

# **Electric Drive Approach to Mobile Power Platforms**

**Oshkosh Truck Corporation**

Nader Nasr  
Chief Engineer  
Advanced Products Group



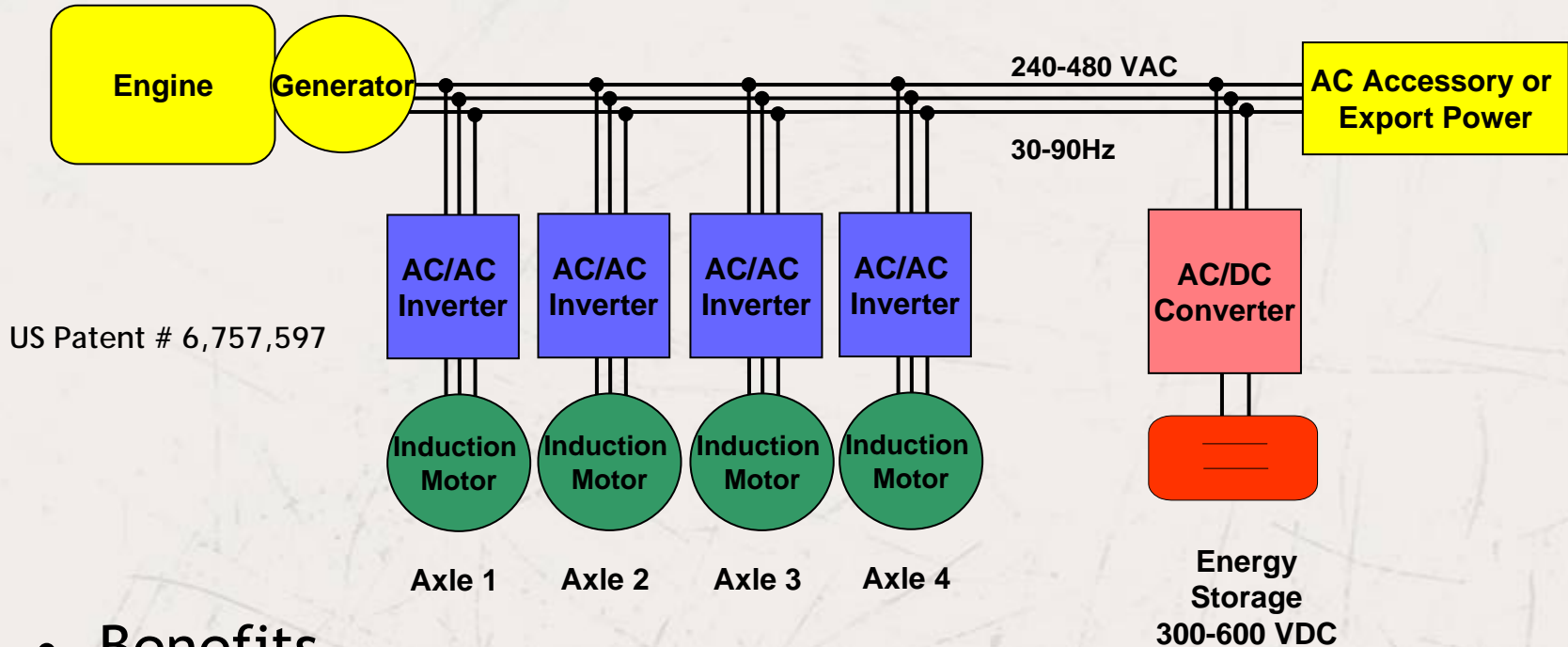
# On Board Vehicle Power

Responding to military's needs for power in the theater

- **Military Relevance**

- Increased mobility, power for onboard weapons
- Back up power for mission critical equipment
- Increased cargo space, reduced logistic footprint
- Power options for early entry forces, high speed mobility

# ProPulse® Electric Drive System



- Benefits

- Large amounts of AC power available for export
- Energy storage is an option
- No batteries
- Zero voltage maintenance
- Improved fuel economy
- Enhanced packaging flexibility

### HEMTT A3

- TACOM PM Heavy
- Improved fuel efficiency
- 100 kW Export power



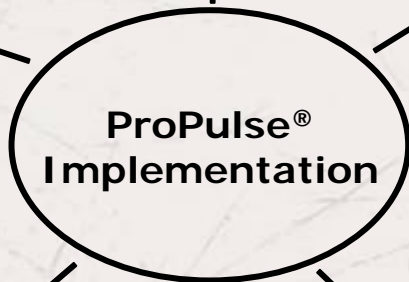
### MTVR OBVP

- ONR funded program
- 120 kW of export power
- Maintain vehicle performance



### Advanced Heavy Hybrid Propulsion System

- DOE / NREL 3 yr program
- Target 2x fuel economy
- Validation vehicle / Waste Management



Homeland Security



ARFF Applications



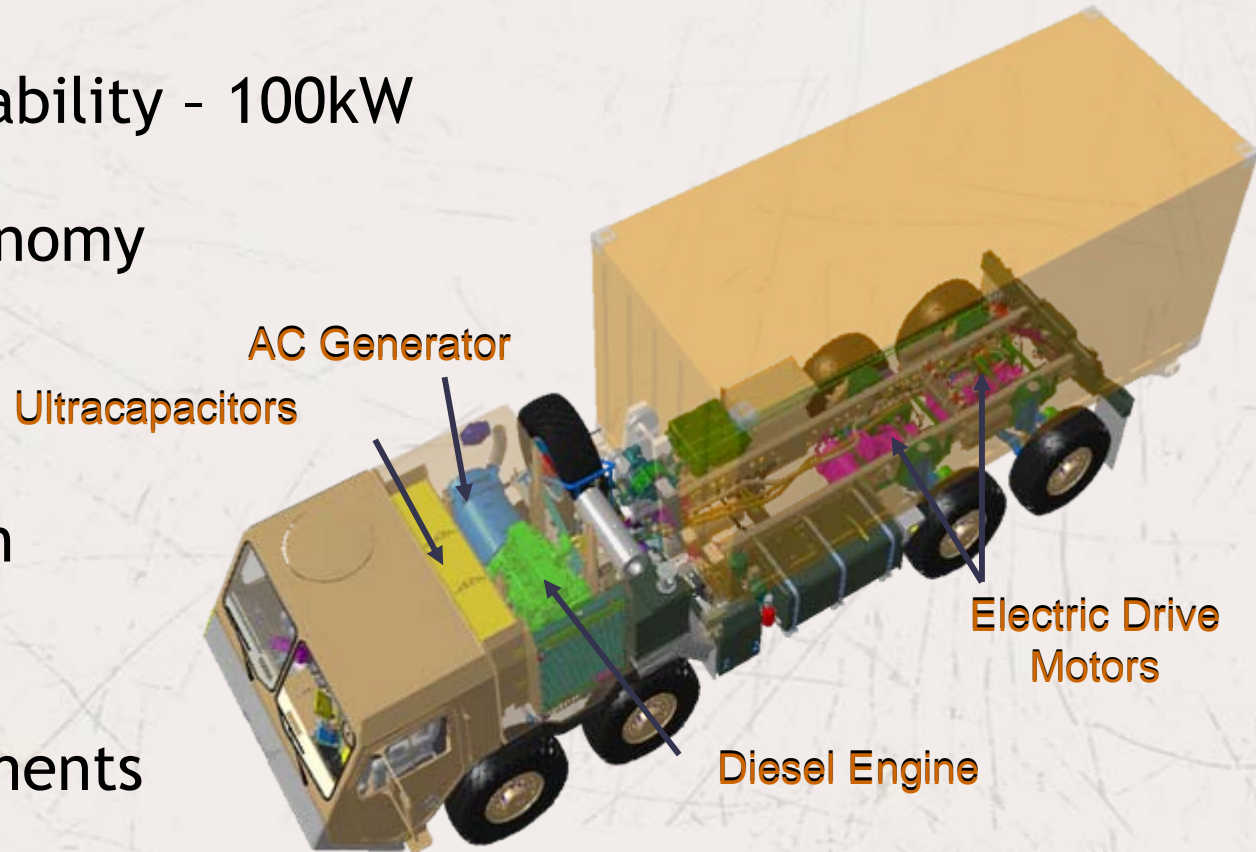
# HEMTT A3



# HEMTT A3

## Program Primary Objectives

- Export Power Capability - 100kW
- Improved fuel economy
- Advanced Load Handling System  
light weight design
- Meet HEMTT  
objective requirements



# HEMTT A3

## Key Technologies - Present

- Light weight modular design
- Diesel electric series hybrid
- Ultracapacitor Energy Storage
  - No batteries, life of vehicle design
- 100kW Exportable AC power
- Variable height independent suspension
- Multiplexed electrical system w/ advanced diagnostics
- C-130 unload capability
  - Enhanced Load Handling System (ELHS)





# HEMTT A3

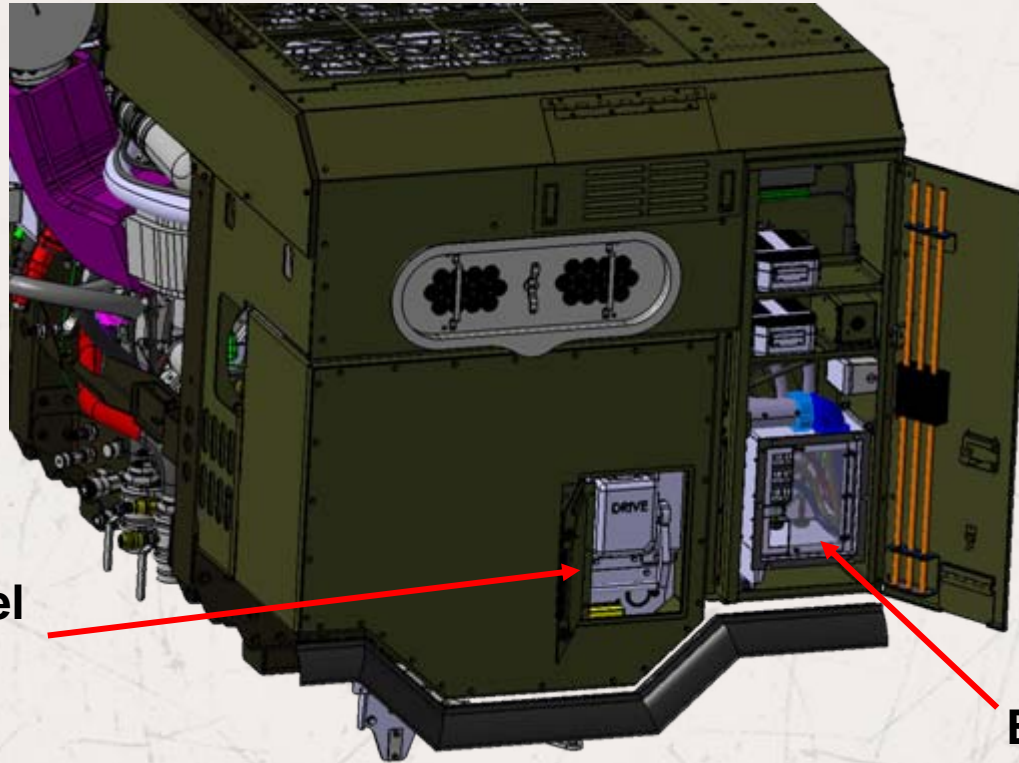
## Testing Completed

- 12K miles off road - Nevada
- Vehicle Performance testing
  - PSD Aberdeen
- Export Power Performance
  - PSD Aberdeen
- Fuel Economy >20% improvement





# HEMTT A3 – Power Module



Reconnect Panel

Export Power Interface

Exportable Power:

100 kW @ 480 V or 240 V 60 Hz

86 kW @ 416 V or 208 V 50 Hz

86 kW @ 120 V 50 Hz or 60 Hz

# Export Power Vehicle Interface Screens

## Export Power Controlled From Inside Cab

- Adjustable voltage (primary voltage and fine adjustment)
- Adjustable frequency (primary frequency and fine adjustment)
- AC contactor on/off (turning on and off output power)



# Export Power

Platform System Demo, August 2006 Aberdeen Test Center

## Tests Performed:

- Short Term Transient
  - Response MIL-STD-705C
  - Section 608.1
- Long Term Steady State
  - Stability MIL-STD-705C
  - Section 608.2
- Harmonic Analysis
  - MIL-STD-705C
  - Section 601.4





# MTVR On-Board Vehicle Power Office of Naval Research

BAA – 04 – 011



# MTVR

- Performance

- Oshkosh TK-4™ Independent Suspension
- 70% Offroad Mission Profile
- 7.1 ton payload cross country
- 15 ton payload primary and secondary roads



- MTVR Based Variants

- Cargo, Dump Truck, Wrecker, HIMARS Re-Supply Vehicle, Tractor, LHS (load handling system)

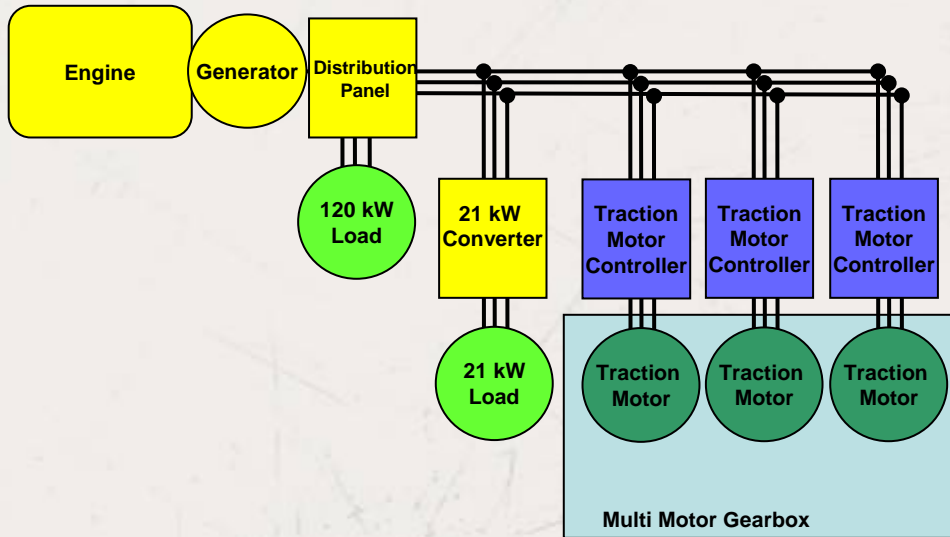
# MTVR OBVP Program – ONR Objectives

- Provide vehicle integrated power source
  - 120 kW of military grade export power
  - 21 kW of power on the move
- Easy retrofit of existing MTVR vehicle
- Use host vehicle's diesel engine for both mobility and power generation
- Retain MTVR performance
- Minimize weight
  - 25 lb / kW Threshold
  - 20 lb / kW Objective

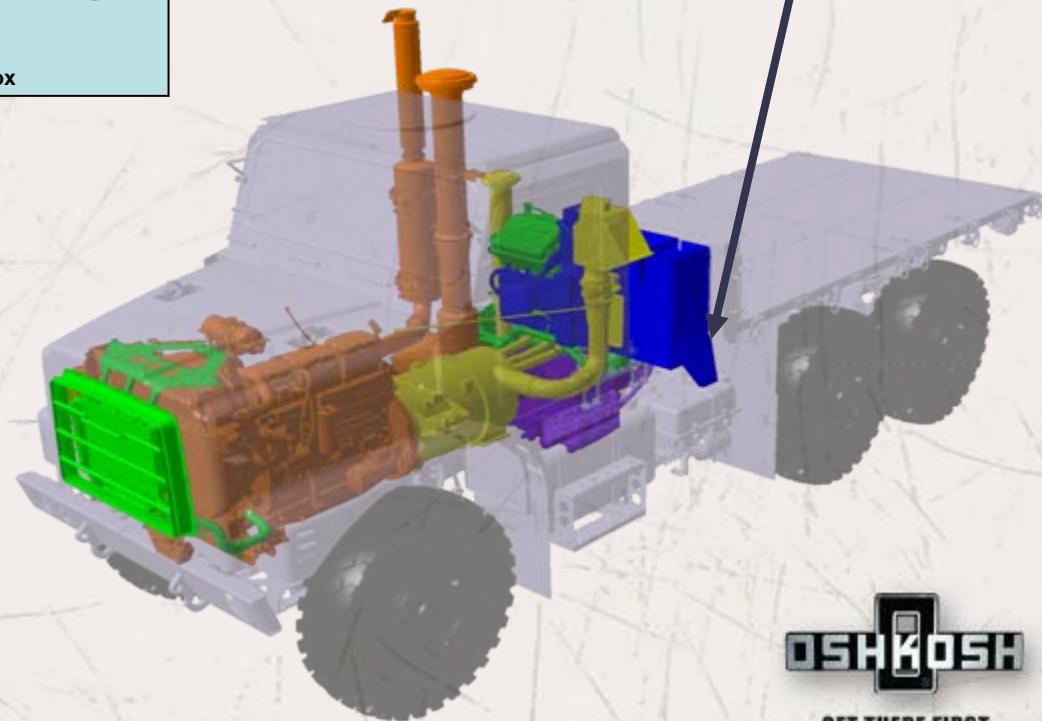




# OBVP System Overview



Export Power Interface



- Pure diesel electric solution
- No Energy Storage
- Synchronous generator design

# OBVP Design

- 300 kW traction generator used for vehicle driving and providing stationary export power
- Synchronous generator design
  - Clean military grade power
  - No need for power electronics or conditioning
- Cab display is used to initiate switch over, voltage and frequency adjustments and diagnostics



# Export Power Performance

- 5 wire CAM style connection - Marine Corps request
- Meets requirements of tactical quiet generator
  - 120 kW of stationary export power
  - 21 kW of power on the move
- Exceeds objective requirements, achieved 19 lb/kW





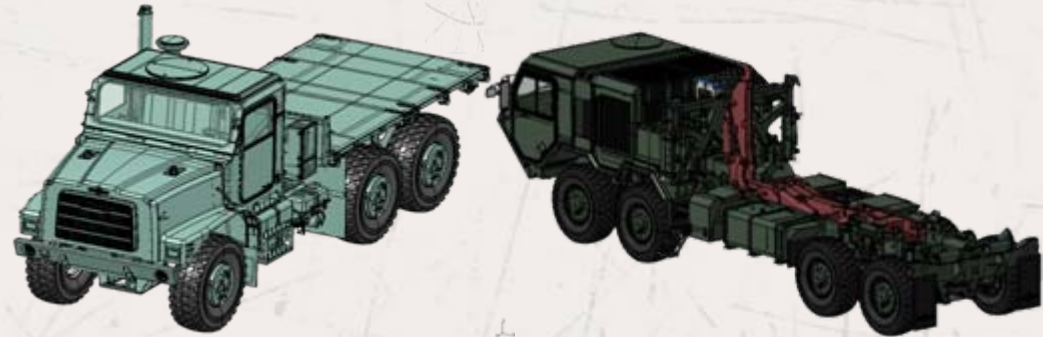
# Project Status

- OBVP build complete – January 2007
- Vehicle commissioning complete – March 2007
  - Basic driving functionality
  - 120kW stationary export power
- Deliver for Government durability testing – December 2007



# Summary

- Oshkosh's diesel electric technology presents a unique and superior solution for large mobile power requirements
  - lb/kW
  - \$/kW
  - Power quality
  - No batteries
- Leverage developed ProPulse<sup>®</sup> system and components
- Provide simple wiring interface, and swift transition to exporting power



# Far Reaching Benefits

- Commercial
  - Improved MPG
  - Lower emissions
  - Packaging flexibility
  - Disaster relief
    - Export power 100 kW+
- Defense
  - Lower logistics burden
  - Export power
    - 100 kW+ Mil spec AC power
  - Higher performance
  - Increased functionality
  - Improved MPG



ProPulse® Technology Demonstrator – Katrina Support



# MEP Power Generation

Generation

Distribution



3 kW TQG  
MEP – 831A  
B0730



Commercial 25 kW  
HMMWV Towable  
Non-TQG  
No TAMCN



60 kW TQG  
MEP – 806 A/B – 60 Hz  
MEP – 816A – 400 Hz  
B1021 / B1016



15, 30, & 100 kW  
MEPDIS  
B0595 / B0600 / B0605



2 kW MTG  
MEP – 531A  
*New to USMC*



10 kW TQG  
MEP – 803A – 60 Hz  
MEP – 813A – 400 Hz  
B0891 / B0921



30 kW TQG  
MEP – 805 A/B – 60 Hz  
MEP – 815A – 400 Hz  
B0953 / B0971



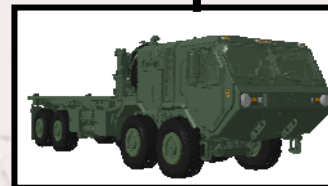
100 kW Mil-Std  
MEP – 007A/B/C  
B1045 / B1046



100 kW TQG  
MEP – 807A  
*Fielding in FY06*

120 kW  
Mil-Std  
MTVR OBVP

100 kW Mil-Std  
HEMTT A3 Option



# Your Questions

