

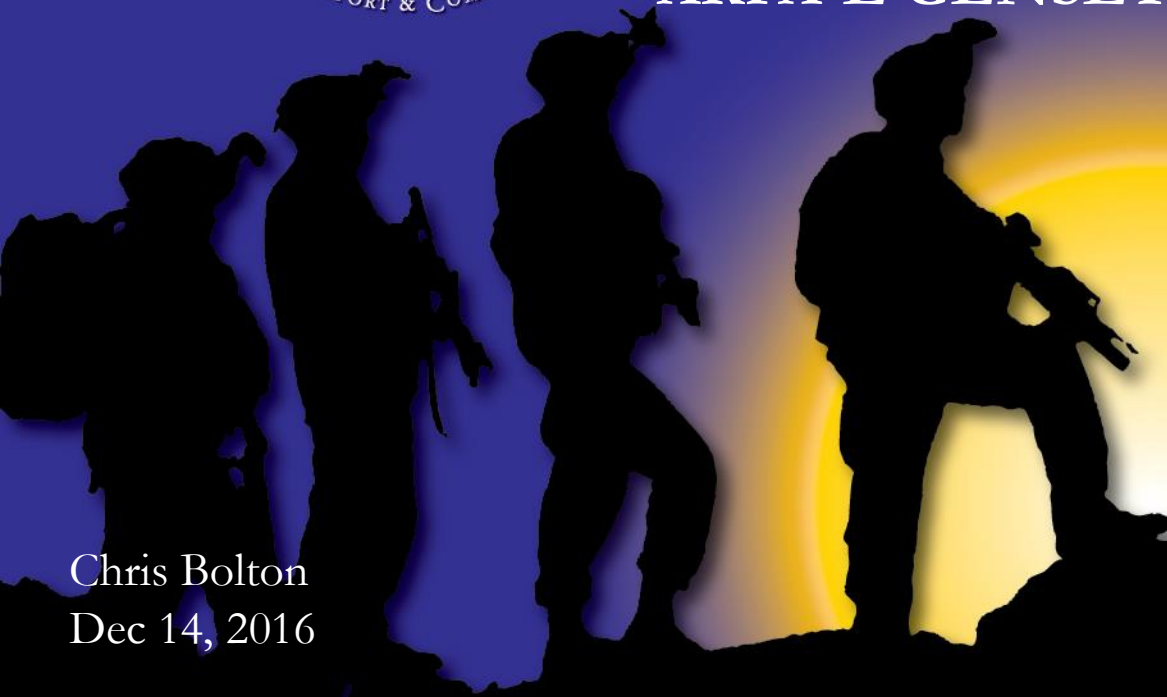


U.S. ARMY



Project Manager Expeditionary Energy and Sustainment Systems

Generator Requirements ARPA-E GENSET'S Annual Meeting



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PM E2S2 Portfolio



Power Generations Systems



**Power Distribution
Illumination Systems**



Microgrids



Aerial Delivery Systems



Field Feeding



**Command Post
Support Systems**



Rigid Wall Shelters



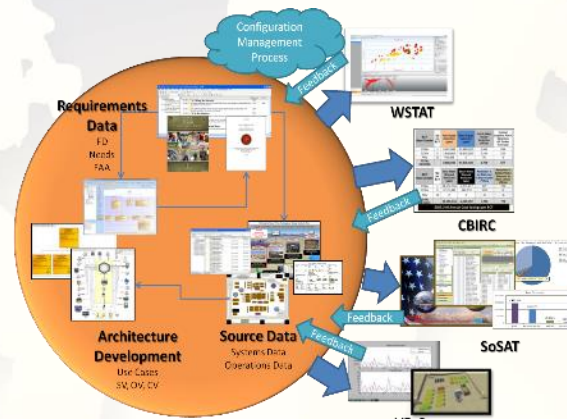
**Environmental
Control Systems**



**Small Unit &
Battery Power**



Air Supported Shelters



Contingency Basing Infrastructure



Shower Water Reuse



**Ultra-Lightweight
Camouflage Net System**



Requirements Hierarchy



High Level Requirements

Direct Requirements

Associated Requirements

Derived Requirements



Army Warfighting Challenges (AWFCs (Oct 15))

12 Conduct Joint Expeditionary Maneuver and Entry Operations – Lead: MCoE

How to project forces, conduct forcible and early entry, and transition rapidly to offensive operations to ensure access and seize the initiative

14 Ensure Interoperability and Operate in a Joint, Interorganizational, and Multinational Environment – Lead: MCCoE, Primary Support: USASOC

How to integrate joint, interorganizational, and multinational partner capabilities and campaigns to ensure unity of effort and accomplish missions across the range of military operations.

16 Set the Theater, Sustain Operations, and Maintain Freedom of Movement –

Lead: SCoE, Primary Support: AMC

How to set the theater, provide strategic agility to the joint force, and maintain freedom of movement and action during sustained and high tempo operations at the end of extended lines of communication in austere environments.

19. Exercise Mission Command – Lead: MCCoE

How to understand, visualize, describe, and direct operations consistent with the philosophy of mission command to seize the initiative over the enemy and accomplish the mission across the range of military operations.

20. Develop Capable Formations – Lead: ARCIC CDD

How to design Army formations capable of rapidly deploying and conducting operations for ample duration and in sufficient scale to accomplish the mission.



Capability Needs Analysis (CNAs)

TRADOC CNA Memo to HQDA Oct 15; High level priorities, S&T imperatives: maximize demand reduction and improve reliability;

General Officer Steering Committee CNA Critical Gaps

Gap 26: The ABCT lacks the ability to reduce energy consumption of its vehicles and equipment to reduce operational pauses during Decisive Action.

Gap 23: Sustainment forces at all levels in all conditions lack the ability to provide single (merging multiple sources), near real time visibility of on-hand property (accountability) and movement of supplies (in transit) in order to manage materiel (Class I, II, III, IV, V, VII, IX) and maintenance status to 95% accuracy.



Other CNAs

'16-'20 CNA List

241 The ABCT Soldiers lack the ability integrated and enhanced protection, power/power management, weapons, and C4ISR to operate in decisive actions at reduced Soldier loads.

248 Army forces at all echelons lack the ability to diagnose and verify the current status of supported equipment faults from extended distances, with greater than 98% accuracy, and order needed parts (or re-order bench stock) across the Range of Military Operations.

448 Sustainment forces lack energy sources that provide sufficient power to enable operations for extended times to minimize sustainment missions for platforms that are adequate to transport LOGPAC.

504 The IBCT lacks the ability to provide and sustain power during persistent operations in all environments under Unified Land Operations to at all echelons BDE and below, and inability to recharge batteries to support organic systems.



Long Term, Broad Requirements

TRADOC Pam 525-3-1, The U.S. Army Operating Concept: Win in a Complex World

2-5 Technologies with Military applications: Power and energy. Development of advanced and efficient power saving and generation technologies, particularly at major contingency bases, may reduce sustainment demand and strategic lift requirements.

3-4 How the Army Operates: *Sustain high tempo operations.* Sustainment units distribute supplies using capabilities that reduce vulnerability to ground interdiction and anticipate demand to allow operations without pause. Army forces operate across supply lines with reduced logistics demand and use local resources, power, energy, and self-sustainment capabilities such as water generation at the point of need. Information systems connect the strategic sustainment base to tactical organizations to anticipate needs, and provide a high degree of responsiveness and reliability in the supply chain.

3-5 Tenets and Core Competencies: *Project national power.* Projecting national power is the ability to deploy and sustain landpower rapidly and effectively in and from multiple locations and domains. The Army provides mission tailored expeditionary forces, deployed quickly and efficiently en masse, combined with regionally engaged forces and land-based cyber capabilities. The Army trains to deploy mission-tailored expeditionary forces capable of generating combat power and conducting operations upon arrival into the theater.



Long Term Cont.

TRADOC Pam 525-3-1, The U.S. Army Operating Concept: Win in a Complex World

Appendix C. Science and Technology: Logistics optimization. Science and technology delivers technologies to enable **increased efficiency** and reduced demand through **lower fuel consumption**; decreased waste generation; **efficient storage; power and energy generation**; and just-in-time (agile) logistics and precision resupply. **Increased reliability, maintainability, and resilience** of vehicles and other systems can reduce force structure requirements, as well as logistical demand. Production at the point of need, such as water production on demand, **3D printing and additive manufacturing** reduce the logistical footprint, shorten mean time to repair, increase operational availability, and reduce the need for intermediate staging bases. **Advanced and efficient power saving and generation technologies** will reduce further sustainment, demand, and lift requirements. In some cases, the Army requires operational energy where regular sources are non-existent or destroyed during operations. **Improved power efficiency, storage, and generation from traditional and renewable sources** will provide power under austere conditions. Additive manufacturing is defined as the process of joining materials to make objects from 3D model data, usually layer upon layer.



Direct Requirements:



- Specific Capability Gap/Material Solution Needed:
- Tactical Electric Power Capability Production Document (CPD)
 - Family of Standard Generators; common characteristics
- Small Unit Power Capability Development Document (CDD)
 - Small, hand-carried fueled power source for Soldier battery charging
- Small Tactical Electric Power CDD
 - Updated solution for power needs between 1 and 5 kW; replaces current 2 and 3 kW sets
- Other Systems with embedded power needs
 - Family of Rigid and Soft-Wall Shelters
 - Force Provider
 - Command Post
 - Base Camp Utilities



Associated Requirements:



- Common requirements for almost all Army equipment
- MIL-STD 810 Environmental
 - Temperature Extremes, Rain, Shock and Vibration, Dust, etc
- MIL-STD 461 Electromagnetic Effects (EMI)
 - Radiated EMI and Susceptibility to EMI
- MIL-STD 1472 Human Factors and Safety
 - Allows for a wide range of personnel and clothing (e.g., allowable carry weight, wearing Artic mittens, etc)
 - Standard warnings and color codes
- For electrical equipment, National Electric Code (when feasible)
 - Example, GFCI often not possible



Derived Requirements:



- Lessons Learned/Specification Sheet Details/Competition Enabling
 - Derating for Temperature and Altitude
 - Tilted operation
 - System Safeties
 - Quality Assurance
 - Fit and Finish (paint color)
 - Test and test criteria (if we ask for it, we have to verify we get it)



Tactical Initiatives

PM E2S2 RDTE supports three main areas of effort in improving and expanding our product lines:

- Capability improvements:
 - Smaller, lighter, cheaper
 - Less manpower
 - Broader range of operation
 - Specific requirements (e.g., airdrop, field feeding)
- Operational Savings
 - Fewer systems/components/parts
 - Higher reliability/longer life
 - Planning/metering/monitoring
 - Less fuel
- Power Availability
 - Reliable components
 - Reliable grids
 - Small unit power
 - Military Megawatts
 - Planning/metering/monitoring





Small Generator Specific

- Desired less weight than current sets
 - 2 kW 156 lbs
 - 3 kW 326 lbs
 - 900W Platoon Power Generation: DC only, no component over 15-20 lb
- 3 kW is mission critical; higher reliability and 24/7 use expected
 - 2 kW and PPG not mission critical; lower reliability acceptable and part time use expected
 - Non-mission critical systems could see relaxation of MIL-STD 810 requirements, or at least change in derating parameters
- Commercial components desired for cost and supportability
- “Single Fuel Forward” policy actually requires operation on DF-2, Ultra-Low Sulfur Diesel, and JP-8.
 - Gas engine-to-diesel engine conversion technologies have shown very promising results, but generator should be self-adjusting to adapt to any fuel without user input (user doesn’t know which fuel is being used)



Current Status

- User School (Sustainment Center of Excellence) conducting field survey to update needs for 1-3 kW users; what are actual loads and how often are they used, etc
 - Will drive how many of what size are purchased
 - Could drive other performance attributes
- RDTE funding planned for next several years to further define “art of the possible”
 - PM funding for concept development and demonstrations (mature technology)
 - CERDEC funding via Broad Agency Announcements (BAAs) for technology advancements (gas-to-diesel, high efficiency alternators, high efficiency power conversion)
 - PM POC is Jennifer.l.whitmore6.civ@mail .mil