

| <u>Time</u> | <u>Presenter</u> | <u>Slides</u>   |
|-------------|------------------|---|
| 00 – 10     | Chuck Coutteau   | <ol style="list-style-type: none"> <li>1.Title</li> <li>2.Mission and Vision</li> <li>3.Organizational Thrust Areas               <ol style="list-style-type: none"> <li>a.\$\$\$ statement of ongoing and future work</li> </ol> </li> <li>4.Needs &amp; Requirements               <ol style="list-style-type: none"> <li>a.General statement drawn from FOC, Warfighter Outcome Statement, and Needs Chart</li> </ol> </li> <li>5.How do I do business with TARDEC?</li> </ol> |
| 10 – 25     | Mike Blain       | <ol style="list-style-type: none"> <li>1.Platform Mobility               <ol style="list-style-type: none"> <li>a.POC</li> <li>b.Listing of follow-on subject areas / slides</li> </ol> </li> <li>2.Hybrid Electric</li> <li>3.Energy Storage</li> <li>4.Track</li> <li>5.Suspension</li> </ol>   |
| 25 – 40     | Rocky Patel      | <ol style="list-style-type: none"> <li>1.Power Systems               <ol style="list-style-type: none"> <li>a.POC</li> <li>b.Listing of follow-on subject areas / slides</li> </ol> </li> <li>2.Prime Power</li> <li>3.Non-primary Power</li> <li>4.Power Management</li> <li>5.Thermal Management</li> </ol>   |
| 40 – 50     | All              | <ol style="list-style-type: none"> <li>1.Questions?               <ol style="list-style-type: none"> <li>a.Repeat POC's</li> </ol> </li> </ol>  |

# Report Documentation Page

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**RDECOM**



***TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.***

Advanced Planning Briefing to Industry (APBI)  
TARDEC Ground Vehicle Power & Mobility (GVPM)  
Chuck Coutteau – Associate Director

23 October 2008

UNCLAS: Dist A. Approved for public release



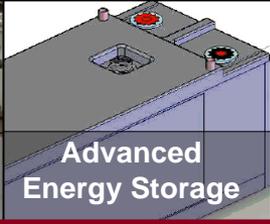
JP-8 Reformer



Engine Testing



Air Cleaner Testing



Advanced Energy Storage



Power and Energy SIL



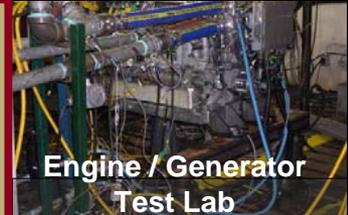
Engine / Generator Test Lab



Advanced Track

**VISION:**  
Be the Army's "Center of Excellence" for technology and engineering expertise for research, development, testing and engineering of ground vehicle power and mobility technologies – today and tomorrow.

**MISSION:**  
Provide technically sound and timely responses to the soldiers' current and future needs for technology and engineering expertise in ground vehicle power and mobility technologies.



Full Load Cooling Test



Transmission Testing



Air Conditioning Test



Auxiliary Power Units



Advanced Power Electronics



Engine Research



Integrated Power and Thermal Systems



APU Testing & Analysis



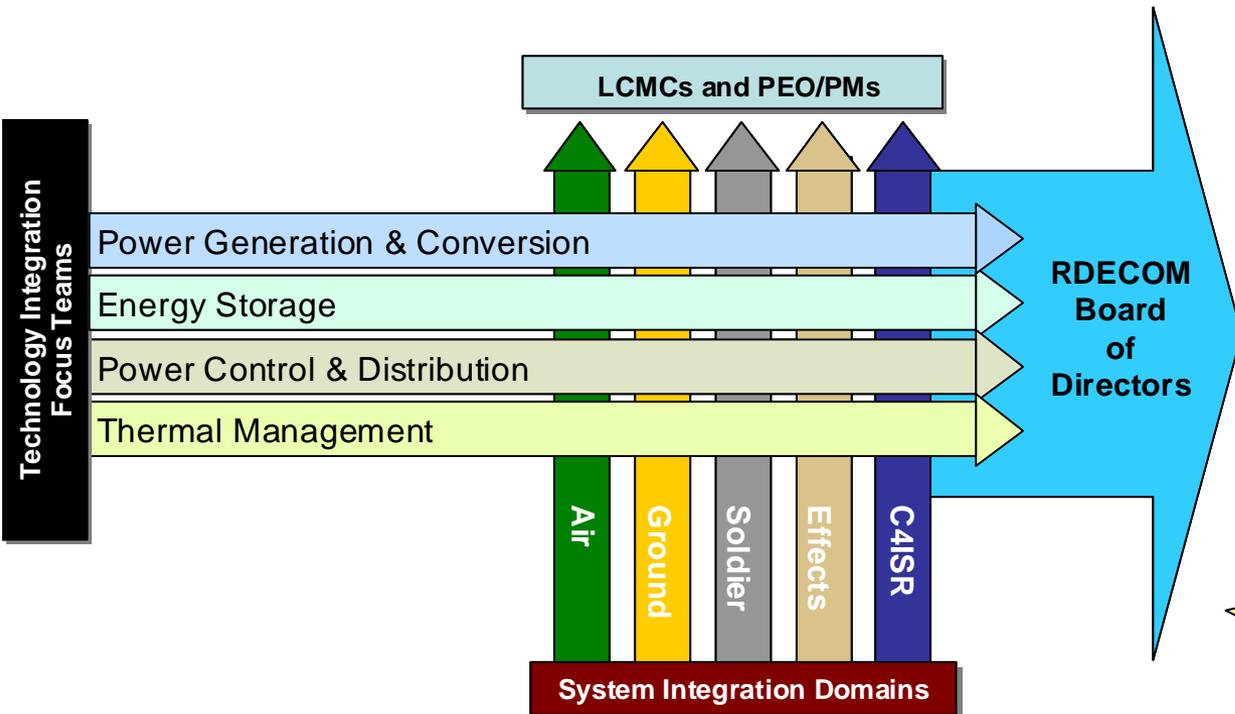
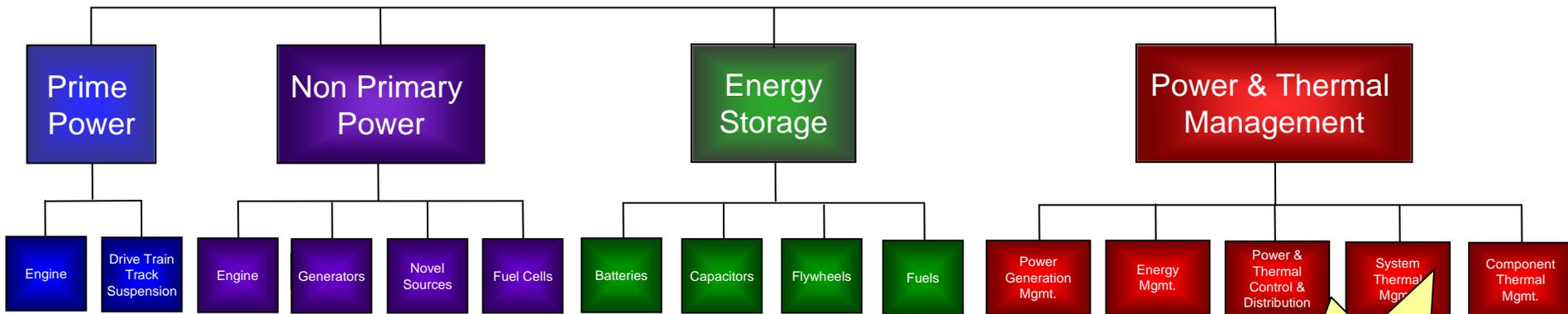
Elastomer Research



Advanced APU Engines



Energy Storage



TARDEC has 217 Ongoing P&E projects with a total funding of \$275M

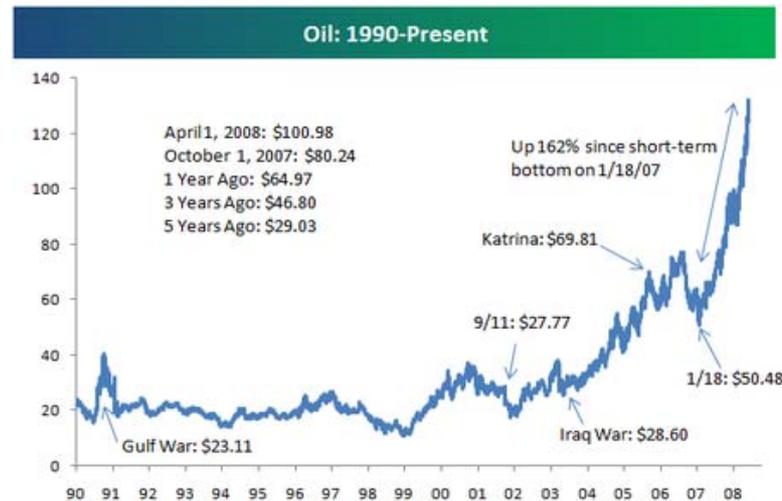
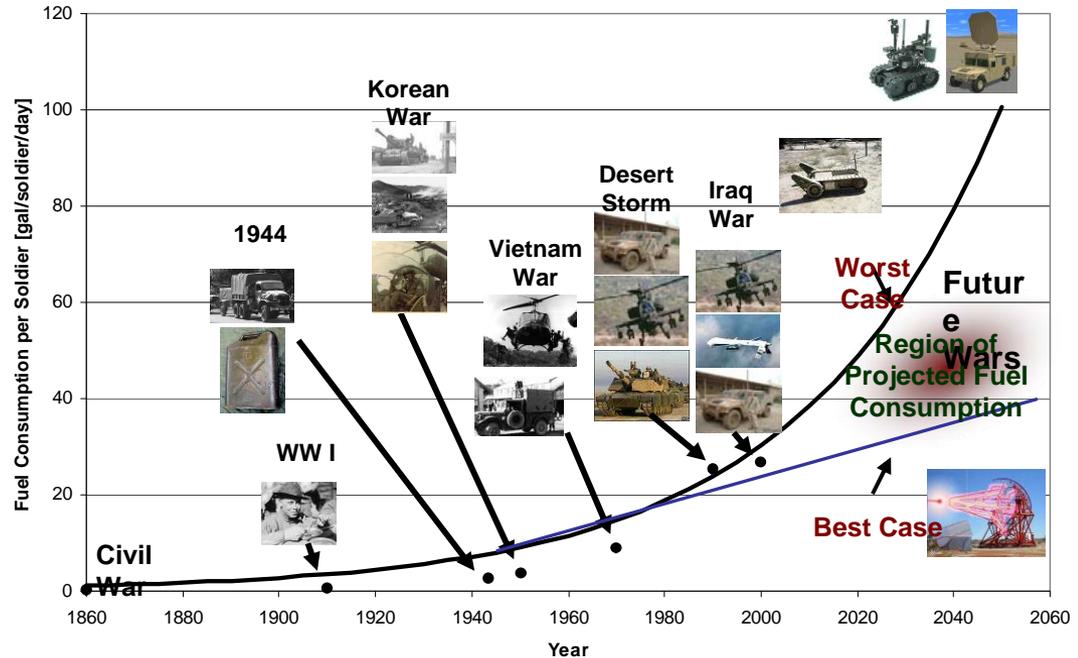
**Synchronized and Aligned Command Technology Solutions**

Each year brings new funding of ~\$100M. Most is already programmed, with more discretionary funding in out years

TARDEC's Ground Vehicle Power and Mobility organization is striving to meet the requirement to provide enhanced worldwide operating agility to the current and future U.S. military ground vehicle force **by reducing significantly the weight and volume of fuel required to power that force.**

Combat platforms require significant increases in pulsed power and continuous power capabilities to enable superior tactical mobility, speed, firepower, an excess capacity for on and off-board power, while **simultaneously making significant improvements in fuel economy.**

The task is formidable, and TARDEC welcomes innovative solutions from new and existing industry partners.

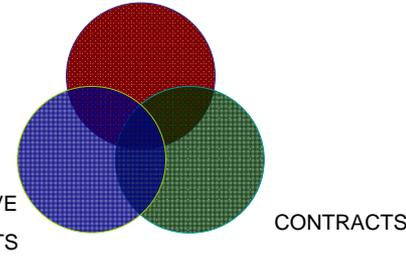


<http://contracting.tacom.army.mil/opportunity.htm>

Questions to answer before approaching TARDEC:

- What TRL is my technology at?
- Am I willing to disclose enough test data to make my case?
- Is there other funding that can be leveraged?
- Do I have other federal funding working this technology, and who are the POC's?
- Does my accounting system restrict what federal contracts I can be awarded?
- Do I qualify for special consideration? (Small business, woman / minority owned, 8A, hub zone...)

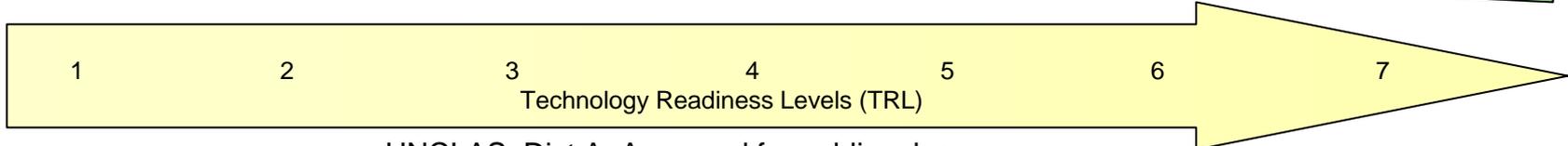
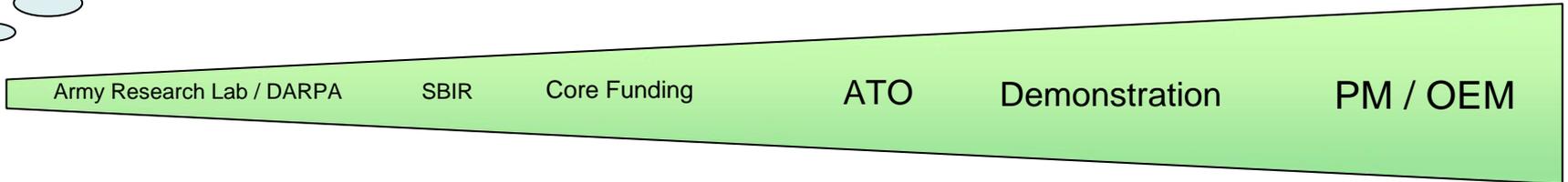
Federal employees do not sign NDA's because federal law carries **criminal** penalties for disclosure



Regulatory Guidance:

- FAR (Federal Acquisition Regulation)
- DFARS (Defense Federal Acquisition Regulation Supplement)
- DODGARS (DoD Grants and Regulatory System)
- ITAR (International Traffic in Arms Regulations)
- EAR (Export Administration Regulations)

Where do I enter the acquisition cycle?



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## Areas of Responsibility Include:

- Hybrid Electric Technology
- Energy Storage Technology
- Track Technology
- Suspension Technology

**Problem:**

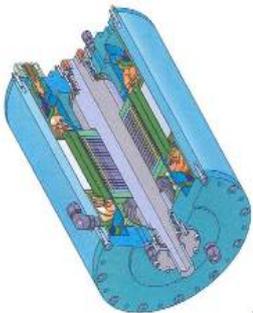
Hybrid electric systems for combat and tactical vehicles challenged to meet mobility requirements within the specified space and weight constraints.

The State Of the Art power electronics operate at low temperatures resulting in large cooling system which also requires a significant amount of power from the prime mover.

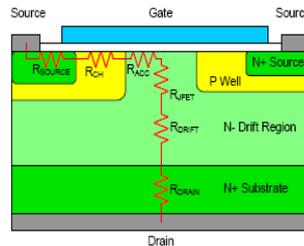
These challenges result in over sizing the engine/generator to gain power lost to the cooling system.

**Research Challenges:**

- Research high temperature / high frequency compact power electronics.
- Research high power / high torque density motor / generators.
- Research advanced power electronics and component thermal management.



Traction Motor



SiC Power Electronics



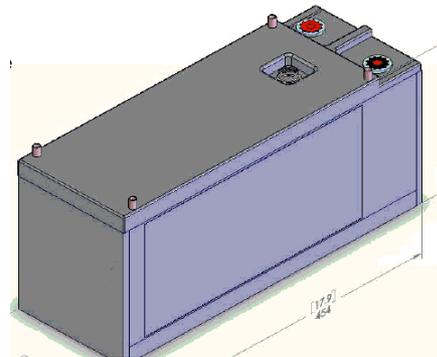
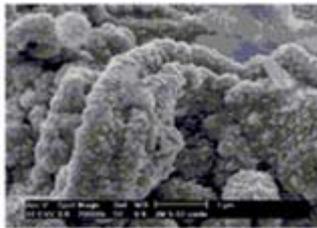
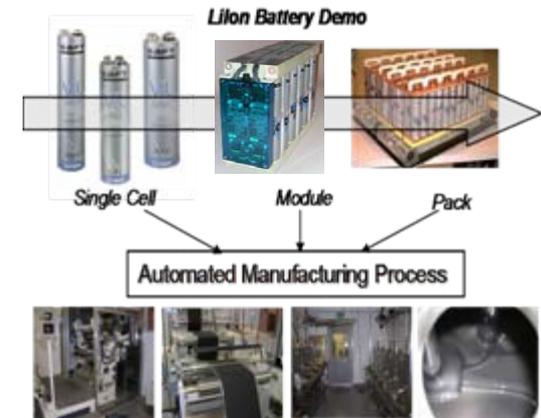
Power & Energy SIL

**Problem:**

High power Li-Ion battery pack sized for combat hybrid electric vehicles is extremely costly. High power Li-Ion batteries for combat hybrid vehicle application must be safer and more reliable.

**Research Challenges:**

- Research thermal runaway process and its control.
- Research power vs. energy trade-off design optimization.
- Research manufacturing process development and cost control.
- Research thermal management.
- Research cell & system, safety & reliability.
- Research system control & cell and battery management systems.
- Research alternative electrochemical improvements.

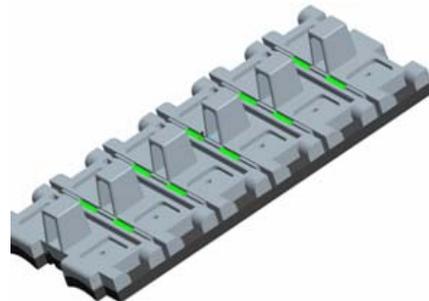


## **Problem:**

Future combat vehicles desire lightweight track with no degradation in robustness or field supportability.  
Current lightweight track durability challenged at higher GVW vehicles.  
Current lightweight track prone to anti personnel mine blast damage.  
Elastomer components are track system life limiter of legacy track fleet.

## **Research Challenges:**

- Research new lightweight metallic materials for track system application.
- Research understanding of mine blast event to improve track survivability.
- Research elastomers for improved life spans under high stress / high temperature conditions

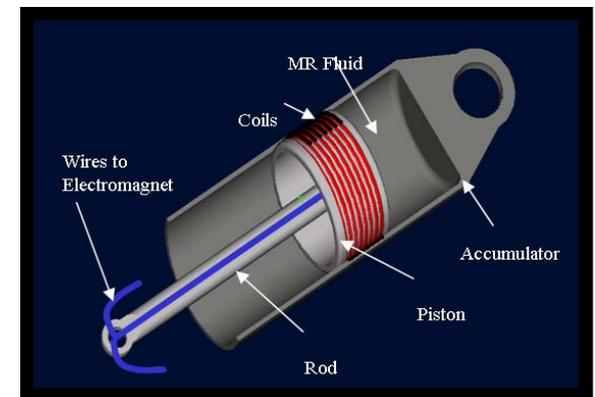
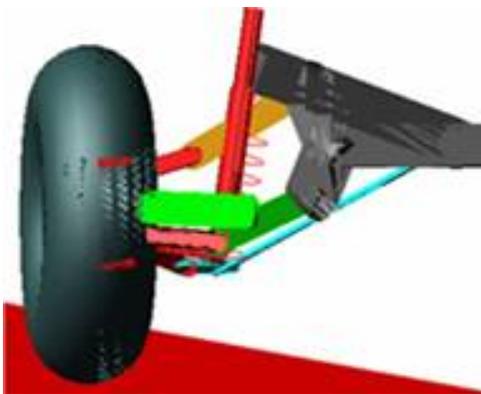


**Problem:**

Army Tactical and Combat vehicles require superior performance for battlefield dominance. Up-Armoring of existing vehicle fleet challenging stock suspension components.

**Research Challenges:**

- Research novel suspension components with adaptive control.
- Research suspension components with adjustable weight carrying capacity.
- Develop suspension components for robust, passive default, outside armor application.



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## Areas of Responsibility Include:

- **Prime Power (Engine) Technology**
- **Non-primary Power System Technology**
- **Power Management Technology**
- **Thermal Management Technology**

## **Problem:**

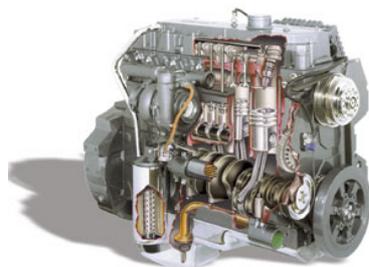
Current high power commercial engines are not compact enough for future manned ground combat platforms.

Future ground combat vehicles will require lighter and more efficient engines that occupy less space.

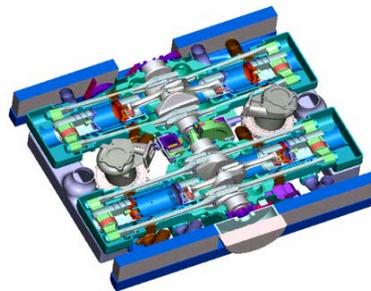
Current state of the art engines require significant development operate on one fuel and meet future vehicle power and mobility needs.

## **Research Challenges:**

- Diesel combustion research to increase physical burn time.
- Propulsion system research to increase power density.
- Engine thermal management research.
- Research combustion optimization strategy for JP-8 military version of an emission compliant commercial engine.



Diesel Engine Research



Advanced Engine Research



Advanced Combustion System Research

## Problem:

Current non-primary power approach in field is inadequate for silent watch.

Lead-acid batteries store insufficient energy to meet War Fighter requirements for vehicle silent watch (main engine off). Silent watch requirements vary from several hours to 24 hours. Current approach requires restarting of main engines during silent watch to recharge batteries, causing excessive fuel use, acoustic and thermal signatures.

## Research Challenges:

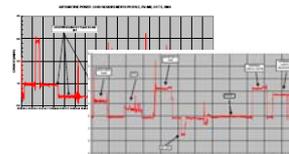
- Research engine-generator technologies with high power densities and low acoustic signatures.
- JP-8 reformation and de-sulfurization necessary for battlefield fuel cell application.
- Fuel cell power units need higher power densities and ruggedization for battlefield application.
- Research fuel cell hybridization with batteries and ultra-capacitors.



*Rotary Engine APU*



*OPOC APU*



*Non-propulsion  
Load Analysis*



*SOFC APU*

**Problem:**

Current and future force electrical power demands exceed power generation and energy storage capabilities. Advanced power generation systems depend on sophisticated control methodologies for safe operation. Limited fuel availability in the field. Increasing number and size of electrical loads on a vehicular platform increases the heat generation. Presently, no automated way to recover from faults and induced faults (i.e. Sympathetic tripping, chain tripping of loads). Current vehicular electrical architectures contain vehicle-unique electrical components which increase the logistics burden.

**Research Challenges:**

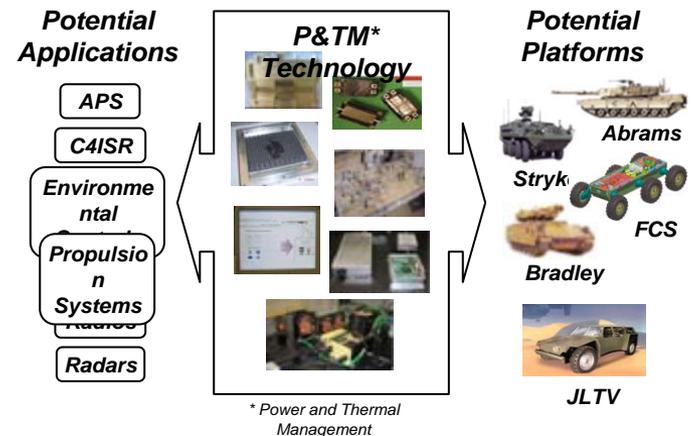
- Research ability to accurately monitor and control the power distribution and react to fluctuating loads and sources in real time through algorithm development.
- Research common architecture approach (plug & play) for future electrical power equipment insertion.
- Research power requirements of military equipment and load management strategy.



Software Standard



Flex cable/PCU integration



## Problem:

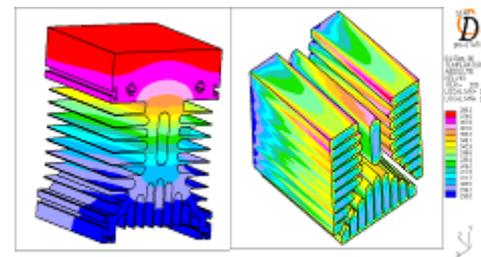
- Cooling systems are not sufficient to meet future hybrid electric combat vehicles requirements.
- Increases in electrical power demand proportionately increase cooling systems' volume and weight.
- Thermal degradation has direct impact on component life and reliability.
- Lack of intelligent control strategies for power system adds to thermal burden.
- Debris and contamination cause damage to vehicle power train components.

## Research Challenges:

- Research heat transfer techniques for the military vehicle application.
- Research improvements in capabilities for filtration (liquid and air) without increasing the system physical size.
- Research compact high efficiency transmission systems
- Research intelligent thermal (heating/cooling) management system



Analogous flow network model



Computational fluid Dynamics (CFD) model



# Questions



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