

Abstract

This thesis examines the Department of the Navy's (DON) programmatic considerations for integrating hydrogen fuel into naval aviation, focusing on challenges and opportunities in the Operations and Sustainment phase of the acquisition lifecycle. The core problem is the absence of a defined sustainment framework for widespread hydrogen use. This research analyzes sustainment requirements via Integrated Product Support (IPS) elements using a Group 2 Unmanned Aircraft System (UAS) case study. Findings indicate significant technical, regulatory, and logistical hurdles for dispersed platoons. Recommendations include developing doctrine, streamlining approvals, and prioritizing R&D for expeditionary hydrogen solutions.

Methods

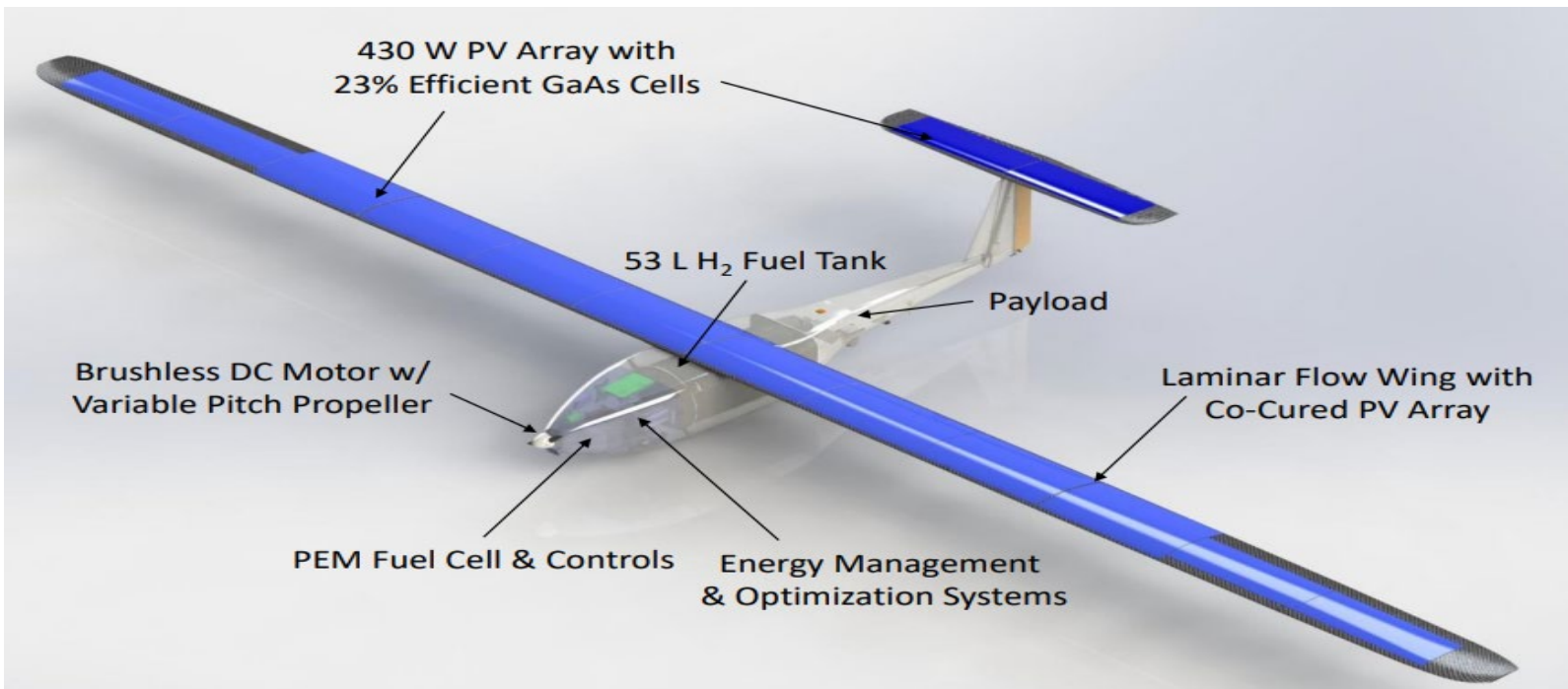
- Analyzed DON programmatic considerations for hydrogen fuel in naval aviation – focused on emergent technology.
- Focuses on Operations and Sustainment phase challenges/opportunities.
- Utilized an emergent Group 2 UAS Rapid Fielding and corresponding GSE (NovaSpark) case study for analysis.
- Examined logistical, maintenance, training, and infrastructure needs via Integrated Product Support (IPS) elements that would enable a Life Cycle Sustainment Plan for future Program Managers to use & improve upon to enable emergent systems in next two to three years.



Project BIGBANG Hydrogen Fuel Cell Range Multiplier. Source: NAWC Wolf, (2019).



NovaSpark Energy Corp. Expeditionary H2 Generation System. Source: NovaSpark, (2025).



Naval Research Laboratory (NRL) Hybrid Tiger Design. Source: Naval Research Laboratory, (2018).

Results

- Technical, regulatory, and logistical hurdles for hydrogen fuel - in test case UAS sustainment.
- Need comprehensive doctrine, streamlined approvals, and R&D for expeditionary hydrogen.
- Recommended tailored sustainment strategies.
- Key pathways: clear governance, safe designs, advanced tech, standardized interfaces, multi-echelon maintenance, training, resilient supply chain.

Impact

- Hydrogen integration offers enhanced endurance, reduced signatures, supports DOD energy goals.
- Requires holistic product support, active R&D to build upon emergent hydrogen solutions & technologies.
- Emergent expeditionary Hydrogen production systems reduces logistics and supports contested logistics.
- Demands comprehensive training and doctrine development.

Future Research

- Pathway for improved hydrogen storage technology to enable maritime and expeditionary capability.
- Exploration of sustainable hydrogen production (e.g., electrolysis with renewables).
- Perform detailed cost-benefit analysis and/or wargaming of USMC hydrogen supply chains.



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