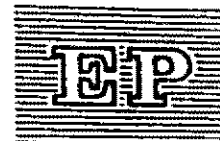




United Nations Environment Programme



Distr.
LIMITED



UNEP/OzL.Pro/ExCom/10/33/Rev.1
11 June 1993

ORIGINAL: ENGLISH

Executive Committee of
the Multilateral Fund for the
Implementation of the Montreal Protocol

Tenth Meeting
Montreal, 28–30 June 1993

PROJECT PROPOSALS: INDIA

PROJECT EVALUATION SHEET

COUNTRY OR REGION: India

PROJECT TITLE: Substitution of CFC-11 Refrigerant by HCFC-123 in Centrifugal Chillers

BUDGET: US \$567,000¹

INCREMENTAL COSTS: US \$567,000¹

ODS PHASE-OUT: 20 MT of CFC-11

COST EFFECTIVENESS²: US \$28.35 per Kg. ODP saved

PROJECT DURATION: Phase I - 2 years (1993-1994)
Phase II - 2 years (1994-1995)

IMPLEMENTING AGENCY: The World Bank

NATIONAL COORDINATING AGENCY : Ministry of Environment and Forests

TECHNICAL REVIEW COMPLETED: YES X NO

SECRETARIAT'S COMMENTS

1. This project will provide technology and facilities for the conversion of a major CFC-11 centrifugal chiller manufacturer to manufacture equipment suited for use with HCFC-123 as the refrigerant. Technology will be obtained under terms of a technology transfer agreement signed in December 1992 and the existing agreement will be expanded to cover the technology for HCFC-123.
2. Phase I of the project will provide the technology and engineering assistance and training needed to build and test centrifugal chillers using HCFC-123 as the refrigerant. Phase II will convert the production of CFC-11 chillers in the existing facility to HCFC-123 chiller production. It is estimated that following the completion of Phase II, 25 HCFC-123 chillers will be manufactured per year.

SECRETARIAT'S RECOMMENDATION

1. The project is recommended for final approval in the amount of US \$567,000. The final grant amount may be adjusted following the results of project appraisal.

¹ Includes 15 per cent contingency and 2 per cent financial institution fee.

² Determined as the ratio of incremental costs to the estimated annual saving of ODP (\$/ODP_{Kg}). For CFC-11, ODS=ODP

PROJECT EVALUATION SHEET

COUNTRY OR REGION:	India
PROJECT TITLE:	Conversion of Compressor Manufacture from CFC-12 to HFC-134a Design
BUDGET:	US \$685,000 ¹
INCREMENTAL COSTS:	US \$685,000 ¹
COST EFFECTIVENESS:	Not determined
PROJECT DURATION:	2 years
IMPLEMENTING AGENCY:	The World Bank
NATIONAL COORDINATING AGENCY :	Ministry of Environment and Forests (MOEF)
TECHNICAL REVIEW COMPLETED:	YES <u> X </u> NO <u> </u>

SECRETARIAT'S COMMENTS

1. 125 MT of CFC-12 will be eliminated in compressor manufacturing through conversion to compressors operating with HFC-134a.

2. The objective of this project is to convert CFC-12 compressor manufacturing to use HFC-134a as the refrigerant.

3. The project will be conducted in two phases. Phase I involves the manufacturing of 12 compressor models in the existing manufacturing facilities for testing. Phase II will entail the full conversion for the manufacturing of HFC-134a compressors. Requested costs are for Phase I only.

SECRETARIAT'S RECOMMENDATION

1. The project is recommended for final approval in the amount of US \$685,000. The final grant amount may be adjusted following the results of project appraisal.

¹ Including contingency (15 per cent) and Financial Agent Fee (2 per cent).

**THE MONTREAL PROTOCOL ON
SUBSTANCES THAT DEplete THE OZONE LAYER**

PROJECT COVER SHEET

COUNTRY: India

PROJECT TITLE: Conversion of Compressor Manufacture from CFC-12 to HFC-134a Designs

SECTOR COVERED: Refrigeration

ODS IN SECTOR (1992): 2400 MT

PROJECT IMPACT: 18 MT CFC-12 (in first year after completion of Phase II)
(125 MT CFC-12 considering Shriram's full compressor capacity in 1997/98)

PROJECT DURATION: 2 years

TOTAL PROJECT COST:

ODS Reduction Investment Cost:	US\$	584,000
Incremental Operating Costs ¹ :	US\$	0

PROPOSED OTF FINANCING²: \$685,000 (@ 100 % Indian Ownership)

COST EFFECTIVENESS: Not Applicable

IMPLEMENTING ENTERPRISE: Shriram Refrigeration Industries Ltd

COORDINATING MINISTRY: Ministry of Environment and Forests (MOEF)

IMPLEMENTING AGENCY: The World Bank

APPRAISAL DATE: August 1993

PROJECT SUMMARY

This OTF request is for phase I funding of a project which will lead to conversion of an existing CFC-12 refrigeration compressor manufacturing facility at Shriram Refrigeration Industries (Shriram) near Hyderabad to a facility which manufactures compressors operating with the non-ozone depleting refrigerant HFC-134a. In Phase I, 1200 compressors will be produced for test purposes. The full project when completed will provide a major indigenous source of HFC-134a compressors for use in the production of non-CFC domestic refrigerators. Technology for HFC-134a compressor manufacture has been transferred by Tecumseh to Shriram under the terms of an existing license agreement. This project is one of the first of a series of similar projects under the Global Refrigeration Project as approved by the Executive Committee of the Multilateral Fund in September 1992.

¹ Net present value of first four years of operating costs/savings.

² Includes 15% contingency and 2% financial institution fee

BACKGROUND

All refrigeration and air conditioning devices manufactured in India use CFCs or HCFC-22 as the refrigerant working fluid. CFC-12 is mainly used for domestic refrigerators and freezers, water coolers, bottle coolers and to some extent in industrial refrigeration systems employing both open and semi-hermetic compressors. Technology for manufacturing these compressors has been imported. Technologies for application of the new non-ODS refrigerant (HFC-134a) to replace CFC-12 must also be imported.

Shriram, a 100% Indian owned company, is a major manufacturer of hermetic compressors in India with about 40% of commercial market share (most compressors in India are currently produced for captive use). It manufactures compressors suitable for both air conditioning and refrigeration applications as well as for replacement of failed units in the field. During 1992, Shriram produced 48,000 CFC-12 compressors and 95,000 HCFC-22 compressors. Present capacity for CFC-12 compressors is 75,000 units per year with a planned production increase by 1997/98 to 500,000 HFC-134a units. Shriram is prepared to cease production of CFC-12 compressors as soon as it can replace existing facilities with those which can produce compressors capable of utilizing HFC-134a as the refrigerant working fluid. Shriram has an active license agreement with the largest compressor manufacturer in the world (Tecumseh) and are in the process of receiving the needed technologies to facilitate the transition to HFC-134a designs. The technology they will receive is specific to Tecumseh compressor designs which have been modified for optimum use of refrigerant HFC-134a.

India has made a decision to phase out the use of CFCs in the refrigerant and foam sectors in compliance with its obligations under the Montreal Protocol. This project, representing essential engineering and manufacturing development, is required to be completed before enterprises can enter the commercial market with non-CFC refrigerators. Commercial production of these non-CFC refrigerators will not be undertaken until subsequent projects are designed and implemented. The commercial production of refrigeration and foam systems will require India to make a policy decision to mandate industry to convert to non-CFC technology, as is being considered under the ODS Country Program for India, now under preparation.

PROJECT OBJECTIVE

The object of this project is to eliminate the use of CFC-12 in compressor manufacturing through conversion to compressors operating with HFC-134a.

PROJECT DESCRIPTION

Phase I involves test manufacturing of 12 compressor models in existing manufacturing facilities. Test manufacturing is necessary as the designs transferred to Shriram under their license agreement must be adapted to local conditions. In particular, the compressor motor must be modified by Shriram to tolerate the power surges common in India. Laboratory equipment with which to develop and test the necessary design modifications is included in the Phase I project scope. Existing laboratory facilities and test equipment will be used to the extent feasible to minimize the incremental costs of the project. Shriram has a major development laboratory in which some of the calorimeter and dynamometer instruments can be constructed in lieu of importing similar equipment. Tecumseh, the Indian Institute of Technology, the Central Mechanical Engineering Research Institute, and the National Chemical Laboratory will support Shriram's development activities.

The Phase I Project plan is as follows:

- a. Obtain the full technology package for HFC-134 compressors from Tecumseh including bill of materials, specifications and detail drawings. Modify designs as required.
- b. Construct testing facilities for compressor evaluation.
- c. Procure necessary materials and components and produce 1200 HFC-134a units.
- d. Conduct life and reliability tests on 12 compressor models.
- e. Field test HFC-134a compressors in domestic refrigerators, freezers, and coolers.
- f. Prepare a feasibility study, cost estimate, and schedule for a Phase 2 project to completely convert the plant to HFC-134a compressor manufacture.

The full cost of Phase I is eligible for OTE funding as defined in Item 2b of the Indicative List of Categories of Incremental Costs. However, no operational costs are included at this time. Also, there are no technology transfer fees

included, as these are already incorporated into the existing Shriram-Tecumseh license agreement.

Shriram is prepared to move quickly to implement the proposed project and expects to start Phase I in April 1993 and complete all testing by April 1995. The schedule is designed to accomplish a variety of life, reliability and field tests in preparation for a full conversion of the Shriram CFC-12 compressor manufacturing facilities to HFC-134a compressors under a Phase II project to be completed in 1997-1998.

There is no direct measure of the cost effectiveness of this project, as it focuses on test manufacture of new compressor designs. However, the indirect impact after Phase II is completed, would correspond to 15 MT per year of CFC-12 phaseout, based on present capacity of 60,000 units.

PROJECT COSTS

The total project cost of US\$584,000 equals the ODS reduction portion of the overall project (investment costs plus net incremental operating costs).

Investment Costs of US\$584,000 include capital investment costs for components, test facilities, and materials, as well as production line modifications.

Net Incremental Operating Costs. There are no incremental recurring operating costs associated with this Phase I project, as it focuses on test manufacture of new compressor designs.

Local Ownership Fraction of 100% was considered to determine the amount of eligible OTF grant financing. The total project cost was multiplied by the fraction of local ownership to determine the proposed grant amount.

Other Costs. A 15% contingency was included to ensure adequate funding of project costs following project appraisal. An additional 2% was added to the grant request to cover the fee for services of the financial institution (FI) that will appraise the projects and oversee procurement, disbursement and audits.

Requested Funding. The proposed OTF grant for Shriram is US\$685,000.

PROJECT IMPLEMENTATION

Management: MOEF will oversee the successful implementation of this project. The project will be carried out at Shriram.

<u>Schedule</u>	<u>Start</u>	<u>Complete</u>
Obtain bill of materials, specs and drawings from Tecumseh	Jul 93	Jan 94
Consultancy with Institutes	Jul 93	Sep 94
Upgrade test facilities	Jul 93	Apr 94
Upgrade assembly and finishing facilities	Sep 93	Apr 94
Component procurement	Jan 94	Oct 94
Procurement of HFC-134a and polyol ester oil	Jan 94	Apr 94
Motor design, relay and OLP selection	Jun 94	Nov 94
Assembly and finishing	Sep 94	Dec 94
Calorimeter and sound test	Dec 94	Jan 95
Life and field test	Dec 94	Jul 95

ESTIMATED DISBURSEMENT: 50% in 1993, and 50% in 1994

TECHNICAL ASSESSMENT

This subproject has been reviewed by the OORG technical reviewer, Dr. L. Kuijpers. The project was supported.

Annex A

**PROJECT SCOPE AND ESTIMATE
SHRIRAM REFRIGERATION INDUSTRIES
PHASE I - CONVERSION OF CFC-12 COMPRESSORS TO HFC-134a**

	Cost	
	<u>M.Rupees</u>	<u>\$US</u>
COMPONENTS FOR TEST MANUFACTURE OF 1200 UNITS (@ 1250 rupees/unit)	1.35	45,000
MODIFICATIONS TO COMPRESSOR MANUFACTURING LINE	3.21	107,000
MATERIALS		
Polyolester Oil (1000 kg)	1.05	35,000
HFC-134a (600 kg)	0.60	20,000
TEST FACILITIES		
Calorimeter	1.50	50,000
Dynamometer	0.84	28,000
Noise and Vibration Instruments	0.81	27,000
CAD/CAM Hardware and Software	1.29	43,000
Refrigeration Test Lab Equipment	0.21	7,000
Life Test Facility	0.30	10,000
Field Test Hardware	0.09	3,000
SALARIES FOR PROGRAM PERSONNEL		
3 Engineers for 2 years	1.17	39,000
Other support	0.30	10,000
CONSULTING SERVICES	3.75	125,000
TRAVEL		
Tecumseh Technical Labs	0.90	30,000
Local Users and Suppliers	0.15	5,000
Subtotal	18.52	584,000
Contingency (15%)	2.78	88,000
Subtotal	21.30	672,000
Financial Agent Fee (2%)	0.43	13,000
TOTAL	21.73	685,000

**THE MONTREAL PROTOCOL ON
SUBSTANCES THAT DEplete THE OZONE LAYER**

PROJECT COVER SHEET

COUNTRY: India

PROJECT TITLE: Substitution of CFC-11 Refrigerant by HCFC-123 in Centrifugal Chillers

SECTORS COVERED: Refrigeration and Air Conditioning

ODS IN AFFECTED SECTORS (1992): 90 MT per year of CFC-11

PROJECT IMPACT: 36 MT/year in 1996, after completion of Phases I and II

PROJECT DURATION: Phase I - 2 years (1993-1994)
Phase II - 2 years (1994-1995)

TOTAL PROJECT COST: ODS Reduction Investment Cost: US\$ 483,000
Incremental Operating Cost¹: US\$ 0

PROPOSED OTF FINANCING²: US\$567,000 (US\$391,000 in Phase I; US\$176,000 in Phase II)
(@ 100% Indian Ownership)

COST EFFECTIVENESS: Not Applicable

IMPLEMENTING ENTERPRISE: Blue Star Ltd.

COORDINATING MINISTRY: Ministry of Environment and Forests (MOEF)

IMPLEMENTING AGENCY: The World Bank

APPRAISAL DATE: August 1993

PROJECT SUMMARY

This project will provide technology and facility for conversion of Blue Star, a major CFC-11 centrifugal chiller manufacturer located near Bombay, India, to manufacture equipment suited for use with HCFC-123 as the refrigerant. Technology will be obtained from York International Corp (US) under terms of a technology transfer agreement signed in December, 1992 to expand the existing agreement to cover the technology for HCFC-123. An in-house test facility will be constructed for prototype testing and quality assurance. Capacity will be developed to support customers with subsequent retrofits of existing CFC-11 chiller installations to HCFC-123 refrigerant. Manufacturing facilities will also be modified for production of new HCFC-123 centrifugal chillers. Over the life of the project, demand for 540 MT of CFC-11 will be eliminated for the charging and servicing of chillers in large office buildings and hotels throughout India.

¹ Net present value of first four years of operating costs/savings

² Includes 15% contingency and 2% financial institution fee.

BACKGROUND

All refrigeration and air conditioning devices manufactured in India use CFCs or HCFC-22 as the refrigerant working fluid. CFC-12 is mainly used for domestic refrigerators and freezers, water coolers, bottle coolers and to some extent in industrial refrigeration systems employing both open and semi-hermetic compressors. Water chillers in India provide comfort cooling in hotels, office buildings, hospitals and other large structures. Chillers are also found in the industrial sector, particularly in textile manufacturing where climate control is important. Large capacity building chillers are generally of the centrifugal type and use CFC-based refrigerants (mostly CFC-11 and CFC-12, with limited use of CFC-113 and R-500). Technology for manufacturing these compressors has been imported. Technologies for application of the new non-ODS refrigerant (HFC 134a) to replace CFC 12 must also be imported.

Blue Star commenced production of Centrifugal Chillers in 1985, using CFC-11 as the refrigerant, under license from York International Corporation, USA. This agreement will continue until York has fully developed the application of HCFC-123 as a substitute refrigerant for CFC-11 in Centrifugal Chillers. HCFC-123 has already been well proven with a few hundred machines in operation in USA and elsewhere.

India has made a decision to phase out the use of CFCs in the refrigerant and foam sectors in compliance with its obligations under the Montreal Protocol. This project, representing essential engineering and manufacturing development, is required to be completed before the enterprise can enter the commercial market with non-CFC chillers. Commercial production of these non-CFC chillers will not be undertaken until a subsequent project is designed and implemented. This will require India to make a policy decision to mandate industry to convert to non-CFC technology, as is being considered under the ODS Country Program for India, now under preparation.

PROJECT OBJECTIVE

The object of this project is to eliminate the use of CFC-11 in manufacturing Centrifugal Chillers through conversion to the use of HCFC-123 refrigerant.

PROJECT DESCRIPTION

This two-phase project will eliminate Blue Star's use of CFC-11 as a refrigerant in Centrifugal Chillers by converting its product line to HCFC-123. Phase I will provide the know-how and engineering assistance and training needed to build and test/evaluate Centrifugal Chillers using HCFC-123 as refrigerant. Phase II will provide for modifications of production facilities to manufacture of HCFC-123 Centrifugal Chillers. At the conclusion of Phase II, Blue Star will have the capability of converting about 25 Blue Star made chillers per year, operating in the field, from CFC-11 to HCFC-123.

Blue Star has approached York International Corporation for transfer of know-how for producing HCFC-123 Centrifugal Chillers in India and phasing out their current range of CFC-11 Chillers. This would also enable Blue Star to offer retrofitting of the CFC-11 Chillers currently operating in the field to work with HCFC-123. In pursuit of this objective, Blue Star has already made a payment of US\$100,000 (in December 1992) for license fee for Plans, Drawings, Specifications Sheets and Engineering Instructions for the selection, conversion from CFC-11 to HCFC-123 and manufacture of Centrifugal Liquid Chillers using HCFC-123 as refrigerant instead of CFC-11.

PROJECT COSTS

The total project cost of US\$ 483,000 equals the ODS reduction portion of the overall project (investment costs plus net incremental operating costs) for Phases I and II.

Investment Costs of US\$483,000 include capital investment costs for test facilities, materials, and modification of manufacturing facilities.

Net Incremental Operating Costs. There are no incremental recurring operating costs associated with this project.

Local Ownership Fraction of 100% was considered to determine the amount of eligible OTF grant financing. The total project cost was multiplied by the fraction of local ownership to determine the proposed grant amount.

Other Costs. A 15% contingency was also included to ensure adequate funding of project costs following project appraisal. An additional 2% was added to the grant request to cover the fee for services of the financial institution (FI) that will appraise the projects and oversee procurement, disbursement and audits.

Requested Funding. The proposed OTF grant for Blue Star is US\$567,000.

PROJECT IMPLEMENTATION

Management: MOEF will oversee the successful implementation of this project. The project will be carried out at Blue Star.

<u>Schedule</u>	<u>Start</u>	<u>Complete</u>
TECHNOLOGY TRANSFER	Dec 92	Apr 93
ENGINEERING	Jul 93	Dec 93
CHILLER TESTING FACILITIES	Oct 93	Mar 94
CONVERSION OF PRODUCTION LINE	Mar 94	Apr 95

ESTIMATED DISBURSEMENT: 50% in 1993, and 50% in 1994

TECHNICAL ASSESSMENT

This subproject has been reviewed by the OORG technical reviewer, Dr. L. Kuijpers. The project was supported.

Annex A

Blue Star Chiller Project Project Scope and Estimate Phase I and II Conversion of CFC-11 Chillers to HCFC-123

	Cost (US\$ 1,000)	
<u>Phase I</u>	<u>Project Cost</u>	<u>With contingency and FI Fee</u>
Technology transfer	100	
Prototype testing facilities and equipment	134	
Engineering	90	
Training	<u>9</u>	
Subtotal	333	333
15% Contingency/2% FI Fee		<u>58</u>
Subtotal		391
 <u>Phase II</u>		
Modification of existing facilities to HCFC-123 design	120	
Design engineering	24	
Training	<u>6</u>	
Subtotal	150	150
15% Contingency/2% FI Fee		<u>26</u>
Subtotal		176
TOTAL	483	567