Concept of Operations for Military Environmental Control Units

Office of the Assistant Secretary of Defense
for Energy, Installations & Environment
Brief for
House Committee on Armed Services

30 June 2017

Agenda

- Congressional Request
- Definitions
- Summary of Findings
  - Distributed ECU Testing and Benefits
  - Organizations Engaged in Testing
- Considerations
- Additional Information

Congressional Request: Respond to House Report 114-537

Concept of Operations for Military Environmental Control Units (ECU)

… prepare a report or briefing to the House Committee on Armed Services on the concept of operations for military environmental control units. The briefing should address the following issues:

"(1) Details of testing accomplished or planned to evaluate the potential efficiency and lower costs that may be obtained using a distributed cooling concept of operations versus legacy approaches"; and

"(2) Potential benefits and savings possible using enclosed-sized ECU units and systems for equipment cooling, and should compare the size, weight, power, purchase, and overall operational costs of employing these units versus legacy expeditionary ECUs."; and

"(3) Department of Defense organizations engaged in this testing and the organization designated as the office of primary responsibility."

Definitions

- Distributed Cooling Concept of Operations
  - Cooling of individual shelter systems or containers from a centralized cooling unit or source.

- Enclosed-Sized ECU Units and Systems
  - Self-contained IT cooling system that provides closed loop cooling for IT server and other electronic equipment. Occupied shelters require additional cooling to maintain acceptable temperature parameters.

Distributed ECU Testing and Benefits: Army

- Army is actively monitoring the results of testing carried out by the other Services

- Army currently addresses the cooling of personnel and specialized equipment separately; therefore, no additional testing of distributive cooling concept is required

Distributed ECU Testing and Benefits: Navy

- Naval Surface Warfare Center (NSWC) Panama City developed a prototype Convective Distributive Cooling System
  - Redirects cool air from a legacy ECU to an electronics server transit case

- In hot climates, modeling suggests annual electrical energy (fuel) and peak power savings of up to 25% if air directed to cool only electronics servers and not cool entire shelter
  - However, additional cooling requirement for personnel remaining inside the shelter eliminates any energy savings

Distributed ECU Testing and Benefits: Air Force

- Air Force currently addresses the cooling of personnel and specialized equipment separately; therefore, no additional testing of distributive cooling concept is required
  - Basic Expeditionary Airfield Resources (BEAR) assets do not have specialized cooling equipment
  - Communication or medical units with unique needs and requiring specialized equipment deploy with required ECUs
- Air Force Civil Engineer Center (AFCEC) and Air Force Research Laboratory (AFRL) evaluated energy efficient, commercial-off-the-shelf (COTS) ECU technologies for use in BEAR
  - Results were not sufficient to change current acquisition strategy
- Next generation shelter and ECU procurement will incorporate energy efficient technology

Distributed ECU Testing and Benefits: Marine Corps

- Marine Corps evaluations of distributed cooling concepts did not identify satisfactory levels of efficiency

- Marine Corps Systems Command tested a trailer mounted central chiller design
  - Central chillers send cooled/heated liquid to multiple expeditionary shelters simultaneously
  - Testing did not identify any energy efficiencies and effort was discontinued

- NSWC Carderock evaluated spot cooling vests for individual personnel
  - Relative to conventional ECUs, spot cooling vests reduced energy consumption by 82% and reduced peak power demand by 75%
  - However, vests did not effectively cool personnel and effort was discontinued

Organizations Engaged in Testing: Army and Navy

- Army
  - Engineer Research and Development Center, Natick Soldier Center
  - Program Executive Office for Combat Support/Combat Service Support

- Navy
  - Naval Surface Warfare Center Panama City Expeditionary Energy, Evaluation, and Integration
  - Materials & Power Systems Branch, Naval Surface Warfare Center, Carderock Division
  - Naval Facilities Engineering Command, Engineering and Expeditionary Warfare Center, Systems Experimentation Division

Organizations Engaged in Testing: Air Force and Marine Corps

- Air Force
  - Civil Engineer Center Readiness Directorate
  - Air Force's Office of Primary Responsibility for Expeditionary Engineering issues is the Director of Civil Engineers, Civil Engineer Readiness Division

- Marine Corps
  - Marine Corps Systems Command, Product Manager Expeditionary Power Systems

Looking Ahead: Relevant Operational Considerations

- Distributed cooling has potential for efficiency gains, but operational factors limit effectiveness
- Enclosed-sized ECU units/systems do not reduce requirement to heat/cool surrounding shelters
  - Does not reduce need to manage heat associated with other electronic equipment
  - Require additional space, planning, routing, and installation of power and data lines
- With cooling appliance separate from electronics enclosure, liquid coolants present significant challenges in tactical environments
- Distributed cooling approach requires analysis of cooling loads for particular equipment sets

Conclusion

- Department is actively monitoring advanced cooling concepts and enclosed-sized ECU systems relevant to austere environments
- Military Services are coordinating to ensure sharing of advanced technologies and best practices
- Savings from these advanced cooling concepts are often insufficient to pursue equipment replacement based on these efficiency gains alone

Additional Information

Details of Testing Planned or Accomplished

- Q1: Details of testing accomplished or planned to evaluate the potential efficiency and lower costs that may be obtained using a distributed cooling concept of operations versus legacy approaches

- A1: HQDA is not aware of any specific testing of distributed cooling applications for electronic equipment that has been conducted or is planned

Potential Benefits and Savings, 1/2

- Q2: Potential benefits and savings possible using enclosed-sized ECU units and systems for equipment cooling, and should compare the size, weight, power, purchase, and overall operational costs of employing these units versus legacy expeditionary ECUs

- A2: While the distributed cooling does hold potential for efficiency gains, other operational factors pose difficulties for the technology, specifically for tactical, mobile systems
  - Potential solutions that have been proposed often include using liquid coolants, with the cooling appliance separate from the electronics enclosure. These solutions present significant challenges for tactical applications. Planning, routing, and installing coolant lines are a tactical burden, while coolant lines are vulnerable to damage. With every displacement of the equipment, replacement coolant would be required which is an additional sustainment requirement, and the particular coolant would have to be environmentally safe for local disposal.

Potential Benefits and Savings, 2/2

- Removing heat-producing electronics from the supported shelter to a separate shelter and cooling only the electronics shelter requires planning, routing and installing power and data lines similar to the coolant lines mentioned above.
- Even if the separately cooled electronics enclosure is maintained within the shelter those electronics support, the lack of cooling of the entire space presents problems with heat affecting other electronic equipment (monitors, displays, projectors, printers, non-standard equipment, etc.). These items may be subject to premature failure from excess heat or humidity.
- Any distributed cooling approach would require an analysis of the cooling load for that particular set of equipment and use to properly size the cooling solution. With the wide variety of potential mission sets, there would be significant work to ensure standardization and integration.

Organizations Engaged in Testing

- Q3: Agency's organizations engaged in this testing and the organization designated as the office of primary responsibility.

- A3: Responsibility for developing and testing any potential solution would depend on the particular application under study and the technical maturity of the proposed solution. In addition, the capability developer responsible for producing the requirements document to support development and acquisition would vary depending on the particular mission application being studied.

Details of Testing Planned or Accomplished

- Q1: Details of testing accomplished or planned to evaluate the potential efficiency and lower costs that may be obtained using a distributed cooling concept of operations versus legacy approaches.

- A1: The Air Force's expeditionary basing construct does not rely on ECUs to simultaneously cool service members and major electronic systems. Our Basic Expeditionary Airfield Resources (BEAR) assets have no major or unique equipment requiring specialized cooling. Functional units such as communications or medical squadrons with unique equipment requiring specialized cooling, deploy with separate equipment packages which contain the required ECUs. Because the Air Force currently addresses the cooling of personnel and specialized equipment separately, we have not accomplished and do not believe we need to accomplish testing of distributed cooling concepts. However, we will continue on-going efforts to ensure we employ the most energy efficient ECU assets.

Military Environmental Control Units

Potential Benefits and Savings

- Q2: Potential benefits and savings possible using enclosed-sized ECU units and systems for equipment cooling, and should compare the size, weight, power, purchase, and overall operational costs of employing these units versus legacy expeditionary ECUs.
- A2: Revised A2: The Air Force's legacy employment concept already addresses the separate cooling of personnel and specialized equipment and therefore we have not tested and do not believe we need to test an enclosed-size ECU focused on distributed cooling. The Air Force will continue to test methods of reducing ECU demand. The Air Force Civil Engineer Center (AFCEC), separately and with the Air Force Research Laboratory (AFRL), Office of the Assistant Secretary of Defense for Energy, Installations, and Environment (Operational Energy (OE)), and the US Army, has tested reducing ECU demand by improving the energy efficiency of BEAR assets. The Air Force has tested a number of legacy and more energy efficient commercial-off-the-shelf (COTS) military ECU technologies. The Department's next generation energy efficient shelter, and ECU procurement will transition these findings into the inventory.

Organizations Engaged in Testing

- Q3: Your agency's organizations engaged in this testing and the organization designated as the office of primary responsibility.

- A3: The Air Force Civil Engineer Center Readiness Directorate (AFCEC/CX) is engaged in testing ECUs. The Air Force's Office of Primary Responsibility for Expeditionary Engineering issues is the Director of Civil Engineers Civil Engineer Readiness Division (AF/A4CX).

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6. REMARKS

House Report 114-537, page 372 that accompanied the National Defense Authorization Act for 2017 (TAB A), directed DoD to brief the Committee on Concept of Operations for Military Environmental Control Units by February 1, 2017. TAB B is the report. The brief was sent by OSD Legislative Affairs to the committee on June 30, 2017. Request to post this congressional report to the Operational Energy web site. http://www.acq.osd.mil/eie/OE/OE_index.html.

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