



Fuel Cells For Marine Applications



INTERAGENCY MARINE FUEL CELL PROGRAM

(The following is an informational brief given to the Fuel
Cell Technology Summit)

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Benefits of Fuel Cells in Marine Applications

- Reduce CO₂ Pollution; < 0.1 ppm NO_x/Particulates
- 10 - 20% More Fuel Efficient than Diesel-Electric
- Reduce Power Room Noise by 10 -20 dB
- Reduce IR Signature
- Enables Flexible Power Distribution
- Reduce Power Room Maint.
- Reduce Engineering Billets
- Produce Potable Water as a By-product
- Provides Waste Heat for Other Applications



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Marine Technical Risk Areas

- Marine Diesel Fuel Reformation and Contaminant Removal
- Salt-laden Air
- Shock and Vibration
- Ship Motion
- System Transient Response
- Start-up Time



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Other Issues to be Addressed

- Costs
- Reliability and Maintainability
- Duty Cycle
- Power Density
- Cell Life
- Signature Reductions
- Environmental Compliance



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Operation on Diesel Fuel

Challenges

- Reforming
- Reformate Cleanup (Contaminant Removal)
- Efficient System Integration
- Transient Response



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Interagency Work Group for Marine Applications

Participants:

Department of Navy

- Chief of Naval Operations
- Naval Sea Systems Command
- Office of Naval Research
- Naval Surface Warfare Center, Annapolis Detachment

Department of Transportation

- U.S. Coast Guard
- Maritime Administration
- Research and Special Programs Administration

Department of Commerce

- National Oceanic and Atmospheric Administration

Department of Energy

- Federal Energy Technology Center

Interested Federal Agencies:

- Federal Railroad Administration, NavAir
- Federal Transit Administration, US Army CECOM



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Interagency Mission Statement

- Foster the use of Fuel Cells for Shipboard Applications Utilizing Diesel Fuels to Fulfill National Transportation Needs.
- Transfer the Technology to the Public.
- Actively Involve Industry in the Development Efforts.
- Reduce Duplicative Efforts - Coordinate/Cooperate on Marine Fuel Cell Requirements.
- Demonstrate the Effectiveness of Focused Interagency Partnership.



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Marine Fuel Cell Implementation Plan

Preliminary Actions: (FY 97)

- Draft Interagency MOU
- Solicit Marine Fuel Cell Proposals _____

Phase I: (FY98, FY99)

- 2.5 MW Ship Service Fuel Cell Power Plant Conceptual Design
- Critical Component Risk Reduction Demonstration (i.e. Shock, Vibration, Salt Atmosphere)
- Trade-off Studies to Optimize Cell Design
- Technical, Cost & Schedule to Build 0.5 MW Reduced-Scale Demonstrator

Phase II: (FY99-00-01)

- 0.5 MW Reduced-Scale Demonstrator
- Land-Based Testing for Design Validation

Concurrent Action: (FY 98-99)

- Integration Study of Molten Carbonate Fuel Cell Aboard 2.5 MW T-AGOS Vessel

Phase III: (FY01-02)

- Perform At-Sea Demonstration
- Dynamic Computer Model



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PROGRAM STATUS

- MOU Signed
- Solicitation Issued
- Proposals Received and Evaluated
- Phase I Award made for Molten Carbonate Plant
- Phase I Award for Proton Exchange Membrane Plant
- Award Made for T-AGOS Ship Fuel Cell Integration Study



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RECENT PROGRAM STATUS

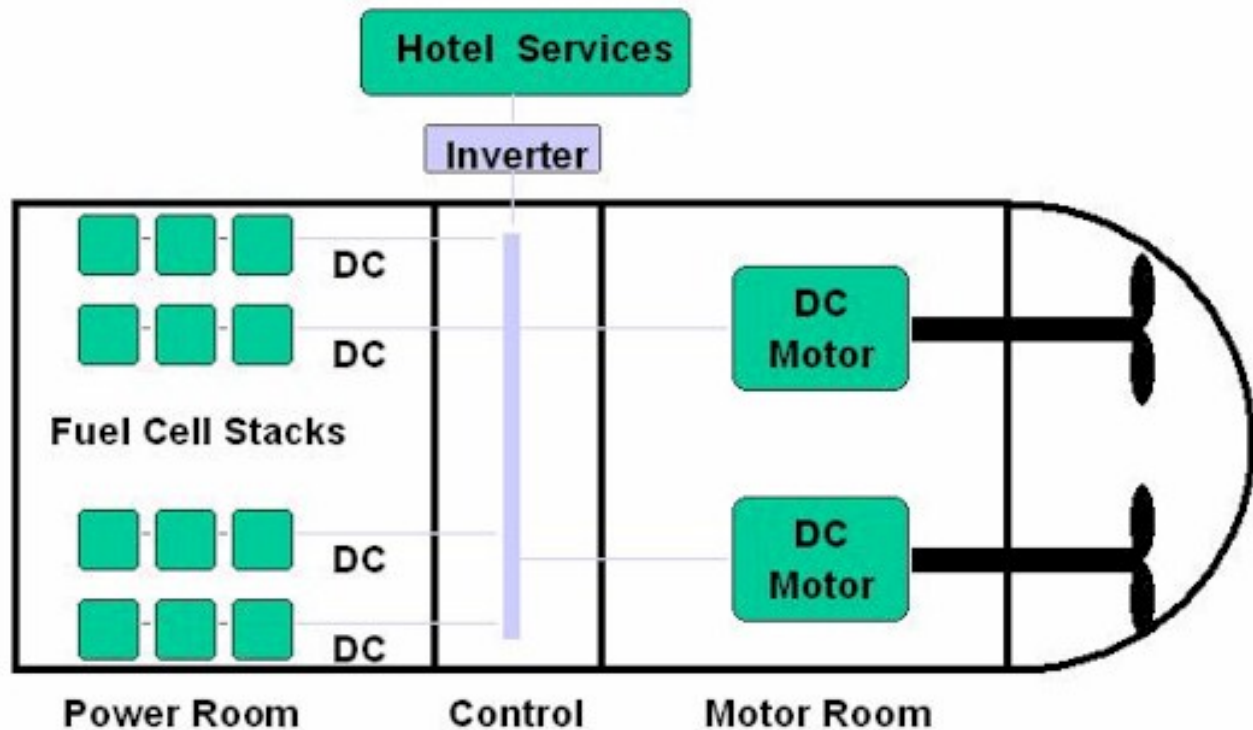
- PEM and Molten Carbonate Designs Rapidly Maturing
- Navy to Downselect to One Technology Phase II
- Coast Guard Worldwide Market Analysis Underway
 - Tens of Thousands Sizable HP Vessels Worldwide
- Coast Guard Considering Remote Light Stations
- MARAD/USMMA Retrofitting Natural Gas Fueled T-AGOS Vessel
 - Will be Available for Fuel Cell Testing on Nat Gas, Methanol, Diesel
- RSPA SBIR for Shipboard Natural Gas Reformation
- ABS Intent on Participating in Marine Fuel Cell Work
- Hydrogen Marine Fuel Cell Program Recently Formed



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Potential T-AGOS Ship Configuration





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NAVY'S FUEL CELL TRANSITIONAL GOALS

- DEMONSTRATE VIABILITY OF FUEL CELLS ON DIESEL FUEL CONTAINING 1% SULFUR
- PERFORM AT SEA DEMONSTRATION OF 500 KW MARINE FUEL CELL PLANT
- CONSIDERATION OF FUEL CELLS FOR SHIP'S SERVICE POWER



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COAST GUARD'S TRANSITIONAL GOALS

- ALSO CONSIDER SULFUR FREE DIESEL FUEL
- PERFORM SIMULTANEOUS STUDY OF 2400 KW T-AGOS VESSEL RETROFIT - SHIP'S SERVICE AND PROPULSION POWER
- PERFORM AT SEA DEMONSTRATION OF 500 KW MARINE FUEL CELL ON T-AGOS VESSEL
- CONSIDER RETROFIT OF ENTIRE T-AGOS POWER PLANT WITH FUEL CELLS
- CONSIDERING REMOTE STATION POWER



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NOAA'S FUEL CELL TRANSITIONAL GOALS

- SHARE FUEL CELL TECHNOLOGY AND INFORMATION WITH THE COMMERCIAL FISHING INDUSTRY



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MARAD'S FUEL CELL TRANSITIONAL GOALS

- DIESEL FUEL CONTAINING 1% SULFUR; ALSO CONSIDER NATURAL GAS AS FUEL
- PERFORM PHASE III TEST 500 KW MARINE FUEL CELL ON T-AGOS VESSEL
- SHARE LESSONS LEARNED WITH INDUSTRY
- CONSIDER FACILITATING DESIGN AND INSTALLATION OF FULL SCALE FUEL CELL PLANT ON COASTWISE VESSEL OR FERRY FOR PROPULSION AND SHIP'S SERVICE POWER



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END