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CHAPTER I

PROJECT OBJECTIVE :

The objective of this project is to phase out the use of Carbontetrachloride , CFC-113 as mould release agent and methylchloroform (MCF) in electronic cleaning operations at Videocon Group of Companies. The process in which the ODS are utilised for example carbontetrachloride in cleaning of machine and machine parts in colour picture tube shell, funnel and panel making, methylchloroform in electronic tuner unit, multistage ultrasonic cleaner for cleaning of PCB carriers and cleaning of dispensing unit for autochip mounting, will be replaced with non ODS cleaning solvents.

CHAPTER - II

SECTOR BACKGROUND

India became a signatory to Montreal Protocol in 1992 and as a part of subsequent exercise, a Country Programme document was prepared by the Government with the assistance of UNDP. This document has assessed the Ozone Depleting Substances (ODS) consumption in the country and on the basis of this, a National Programme for the Phase-out of ODSs has been prepared to ensure the Phase-out of ODSs according to the national development strategy, without undue burden to consumers and industry.

- 2.2 The solvents sector is the largest user of ozone depleting substances (ODS) in India. The size of consumption has been investigated in a number of studies. According to India Country Programme : August 1992, the total consumption of ODS in the country by 1991 was 10,370 tonnes equivalent to 13,111 tonnes ODP. Out of which, the solvent sector consumed 100 MT of CFC-12, 300 MT of CFC-113, 4,000 MT of carbontetrachloride and 550 MT of 1,1,1-trichloroethane (MCF), i.e. a total of 4,876 MT of ODP (ozone depletion potential)-weighted consumption, that is 36.6 per cent of total ODP-weighted consumption in India.
- 2.3 ODS consumption in the solvents industry is split between electronics, metal cleaning and other processes such as textiles, pharmaceuticals, pesticides, chlorinated rubber, etc. Cleaning processes used in the electronics industry consumed in 1991, 150 MT CFC-113, 75 MT CTC and 30 MT of MFC and included flux removal (printed circuit cards and hybrid circuits), semi-conductor manufacturing, microelectronics component cleaning, metal and plastic part cleaning and photoresist development and stripping. The use of ODSs in electronics cleaning in India has been increasing as a result of the development of the electronics industry.
- 2.4 ODS consumption in India : As per the India Country Programme, the ODS & ODP figures for the year 1991 and unconstrained scenario by 2010 is given in the following Table-1, Exhibit-1

Table-1
1991 Consumption

Types of ODS	All Sectors			Solvents		
	Actual MT	ODP MT	Weighted %	Actual MT	ODP MT	Weighted %
CFC-11	900	1900	14.4	0	0	0.0
CFC-12	2850	2850	21.6	100	100	2.1
CFC-113	320	342	2.6	300	321	6.6
Sub-total	5070	5092	38.6	400	421	9.7
Halon-1211	550	1650	12.5	0	0	0.0
Halon-1301	200	2000	15.1	0	0	0.0
Sub-total	750	3650	27.6	0	0	0.0
CTC	4000	4400	33.3	4000	4400	90.2
MCF	550	66	0.5	550	55	1.1
TOTAL	10370	13208	100.0	4950	876	100.0

Sectoral Distribution

Aerosols	1100	1100	8.3
Forams	1580	1580	12.0
Refrigeration	1990	1990	15.1
Solvents	4950	4876	36.9
Halons	750	3662	27.7
TOTAL	10370	13208	100.0

The total ODS consumption as solvent in India in 1991 is given at Table-2

Table-2

ODS Consumption in Solvent Sector

Sub-Sector	ODS	Qty.	ODP
Electronics	CFC-113	150	120
	CTC	80	88
	MCF	30	3
Textile Cleaning	CTC	600	660
Pharmaceuticals	CTC	1060	1160
Pesticides	CTC	800	880
Rubber industry	CTC	320	352
Chemicals & Laboratory	CTC	70	77
	MCF	50	5
Sterlization	CFC-113	10	8
	CFC-12	100	100
Metal & precision cleaning	CFC-113	130	104
	MCF	40	4
Miscellaneous uses	CFC-113	10	8
	CTC	1070	1177
	MCF	430	43
Sub total	CFC-12	100	100
	CFC-113	300	240
	CTC	4000	4400
	MCF	550	55

2.5 Subsequently to the finalisation of India Country Programme for ozone depleting phase out under Montreal Protocol Department of Electronics (DoE) / Electronics Technology Development & Trade (ET&T) has formulated a programme under which a few solvent phase out proposals can be worked out. ET&T is a commercial venture by DoE and involved in the manufacturing of electronics components & products and has got expertise and infrastructure to carry out such programmes in an efficient manner. and taking into consideration the structure and distribution of Indian Electronics Industry and lack of awareness, UNIDO in co-operation with Department of Electronics/ Centre for Materials for Electronics Technology formulated a programme under which 04 ODS solvent phase out projects were worked out which have been approved by multilateral Fund for financial assistance. As a follow up to this programme, UNIDO in co-operation with Department of Electronics / Electronics Trade & Technology Development (ET&T) are currently working on the preparation of five projects for ODS phase out by Industry under the guidance of UNIDO.

CHAPTER III

ENTERPRISE BACKGROUND :

The Videocon Group is comprising of Videocon International Ltd., Aurangabad, which is also the Head Office, Videocon Narmada Electronics Ltd, Bharuch, Videocon Appliances Ltd. Aurangabad and Videocon VCR Ltd., Aurangabad. Videocon stepped in electronics sector way back in 1985 with a technical tie up with Toshiba Corporation of Japan and launched world class colour television. Today Videocon has got the following units in Aurangabad and Bharuch namely :-

- (i) Videocon International Ltd. - Colour TV plant at Chitegaon
- (ii) Videocon Appliances Ltd.- Washing Machine Plant at Chitegaon
- (iii) Videocon Appliances Ltd. - Refrigerator plant at Chitegaon
- (iv) Videocon's Modern VCR plant at Bhalgaon
- v) Videocon Narmada Electronics Ltd.- CTV Glass Shell Plant at Bharuch.

3.2 The company currently manufactures colour TVs, Black & White TVs and Audio Products. In its modern plant at Chitegaon, Aurganabad, the compnay has also undertaken complete backward integration to captively manufacture the critical and important components of its products such as Electronic Tuners, fly back transformers, ATDMs and Deflection Yokes ensuring quality control and becoming vertically integrated. It has set up a unit at Gandhi Nagar in Gujarat for manufacturing Black & White TV picture tubes. Videocon Narmada Electronics Ltd. (VNEL) has the distinction of having set up India's first plant for the manufacture of Glass Shells for Colour TV picture tubes, in technical collaboration with Techneglas Inc. USA (formally known as OI-NEG-TV Products Inc. USA), world leader in Glass Shell Technology. The company was incorporated in 1990. The Aurangabad Plant of Videocon International Ltd. has an in house plastic mould making unit (PMS unit). The present proposal is a combine proposal for Videocon Group of Companies at Aurangabad and VNEL, Bharuch. Videocon Group of Companies has an investment of Rs. 9250 millions and has a total manpower strength of about 2000. Videocon Group of Companies under consideration are mainly concentrating on the product mix described below :

Name of Unit	Product	Installed capacity (Nos)	No. of shifts	Production (Nos.)
Videocon International Ltd.	CTV & B&W TV	7.5 lakhs 2 lakhs	01 01	06 lakhs 1.5 lakhs
Videocon International Ltd.	Electronic Tuner	7.5 lakhs	01	06 lakhs
Videocon International International Ltd.	Flyback Transformers	7.5 lakhs	01	06 lakhs
Videocon International Ltd	Moulded Plastic cabinet and its parts	3600 Nos. per year	01	3000 Nos per year
Videocon Narmada Electronics Ltd.	CTV Glass Shells	20 lakhs per annum	03	20 lakhs

3.3 The areas where Ozone Depleting Substances are used include manufacture of CTV glass shells, tuners, fly back transformers, autochip mounting (surface mount devices) and cleaning of PCB carriers. VNEL produces colour picture tube shells (funnel and panel) of 13", 19" and 20" in size. The shells are polished with the automatic grinding machines. Periodically the machine and its parts are cleaned using carbontetrachloride (CTC). Cleaning is performed manually using adequate work force. CTV unit of Videocon International Ltd., Aurangabad produces Colour and B&W Televisions. Pallets are cleaned using ultrasonic cleaners (four numbers). Since Videocon has its own plastic moulding unit for cabinets and parts, the moulds require thorough cleaning regularly by mould agent spray coating.

3.4 The major manufacturing Divisions of the Videocon employing the use of ODS are as follows :

1. Electronic Tuner Manufacture
 - Tuner Assembly Division
2. Fly back Transformer Manufacture
 - FBT Assembly Division
 - Focus Register Pack Assembly Division
 - Potting Division

3. CTV Manufacture
- CTV Assembly Division
4. CTV Glass Manufacture
- Raw material and composition Division
- Furnace Division
- Moulding Divisio
- Finishing Division
5. Plastic Mould Manufacturing
- Moulding Division

3.5 Ozone Depleting Substances (ODS) are used in the following operations :-

- (a) After each days utilisation of the two potting plants, the pipings which transport the epoxy for dispensing are cleaned with 1,1,1 trichloroethane using a flushing device. Also the vacuum chamber is cleaned manually to remove the traces of epoxy spilled out during vacuum foaming.
- (b) The chip mounting machine nozzles needs cleaning frequently. These nozzles are cleaned using a ultrasonic cleaner employing 1,1,1 trichloroethane as solvents.
- (c) The PCB carriers are also cleaned periodically using ultrasonic cleaner, employing 1,1,1 trichloroethane as solvent
- (d) While manufacturing moulded plastic cabinets and parts for captive use, the moulds needs cleaning frequently
- (e) while in use. CFC-113 based mould releasing spray is used to clean the moulds.
- (e) CTV Glass is cleaned using Carbontetrachloride.

3.5 The various cleaning machines used for ODS handling along with their production capacities are shown below.

ODS Solvent using Equipment

Activity	Production capacity	Purpose	Cleaning process	Cost
Glass shells	25 lakhs nos. per annum	Cleaning of machine & parts	Manual	-
Electronic Tuner Assembly	7.5 lakhs nos per annum	Cleaning of PCB carriers & Chip mounting machine nozzles	Ultrasonic cleaners(2nos)	(a)\$ 10,000 (Vibronics) (b) \$ 5,000 (KLN Germany)
CTV manufactures	9.6 lakhs per annum	Pallet cleaning	Ultrasonic cleaner (2 Nos.)	(a) \$10,000 each (Vibronics) (b) \$ 20,000 (Murata)
Potting Plant for FBT 2 Nos		Cleaning of the potting after potting operations	Flushing system	\$ 20,000 (Murata)
Plastic Moulding Unit	36000 Nos per annum	Cleaning of Moulds	Spray cleaning	--

CHAPTER - 4

PROJECT DESCRIPTION :

4.1 Sector wise approach

The Electronics Industry uses a variety of chemical substances in the manufacturing processes and packaging operations. Some of these include chemicals which pollute the environment, of which a number of them are classified as Ozone Depleting Substances.

Considering this, a broad based programme to enhance the awareness about use of such substances in the Electronics and Allied Industries and to assist the industry for selecting the alternatives for replacing/phasing out of such substances etc., is being pursued under the activities of Electronics Trade and Technology Development Ltd.(ET&T) of the Department of Electronics, in collaboration with UNIDO. This would be a part of the overall programme within the Govt. of India i.e. being implemented by Ministry of Environment & Forest.

The replacement of ODSs in electronics industry application with alternate processes (aqueous process/semi-aqueous process/no clean technologies/cleaning with ODS free solvents) will require extensive engineering know how to carry out the task such as :

- Reliability testing
- Material compatibility testing and process development
- Technology selection
- Equipment selection/modification of existing equipment
- Purchase of alternate cleaning machine and systems
- Site preparation
- Installation of machinery
- Operator training

It is, therefore, decided that ET&T of DoE will take part from its start in order to accumulate information and experience to assist Videocon, Aurangabad as well as to other enterprises of Indian Electronics Industry.

4.2 Description of the Videocon, Aurangabad Project

As discussed above, the replacement of ODSs in Electronics Industry Application with alternate technology require extensive know how to perform a number of tasks. This will be performed prior to the purchase of the cleaning machine in order to choose the best equipment

4.3 Technology & Equipment Selection

Videocon International Ltd., Aurangabad will phase out the use of CFC-113 in plastic moulding as mould release spray, MCF in cleaning of electronic tuner (chip mounting nozzle cleaning and PCB carrier cleaning) and flyback transformer components (cleaning of potting machine and its parts) by selecting and utilising the appropriate non-ODS processors. Currently 04 ultrasonic cleaners are used for cleaning of tuner and flyback transformer components. One of its units of CTV glass making uses carbontetrachloride for cleaning of CTV glass. This would also be replaced with non-ODS solvent cleaning.

In the solvent sector, especially in the case of electronics cleaning, there are many options to the use of Ozone Depleting Solvents. Usually, the choice of the alternative cleaning process is dependent on the type of markets served by the solvent user. Most commercial application have more flexibility in the use of new technology, because of the inherent need of maintaining their competitiveness in the world market. However, many organisations build products known for their high degree of reliability for use in military aircraft, satellite or other difficult professional (industrial and commercial) operations. These organisation spare no cost to ensure that product made by their organisation are dependable and reliable. Considering the high reliability requirements of Videocon International Ltd. Aurangabad products, the conversion to non-ODS cleaning will be planned and evaluated extremely carefully. US EPA staff have found that the other chlorinated solvents (trichloroethylene, per chloroethylene and methylene chloride), aqueous and semi-aqueous cleaning and cleaning with petroleum solvents, Ketones and alcohol are to be viewed as acceptable.

3.7 Carbontetrachloride, MCF and CFC-113 are the three ODS used in Videocon. The cost incurred in the ODS is indicated below :-

ODS Solvents Costs at Videocon

Division/ Purpose	ODS used	ODS amount MT/ year	unit price US\$/Kg	Annual cost US\$	ODP weighted MT/year
A. Glass Shells					
1. Cleaning of machine & its parts	CTC	2.00	3.00	6,000	2.2
B. Colour TV					
Pallet cleaning	MCF	24.00	2.50	60,000	2.4
C. Electronic Tu ner					
1. Cleaning of Frames	MCF	10.00	2.50	25,000	1.0
2. Cleaning of chip mounting machine nozzles	MCF	1.00	2.50	2,500	0.1
D .Flyback Transformers					
Flushing of potting plants & parts	MCF	15.00	2.50	37,500	1.5
E. Plastic Moulds					
1. Mould Releasing spray	CFC-113	18.00	3.50	63,000	14.4
Total					21.6

3.8 However, considering the importance of environmental protection and the commitment made by India to phase out ODS, Videocon took initiative and initiated the phase out soon after the Protocol was signed. The status of phase out is as follows :-

Status of Consumption of ODS at Videocon (Qty. in Kgs.)

Item	1993-94	1994-95	1995-96	1996-97
Mould release agent (CFC-113)	18	18	12	6
Methyl chloroform	50	50	25	20
Carbon Tetrachloide	2	2	2	2

3.9 In this effort of ODS phase out Videocon has put in considerable efforts and have phased out ODS to some extent. The remaining quantities are also planned out as early as possible. The phase out has already costed Videocon approximately US\$ 134,000.

In the case of pallet cleaning, chlorinated hydrocarbon solvents using suitable ultrasonic cleaner would be the choice. Similarly, in the case of electronic tuner, cleaning of PCB carrier and chip mounting nozzles, ultrasonic cleaners with chlorinated hydrocarbon solvents would be preferable. CTV glass cleaning is very specific for removing very fine particles. High speed ultrasonic cleaning would be appropriate.

4.5 Site preparation and Installation of machinery

The project includes funding to prepare the sites for the equipment installation. This funding is for electric supply and plumbing to ensure safe installation of the equipment. The modifications are necessary to the cleaning areas for introduction of new system. Technical staff of the equipment manufacturers or their agent in India will help the installation work.

4.6 Operator training

Operator and maintenance personnel will be trained in the proper operation and maintenance of the new equipment. The training programme will be designed in co-operation with the equipment manufacturers and Videoco, Aurangabad.

4.7 Project Costs

The project costs refer to all costs including incremental recurring costs. The cost of utilities and solvents may differ between project to project in the country. Annexure-I indicates the total project cost of US\$ 400,000. The total project incremental cost of US \$ 389,815 was calculated as the investment capital cost US \$ 400,000 minus the net incremental operating savings of US\$ 10,185 for 04 years discounted at 10%.

4.8 Capital Investment Cost

As given in Annexure-I, the total investment cost is US \$ 400,000. The major components of this cost include the purchase, installation of heat cleaning system and retrofitting of Blade Coating Systems with necessary ancillary equipments.

4.9 Incremental Operating Costs/Savings

If the project was not undertaken, the annual operating cost could have been US \$ 74,400. Once the project is implemented, the annual operating cost is US \$ 70,870, resulting in annual operating saving of US \$ 3,530. Given an equipment lifetime of 10 years and discount rate of 10%, the net value of the first 04 years of incremental operating savings is US \$ 10,185. The details are provided in Annexure II.

4.10 Revenues

This project provides to Videocon, Aurangabad with US\$ 10.080 as annual incremental savings. Local Ownership ratio.

4.11 Since the total project incremental cost should be multiplied by the fraction of local ownership i.e. 100% to determine the proposed grant amount, so the total proposed multilateral fund financing is equal to total project incremental cost i.e. US \$ 389,815.

4.12 Contingencies

The calculations are based on tentative costs and, therefore, suitable amount has been provided as contingencies to meet the unforeseen expenditure.

4.4. Technology and Equipment Selection

Videocon International Ltd. will phase out the use of CFC-113, in plastic mould release spray, methylchloroform in cleaning of the potting systems and precision cleaning of the flyback transformer components and cleaning of chip mounting machine nozzle cleaning and PCB carrier cleaning in flyback transformer manufacturing division and tuner manufacturing division by modifying their processes. Similarly in the CTV glass manufacturing carbontetrachloride would be replaced with alternate non-ODS solvents.

Process	Existing	Proposed	Method
PLASTIC MOULDING UNIT			
1. Spray cleaning of moulds for plastic cabinet & parts	Spray cleaning using CFC-113	Spray cleaning with non-ODS silicon spray	Manual Spray
ELECTRONIC TUNER UNIT			
1. Cleaning of PCB of PCB carrier	Dip cleaning using 1,1,1- trichloroethane	Non-ODS cleaning	Ultrasonic cleaning
2. Chip mounting machine nozzle cleaning	Dip cleaning using 1,1,1- trichloroethane	Non-ODS cleaning	Ultrasonic cleaning
FLY BACK TRANSFORMER UNIT			
1. Cleaning of potting machine & and its parts	Cleaning using pressurised chamber and solvent 1,1,1 trichloroethane	Environmentally compatible cleaning system using dibasic esters	Modification of the present system to adopt water based system
CTV GLASS UNIT			
1. Cleaning of Machines & Machines parts	Manual cleaning using carbon-tetrachloride	Water based with high ultrasonication	High speed ultrasonication system capable of removing fine particals
CTV UNIT			
1. Cleaning of Pallets	Ultrasonic cleaning using 1,1,1 trichloro- ethane	Batch operation immersion ultra-sonic cleaning	Dip immersion type ultrasonic cleaning with non ODS solvents attached with Distillatio Unit

Operators and maintenance personnel will be trained in the proper operation and maintenance of the new equipment. Personnel will also be trained to appraise important process changes in the cleaning effectiveness of the new processes.

Videocon has special units for potting component with epoxy resins. These units require cleaning after each operation. It is proposed to change to an eco-friendly solvents (hydrocarbons) to maintain current cleaning standards.

Breakdown of total investment (capital) cost

Sl. No	Description of cost item	Unit US \$	Unit cost US \$	Qty.	Total cost
1. CLEANING EQUIPMENT					
1.1	Ultrasonic cleaning unit for pallets with flame proof motor etc. (300L)	ea	50,000	2	100,000
1.2	Ultrasonic cleaning unit for PCB carrier (300L)	ea	50,000	1	50,000
1.3	Ultrasonic cleaning unit for chop mounting nozzls (2L)	ea	20,000	1	20,000
1.4	High speed ultrasonic cleaning unit for glass shells.	ea	150,000	1	150,000
1.5	Installation cost (electrical, Piping, etc.)	ea	20,000	1	20,000
1.6	Water treatment plant	ea	20,000	1	20,000
1.7	Transportation, shipping and insurance.		10,000		10,000
1.8	Contingencies				30,000
TOTAL					400,000

- All the figures are tentative, needs revision on the basis of firm quotations/costs.

4.13 Unit Abatement cost (UAC)

As in Annexure III, the UAC is US \$ 2.85 per ODP weighted kilogram of ODS phased out per year. This number is derived from an annualised incremental cost of capital US \$ 400,000 and first year incremental annual operating savings of US \$ 10,185 and phasing out of 18 MT of CFC-113 (14.4 ODP tons), 2 MT CTC (2.2 ODP tons) and 50 MT MCA (5 MT ODP) ODS per year i.e. 21.6 ODP tons.

4.14 Proposed MF Grant

The proposed MF grant for this project was US \$. 389,815 calculated below :

The total investment cost of US \$ 400,000 was deducted with the net present value of the incremental operating savings over the first 04 years of the project which is US \$ 10,185. The sum was then multiplied by the 100% Indian ownership ratio of, Videocon, Aurangabad yield the resultant grant of US \$ 389,815.

MF Grant Calculation

Total investment cost US \$: 400,000
Incremental Operating costs over the first four years US \$: 10,185
Project preparation cost US \$: 389,815
Proposed MF grant US \$: 389,815

Financing Plan

MF funding is a grant and is limited to the capital and incremental savings as calculated above.

Project Implementation

The project will be carried out at Videocon, Aurangabad in co-operation with Ozone Cell, Ministry of Environment and Forests, Government of India. UNIDO will also provide technical assistance to the project during its implementation.

Required Regulatory Action

No regulatory action, other than routine permitting are required to implement this project.

Direct Project Impacts

The project will eliminated annually 70 MT of ODS (21.6 MT ODP weighted) at Videocon Group of Companies, Aurangabad.

Calculation of Unit-Abatement cost

A.	ODS Phase out		
A.1	Annual Consumption of		
	• CFC-113	mt	18
	• CTC	mt	2
	• MCA	mt	50
A.2	ODP of		
	• CFC-113		0.8
	• CTC		1.1
	• MCA		0.1
A.3	ODP		
	• CFC-113	mt	14.4
	• CTC		2.2
	• MCA		5.0
B.	Annualised Capital Cost		
B.1	Total Investment cost from Annexure	US\$	400,000
B.2	Equipment Life	years	10
B.3	Discount rate	%	10
B.4	Annualised Capital cost $B.1 * 0.1627$	US%	65,080
C.	Annual Incremental Operating Cost/Savings	US\$	3,530
D.	Unit abatement cost		
D.1	Annualised Capital Cost per kg. ODS phased out ($B.4/A.3 * 1000$)	US\$/Kg.	3.01
D.2	Annual incremental operating savings per kg. phased out ($C/A.3 * 1000$)	US\$/Kg	0.16
D.3	Unit Abatement Cost ($D_1 + D_2$)	US\$/Kg	2.85

Annexure II

Breakdown of incremental cost/ savings

Description of cost item	Unit	Unit cost US\$	Qty.	Pre-project cost US\$	Post Project cost US\$
A. Solvent/media cost per year					
A.1 CFC-113 Mould spray cleaning	Kgs.	3.00	18,000	54,000	-
A.2 CFC free silicone spray	Kgs.	3.00	18,000	-	54,000
A.3 MCF cleaning	Kgs.	2.5	50,000	12,500	--
A.4 CTC cleaning of glass	Kgs.	2.75	2,000	5,500	--
A.5 Hydrocarbon solvent Cleaning (TCA/IPA)	Kgs.	2.75	50,000	--	13,750
			Sub-Total	72,000	67,750
B. Electricity cost per year					
B.1 Ultrasonic cleaners (4 Nos)	KWH	0.10	9,000	900	--
B.2 Ultrasonic cleaners (4 Nos)	KWH	0.10	9,000	--	900
B.3 High speed Ultrasonic cleaning	KWH	0.10	7,200	--	720
			Sub-Total	900	1,620
C. Labour costs					
C.1 Labour for CFC cleaning	w/m	100	15	1,500	--
C.2 Labour for ODS freecleaning	w/m	100	15	--	1,500
			Sub-Total	1,500	1,500
			TOTAL	74,400	70,870
			Difference	(-) 3,530	