



# **C5ISR Center Power Division**

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**IONICS Program Review**

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# OPERATIONAL POWER AND ENERGY OV-1





# C5ISR CENTER OPERATIONAL ENERGY



## Technology Focus Areas



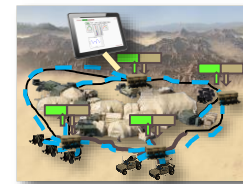
**Expeditionary Power Generation & Conversion**  
Fuel to Electricity, Alternative & Renewable



**Advanced Energy Storage**  
Batteries, Capacitors, etc.



**Intelligent Power Management & Distribution**



### Soldier & Small Unit (up to 2kW)

#### Tactical Energy for Soldier Lethality



**Increased Soldier Lethality through longer runtimes in distributed operations, with limited resupply**

- Energy storage materials for unique battery configurations
- Power generation devices to enable integrated Soldier borne/operated sensors and radios

### C5ISR Power & Intelligent Tactical Micro-Grids (up to 360kW)



#### Energy Informed Operations

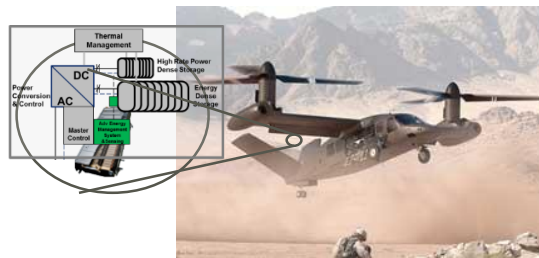
##### Reduced Logistics and Increased Flexibility

- Control Standards for Distributed Power Systems
- Energy Predictive Applications for Power Management
- Intelligent Microgrid Demonstrations

#### Optimized Energy Storage for C5ISR Power

##### Optimizing platforms to enable C5ISR Dominance

- Pulse Power Energy Storage
- Thermal Analysis & Management
- Control Standards & Distribution



**Enabling C5ISR Dominance through holistic Operational Energy Solutions**





# POWER DIVISION RESOURCES



## FACILITIES

### WORLD CLASS FACILITIES & RESEARCH CAPABILITIES

- More than 60,000 square feet of RDT&E facilities & 20,00 square feet of hard stand test areas
- Simulated operational and equipment duty cycles over 150 programmable test channels, 0 - 48 V, 10uA - 200 A
- Over 50 environmental chambers, ranging from 1 – 10,000 CuF and programmable from -68°C to 79°C
- Capabilities range from materials synthesis through rigorous military specific testing, prototyping, and system integration

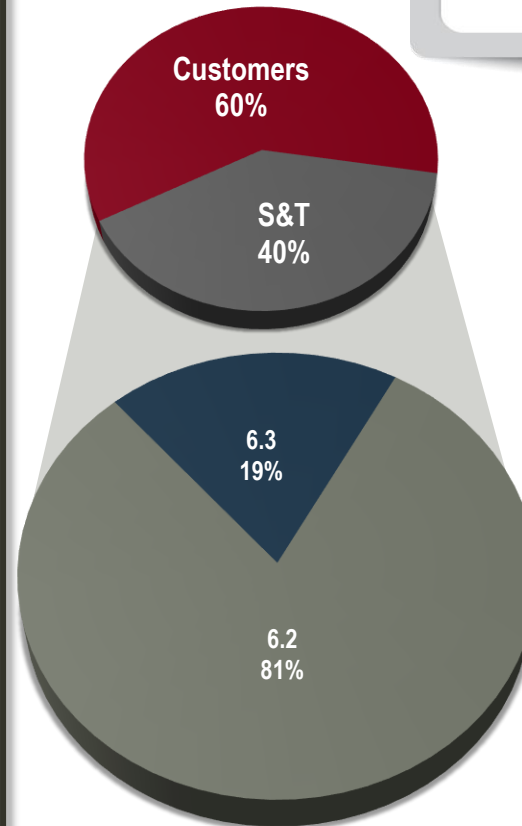
### CRADLE TO GRAVE HOLISTIC POWER & ENERGY DEVELOPMENT

#### *Additional facilities at Ft. Belvoir, VA*

- **Power Generation, Distribution, and Environmental Control Support**
  - Characterize power & environmental control technologies
  - Assess technology maturity and transition Support PM-E2S2 programs & Coordinate joint PM-E2S2 and CP&I R&D transition plan
- **Contract Support:** Provide technical support and leadership for SSEBs & R&D/Production contracts
- **Test and Evaluation Support:** Testing of proof of concepts, prototypes, and first article system; Environmental testing; Modeling and Simulation; Testing of Micro-grid systems
- **Power Assessments:** Provide onsite field support

### CP&ID Power Division Education Levels

- **Undergrad Degree:** 43%
- **Graduate Degree:** 43%
- **Doctorate Degree:** 14%





# KEY ATTRIBUTES – A. RUTH PERSPECTIVE



**Standardization** - Ability to be applied to many different devices. More of a form factor concern and is typically battery-level responsibility.

**Ruggedization in single product** – Drop, impact, nail penetration, bullet penetration, etc.

**Wider temperature operation** – Typically ~ -20°C to 55°C, with storage up to 71°C.

**Safety** – Pass UN 38.3 at cell and battery level at a minimum. Perform nail penetration for understanding (EUCAR Hazard level non-specified at this point). Depends upon platform and approval authority. Ex. Air platform requires Air worthiness

**Reliability** – A Warfighter's life is on the line. Shall not fail.

**Efficiency** - Warfighters must bring all charging capability and energy with them and don't have the luxury of plugging into a wall, where charging inefficiencies are acceptable. Energy transport to the field is a leading cause of casualties (50% of casualties in Iraq and Afghanistan in 2007 were allocated to fuel resupply<sup>1</sup>).

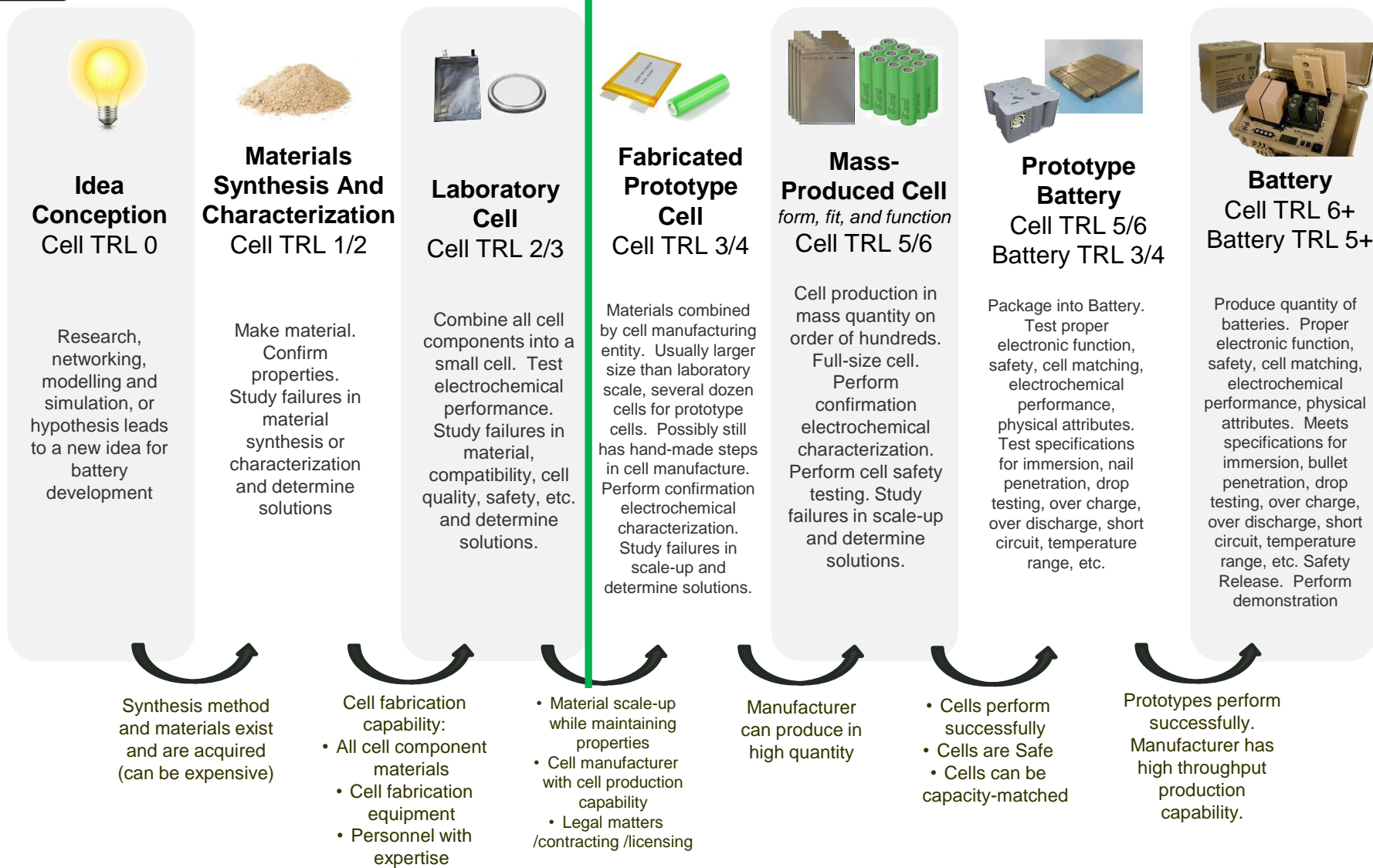
**For Soldier Power specifically:**

- C/5 or better charge and discharge
- High volumetric (~ > 700Wh/L cell level) and gravimetric energy density (~ >350Wh/kg cell level). Must be small AND lightweight
- Something to be said for non-rechargeable chemistries – Not yet a major pull from Army leadership but trends in the commercial sector are for rechargeables. Charging infrastructure is not always available for the Soldier.

1: <https://apps.dtic.mil/dtic/tr/fulltext/u2/b356341.pdf>



# Battery Development Progression to TRL 6



## FROM IDEA CONCEPTION TO TRL 6 BATTERY



# ARMY CENTER ALIGNMENT STRATEGY

**Where to Begin:** Minimum Laboratory Cell, ideally beginning to scale up to prototype cell (~ >500 mAh) to satisfy TRL 3 Cell Level, before this perhaps discuss with our Basic Research Organization: Army Research Laboratory  
*Possible exceptions:* SBIR/STTR and Congressional Program Increase – due to length sometimes applicable since deliverables tend to be higher TRL

## What is your targeted application platform?

Vehicles → Ground Vehicle Systems Center

Air → Aviation and Missile Center

Munitions → Armaments Center

Soldier Portable → C5ISR Center

## **Soldier:** *Below are BATTERY Specifications (not cells)*

Rechargeable Base Specification: MIL-PRF 32383

Non-rechargeable Base Specification: MIL-PRF 32271

Official documents published here: <https://quicksearch.dla.mil/qsSearch.aspx>

Recommendation: type just “32383” or “32271” and you can see the published slash sheets as well for specific batteries. Note: Some are still in draft and not yet published