Multilateral Fund
for the Implementation of the Montreal Protocol

OBJECTIVE

Demonstrate the safe use of R-290 in the commercial air-conditioning (AC) manufacturing sector with ranges between 3.5 kW (one tonne of refrigeration, TR) and 17.5 kW (five TR). Facilitate the manufacturing of hydrocarbon-based AC equipment with good performance and minimum incremental operating cost. Demonstrate the safe handling and proper risk management for the introduction of flammable refrigerants in the commercial AC sector.

DEMONSTRATION OF R-290 IN COMMERCIAL AIR-CONDITIONING

Project title	Demonstration of R-290 (propane) as an alternative refrigerant in commercial air-conditioning manufacturing at Industrias Thermotar Ltda
Country	Colombia
Agency	UNDP
Sector	Refrigeration and AC
Subsector/application	Commercial AC manufacturing
Enterprise/ systems house	Industrias Thermotar Ltda
Baseline technology	HCFC-22
Alternative technology	R-290
GWP (alternative technology)	Negligible
Potential safety issues	Flammable
ODS phase-out (mt)	13.27
ODS phase-out (ODP tonnes)	0.73

DESCRIPTION

The conversion to R-290 was implemented at Industrias Thermotar Ltda., an enterprise manufacturing HCFC-22 ducted split condensing units and package-type equipment, with an average production of 4,100 units per year. Safety measures for the new manufacture line and for the entire enterprise were defined through the safety assessment carried out by an independent insurance company, and the conversion has been implemented. Training activities were carried out under the supervision of the international consultant. Technical documents for updating national standards (NTC 6828) based on ISO 5149 were developed, and a support plan was prepared focusing on the end-users and the servicing sector.

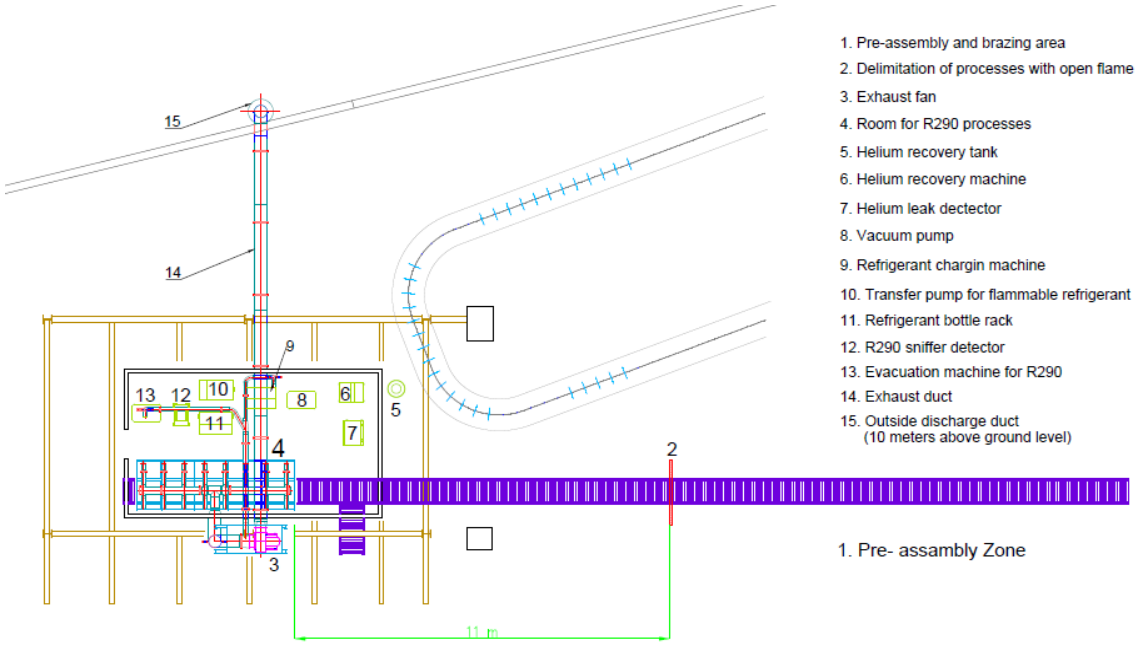

Figure 1. Plant layout after conversion to R-290

RESULTS

- Reduction of the heat exchanger tube diameter (condenser): Two models were chosen for both types of AC equipment, namely, aluminium micro-channel heat exchangers and 8 mm copper tube heat exchangers. The designs and tests performed were applied to the largest model (5 TR), because it is replicable to the rest of the models.

- Reduction of R-290 refrigerant charge: The estimated charge was 1.00 kg for the ducted split condensing unit (5 TR) with a 5-meter pipe; the charge for the packaged-type condenser unit was 0.95 kg. In some cases, the charge was reduced by more than 50 per cent compared to HCFC-22 models. Typical refrigerant charge distribution in an AC system is shown in Figure 2.

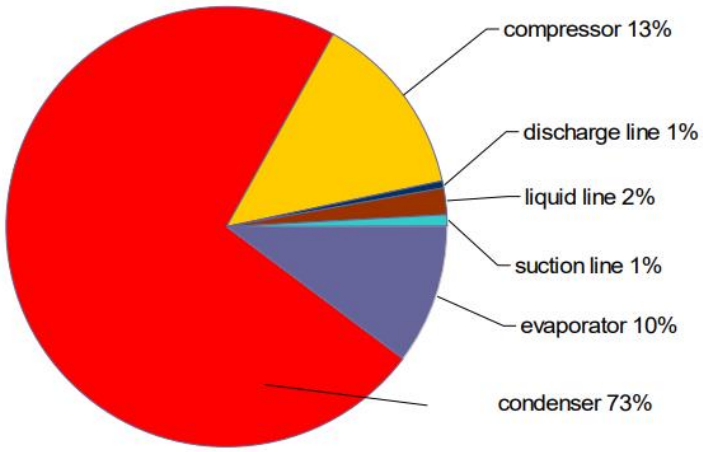

Figure 2. Typical refrigerant charge distribution in an AC system

- Modification of the metal structure (cabinet) of condensing units: The metal structure for both types of equipment was modified, and the electrical boxes were individualized or insulated.

- Modification of the metal structure of the handling unit: The metal structure of the handling unit (part of the split condensing unit) was modified to insulate the electrical box and the entire frame, mainly the air-intake area, to prevent the accumulation of R-290 inside an enclosure in case of leaks.

- Pump down cycle installation: The split condensing unit and the package-type unit have a "pump down" cycle, which collects the largest amount of refrigerant in the condensing unit (outside of the equipment). This occurs once pressure variations are detected through two pressure switches located in the AC unit.

- Ultrasonic sensor: The handling unit has an ultrasonic sensor for leak detection as an additional safety feature that prevents high levels of R-290 inside an enclosure in case of leaks.

- Power consumption: The enterprise conducted comparative tests related to energy consumption between R-410A and R-290-based equipment (5 TR). R-290-based equipment consumes 15 per cent less energy than the HCFC-22-based equipment and 13 per cent less than the R-410A-based equipment.

COST ANALYSIS

Detailed costs are available in the final report.

CONCLUSION

Condensing units and ducted package-type AC systems that work with R-290 refrigerant were designed, including measures to reduce the refrigerant charge and safety measures, and the manufacturing line was successfully converted to enable safe manufacturing with R-290.

FINAL REPORT AND SECRETARIAT'S COMMENTS

Additional details on this project are available at the link below:

http://www.multilateralfund.org/81/English/1/8110.pdf
(paragraphs 63 to 73 and Annex III)