L3HARRIS™
FAST. FORWARD.

ALUMINUM-WATER (AL-H_2O) ENERGY MODULES FOR DYNAMIC APPLICATIONS

Al-H_2O Energy Modules are designed for undersea power generation and are scalable and modular.

TECHNOLOGY

Al-H_2O technology harnesses the significant electrochemical energy stored in aluminum metal to safely deliver an unprecedented energy density for undersea power generation. Al-H_2O provides safe, cost competitive, depth-tolerant, energy dense solutions for a variety of undersea applications.

Al-H_2O energy modules offer a 2-10x improvement in endurance vs. alternative chemistries and can be integrated into dynamic applications, such as UUVs, and static applications such as seabed systems or expendables in the water column. Our systems can be placed in stasis and lie dormant in storage or at the seabottom until needed, or activated in sequence to support evolving mission requirements.

Al-H_2O energy modules are scalable and modular to enable rapid, cost effective customization. Al-H_2O produces a hydrogen byproduct that has been verified as inert by the Naval Warfare Center Carderock across a variety of abusive conditions that would cause lithium-ion or even silver-zinc batteries to fail dangerously. Modules are safe for deployment via submarine and can be hand carried on commercial flights.

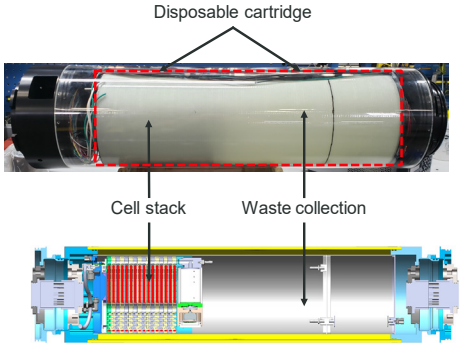
CHEMISTRY

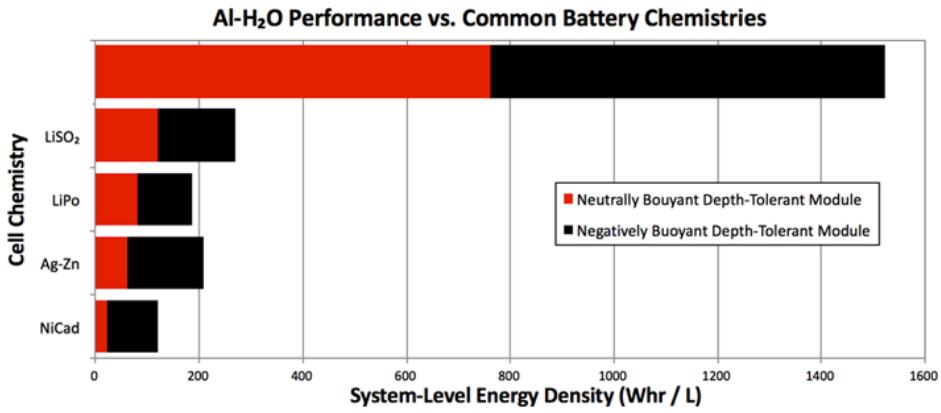
Al-H_2O systems consists of three main components:

> Activated aluminum anode
> Aqueous alkaline electrolyte
> Hydrogen-evolving cathode

"Note: the injection of water as an oxidizer into the system, and the removal of the nontoxic aluminum hydroxide and hydrogen gas byproducts. This mass transfer can be done continuously or intermittently."

Figure 1: Waste on Board(WOB)





DYNAMIC ENERGY MODULES

- Optimized for long-endurance vehicle applications (e.g., unmanned undersea vehicles [UUVs], small submersibles)
- Pressure tolerant cells and health monitoring electronics operate at ambient pressure
- Scalable design enables multi-day to multi-month endurance on small to extra large UUVs
- Modular system, easily adapted to customer power and energy specifications

Available in two variants:

Waste-on-Board

- Most mature design - delivered 4.3 KwH to Iver4 UUV during 45 hour, 138km demonstration
- Currently at TRL 7
- Retains waste product on board for maximum simplicity
- ~200 Wh/L

Waste Jettisoning

- Highest energy density system
- Periodically ejects inert waste products
- Native battery management
- TRL 7 expected Q2 2022
- 350-600 Wh/L

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DYNAMIC ENERGY MODULES

- Dynamic power modules are configured with many self-contained “stacks” which sit dormant until needed, allowing flexibility around mission length and the ability to put unused components back into storage as needed. Each module can achieve a runtime of >1 week depending on the host vehicle’s “hotel” power draw and any mission specific power requirements (e.g., charging a buffer battery).
- Design commonalities maximize efficiency, reduce redundancy, and decrease logistics and cost associated with integration into new vehicle types. As such, L3Harris dynamic modules can easily be scaled (as shown in Figure 2) to provide air independent propulsion (AIP) for large UUVs, such as XL and LD, and can provide weeks to months of continuous operations.

Figure 1 - Energy Module Integrated on L3Harris’ Iver4 900 Unmanned Underwater Vehicle

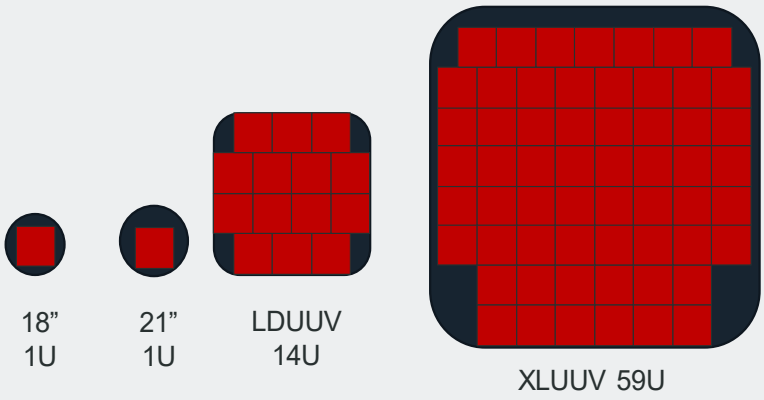

Figure 2 - Energy Module Scalability

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