Auxiliary Power Units

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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Report Documentation Page

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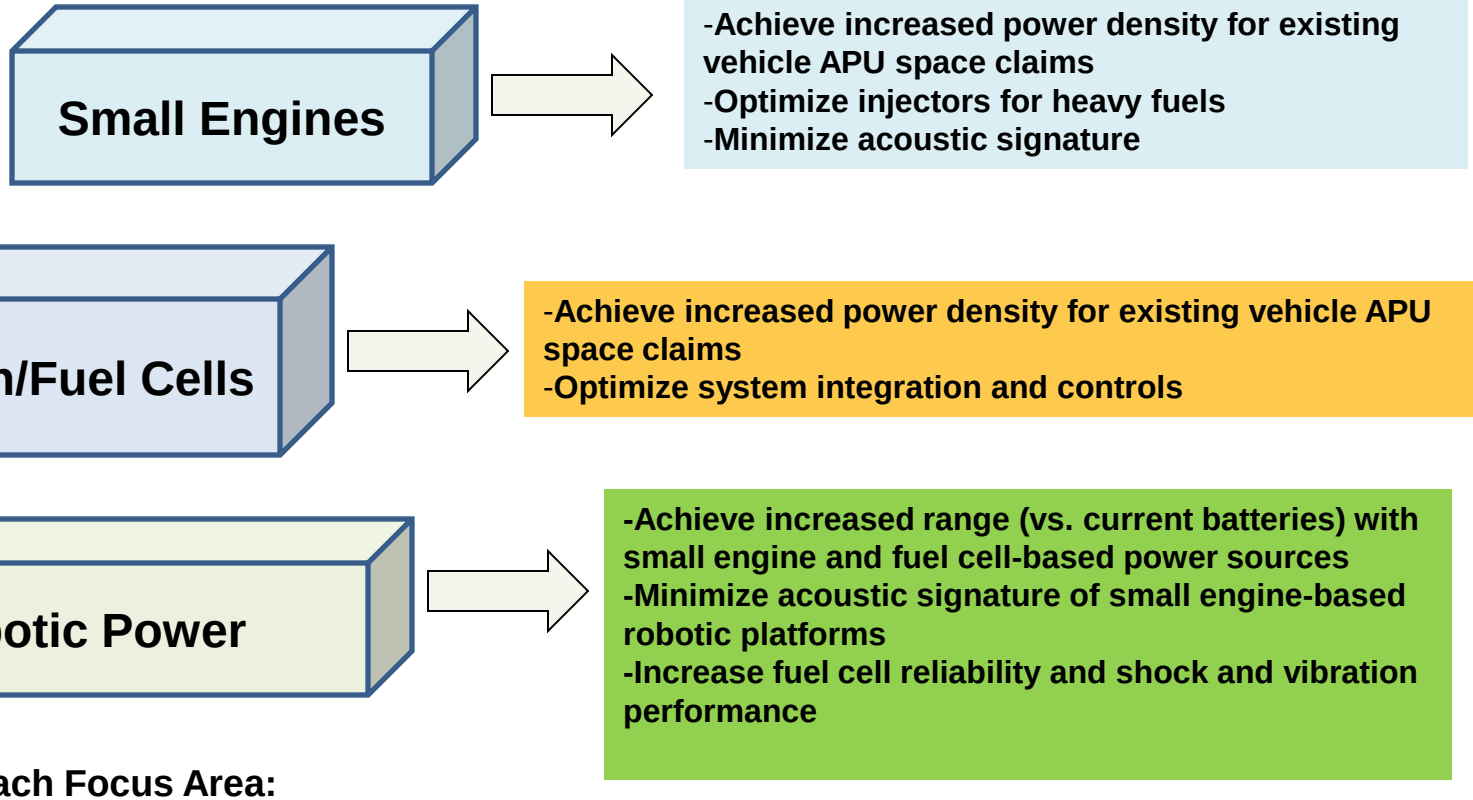
NPS Technology Focus Areas



Mission Goals for each Focus Area:

- High Power Density Engine APU that can provide up to 45 kWe auxiliary power to meet increasing onboard vehicle power demands without reducing mobility.
- Silent Watch (undetectable at 50m) through the use of a fuel cell based APU that power mission equipment with main engine off while the vehicle is stationary with reduced acoustic and thermal signature.
- Small UGV power through small engine and fuel cell based solutions that can extend the mission duration and range of UGVs, reducing risk to soldiers.

9kW JP-8 Rotary APU:
Integrated, Demonstrated, Tested

Project Purpose & Goal:

- Develop, integrate, test and demonstrate a 9kW rotary engine APU in Abrams M1A2 SEP V1 tank
- Ruggedize design to meet vibration requirements of tank
- Optimize component placement for ease of maintenance
- Produce 6 units for testing at various government test facilities

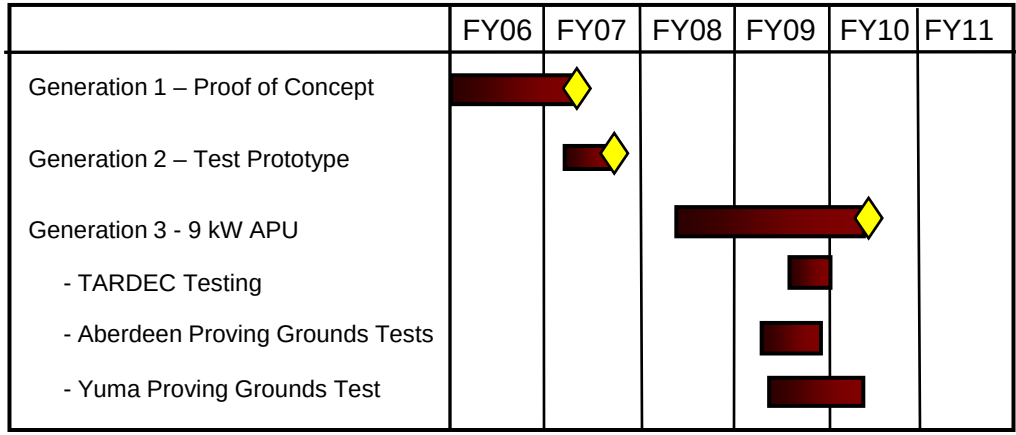
Program Status:

- Completed 200+ hours (2000 miles) of in-vehicle operational conditions at Yuma
- Completed two 100 hour high temperature (125F) tests at TARDEC Propulsion Lab
- Completed M1A2 SEP V1 Integration Test of 300+ tank commands
- Delivered performance specification to PM HBCT, which may be used for open competition
- Delivered test report of all testing completed

Challenges:

- Consumes oil: 1 qt. every 12hrs.
- Requires constant use of glow plug
- Maintenance required every 75hrs
- Minimal noise mitigation work done

Schedule



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17 kW Rotary JP-8 APU:
Current Program

Project Purpose & Goals:

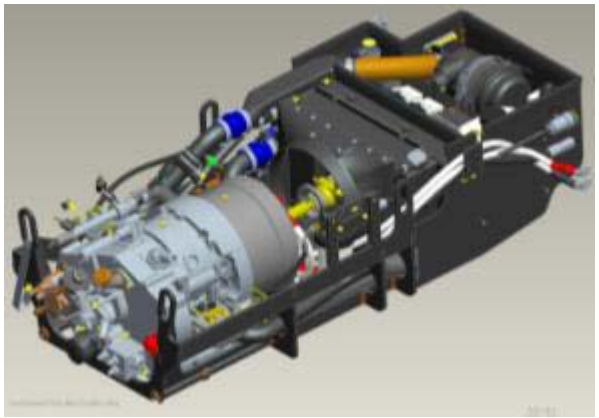
- o Design, model, build & deliver Rotary Diesel APU
- o Utilize lessons learned from previous Rotary APU work
- o Produce APU for Abrams space claim
- o Increase power by utilizing modern rotary engine technology
- o Minimize dependence on glowplug
- o Decrease oil consumption

Technology Description:

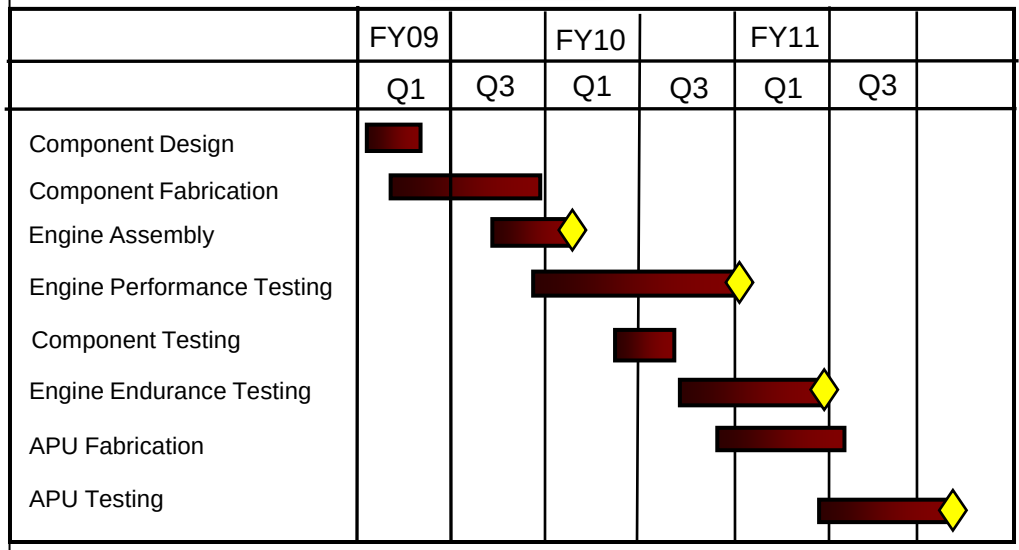
- o Rotary engine, continuous glowplug ignition
- o 17kW electrical output
- o Improved fuel economy
- o 350 lbs
- o Fits in Abrams space
- o Reduced cooling burden
- o Lower fuel consumption (kg/kW)

Challenges

- o Consumes oil, but at lower rate than previous generation
- o Requires use of glowplug for combustion
- o New engine design: limited evaluation done



Schedule



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Reciprocating Piston APU:
Current Program

Project Purpose & Goals:

- Produce APU for Abrams space claim
- Utilize COTS Direct Injection (DI) compression ignition engine
  - State of the art in reducing fuel consumption and optimizing fuel control
- Integrate muffler inside space claim

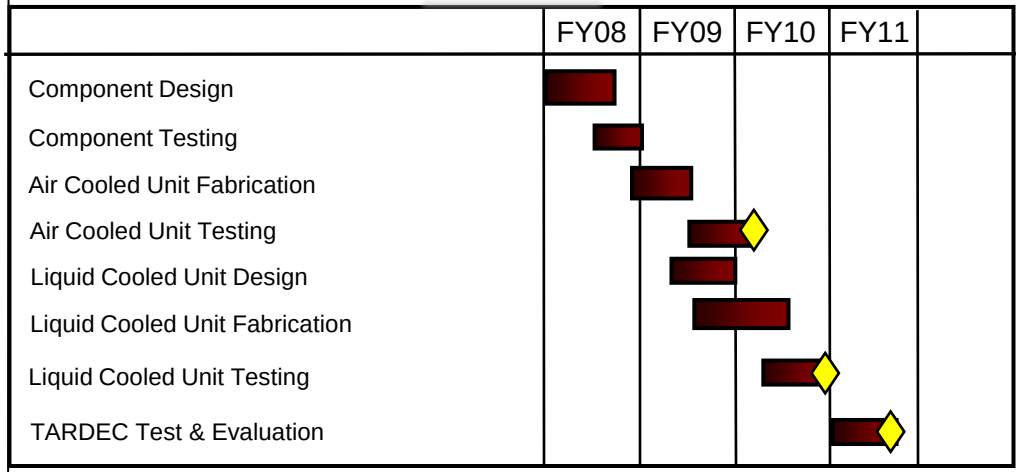
Technology Description:

- 10kW electrical output (360A)
- Single Cylinder 4-stroke Diesel engine
- Liquid Cooled
- In-cylinder fuel injection
- 420 lbs
- Fits in Abrams space (including muffler)
- True compression ignition

Challenges

- Consumes oil: 1 qt. every 24hrs. Reservoir needs refill every 40 hrs
- No ballistic protection in unit design
- Not a drop-in design
- Minimal noise mitigation work done

Schedule



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Turbocharged Rotary JP-8 Engine:

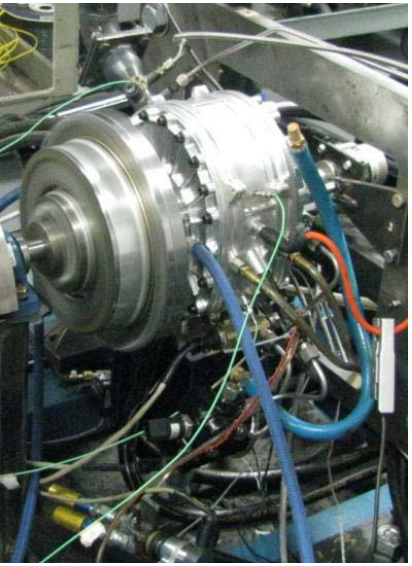
Current Program

Project Purpose & Goals:

- o Build, test, mature & deliver Rotary Diesel Engine
- o Utilize state of the art high pressure fuel system, direct injection, and turbocharger system
- o Produce 25kW APU for Abrams in 3 yrs.
- o Collaborate with AMRDEC UAV Shadow program to use same technology for multiple applications
- o Minimize oil consumption, use oil for cooling to minimize logistical burden

Technology Description:

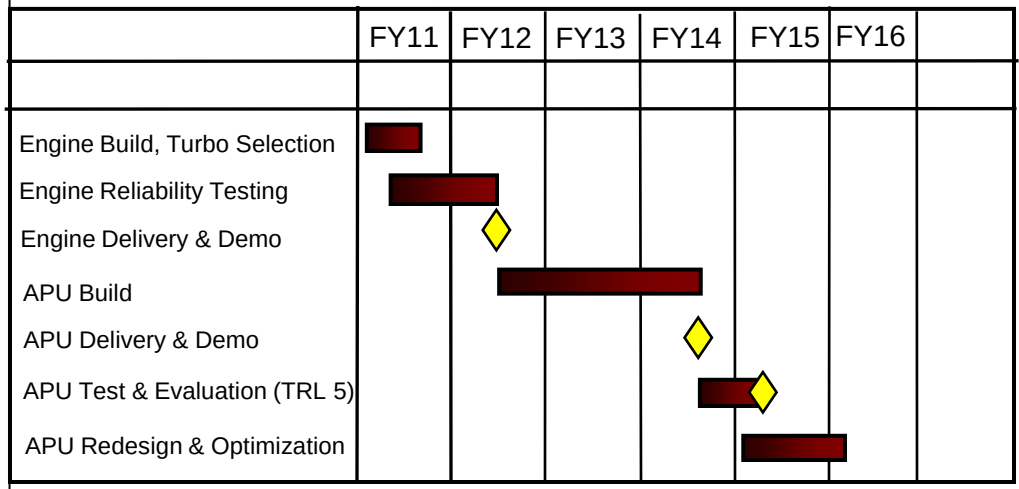
- o 25kW shaft output , spark ignition
- o Low noise & vibration design
- o Extremely lightweight and power dense
- o Fits in Abrams APU space
- o Optimized fuel control and low fuel consumption
- o Reduced logistic burden



Challenges

- o New engine design: limited evaluation done
- o Optimizing oil consumption, while providing enough lubrication for side seals
- o Spark plug long term durability
- o Use of multiple injectors have not been fully determined

Schedule



JP-8 Fuel Cell APU:
Current Program

Project Purpose & Goals:

o Provide quiet, continuous, non-primary electrical power for extended engine-off operation with reduced acoustic and thermal signatures in a fuel cell based APU.

o Design and develop two APUs that deliver 5 kW (T), 10 kW (O) of vehicle electrical power

o Design systems to fit into the existing Abrams APU space claim

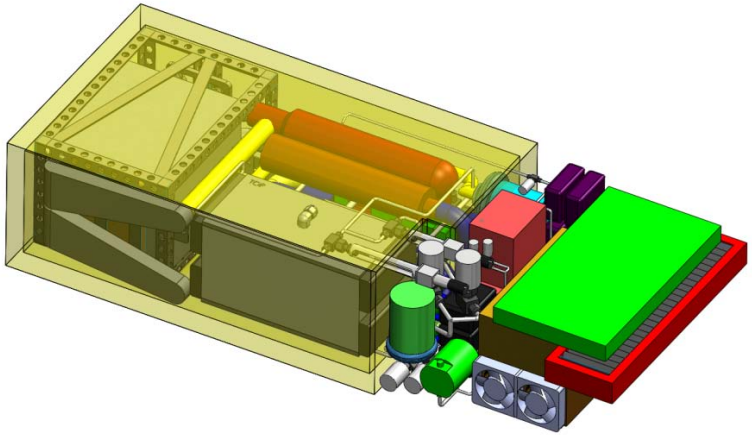
Technology Descriptions:

High Temperature PEM APU
- o Regenerable Desulfurization System
- o Steam Reformer
- o Water Gas Shift Reactor

Solid Oxide Fuel Cell APU
- o Regenerable Desulfurization System
- o Autothermal Reformer
- o Sulfur Tolerant Stack

Challenges:

- o Sulfur tolerant systems
- o Immature technologies; Limited reliability data available
- o High cost compared to conventional APUs



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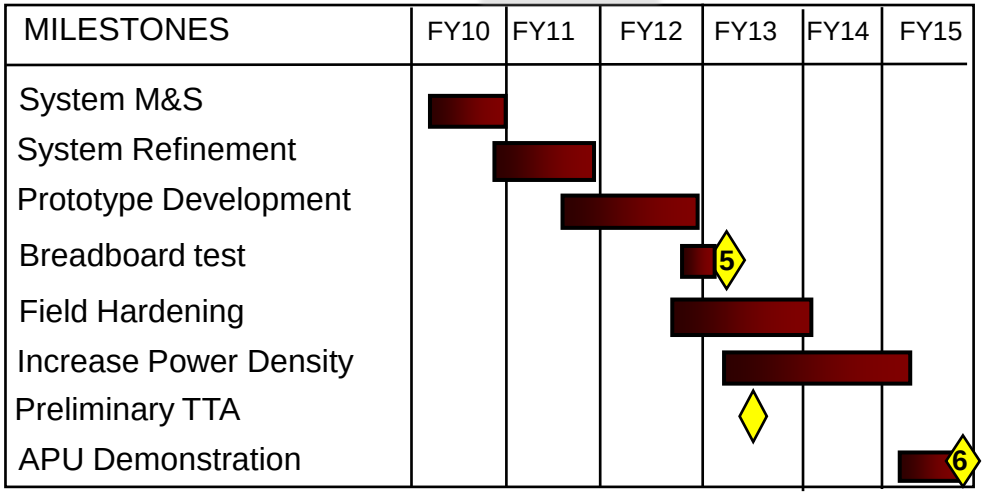

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Unmanned Robotic System Utilizing Hydrocarbon Fueled Oxide Fuel Cell

Current Program

Project Purpose & Goals:

- To integrate a 250 Watt Solid Oxide Fuel Cell system onto an existing Unmanned Ground Vehicle (UGV)
- Analyze current manufacturing process and perform a low rate initial production of 20 units
- Analyze production cost and unit variability
- Test 5 units at contractor facility for 2000 hours or failure

Technology Description:

- 250 Watt Solid Oxide Fuel Cell System
- Uses commercially available propane
- Fits into existing battery compartment
- Power system can be used as stand alone power source
- Increases mission duration over batteries

Challenges:

- Limited shock and vibration testing
- Meeting limited space constraints
- Manufacturability

Schedule

	FY10	FY11	FY12
250 Watt Sub-system analysis			
UGV SOFC system configuration			
Environmental testing shock/vib			
Design for Manufacture Study			
LRIP Mfg plan and execution			
User/safety assessment			
Delivery of SOFC power systems			

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Non-Primary Power Systems
Technical Challenges

- Obtain 45kW in current or smaller space claim
- 2.5 gallon/hr for 25kW output
- Undetectable at 50 meters
- Mean time between failure 1140 hours