



**communications**

***Integrated Starter Generator***

***“More than a 24V Vehicle Power Supply”***

**L-3 Combat Propulsion Systems**

**Muskegon, MI 49442**

**Presented by**

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Unclassified - Approved for Public Release

# Talking Points

- # Power & Energy – Critical Combat Enablers
- # ISG System Architecture
- # Performance Capabilities
- # Retrospective



# *Over-Arching Technology Requirements*

- # Build Lighter and Smaller (Weight, Volume)
- # Build to Last (RAM)
- # Build User-Friendly (Interfaces, displays, and automation to manage operator workload)
- # Reduce/Manage Required Network Bandwidth
- # Build Affordably (Production Cost Reduction)



# *Terms of Reference*

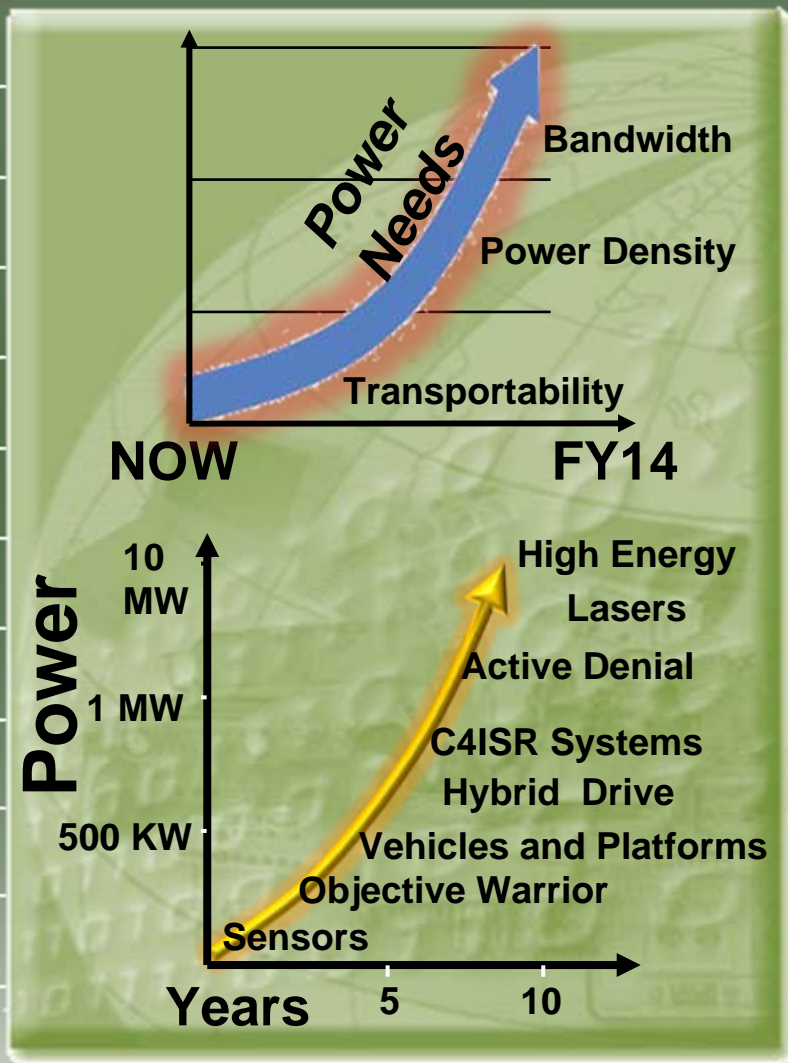
- # High Energy Systems (High Value) will dominate the “Future Battlespace”
- # Tactical Vehicle designs impose severe limitations on volume and weight
- # Fuel Economy is Combat Power ... a key performance parameter
  - # Energy Density is the primary figure of merit for mobility solutions
  - # Long term commitment to manufactured liquid hydrocarbon fuels from domestically abundant feedstocks (Bio-diesel, methanol, ethanol)
  - # Hydrogen presently unsuitable for tactical mobility fuel but is feasible for hotel power
- # Network Centric Operations and increasing bandwidth are driving electrical power requirements exponentially
- # U.S. Defense has committed to hybrid-electric architecture for FCS and future Tactical Wheeled Vehicles (e.g. JLTV)

***Power and Energy are Critical Transformation Enablers***



# The Power Issue

- # **Total System Energy Management:** is a critical resource for future economies
  - # **Stability/instability** of World regions
  - # Energy “independence” should be based on **diversity**
- # **Scaleable Options:** Concepts must include methods for supporting and facilitating natural resources and alternative energy sources
  - # **Highest Possible Packing Density and Utility** to maximize system’s use
  - # S&T funding is supporting **fuels/synfuels/bio-diesel** research



*“Power”... Critical Resource on Tomorrow’s Battlefield*

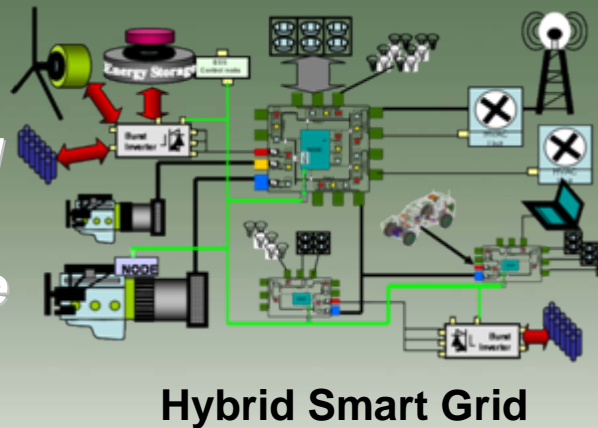
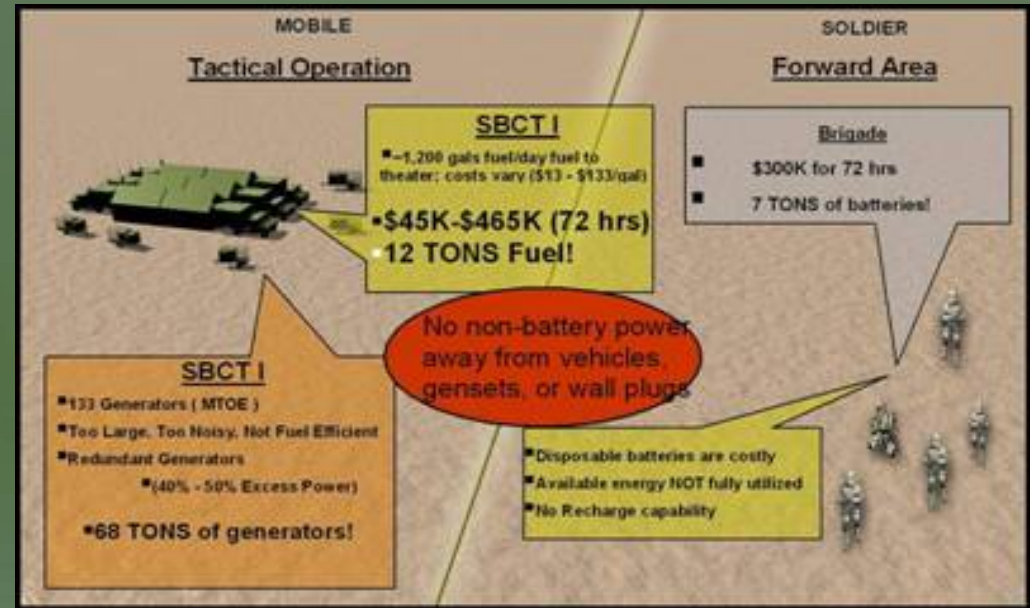


# Adv Mobile Electric Tactical Power Sources

Addresses Power Generation Mission Capabilities Gaps (5-75kW) to support Future Force and dismounted warfighter

Development of high power density (>1kW/kg) systems (generators and fuel cells)

Development of Hybrid Intelligent Power Mgmt architecture using node control switchgear



30 kW  
Modern  
Tactical  
Quiet  
Generator



OPOC-FL  
1.5kW

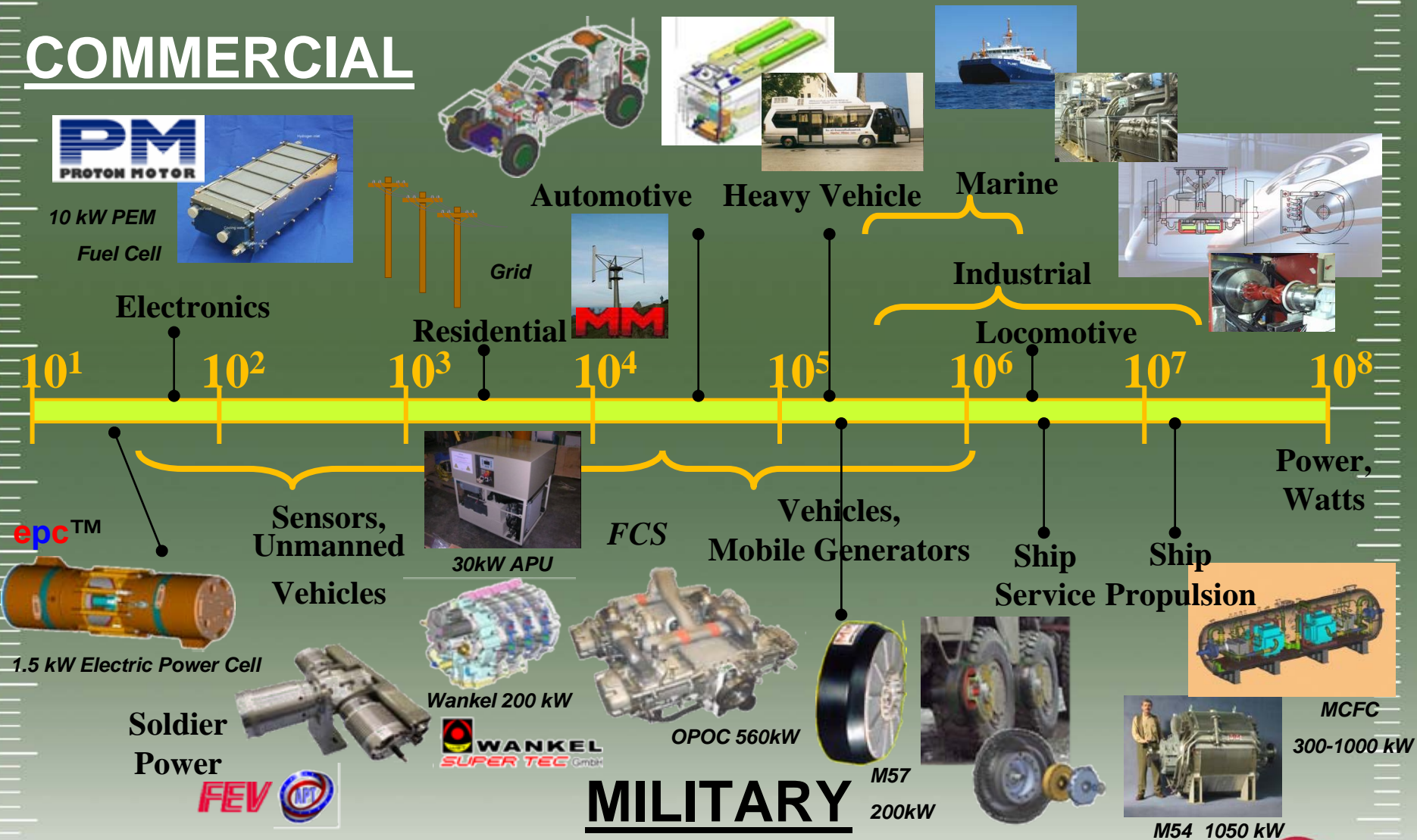


# Proven Exportable Power Systems: TRL 6-7



# L-3 Commitment to Hybrid Architectures

## COMMERCIAL



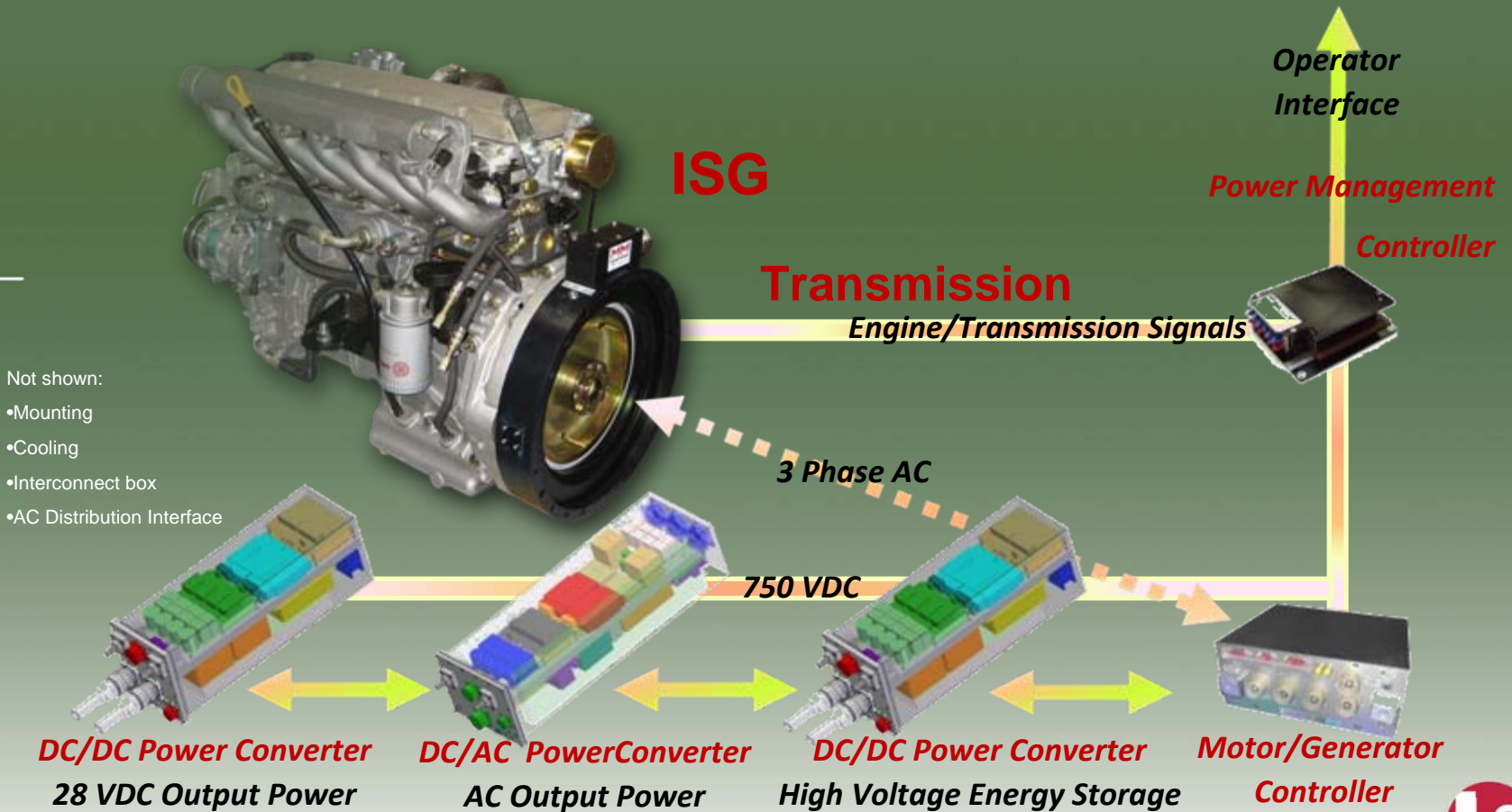
## MILITARY





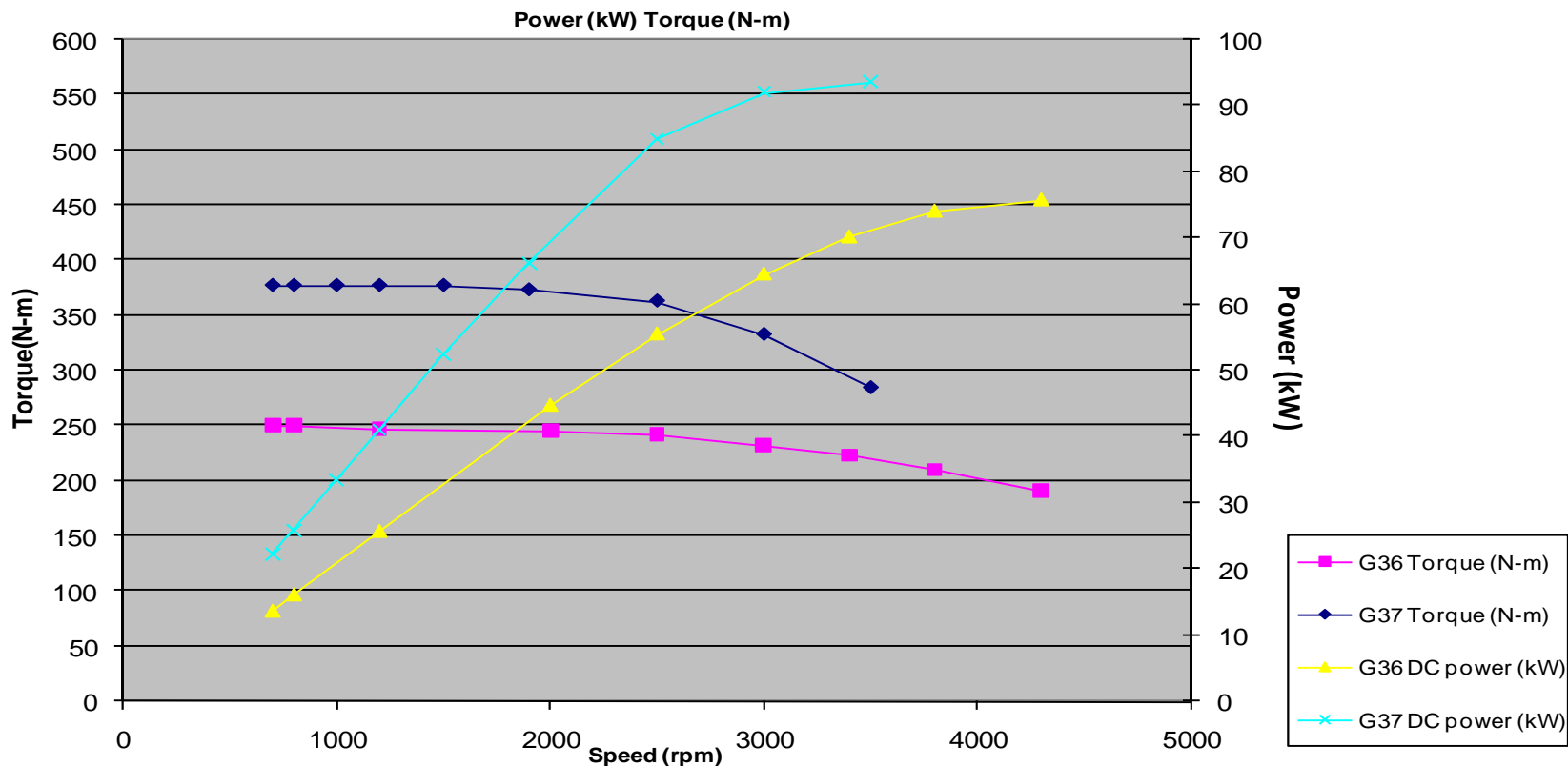
# ISG System Architecture

- Design based on military application prototypes
- Modular capability with incremental power 20-110kW

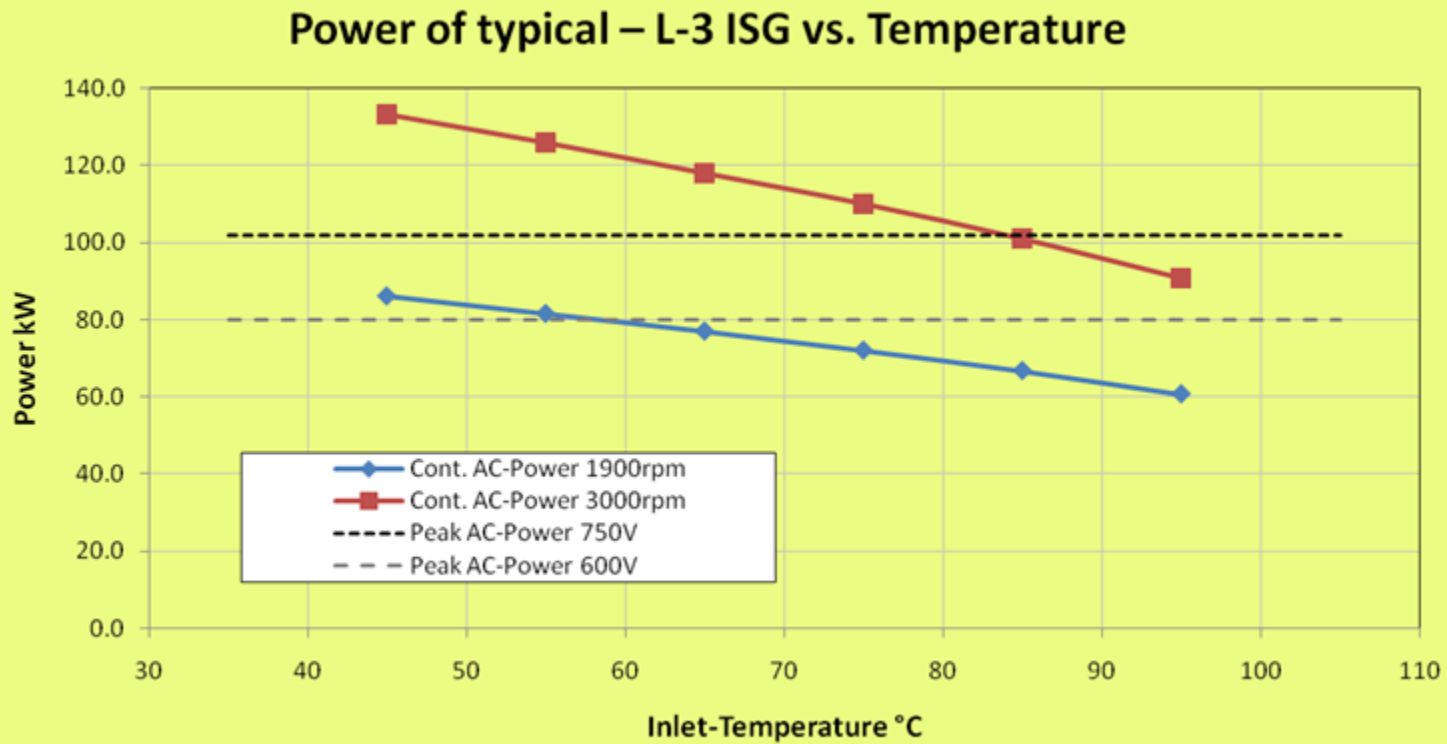


# Nominal ISG Performance Capabilities

G36 and G37 + S31 Continuous Generator Power  
(@750V)



# ISG AC Output vs. Temperature



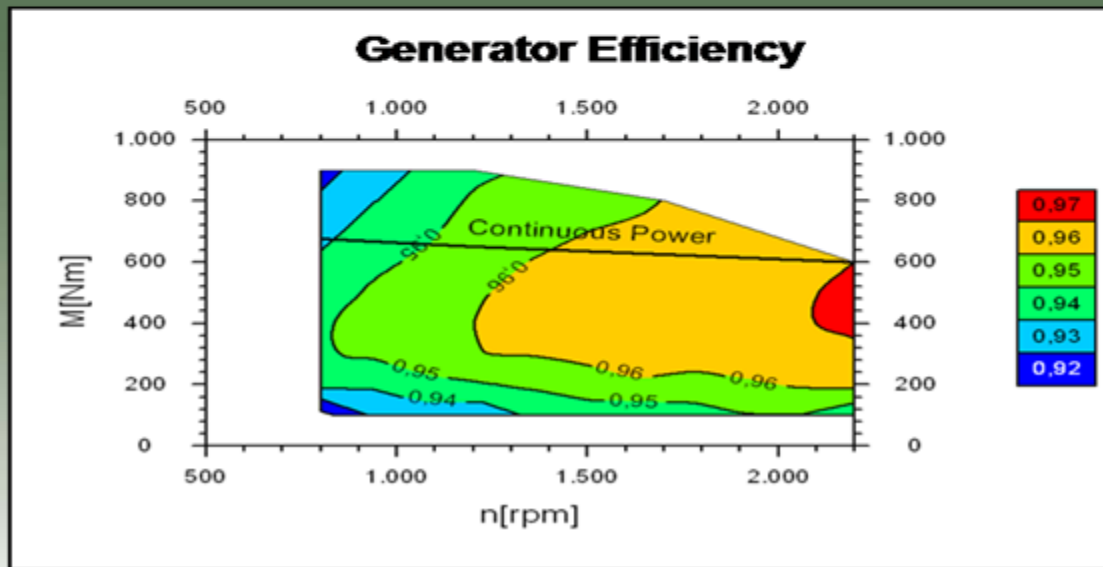
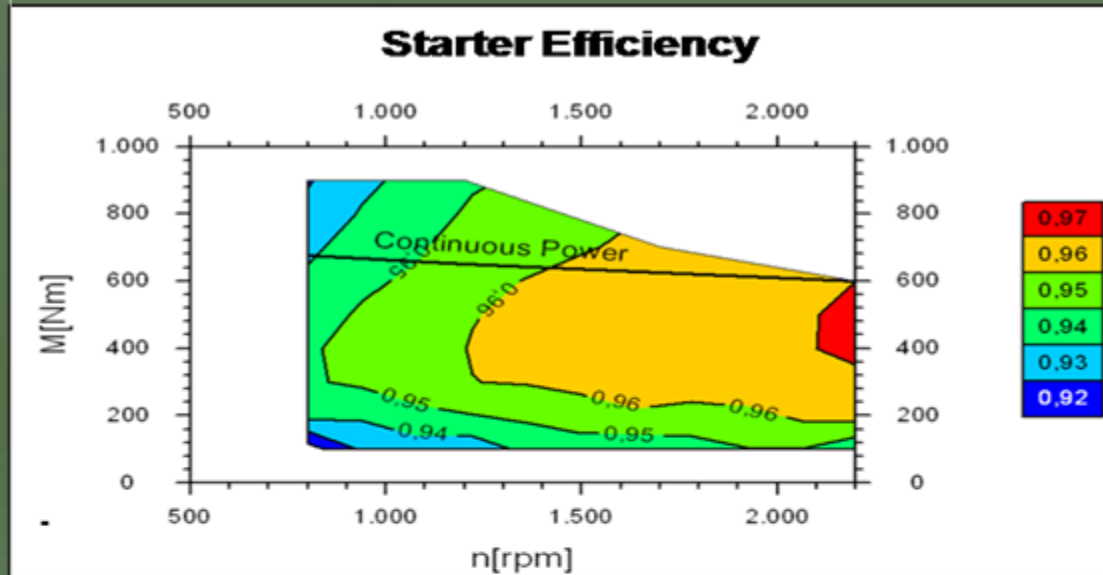
- AC-Power = Power at 3-Phase between Generator and PE
- Cont = Continuous = Thermal Limit
- Peak = Possible Power due to DC-Voltage, BEMF and Inductance of Coils

#### How to use:

- 1) Choose rpm + chose Inlet temp -> get possible cont. Power
  - 2) Choose DC-Voltage -> get possible Peak Power
  - 3) Power that can be used = Minimum of 1) and 2)
- DC-Voltage-dependency indicates that lower temp does not always mean higher power.



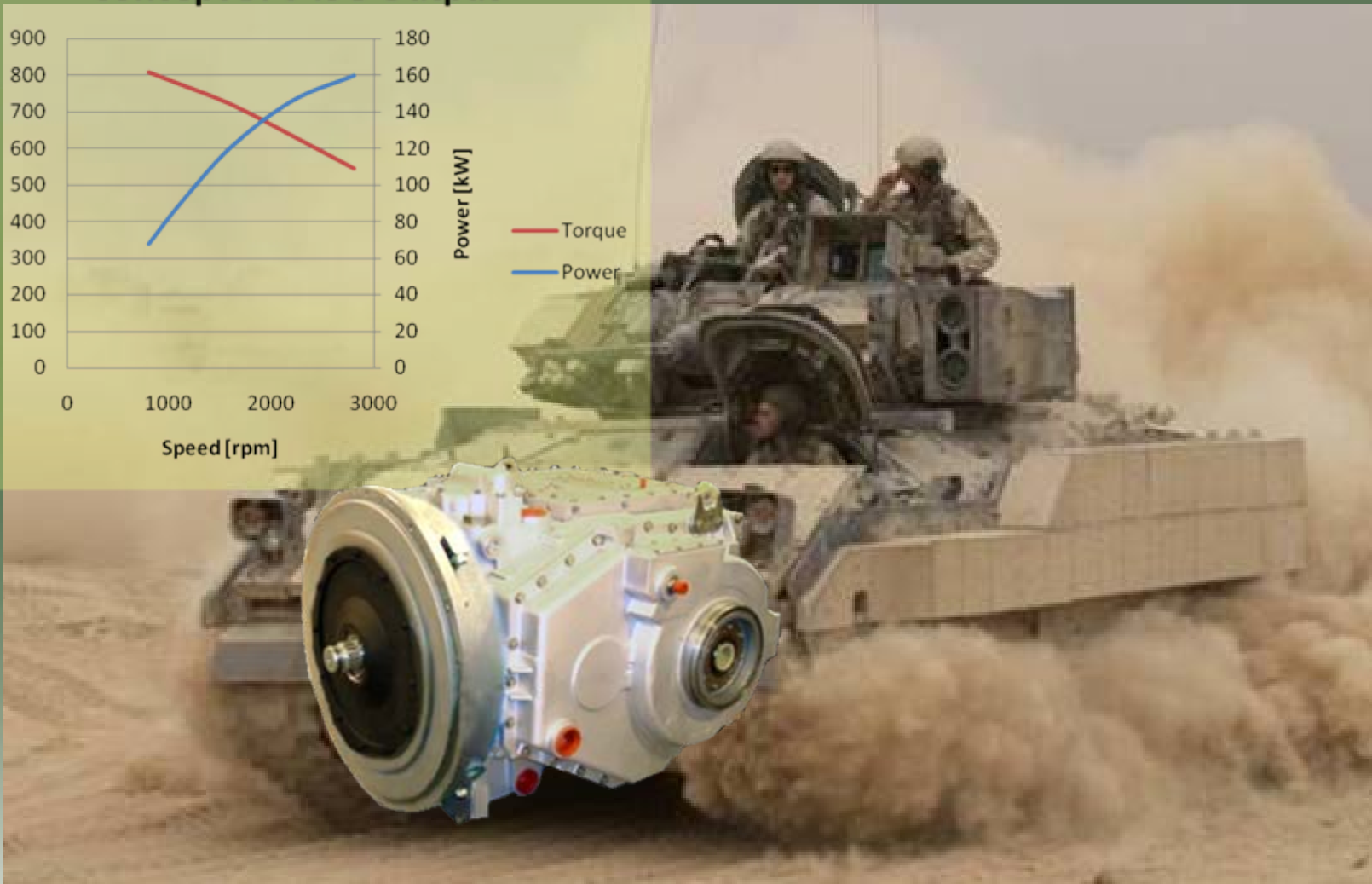
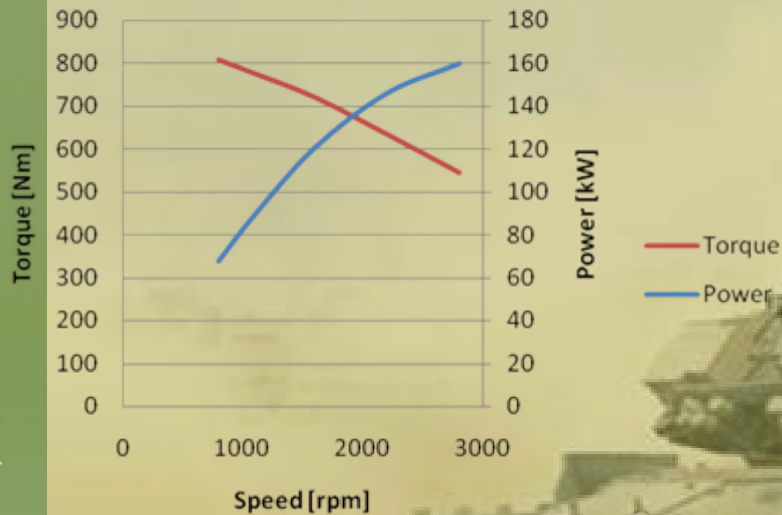
# G37 - ISG Motor /Starter Efficiency



# HMPT 600/675/800 with ISG

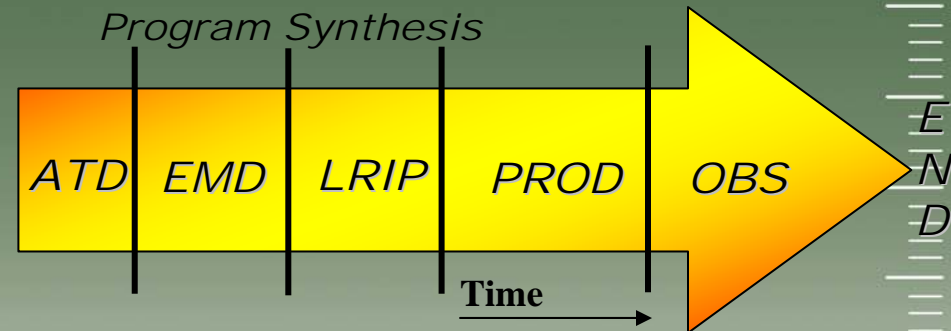
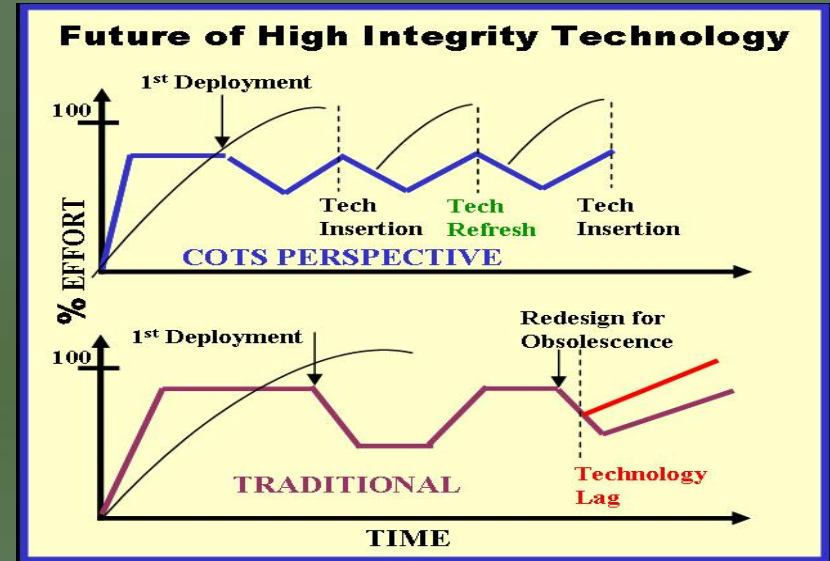


### Concept BFV ISG Output



# Open Systems Technology

- # Leverages Hybrid and energy management validated legacy
  - # **Combat Vehicle Concepts & Iterations**
  - # **Wheel-hub drive product application**
  - # **High energy / Power Density**
- # Seamless Horizontal Technology Insertion into current and future platforms
- # Dual use COTS / NDI components maximizes affordability



*HEV modular power control design  
provides continuous upgrade/modernization during the life of the system*



# Retrospective

- ❖ Evolutionary acquisition focused on spiral development
  - New technology that gives conventional systems more capability
  - New technology that provides unconventional capabilities
- ❖ Multi-dimensional options
- ❖ Logistics transformation enabler
  - Builds, generates and sustains combat power
  - Pathway to energy “independence”

- # L-3 CPS is meeting emergent challenges with innovative applications of leading technology and extensive expertise in engineering and analysis
- # The Presence of Hybrid Powered Vehicles and Energy Generation Systems permits the utilization of broad ranging concepts for energy management that will revolutionize the makeup of future economies and infrastructures
- # Energy Management Architectures and Power Distribution Products are modular and scalable to provide maximum system flexibility
- # Spin-Out technologies (FCS/JLTV) applications provides current and future force systems growth margins to meet emerging requirements

