy was funded by the Multilateral Fund and was submitted by UNDP to the Executive Committee in July 1999. The following was stated in the Strategy about the Halon production in India:

> " Since the demand of Halon has decreased in the Indian Market, M/s NFI stopped production in 1995. Only SRF continues to operate and produce from its plant when there is a demand."

The strategy included an esimate of US $2.5 million for closing down the halon production in India.

(c) Experience of the Multilateral Fund in Funding ODS Production Closures

The following is a summary of ODS production sector projects and strategies approved by the Executive Committee.

Halon production phase out

Project Title:	Halon 1211 production closure at Tongxiang Chemical Fertilizer Factory, China
Year of Funding:	1994
Impact:	400 MT/year
Status of plant:	Producing
Funding criteria:	Lost profit, labour compensation
Funding level:	$838,000 reduced to $104,000 to cover labour compensation only because China did not reduce the 400 MT permanently from its production

Project Title:	China Halon Sector Strategy (only the Halon production part)
Year of Funding:	1997
Impact:	9,950 MT of Halon 1211, 750 MT of Halon 1301 (1995 production)
No. of Plants:	14 Halon 1211 plants, 1 Halon 1301 plant
Status of plant:	Producing
Funding criteria:	Lost profit, labour compensation
Funding level:	$15.1million for 14 Halon 1211 plants, and $0.9 million for one Halon 1301 plant

CFC production phase out

Project Title:	China CFC Production Sector Plan
Year of Funding:	1999
Impact:	50,351 MT (1997 production)
No. of Plants:	37 CFC plants
Status of plant:	14 plants closed in 1997, 23 plants producing in 1997
Funding criteria:	Labour compensation only for the 14 closed plants; and lost profit and labour compensation for 23 producing plants
Funding level:	$150 million including $2 million for labour compensation for the 14 closed plants

Project Title:	India CFC Production Sector Plan
Year of Funding:	1999
Impact:	22,588 MT in 1999
No. of Plants:	4 CFC plants
Status of plant:	Producing
Funding criteria:	Labour compensation and lost profit
Funding level:	$ 82 million

PROJECT COVER SHEET

COUNTRY India **IMPLEMENTING AGENCY** The World Bank

PROJECT TITLE Umbrella project for the closure of two halon plants in India, SRF and NFI

PROJECT IN CURRENT BUSINESS PLAN Yes
SECTOR/SUB-SECTOR COVERED Halon sector

ODS USE IN SECTOR (YEAR)
PROJECT IMPACT 600 tonnes ODP halon
PROJECT DURATION One year
TOTAL PROJECT COST

Compensation for lost profit:	**$ 4,508,317**
Labor compensation:	**$ 478,920**
Contingency:	0
Total project costs:	**$ 4,987,237**

LOCAL OWNERSHIP 100% **EXPORT COMPONENT** 0%

REQUESTED GRANT **US$ 4,987,237**
IA SUPPORT COST (8%) **US$ 398, 979**
Total costs to the MLF: **US$ 5,386, 216**

COST EFFECTIVENESS **US $ 8.31 /kg ODP**

STATUS OF COUNTERPART FUNDING None
PROJECT MONITORING MILESTONES INCLUDED Yes
NATIONAL COORDINATING AGENCY MOEF, National Ozone Unit

Project Summary

The objective of this project is to close down and dismantle two halon production facilities at Navin Fluorine, Ltd. and SRF, Ltd. in India. Closure and dismantling of the production facilities are part of the "India Halon Phase-out Strategy" presented to the Executive Committee of the Multilateral Fund of the Montreal Protocol at its 28th Meeting. The project will completely eliminate India's capacity to produce Halon 1211 and Halon 1301. The proposal is based on the technical audit conducted by SRIC on behalf of the ExCom. However, financial cost & prices reported by SRIC have been adjusted to remove the impact of custom duties and other relevant taxes on input and output prices.

OORG: The proposal has been reviewed by Barbara Kucnerowicz-Polak, and her comments and endorsement are attached.

Prepared by: The World Bank Date: October 5, 2000
Reviewed by: Barbara Kucnerowicz-Polak Date: Aug 2000

1. Objectives:

The objective of this project is to close down and dismantle two halon production facilities at Navin Fluorine, Ltd. and SRF, Ltd. in India. Closure and dismantling of the production facilities are part of the report "India Halon Phase-out Strategy" presented to the Executive Committee of the Multilateral Fund of the Montreal Protocol at its 28th Meeting. The project will completely eliminate India's capacity to produce Halon 1211 and Halon 1301.

2. Sector Background

India ratified the Montreal Protocol on Substances that Deplete the Ozone Layer in June 1992 along with the 1990 London amendment. Since then, India has moved ahead in implementing its country program as submitted and endorsed by the ExCom in 1993. Due to its high ozone-depleting potential (ODP), production and consumption of halons in the fire protection sector were already addressed at the beginning of the program in 1993 through awareness-creating activities and technical assistance programs. With the support of the Halon Technical Options Committee, halon phase-out conferences were held in Delhi and Bombay in 1997 and 1998.

The awareness-enhancement campaigns and the TA programs have been supported by regulatory actions of GOI. The halon fire protection industry has been addressed through a ODS Regulation dated April 28, 2000, which is being notified shortly. This regulation stipulates that production of halon-based fire equipment, except for some critical/essential uses, will be halted by January 1, 2001. In addition, legislation which restricts import and export of halons has been enacted.

Detailed information about the fire protection industry in India is given in the report "Indian Halon Phase-out Strategy" submitted to the ExCom in 1999 (UNEP/Ozl.Pro/ExCom /28/50/Corr.1, July 6, 1999). The following is a brief summary of the information provided in the Indian halon sector strategy:

Halon consumption and production are shown in Table 1 below. Based on the report by SRIC, baseline halon 1211 production is 100 MT (1995-1997 average), equal to 300 tons ODP. While the producers in India are technically capable of producing halon 1301, it has never been produced in commercial quantities.

According to the "Indian Halon Phase-out Strategy" report, the baseline (1995-97 average) consumption of Halon 1211 is 178.7 MT (536 ODP tons) and of Halon 1301 is 71.3 MT (713 ODP tons), equal to a total of 1,249 ODP tons.

Table 1: Indian Halon Production and Consumption Figures

	1991	1992	1993	1994	1995	1996	1997	1998
Unconstrained demand forecast (MT) 1/								
Halon 1211	600	700	800	900	975	1,050	1,125	1,200
Halon 1301	220	240	260	280	310	340	380	420
Consumption (MT)2/								
Halon 1211	550	266	287	237	206.4	167.6	162	
Halon 1301	200	120	110	110	89.5	66	58.5	
Production (MT) 3/								
Halon 1211	16	38	27	80	127	89	84	109
Halon 1301						0.6	0.8	

1/ Appendices D and E of the "Indian Halon Phase-out Strategy"
2/ Consumption as reported in the "Indian Halon Phase-out Strategy"
3/ Production as reported in the SRIC report.

While halon consumption in India is relatively small, it constitutes around 15% of the fire extinguishing agent market and is used primarily for protection of key industrial facilities and installations and other facilities critical to society. The "Indian Halon Sector Phase-out Strategy" provides the following break-down in terms of percentage of stock of halon 1211 by different users, as presented in Table 2:

Table 2: Types of Halon Users in India

Type of Halon Users	Share of Total
Private homes, offices and shops	12.5 %
Industries and utilities (e.g. electronic industry, power supply, oil and gas industry)	55.5%
Defense (e.g. defense equipment)	12.0%
Transportation (e.g. aviation, railways, cars, buses and trucks)	20.0%

Source: "Indian Halon Sector Phase-out Strategy"

The fire protection industry in India consists of about 250 fire extinguishers and system manufacturing companies. Out of these, around 80 companies in 1995 produced fire equipment/systems based on halons. According to the "Halon Sector Phase-out Strategy", the portable fire extinguisher market using halon 1211 was approximately 500,000 units, mainly in the 500 gms and 1 kg range, in the first half of the last decade, and expected market growth of 10% per annum would have increased the market to about 1 million units by 1999. However, the actual market has decreased as a result of phase-out projects. Projects for 14 enterprises have been developed and approved by the Executive Committee of the Multilateral Fund of the Montreal Protocol (Table 3) and are presently under implementation.

Table 3: Conversion of Indian fire equipment companies funded by the MLF.

Fire extinguishing companies	ODP tons	H-1211*	H-1301*	USD
Standard Casting	64	14.7	2	92,000
Bharat Engineering	49.5	9.8	2	73,260
Cascade Counsel	54	11.3	2	79,920
New Fire Engineers	120	23.3	5	130,000
Zenith	36	12.0	0	53,280
Devshi	25.5	8.5	0	37,740
Total at the 28th meeting of the ExCom	**349**	**80**	**11**	**466,200**
Vijay	292	27.3	21	219,152
Nitin	212	37.3	10	165,818
New ages	133	24.3	6	132,248
Steel ages	116	22.0	5	131,915
Vimal	133	27.7	5	186,152
Atkins	37	10.7	0.5	54,760
Ashoka	34	11.3	0	50,320
Total at the 25th meeting of the ExCom	**957**	**160.7**	**47.5**	**754,250**
Cease fire, Real Value Corp.	150	142	0	251,736
Total at the 13th Meeting of the ExCom	**426**	**142**	**0**	**251,736**
Total impact of MLF funded projects	**1,732.1**	**382.7**	**58.5**	**1,472,186**

*ODP figures in accordance with ExCom document

In evaluating the Indian halon phase-out approach adopted in 1991, it is worth remembering that the Montreal Protocol at that time only required halon consumption in industrialized countries to be frozen at the 1986 level up to November 1992. Development of halon 1211 and halon 1301 production in India started in 1989/1990 based on a specific request to the chemical industry from the government based on national security concerns. The idea was to have a secure supply of halons for military equipment and other critical uses in India, especially if production stopped in non-Article 5 countries or supply was cut off for other reasons. In 1992, halon 1211 and halon 1301 were produced in significant quantities only by the USA, UK and France, (including halon 2402 in the former Soviet Union). Halon 1211 production in China was then only around 3,000 MT and only sufficient to cover internal consumption. The decision by the Parties to the Montreal Protocol in 1992 at the Copenhagen meeting to stop halon production in non-Article 5

countries by January 1, 1994 only underlined the importance of domestic production in Article 2 countries.

Both SRF and Navin Flourine developed and established their halon production facilities in the beginning of the 1990s. NFI went into production in 1990 based on a small (50 MT) pilot plant, which was expanded to a nominal capacity of 300 MT in 1992. SRF started its pilot production in October 1994 and went into full operation in 1995.

However, by the time halon production in India came into full operation in 1994/1995, the international picture and the situation in India had changed completely. The impact in India of TA activities and the availability of substitute chemicals had reduced the demand for halons in India, and conversion projects for the fire protection industry were underway. In addition, halon 1211 producers in China were selling halons in India at a very low price, and the Indian defense sector had decided to base its future supply of halons on recycled halons and halon banking only, rather than on virgin halon. Consequently, domestic production of halon 1211 and 1301 began to decline rather than increase. Navin stopped production in 1996 and SRF in 1998.

3. Enterprise information: The following information is based on the SRIC report.

3.1 SRF Plant:

Location	Bhiwadi, Rajastan
Ownership	Public Limited Company, with 100% domestic ownership
Products	Halon 1211 and halon 1301
History	Plant was commissioned in October 1994, and was in production until 1998.
Configuration	Swing plant capable of producing both halon 1211 and halon 1301. Halon 1211 is produced by captive consumption of HCFC-22. HCFC-23 co-produced with HCFC-22 is separated, purified and used for production of halon 1301
Technology	Developed internally
Current status	Plant is shut down, but completely intact under nitrogen blanketing, and could easily be restarted without any investment costs.
Operating rate	22% (FY1998, best year)
Reason for low operating rate	Low market demand
Comments	R&D work for the plant started in October 1988 on the basis of an agreement with the Indian Institute of Technology. The reason for putting up a halon plant in 1994 was a request from the government of India to meet defense requirements. Plant is well designed and well maintained.

Halon 1211 production by SRF (metric tons)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Production	-	-	-	-	32	48	84	109	0	0

3.1.1. The production equipment is located in a four-story steel structure. Bromine and HCFC-22 are the two main raw-materials used for the production of halon 1211, while Bromine and HCFC-23 are the main components for the production of halon 1301. HCFC-22 is also produced by SRF. Hydrogen fluoride and chloroform are used for the production of HCFC-22[1]. The halon plant is directly connected to the HCFC-22 plant through a piping system. Bromine is obtained from a combination of an indigenous supply source in western India and imports from Israel.

3.1.2. The SRIC report provides information regarding the nominal plant capacity. In the context of preparation of this project, the actual plant capacity has also been verified through production logs, in accordance with the draft guidelines for the production sector. Copies of the logs are available in the Bank's project files.

3.1.3. Verified production costs and sales figures given in the SRIC report are discussed in section 5.3 below.

3.1.4. The remaining lifetime of the plant was assessed as 27 years as of the end of 1998 by the SRIC report.

3.1.5 Two sets of information are provided in the SRIC report regarding labor. The total number of employees directly assigned to the plant was 12 people. In addition, the laboratory and quality control department provided services to the halon plant as part of its in-house work. Similarly, the packaging and shipping and maintenance departments are centralized for all production facilities at Bhiwadi. In the SRIC report, adjustments regarding the labor force and labor costs were made on the basis of SRIC's experiences. As the labor costs are used to calculate the production costs per MT, the adjustments affect both the calculation of production costs (US$/MT) and the labor compensation package.

[1]

3.2 NFI Plant:

Location	Bhestan, near Surat, Gjurat
Ownership	Part of Mafatial Group. Public Limited Company, with 100% domestic ownership
Products	Halon 1211 and halon 1301
History	Decision to establish the plant was taken in 1989; the plant started production in 1990 and closed in 1996.
Configuration	Began a small scale (50 MT/year) production in 1990, expanded to 300 MT/year commercial-scale production in 1992, with the possibility of expanding to 1,000 MT/year.
Technology	Developed internally by in-house R&D group (plus research contract with R&D institute in Madras)
Current status	The plant is located in a two story building. Plant has been cannibalized (some pipes and some tanks have been removed), but all major unit operating systems are still in place. (The control room and all utilities, including halon storage facilities, power supply and pipe connection to the HCFC-22 plant, are still operational.)
Operating rate	32% (FY1995, best year)
Reason for low operating rate	Low market demand
Comments	Began production phaseout in FY1995 due to low market demand, and closed in FY1996. Plant has been shut down since then and left idle without maintenance. The plant would need retrofitting and reconditioning to restart production.

The plant is actually a swing plant able to produce both halon 1301 and halon 1211.
The following section is based on the SRIC report, and has been supplemented by additional information obtained during the preparation of the project by the Bank:

Halon 1211 production by NFI (metric tons)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Production	16	38	77	80	95	41	0	0	0	0

3.2.1. Bromine and HCFC-22 are the two raw materials used for the production of halon 1211, while bromine and HCFC-23 are the two components used for the production of halon 1301. HCFC-23 is a byproduct in the production of HCFC-22. Hydrogen fluoride and chloroform are used for the production of HCFC-22[2]. A production flow diagram of the process is attached as annex 1. The halon plant is directly connected through pipelines to the HCFC-22 plant. Bromine is obtained from a combination of an indigenous supply source in western India and imports from Israel.

[2] The process is described in detail in the SRIC report on page six.

3.2.2. The SRIC report provides information regarding nominal plant capacity. In the context of preparation of this project, the actual plant capacity has also been verified through production logs in accordance with the draft guidelines for the production sector. Copies of the logs are available in the Bank's project file.

3.2.3. Verified production costs and sales figures as given in the SRIC report are discussed in section 5. 3 below. .

3.2.4. Remaining lifetime is reported by SRIC to be 23 years as of end of 1998.

3.2.5. Two sets of information are provided in the SRIC report regarding labor. A total of 21 employees were directly assigned to the halon plant, including laboratory staff and packaging and shipping personnel. The SRIC report provides an adjusted labor force and labor costs based on SRIC experiences. As labor costs are used to calculate the production costs per MT based on the production, the adjustments affect both the calculation of production costs (US$/MT) and the labor compensation package.

Halon production costs and sales prices

The SRIC audit report included the following information regarding production costs and halon sales prices for the two plants.

SRF and NFI halon production costs and sales prices

Plant	SRF		NFI		
Audit Capacity Production	07/27/99 500 MT 109 MT	SRIC Final costs comparison	07/29/99 300 MT 95 MT	SRIC Final costs comparison	
	Field data	SRIC Estimate	Field data	SRIC estimate	
Investment	$MM0.93	$MM0.93	$MM 2.33	$MM 2.33	
Production costs (US$/kg)					
Raw materials	1.6115	1.6115	1.2786	1.579	
By products	(0.0444)	(0.0444)	-		
Utilities	0.2442	0.2442	0.347	0.428	
Variable costs:	1.8113	1.8113	1.625	2.007	
Operators/shift	0.4/shift	2.5/shift	2.7/shift	2.7/shift	
Operating labor	0.0343	0.229	0.482	0.596	
Control labor	0.0117	0.034	0.049	0.060	
Maintenance labor	0.0114	0.047	0.170	0.210	
Operating supplies	0.0069	0.046	0.049	0.060	
Maintenance materials	0.0552	0.055	0.389	0.481	
Fixed Costs	0.1195	0.481		1.413	
Total direct costs	1.9308	2.223	2.753	3.413	
Plant overhead	0.0410	0.084	0.261	0.218	
Taxes and insurance	0.0234	0.0234	-	0.032	
Cash costs	1.9952	2.330	3.024	3.663	
Depreciation	0.0685*	0.0685*	1.041*	1.041	
Plant gate costs	2.62*	3.015	4.065	4.704	
G&A, sales, Research	0.262	0.1780	0.012	0.122	
Production Costs	3.0705	3.0705	5.1251	4.826	
Halon 1211 sales prices:	7.1428**	7.1428**	6.1138**	6.114**	

Source: SRIC Audit report * 1998 halon 1211 contract prices.

3.3 Project Proposal:

The proposal includes the following:

- Dismantling of halon production equipment, including storage tanks, piping, disconnection of the HCFC-22 pipelines, etc.
- Removal and destruction of all production equipment and piping that is not reusable.
- Clean-up of any residual chemicals used in the production of halons, such as bromine and bromine containers.
- Prior to plant dismantling, preparation of an Environmental Management Plan (EMP) to ensure that plant dismantling, and clean-up if needed, will be carried out in an environmentally responsible manner; and after dismantling, an assessment confirming that the dismantling and necessary clean-up were carried out according to the EMP.

It is expected that the clean-up can be partly financed by the scrap value of the tanks and pipes. Both Navin and SRF have agreed to pay any additional costs. The EMP preparation is to be financed by the enterprises prior to signing of Subgrant Agreements.

4. Justification for Selection of the Substitute Technology

The substitutes for halon are ABC powder, foam, Inergen (a mixture of argon, nitrogen and CO2), CO2, and HCFCs, blends of HCFCs (e.g. HCFC 22, HCFC-123, HCFC-124) and HFCs (HFC--227ea and HFC-23). As flourocarbon producers, the companies would be interested only in production of HCFCs and HFCs. However, while there might not be any restriction for the production of HCFC's and HFCs, the use of those chemicals (and blends of them) as fire extinguishing agents are covered by "use application patents" held by the fire protection industry and flourocarbon producers in the USA and Europe. Furthermore, the production of HFC and HCFCs is very different from halon production and would require investment in a complete new production plant.. Based on the above and the present situation created by the Montreal Protocol, closure and dismantling of the two plants is the only option and has been agreed upon between the companies and the National Ozone Unit.

5. Project Costs

The following paragraphs lay out the information and assumptions used for the calculation of the closure costs for the two enterprises. The data described below were used in a cost model that generates the net present value and current value of the flows of lost profits for the two companies.

5.1. Remaining Lifetime of the Two Plants.

The SRIC report assigns 23 years remaining lifetime to NFI and 27 years to SRF, as of the end of 1998, based on plant lifetime of 30 years from construction. SRIC has confirmed that technically the plants could continue production for at least that period. However, this proposal adopts a more conservative estimate of total plant lifetime, assuming that plant lifetime from construction would be 25 years. Therefore, NFI's compensation costs are computed on the basis of a lifetime until 2015, and SRF's until 2019.

5.2. Production Baseline and Growth Rate

The "without Montreal Protocol" scenario is predicated on the assumption that the production baseline for the two plants is the year of highest production. This is 1995 for NFI and 1998 for SRF.

The "without Montreal Protocol" scenario is constructed on the assumption that the plants would have continued at the same levels as the year of highest production. Since the "without Montreal Protocol" scenario is a hypothetical case, it is necessarily subject to judgement. The "Halon Sector Phase-out Strategy" projected that fire protection was growing at approximately 10% per annum in the first half of the 1990s, at a time when GDP was growing at 5-6%, and that growth

of consumption of halon was somewhat faster (see Appendix D). It was projected that the growth rate in the consumption of halon would fall to parity with GDP growth by 2000 and thereafter. These growth rates for halon consumption in the "unconstrained demand" or "without Montreal Protocol" situations are considered reasonable for the circumstances of India.

Between 1991 and 1998, production of halon in India grew from 16 tons to 109 tons, an average annual growth of more than 20%. In principle, these growth rates could have continued for several years, because total production was starting from a low base and could have replaced imports. .

However, such high rates of growth of domestic halon production were supported by high tariff rates on both halon inputs and outputs, resulting in high effective rates of protection, and were facilitated by the phaseout of production in non-Article 5 countries. In a "without Montreal Protocol" scenario, it is realistic to assume that domestic producers would have been subject to more intense competition from imports of halon, especially if tariff protection had not been provided by the government. In the light of these considerations, the cost model assumes that, in the "without Montreal Protocol" scenario, SRF's and NFI's production would not have grown over the year of highest actual production.

Based on the above, the following halon production figures are proposed for the two plants:

Halon 1211 Projected Production under "without MP" Scenario
(bold figures are actual production)

	1995	**1996**	**1997**	**1998**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005-2019**
NFI	**95***	*95*	*95*	*95*	*95*	*95*	*95*	*95*	*95*	*95*
SRF	**32**	**48**	**84**	**109***	*109*	*109*	*109*	*109*	*109*	*109*

*** Highest actual production/baseline**

5.3. Plant Capacity

Plant capacities are provided below. However, they do not exercise any impact on the compensation calculation under any scenario, as the production does not, at any point, exceed the capacity of either of the plants.

Halon Plant	Nominal capacity	Verified achieved capacity
NFI	300 MT	450 MT
SRF	500 MT	330 MT

5.43 Production Costs and Sales Prices of Halons.

The production costs and sales prices are the starting point for the costs and prices that are used in the cost model.

Based on the data reported by the two enterprises and audited by SRIC, the production costs are estimated as follows:

Navin

	Financial Price	Duties (%)	"Economic" Price
Sales Price (US$/kg)	**6.114**	37.7	**4.440**
Costs (US$/kg)			
Bromine	0.551	20.6	0.457
Sulphuric acid	0.034	20.6	0.028
Chloroform	0.545	37.7	0.396
Fluorspar	0.147	38.3	0.106
Others	-		-
(Total raw mats)	1.278		0.987
Utilities	0.347	-	0.347
By-products	-	-	-
(Variable Costs)	1.625		1.334
Labor	1.138	-	1.138
(Total Direct Costs)	2.763		2.472
Overhead	0.261	-	0.261
(Cash Costs)	3.024		2.733
Depreciation		40	
(Plant Gate Cost)	3.024		2.733
R and D	0.012	-	0.012
Total Production Costs (US$.kg)	**3.036**		**2.945**

SRF

	Financial Price	Duties (%)	"Economic" Price
Sales Price (US$/kg)	**7.143**	37.7	**5.188**
Costs (US$/kg)			
Bromine	0.676	20.6	0.561
Sulphuric acid	0.036	20.6	0.030
Chloroform	0.731	37.7	0.531
Fluorspar	0.150	38.3	0.108
Others	0.019	20.6	0.016
(Total raw mats)	1.612		1.246
Utilities	0.244		0.244
By-products	(0.044)	22	(0.036)
(Variable Costs)	1.812		1.454
Labor	0.411		0.411
(Total Direct Costs)	2.223		1.865
Overhead	0.107		0.107
(Cash Costs)	2.330		1.972
Depreciation		40	
(Plant Gate Cost)	2.330		1.972
R and D	0.178		0.178
Total Production Costs (US$/kg)	**2.508**		**2.150**

The financial prices and costs derived from the figures audited and confirmed by SRIC have been adjusted by the Bank to take into account the imposition of tariffs and domestic taxes on inputs and outputs. As the above tables imply, the profit rates in financial terms are high in both plants, and especially so in the case of SRF. While part of the profit earned by the enterprises reflects the inherent value-added of halon production, a significant part was due to the high effective rate of protection provided to the industry. On the basis of data supplied by the industry for the period 1995-1998, the financial prices and costs have been adjusted to remove the impact of relevant tariffs and taxes. The impact is to express sales prices, production costs and profits in the values that would obtain in a tariff- and tax-free situation, or in what could be described as "economic prices". The lost profits for each company have been calculated using these economic prices.

5.5 Labor Compensation

The plants will be closed down and labor will be made redundant. NFI has reported that it has already adjusted its workforce, and SRF will do so when the project is approved. For the calculation of labor compensation, the information on labor cost per kilogram of halon production is taken from the SRIC report, as provided below. Both companies have adjusted or are adjusting their work force at the enterprise level, which means that some other workers in the enterprise

might accept an early retirement package instead of the halon plant workers. Based on court rules in India, labor is entitled to compensation equivalent to six years' salary, when a plant is closed due to environmental matters. Therefore, compensation for SRF would be US $236,580 and for NFI US$ $242,340.

SRF:

SRIC:

operating labor:	c22.92/kg	US$ 22,920/year
control lab labor:	c 3.44/kg	US$ 3,440/year
maintenance labor:	c 4.71/kg	US$ 4,710/year
Management:	c 8,36/kg	US$ 8,360/year
		US$ 39,430/year

Compensation, 6 years: 39,430 x 6= **US$ 236,580**

NFI:

SRIC:

operating labor:	c20,26/kg	US$ 20,260/year
control lab. labor:	c 2,02/kg	US$ 2,020/year
maintenance labor:	c 7,14/kg	US$ 7,140/year
Management:	c 10,97/kg	US$ 10,970/year
		US$ 40,390/year

Compensation, 6 years: 40,390 x 6= **US$ 242,340**

SRF:	US$ 236,580
NFI:	US$ 242,340
Labor Compensation Total	**US$478,920**

5.6 Lost Profits

The table below summarizes the methodology and assumptions discussed above, and the foregone profits.

Halon Production Facilities	Highest Production and Year	Projected Production	Other Adjustments	Discount Rate	NPV of Profit Stream over Period of…	NPV
NFI	95 MT in 1995	Constant at 95 MT from 1995	$8,000 (Rs 250,000) deducted from 2002 profit for replacement of reactor.	8%	2000-2015	**$ 1,257,116**
SRF	109 MT in 1998	Constant at 109 MT from 1998	Same	8%	2000-2019	**$3,251,201**

Based on the foregoing, the requested funding for Navin and SRF would be as follows:

Halon plant	**Foregone Profits**	**Labor Compensation**	
Navine Flourine Industries	**US$ 1,257,116**	**US$ 242,340**	**US$ 1,499,456**
SRF Limited	**US$ 3,251,201**	**US$ 236,580**	**US$ 3,487,781**
Total	**US$ 4,508,317**	**US$ 478,920**	**US$ 4,987,237**

The funding request generated by this methodology can be compared with the calculation that uses SRIC's financial data for inputs and outputs.

- Using **25 year plant life**, the foregone profits based on unadjusted financial prices would be **US$2,170,311 for Navin** and **US$5,150,767 for SRF**, for a total of US$7,321,078.
- Using **30 year plant life**, the corresponding figures would be **US$2,456,070 for Navin** and **US$5,600,169 for SRF**, for a total of US$8,056,239.

6. Implementation plan

6.1 Implementation.

Sub-grant Agreements will be signed with each of the two enterprises based on the existing modality under which the Bank operates. The disbursement will take place after the Bank confirms that the plants have been dismantled, and that the dismantling has been carried out according to EMPs.

6.2 Time schedule

MILESTONES	Q4, 2000	Q1, 2001	Q2, 2001
Approval by MLF	X		
Appraisal by IDBI		XX	
EMP preparation		XX	
Subgrant Agreement signing		XX	
Dismantling			XXX
Verification			XX
Disbursement			X

REFERENCES

1: SRI Consulting: "Technoeconomic Audit of Halon Plants in India". October 1999.

2. SRI Consulting: "Appendix A; Technoeconomic Audit of Halon Plants in India. Summary Presentation". . October 1999:

3: SRI Consulting: "Appendix B; Technoeconomic Audit of Halon Plants in India. Plant Data.". October 1999.

4. SRI Consulting "Appendix C; Technoeconomic Audit of Halon Plants in India. Production Costs Analysis". October 1999.

5: Defense Institute of Fire Research: "India Halon Sector Phase-out Strategy", May 1999. ((UNEP/Ozl.Pro/ExCom/28/50/Corr.1)

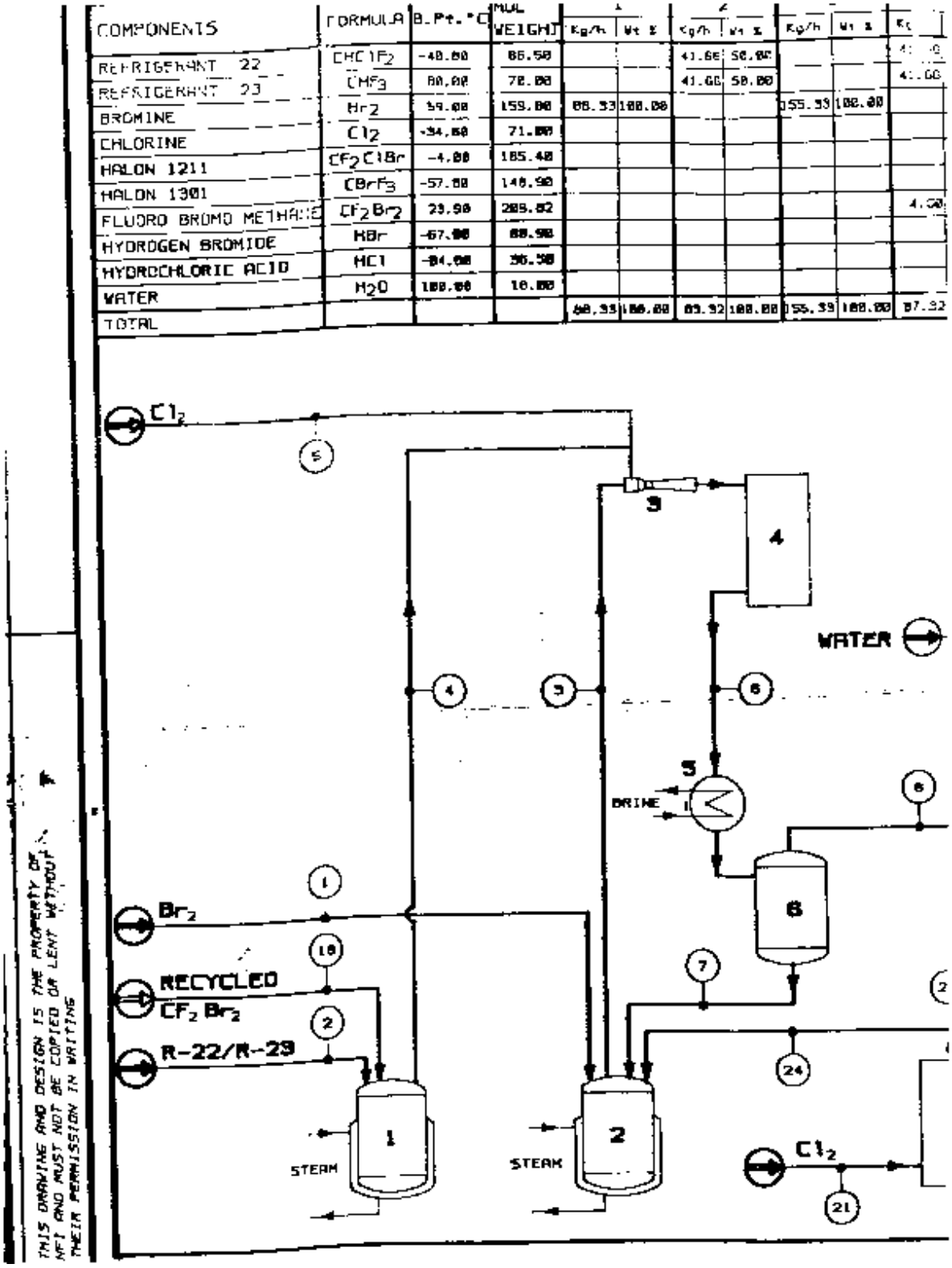
ANNEXES

Annex 1: Baseline information
NFI: Halon production flow diagram
SRF: Halon production flow diagram

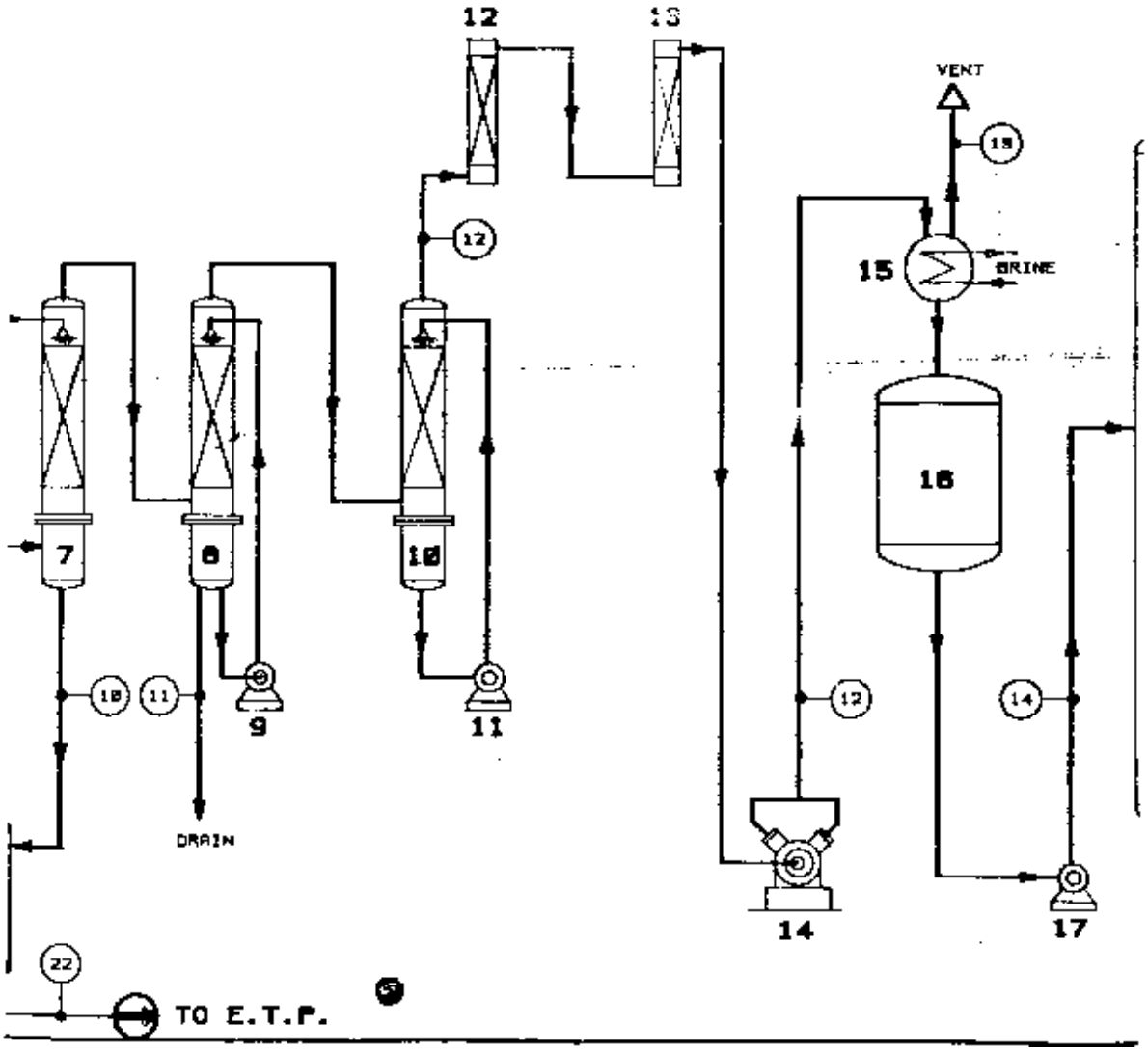
Annex 2: Environment Assessment

Annex 3: Enterprise commitments

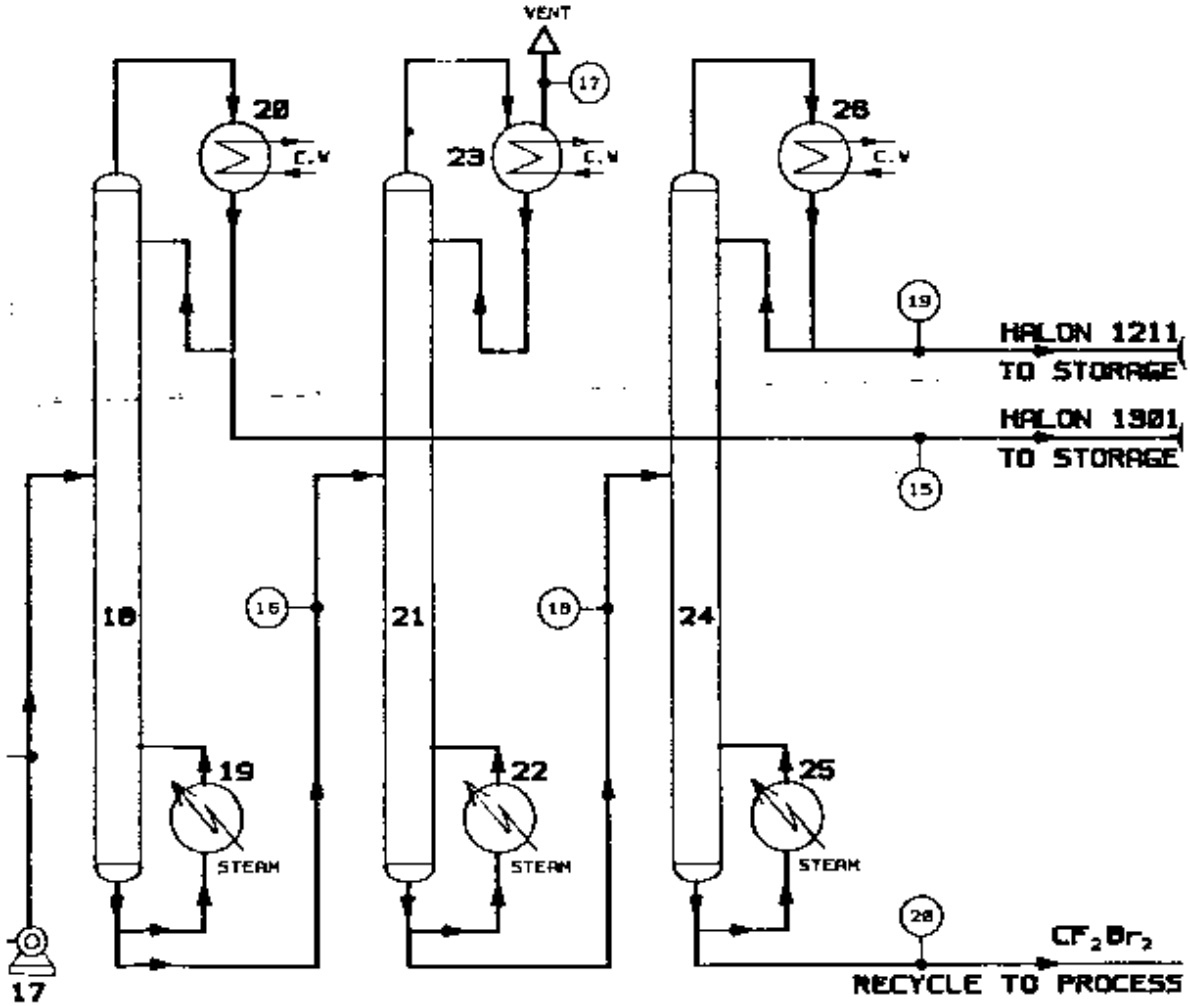
Annex 4: Technical Review


COMPONENTS
FORMULA
B.Pt. °C
MOL WEIGHT
REFRIGERANT 22
CHClF2
-40.80
86.50
REFRIGERANT 23
CHF3
-80.00
70.00
BROMINE
Br2
59.00
159.00
CHLORINE
Cl2
-34.60
71.00
HALON 1211
CF2ClBr
-4.00
165.40
HALON 1301
CBrF3
-57.80
148.90
FLUORO BROMO METHANE
CF2Br2
23.90
209.82
HYDROGEN BROMIDE
HBr
-67.00
80.90
HYDROCHLORIC ACID
HCl
-84.00
36.50
WATER
H2O
100.00
18.00
TOTAL
Cl2
Br2
RECYCLED
CF2 Br2
R-22/R-29
STEAM
STEAM
BRINE
WATER
Cl2
THIS DRAWING AND DESIGN IS THE PROPERTY OF NFI AND MUST NOT BE COPIED OR LENT WITHOUT THEIR PERMISSION IN WRITING

Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %	Kg/h	V
		5.35	2.30			5.35	2.31			0.37	0.01	0.54	35.06	4.44	2.87		
		9.02	3.71			9.02	3.90			0.67	0.03	1.00	64.94	7.39	4.78	7.99	10
		14.00	6.04	12.00	100.00	2.66	1.16			2.66	0.11						
0.43	100.00																
		69.44	28.57			69.44	30.05							69.44	44.66		
		69.44	28.57			69.44	30.05							69.44	44.66		
		4.00	1.64			4.00	1.73							4.00	2.59		
		70.71	29.09			70.71	30.60			70.71	3.00						
		0.44	0.18			0.44	0.20			0.44	0.02						
								2252.0	100.00	2240.0	96.03						
0.43	100.00	243.00	100.00	12.00	100.00	231.00	100.00	2298.0	100.00	2964.05	100.00	1.54	100.00	154.71	100.00	7.99	10



13		14		15		16		17		18		19		20		21	
Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %
		4.44	3.01			4.44	5.70	4.44	100.00								
7.39	100.00																
																	30.00
		69.44	47.13			69.44	89.15			69.44	94.55	69.44	100.00				
		69.44	47.13	69.44	100.00												
		4.00	2.75			4.00	5.14			4.00	5.45			4.00	100.00		
7.39	100.00	147.92	100.00	69.44	100.00	77.88	100.00	4.44	100.00	73.44	100.00	69.44	100.00	4.00	100.00	30.00	100



21		22		23		24	
Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %	Kg/h	Wt %
				0.37	~~[illegible]~~		
				0.63	[illegible]		
		9.02	0.39			60.00	100.00
32.00	100.00			0.59	~~34.04~~		
				[illegible]	[illegible]		
		3.54	0.15				
		50.74	1.32				
		2290.0	98.14				
30.00	100.00	2353.9	100.00	1.65	100.00	60.00	100.00

1211 ...RAGE

1301 ...RAGE

Br_2 ...CESS

CHEMICAL REACTIONS:-

AT EQUIPMENT NO.4

1. $CHClF_2 + Br_2 \longrightarrow CF_2ClBr + HBr$
2. $CHClF_2 + Br_2 \longrightarrow CF_2Br_2 + HCl$
3. $CF_2Br_2 + 1/2\ Cl_2 \longrightarrow CF_2ClBr + 1/2\ Br_2$
4. $CHF_3 + Br_2 \longrightarrow CBrF_3 + HBr$

AT EQUIPMENT NO.27

1. $2HBr + Cl_2 \longrightarrow 2HCl + Br_2$

EQUIPMENTS:-

1. R-22 EVAPORATOR
2. BROMINE EVAPORATOR
3. VENTURI.
4. REACTOR.
5. CONDENSER
6. Br_2 COLLECTION POT.
7. HBr SCRUBBER.
8. ALKALI SCRUBBER
9. CIRCULATION PUMP.
10. SULPHURIC SCRUBBER.
11. CIRCULATION PUMP.
12. MIST SEPARATOR
13. CANDLE FILTER
14. COMPRESSOR.
15. CONDENSER
16. CRUDE PRODUCT STORAGE TANK.
17. DISTILLATION FEED PUMP
18. DISTILLATION COLUMN — I
19. REBOILER - I
20. CONDENSER - I
21. DISTILLATION COLUMN — II
22. REBOILER - II
23. CONDENSER - II
24. DISTILLATION COLUMN — III
25. REBOILER - III
26. CONDENSER - III
27. BROMINE RECOVERY UNIT

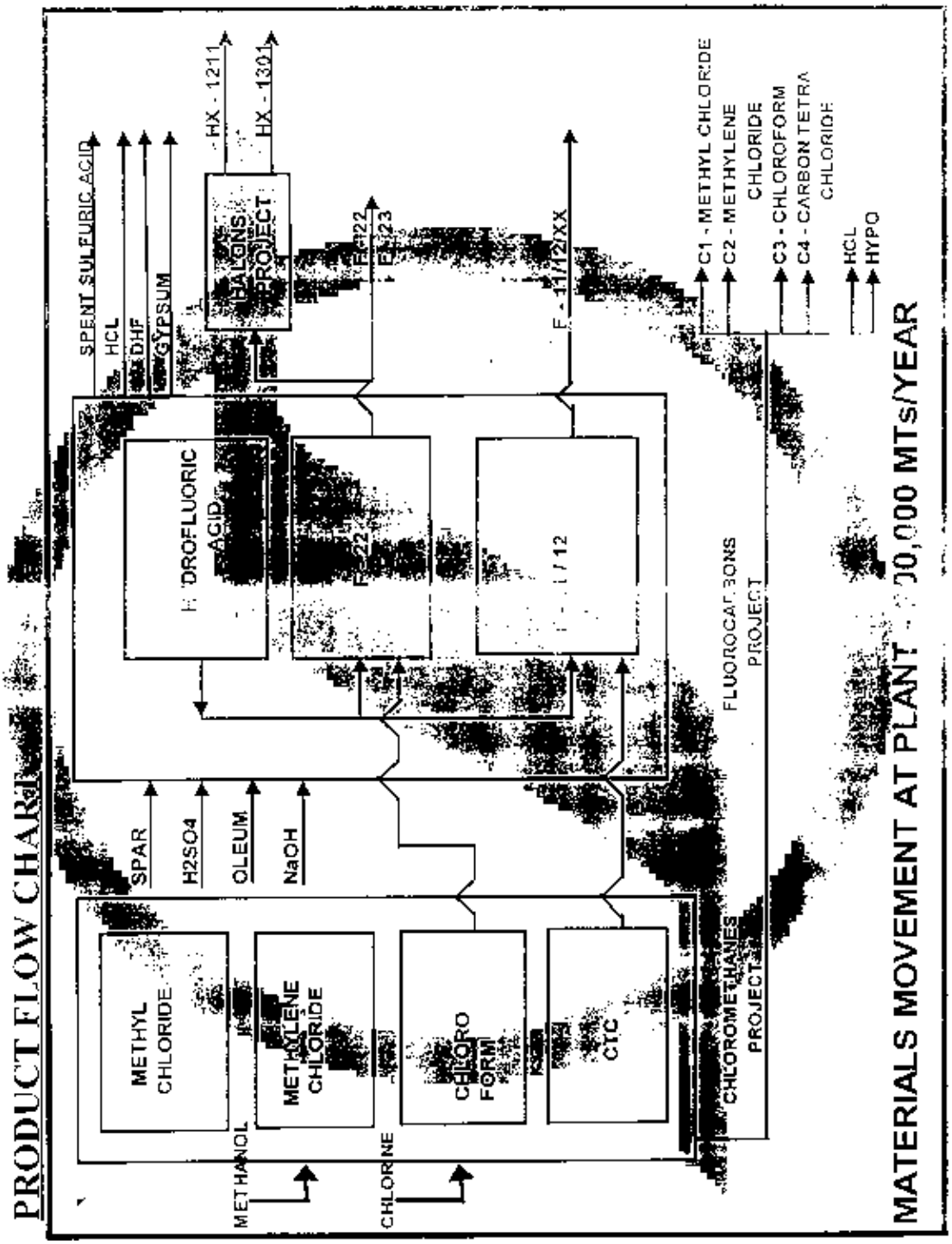
CLIENT:- HALON 1211 / 1301 PLANT - NFI

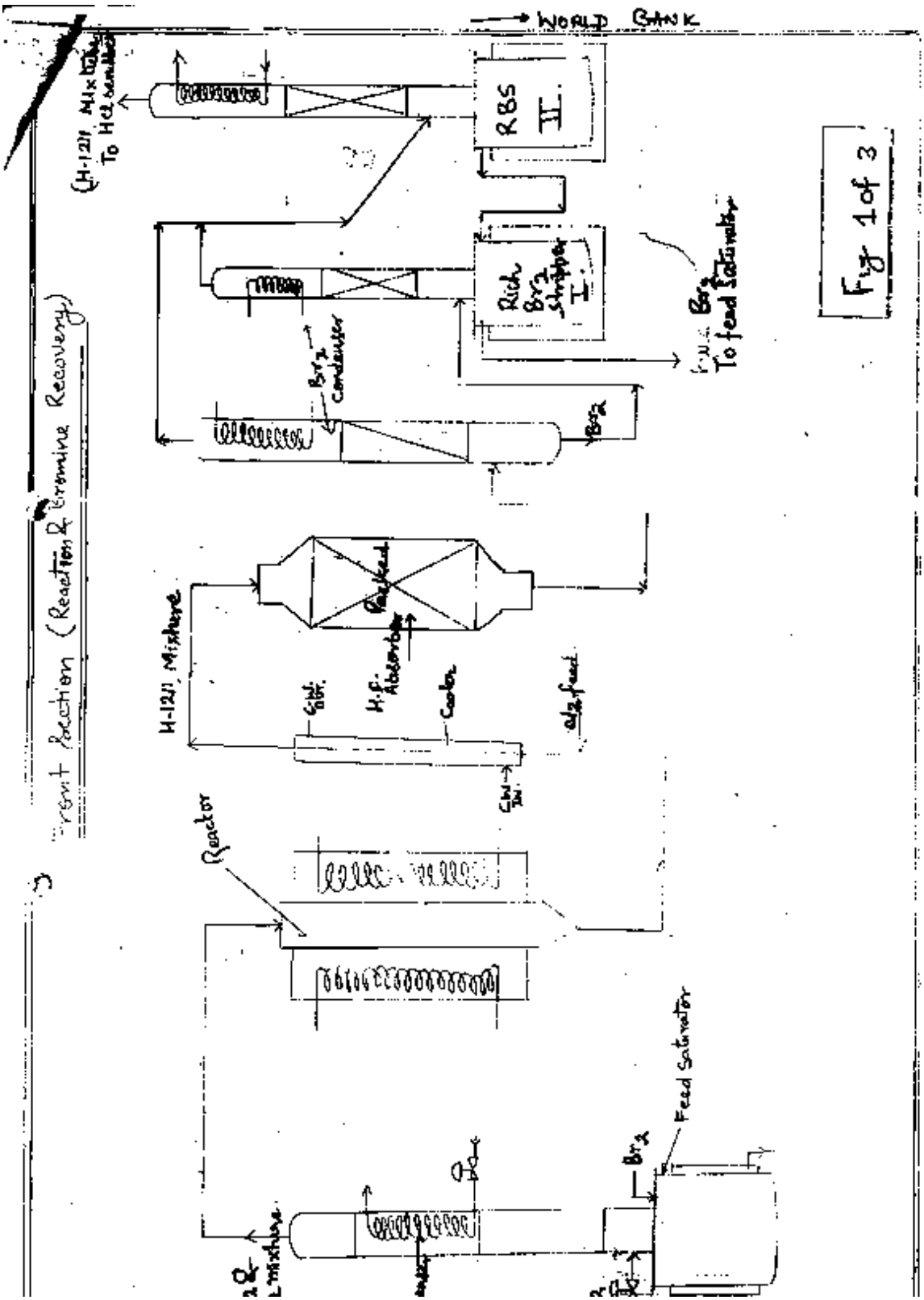
	NAME	DATE	SCALE
DRN BY		29-6-9	
CHD BY			ITEM NO.
APD BY			

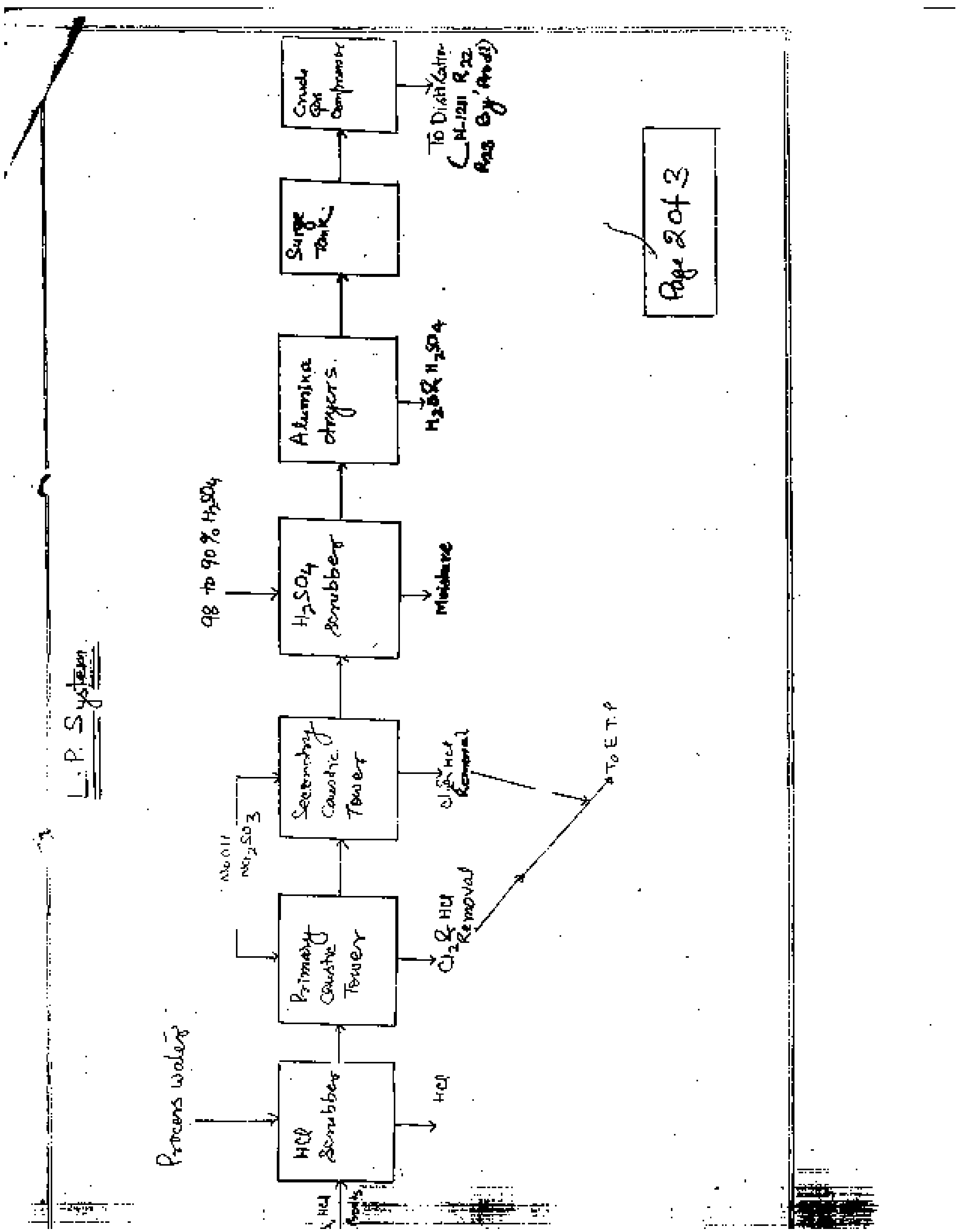
Navin Fluorine Industries,
MAFATLAL CENTRE,
NARIMAN POINT,
BOMBAY-400 021.

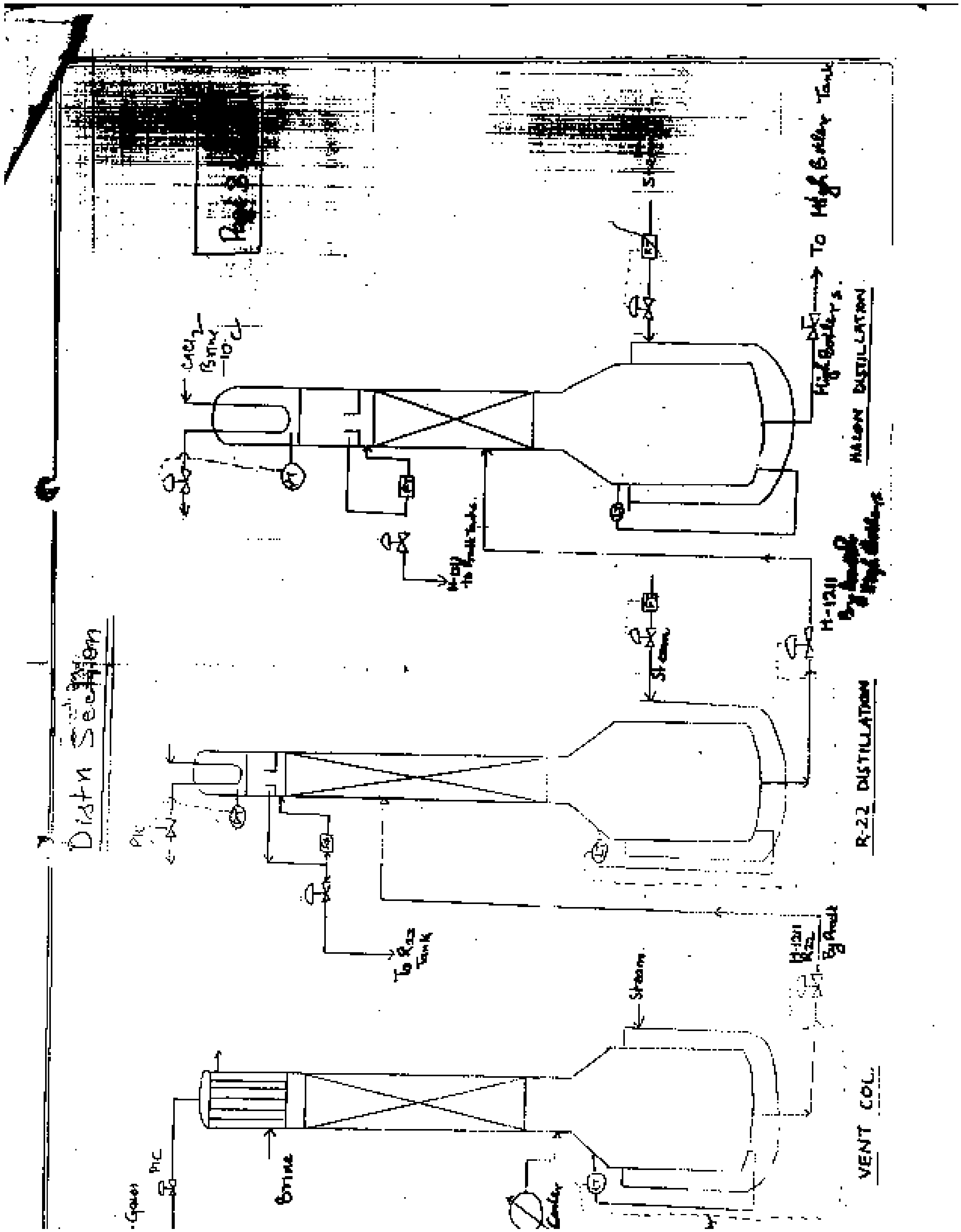
MATERIAL BALANCE SHEET FOR
HALON 1211/1301 PRODUCTION
TOTAL CAPACITY 1000 MTA

JOB NO.
SHEET NO. OF
DRG. NO.
HALON-3-09-[illegible]-2
REV.


PRODUCT FLOW CHART
MATERIALS MOVEMENT AT PLANT - 20,000 MTs/YEAR
METHYL CHLORIDE
METHYLENE CHLORIDE
CHLORO FORM
CTC
CHLOROMETHANES PROJECT
FLUOROCARBONS PROJECT
HYDROFLUORIC ACID
HALONS PROJECT
METHANOL
CHLORINE
SPAR
H2SO4
OLEUM
NaOH
SPENT SULFURIC ACID
HCL
DHF
GYPSUM
HX - 1211
HX - 1301
F-22
F-123
F-11/12/XX
C1 - METHYL CHLORIDE
C2 - METHYLENE CHLORIDE
C3 - CHLOROFORM
C4 - CARBON TETRA CHLORIDE
HCL
HYPO


WORLD BANK
RBS II.
Rich Br2 stripper
Br2 condenser
To feed Saturator
Fig 1 of 3
H-121 Mixture
Reactor
Feed Saturator


L.P. System
HCl Scrubber
Process water
HCl
Primary Caustic Tower
Cl_2 & HCl Removal
NaOH
Na_2SO_3
Secondary Caustic Tower
To E.T.P
H_2SO_4 Scrubber
98 to 90% H_2SO_4
Moisture
Alumina dryers
H_2O & H_2SO_4
Surge Tank
Crude Gas Compressor
To Distillation
Page 2 of 3


Distn Section
R-22 DISTILLATION
HALON DISTILLATION
VENT COL.
To High Boiler Tank
Steam
Brine
To R22 Tank

ANNEX 2
ENVIRONMENTAL ASSESSMENT

The purpose of this project is to close down and dismantle the two halon production facilities. The plant will be fully dismantled.

- All production equipment, reactors, tanks, pipes will be scrapped and disposed in accordance with Indian environmental requirements.
- Any remaining bromine will be collected and used as feed stock in relevant production.

- Any remaining halon at the plant will be sold and used as fire extinguishing agent.

- The reuse of the buildings and existing steel structures will be assessed by the two companies. If decided to dismantled the buildings, disposal of building material will be done in accordance with Indian environmental requirements.

- The necessary documentation and verification will be provided as part of the project completion report. The safe disposal will be verified by the Indian environmental authorities.

The substitutes to be used instead of halons will be ABC powder, CO2, Inert gasses and HFCs. None of them have a residual ODP. HFCs have some global warming potentials, but are the recommended substitutes for halon 1301 and the GWP for HFC-227ea is less than the GWP for halon 1301.

ANNEX 3
ENTERPRISE COMMITMENT LETTERS

Both enterprises have provided the necessary commitments covering the following items

NFI and SRF have confirms having received a copy of an ODS phaseout project, prepared on their behalf and on behalf of the Government of Indian by the World Bank. NFI and SRF hereby acknowledged the following:

a) It agrees that the World Bank will submit this project to the Executive Committee of the Multilateral Fund of the Montreal Protocol (MPTC) with the objective to receive funding as described in the project document;

b) they will completely close down their halon production and dismantle their halon plants

c) they will dispose of any equipment that has been dismantled under this project in compliance with the stipulations that have been drawn up in the project document;

d) It will allow monitoring inspections by the World Bank or designate during project implementation and thereafter to verify proper implementation, dismantling and disposal of the halon plants

ANNEX 4
TECHNICAL REVIEW

DR. BARBARA KUCNEROWICZ-POLAK

]
PROJECT TECHNICAL REVIEW

1. COUNTRY: INDIA

2. PROJECT TITLE: Umbrella project for the closure of two halon plants in India, SRF and NFI

3. SECTOR TITLE: Fire Protection. Halon production sector.

4. OBJECTIVE of the PROJECT and RELATIONSHIP TO COUNTRY PROGRAM:

1. The objectives of the project are closure and dismantle two halon production facilities in India, at Navin Fluorine, Ltd. and SRF, Ltd. The project is a part of "India Halon Phaseout Strategy" presented to the Executive Committee of the Multilateral Found of the Montreal Protocol at its 28th Meeting.

5. METHODOLOGY - GENERAL COMMENTS:

6. DETAILED COMMENTS TO PROJECT DESCRIPTION

1. The last sentence in p.1 of the project (Objectives) overemphasis its role for eliminating India's capacity to produce halon, in particular in the context of both subjected enterprises. Their production in the best period reached only less then 30 % of their capacity. The capacity in lack of the market for product is only theoretical and does not have practical implication.

2. The units and onomastics used in the project description for different data are not consistent and are misleading. For example, in Table 1 consumption and production data have been expressed as ODS tons, which is something what does not exist. The data itself indicate tonnes (often called under the MP documentation as metric tonnes, MT). It seems that the intention was to show ODS-Halon Consumption (in tonnes) and adequately – ODS-Halon Production (in tonnes). It could be easier if those data would be given either in tonnes (MT could be acceptable, as it is well-established description used under the MP documentation, however, it is not correct under the SI metric system) or by ODP tonnes.

3. Unconstrained demand forecast data in Table 1. do not have any units. If data are expressed at the same units as consumption and production data (in tonnes), they seem to be rather overestimated. Particularly if we compare consumption and production data for India. "Indian Halon Phase-out Strategy" document was not provided to me, therefore I have difficulties to give more accurate interpretation on that estimation.

1. Comments in p. 4 below table 3, should also mentioned that under the MP it has been required 100% reduction of halon consumption in developing countries by January 1st, 2010. This has been significant element, which influenced the fire protection market in art. (5) 1 countries.

2. I would also like to draw attention to the fact that total number of employees in the NFI was almost double of the number employees in the SRF plant, while the production level was slight lower.

7. TECHNOLOGY:

N/A

8. ENVIRONMENTAL IMPACT:

The project will assist in a properly, safe for environment close down and dismantling halon production facilities in India. As halon production was already stopped in both, NFI and SRF facilities, the environmental impact in the regard to the MP objectives, is not direct. However, indirect positive environmental impact is evident, particularly that the facilities will not be use for future production of halocarbons, such as HCFCs with non-zero ODP values or HFCs- Greenhouse Gases, included in the "Kyoto Protocol emission basket". The development of an adequate Environmental Management Plan and its implementation is very important element of the project and its environmental impact.

9. PROJECT COSTS:

The closure cost for the two enterprises (NFI and SRF) are based on calculations of the two key elements: estimated lost of profits and labour compensation.

9.1. The Lost of profits

Lost of profits cost model of the project has been based on the following estimated data: assumed production level based on the scenario "in the absence of the Montreal Protocol", production costs and sales prices, a lifetime of halon production plants.

Calculations for lost of profits were done using the "without Montreal Protocol" scenario, with the baseline halon 1211 production levels assumed to be at the highest level production before its closing (109 tonnes for SRF and 95 tonnes for NFI). This assumption includes elements of market competition from imports, particularly in the absence of tariff protection, which had not been provided by the Indian government. Projected production data under "without the MP" scenario proposed for the cost model, are based on correct assumptions and are to be accepted.

From the previous experience of the technical reviewer and recently collected information, the production costs and sales prices used for the cost model of the project, are reasonable and

acceptable. However, halon 1211 prices used for calculations, at their "economic" as well as "financial" levels, are lower then most of the actual prices of the recycled halon 1211 in non article 5 (1) countries and a vergin halon in China. Halon 1211 sales prices differ significantly by the region, sometimes also within a country. It was reported by the HTOC that halon 1211 in global scale is in an excess in comparison with the demand, while halon 1301 is in equilibrium between demand and support. At present prices for halon 1211 are at the level of several US$/kg (10-14 in the USA and Canada, approximately 8 in China and some European countries e.g. UK), up to 60 US$/kg (Japan). In general, sales prices for halon 1211 have not been changed visibly over last 5 years. Prices for halon 1301 are 80 to 100% higher. In 1995 prices for halon 1301 were generally about 25 % higher then recently, however, in some countries they reach very high level during last year.

Based on the audits technical lifetime for both plants were assumed to be 30 years. That type of a lifetime for halocarbon plant is generally rather high. It depends on several factors, including maintenance and servicing, quality of material, technical conditions as well as management system. Most agents use in the halon production is very aggressive and particularly high quality and purity is required to avoid corrosivity (ppm of H2O). Comparing it with fire protection equipment lifetime, which is between 20-25 years, one can conclude that the main hardware lifetime should be of the similar value. The remaining lifetime of the SRF plant was assessed adequately as 27 years as of the 1998 and 23 years for NFI. In the context of previous comments and experience on technical and labour infrastructure and conditions in India, it seems to be too long.

It is suggested to review the lost of profits assuming the lifetime as being maximum 25 years.

9.2. Labour Compensation

Estimation on labour compensation, based on SRIC report and estimation on labour cost per kilogram of halon production and court rules in India for labour compensation equivalent to six years salary, when plant is closed due to environmental matters, are reasonable and to be accepted.

10. TIME SCHEDULE:

From past experience, this technical reviewer agrees with the proposed time schedule as outlined in the proposal. Close monitoring of implementation is required, maintained over the nominated period.

11. RECOMENDATION

1. The concept of the closure down and dismantling halon production facilities, without changing their production towards other halocarbon type product is in the present situtation of halon market in India and in the region, the best possible solution. Therefor the umbrella project for the closure of the two halon production plants in India is recommended for approval.

2. The closure cost for the two enterprises (NFI and SRF) is slightly overestimated by the assumption of the 30 years lifetime of the production facility.

3. The project cost should be overview in the context of comments from p. 9.1.

Warsaw, Poland

August 2000