NEW REFRIGERANTS FOR ARMY ENVIRONMENTAL CONTROL UNITS

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Introduction

On Jan. 1, 2000, with the world's attention focused on the pending collapse of our information infrastructure, the first deadlines restricting the use of Class II Ozone-Depleting Substances quietly went into effect for several European Union countries. Automobile owners have already experienced the impact of ozone legislation on their air conditioners, either by having to trade in their older vehicles, converting their air conditioners, or paying the high price for a dwindling supply of R-12 refrigerant. Home air conditioners and heat pumps predominately use R-22, a Class II ozone-depleting substance, and so does the Army's standard family of Environmental Control Units (ECUs), which are managed by the U.S. Army Communications-Electronics Command (CECOM).

Deadlines

Statutory regulations to eliminate R-22 mandate decreasing annual production limits of R-22 and restricting its consumption. In the United States, a production cap of 15 million tons went into effect in 1996. This cap decreases to 10 million tons in 2003, 5 million tons in 2010, and zero in 2020. Newly manufactured products that use R-22 will be banned in the U.S. in 2010.

The Netherlands and Germany took a more aggressive stance toward eliminating R-22 and banned introduction of newly manufactured products containing R-22 effective Jan. 1, 2000. DOD environmental policy as applied to host countries is outlined in each country's overseas baseline guidance and final governing standards. Generally, the more restrictive U.S. policy or foreign law is imposed.

Impact

More than 9,500 military standard ECUs are fielded across the Army and integrated throughout a wide variety of combat and combat-service support systems. The standard ECU provides developers and users with a "hardened" heating and cooling capability with a common interface for tactical equipment shelters. As users and program managers (PMs) are aware, ECUs perform a critical role in the reliability and performance of the systems into which they are integrated.

Impending deadlines have caused industry to retool and introduce commercial products for the new refrigerants. However, only a small percentage of commercial sales include alternative refrigerants. Although the military standard ECUs have no commercial equivalent, they are manufactured largely with commercial heating, ventilation, and air conditioning components. Because the U.S. "drop-dead" date is 10 years later than some of the countries where the Army operates and maintains ECUs, CECOM must act quickly and smartly to reconcile the urgency and the readiness of the commercial sector to meet the Army's needs.

Background

The standard military ECU was "born" July 17, 1967, as a result of the ECU policy letter that directed standardization of ECUs. In 1994, an Operational Requirements Document for the Improved Environmental Control Unit (IECU) was approved that addressed the need for a zero ozone-depleting refrigerant ECU. Additional improvements were also outlined for increased high- and low-temperature operation, lower noise, and higher reliability.

The CECOM Research, Development and Engineering Center (RDEC) has conducted evaluations on three alternative refrigerants: R-134a, R-407C, and R-410A. R-134a, widely used in automotive applications, was considered and quickly discarded because of its poor efficiency that would require a larger and heavier ECU design. R-407C is formulated to closely match the performance of R-22, which it does to a

large extent, but requires some material compatibility changes. R-410A is a high-pressure refrigerant used in commercial air conditioning and heat pumps. Although the use of R-410A would require a new ECU design, this refrigerant offers the potential for improved efficiency and reduced ECU weight and size.

A market survey conducted in June 1999 revealed that no industry products could fulfill the requirements outlined in the Operational Requirements Document. As such, the CECOM RDEC hosted a conference attended by more than 40 industry representatives who were interested in developing and producing military ECUs. During the conference's planning stage, industry consortiums, the American Refrigeration Institute, and the American Society of Heating and Refrigeration Engineers were consulted about industry trends.

Performance specifications for the IECU include detailed interface information that defines the integration of the IECU with host systems. The interface specification, which identifies critical interactions with legacy systems, was circulated between April and August 1999 to more than 300 PMs and users to solicit comments. This "freezing" of the interfaces will allow designers to focus on performance of the IECU. For developers who are uncertain of their requirements, CECOM maintains a systems assessment capability to assist developers in determining heating and cooling requirements for new and changing systems and to recommend application of standard ECUs.

Near-Term Planning

CECOM has established an integrated product team to manage the IECU Program. This team, which is comprised of functional representatives from CECOM's Logistics and Readiness Center, RDEC, and the Acquisition Center, has worked closely with the project leader to do detailed planning for the program. Early in the program planning stage, cost as an independent variable reviews identified marginal requirements that resulted in a $17 million acquisition cost avoidance.

During the engineering and manufacturing phase (EMD) of the program, two contractors will select a zero ozone-depleting refrigerant, and they will design, develop, and test prototypes of each horizontal configuration of the IECU family. Contractor selection is based on best-value criteria that emphasize the contractor's engineering design approach, unit and life-cycle cost-management approach, and manufacturing capabilities. Also during the EMD phase, extensive testing will demonstrate that the prototypes meet the ORD's requirements.

A streamlined acquisition approach will allow the production phase to be linked to the EMD phase as options on the contract. This contracting approach will preserve continuity of effort and result in cost-effective technology transfer between phases. The production phase consists of two parts. The first part allows for one contractor to be selected, based on demonstrated ECU performance and proposed unit costs, to provide production test quantities. Limited testing of these units will verify the contractor's production capability and successful transition of the design from EMD to production. The second part will allow for continued production through 2013 to meet the Army's ECU requirements. The first production units are scheduled for fielding in 2003.

The Future

While hydrofluorocarbons such as R-407C and R-410A are becoming the industry standard to meet statutory requirements, investigations of natural refrigerants are continuing. Hydrofluorocarbons have extremely high global-warming potential and are subject to regulation by both the Montreal and the emerging Kyoto Protocols. These hydrofluorocarbons require special handling, recovery, and reclaiming equipment. On the other hand, the natural refrigerant carbon dioxide CO_2 has a global warming potential 1,500 times less than hydrofluorocarbons and does not require special recovery or reclaiming equipment, resulting in a reduced logistics burden in a military application. Also, because of the higher working pressures, CO_2 offers the potential for ECU weight and volume reductions.

The Army is investigating the potential benefits of using CO_2 in a packaged-unitary tactical ECU to heat and cool operations. Past efforts have identified commercially available components for use in both vehicular and packaged-unitary units. Currently, two military ECUs are being fitted with CO_2 components for performance evaluation. A life-cycle cost analysis will also determine the economics of the technology. Should the CO_2 cycle prove successful and cost effective, the Army could introduce ECUs with CO_2 as the refrigerant by the 2010 deadline.

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