



NATIONAL MARINE SANCTUARIES





OFFICE OF NATIONAL MARINE SANCTUARIES

*Small Boat Program
Focus on Hydrogen*

NEW VESSEL REQUIREMENTS:

Mammal-safe propulsion

Reduced emissions in transit

Zero-emission loitering

Reduced noise

Low wake hull forms

Real-time data transmission

DESIGN FOCUS:

Hydrogen fuel cells

Hydrogen sourcing and storage

Rim-drive propulsors

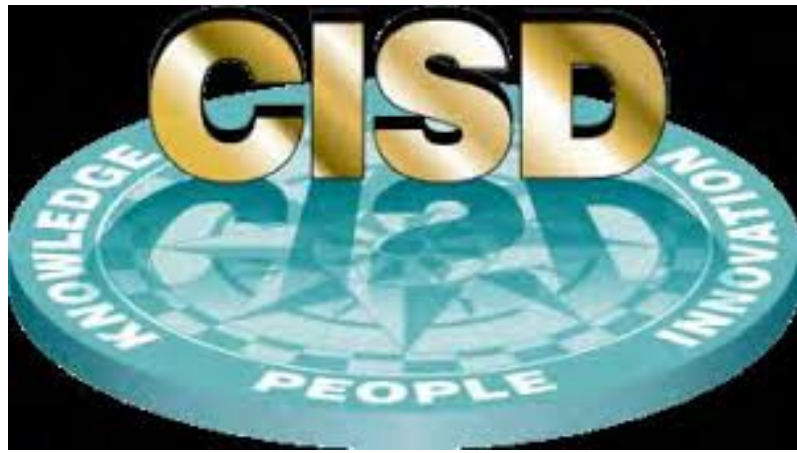
Auxiliary low-speed propulsors

Advanced hydrodynamics

RECENT STUDIES BY:

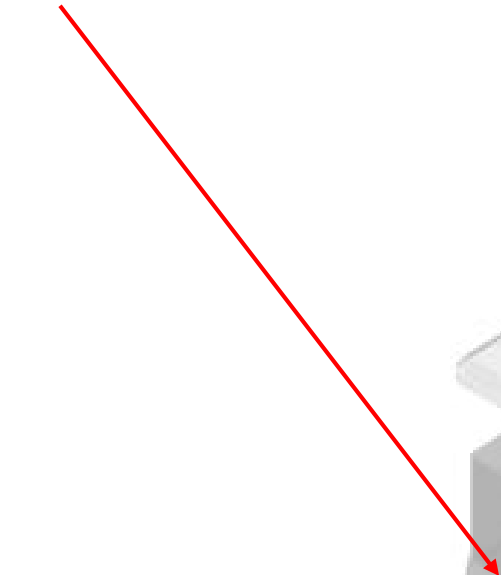
USN Center for Innovation in Ship Design

Stevens Institute of Technology

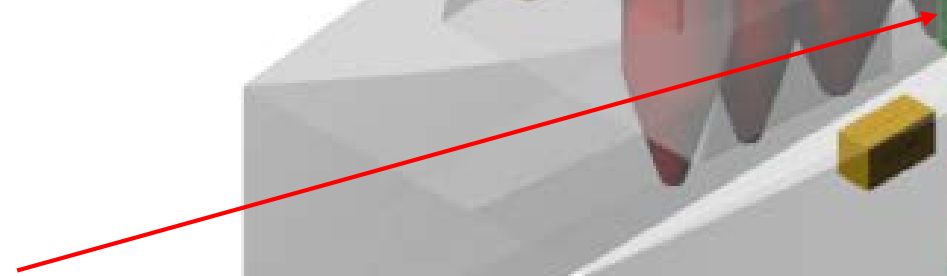


Conceptual Arrangement

Inverters



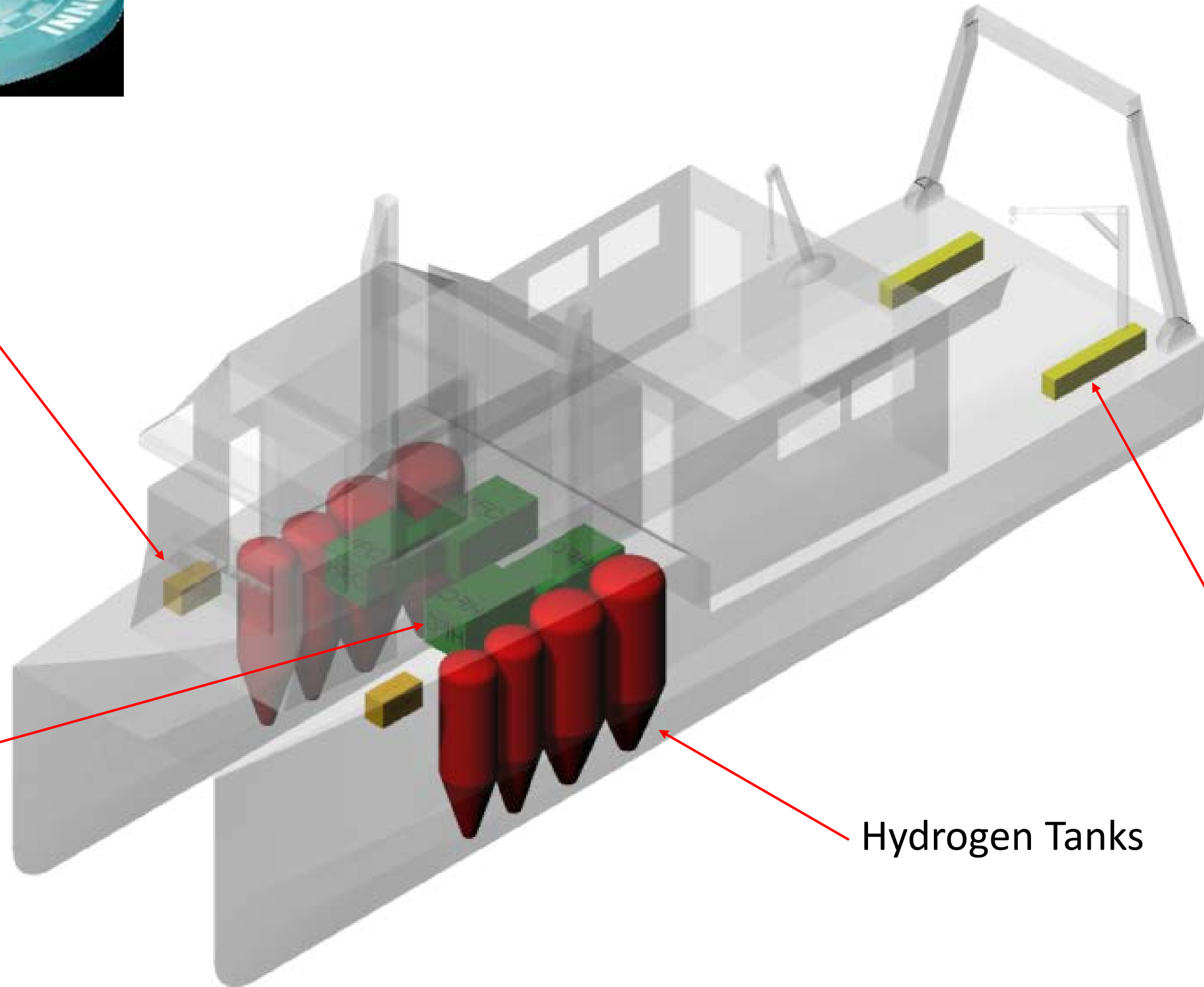
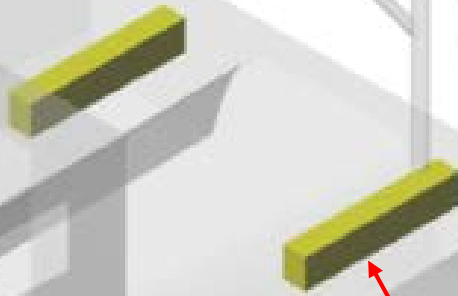
Hydrogen Fuel Cells



Hydrogen Tanks

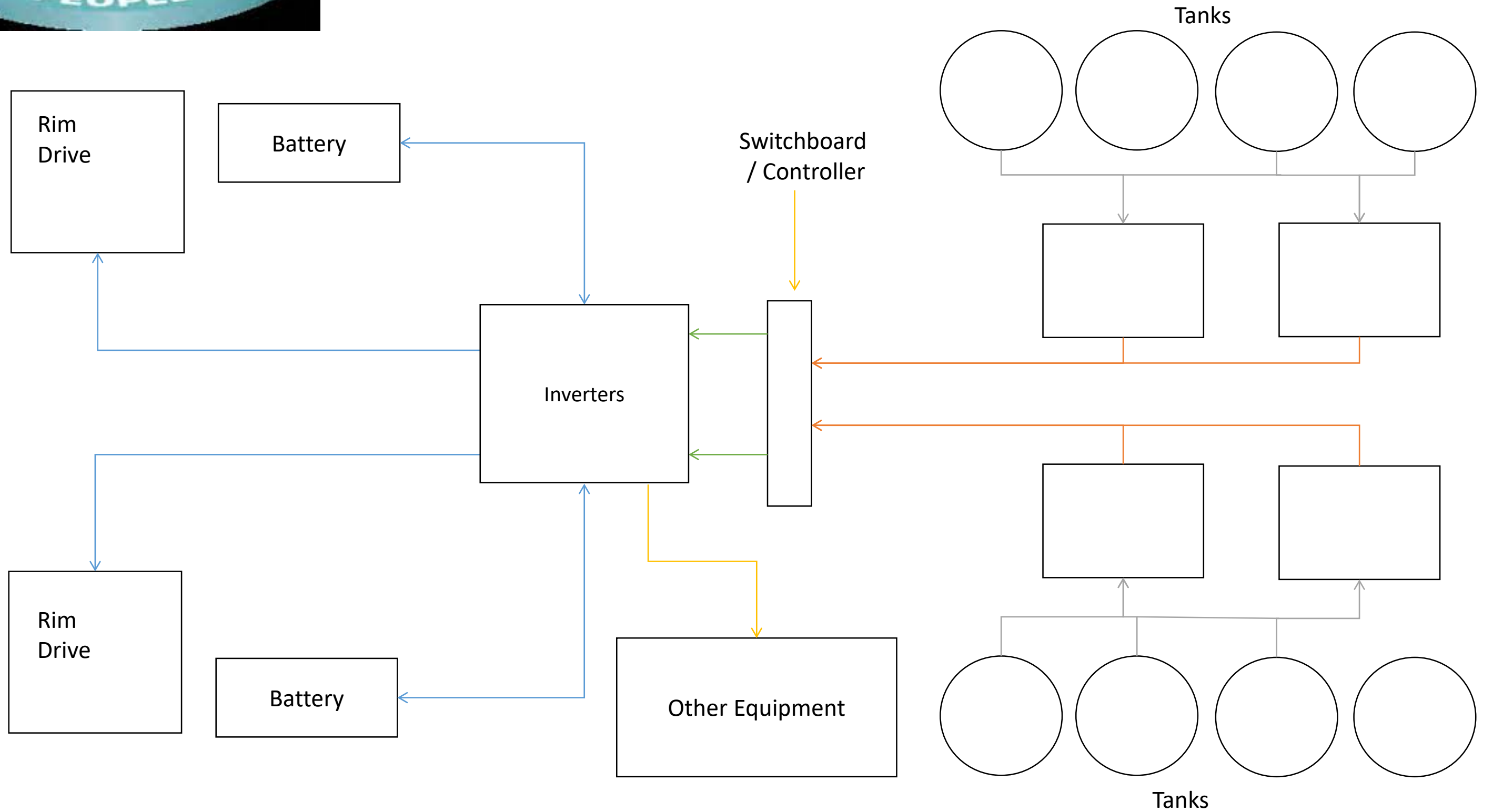


Batteries

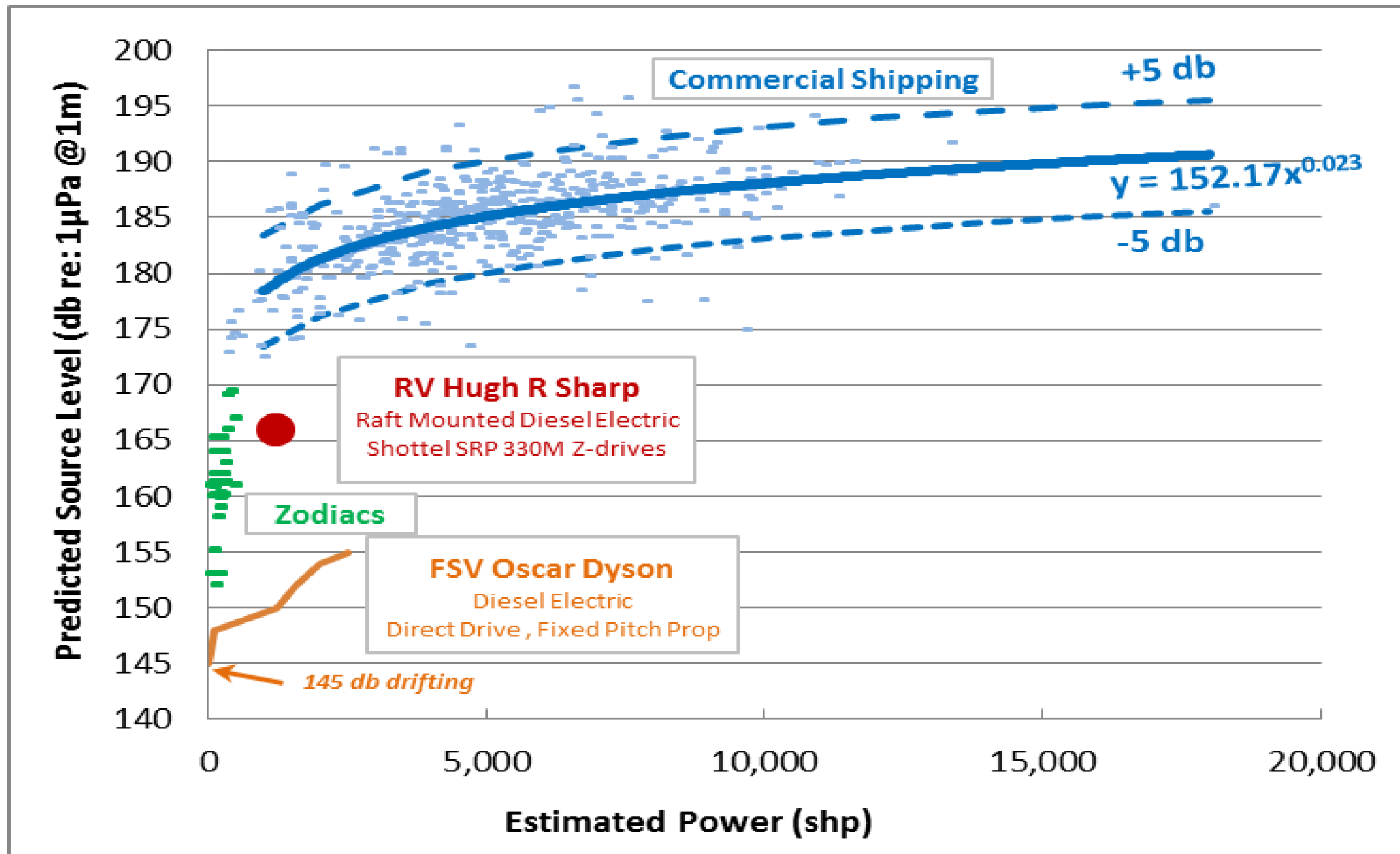
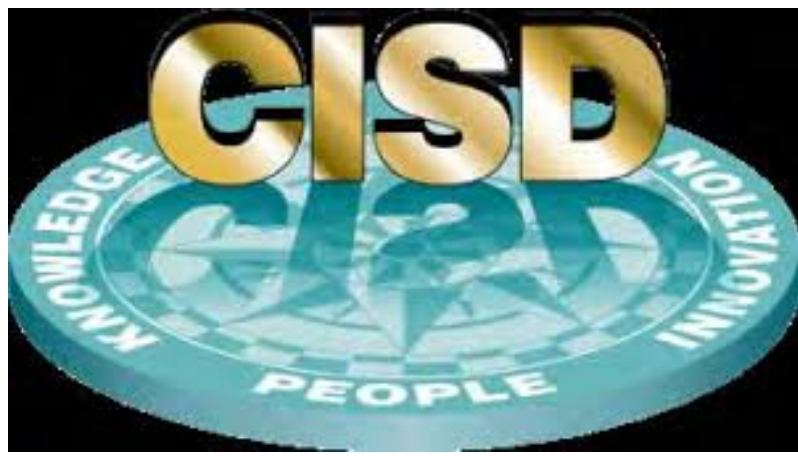


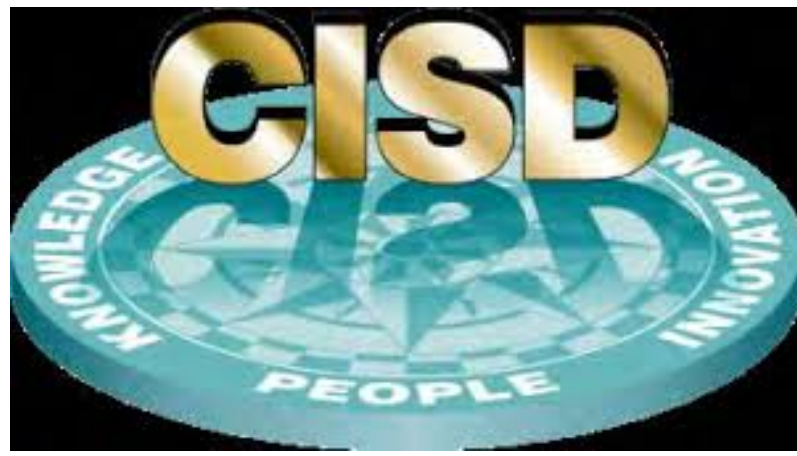


System Schematic



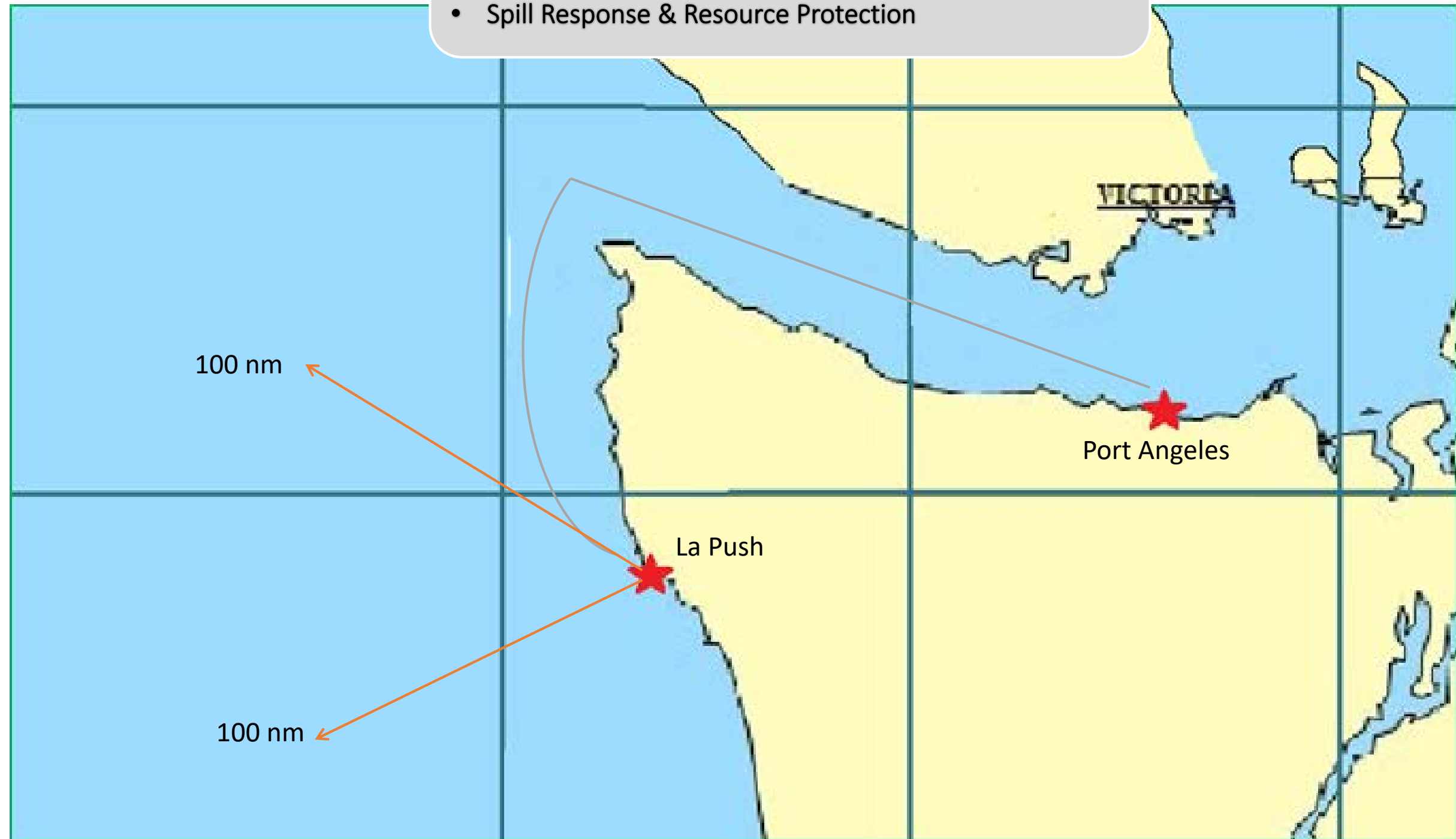
Acoustic Profile Review



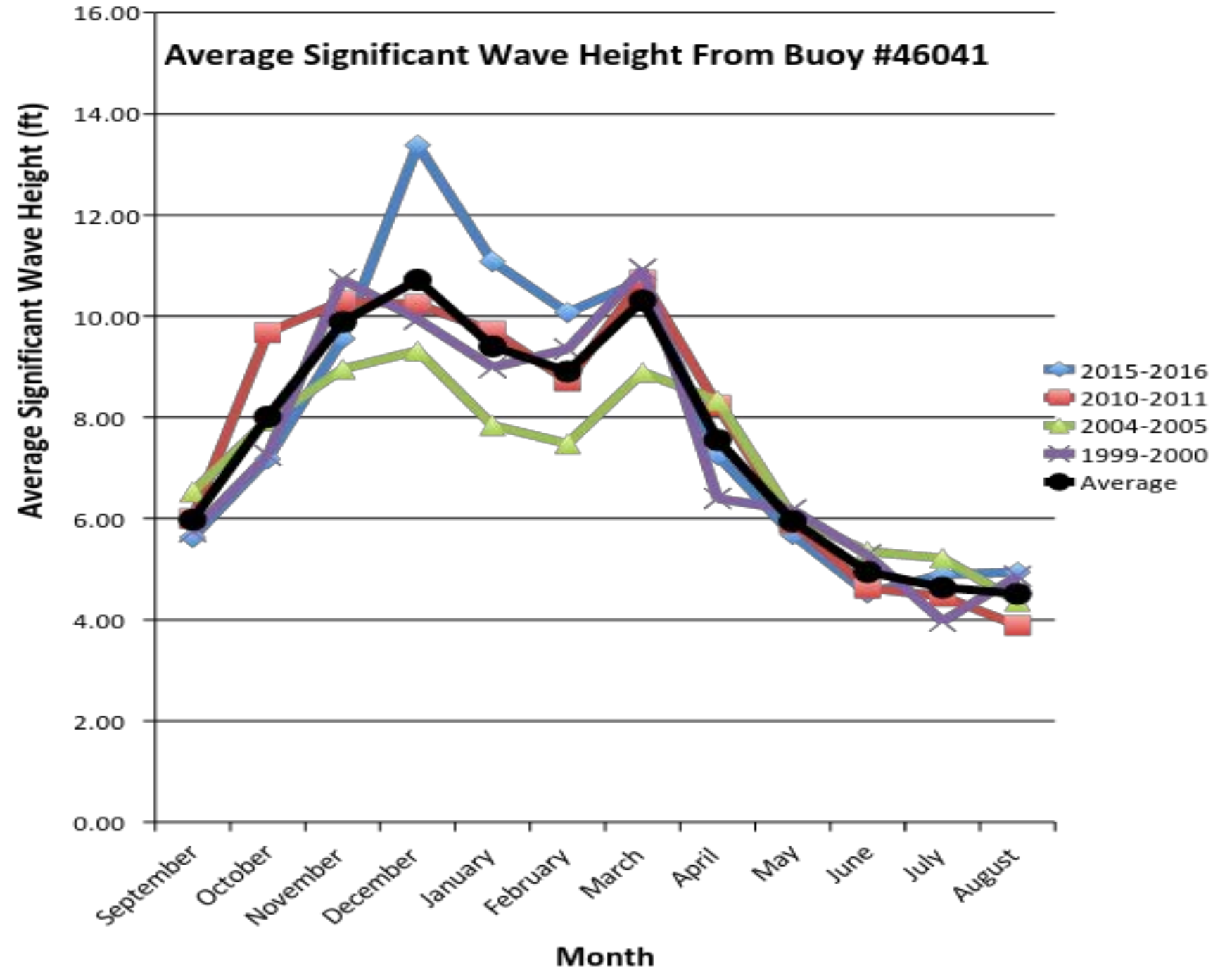
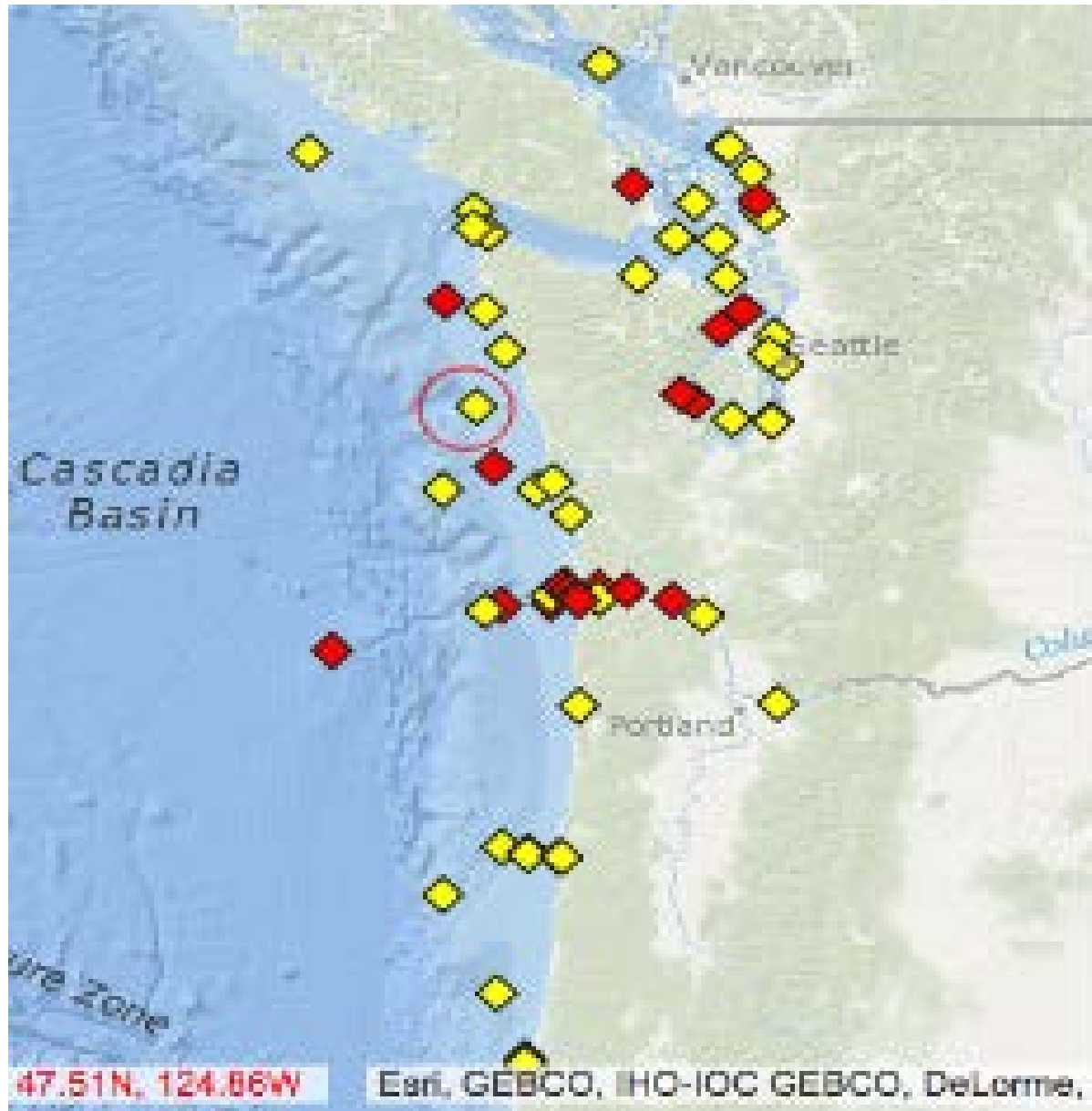


Operational Area Review

- Habitat Characterization
- Oceanographic Monitoring
- Living Marine Resources
- Spill Response & Resource Protection



Sea State Analysis



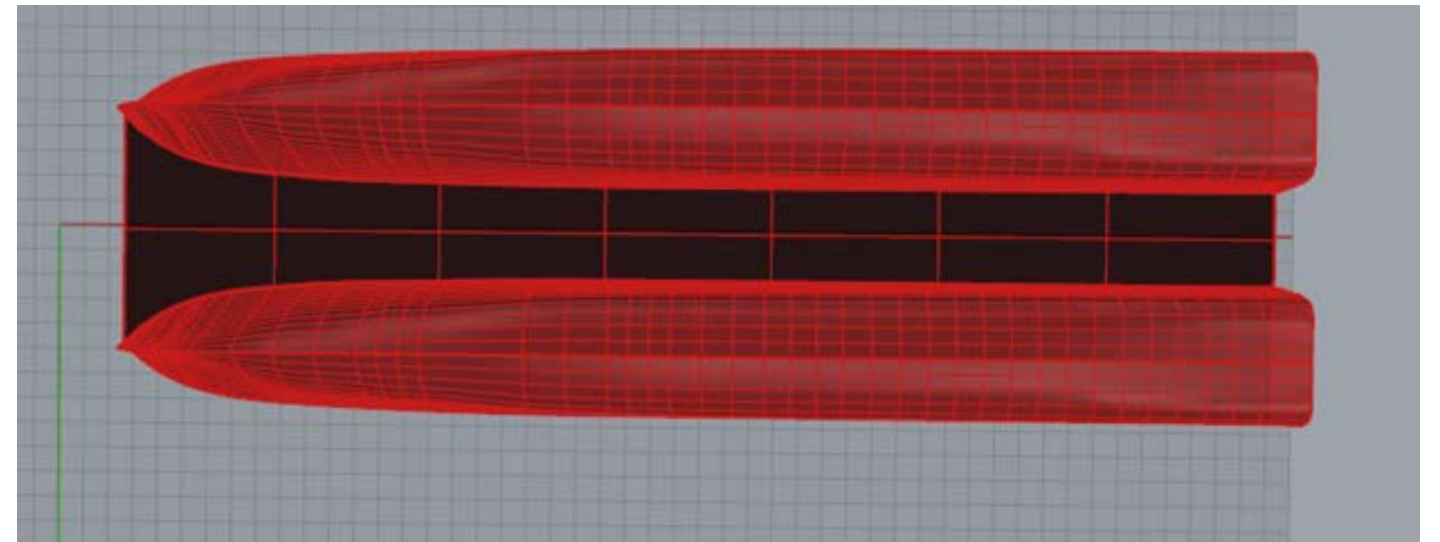
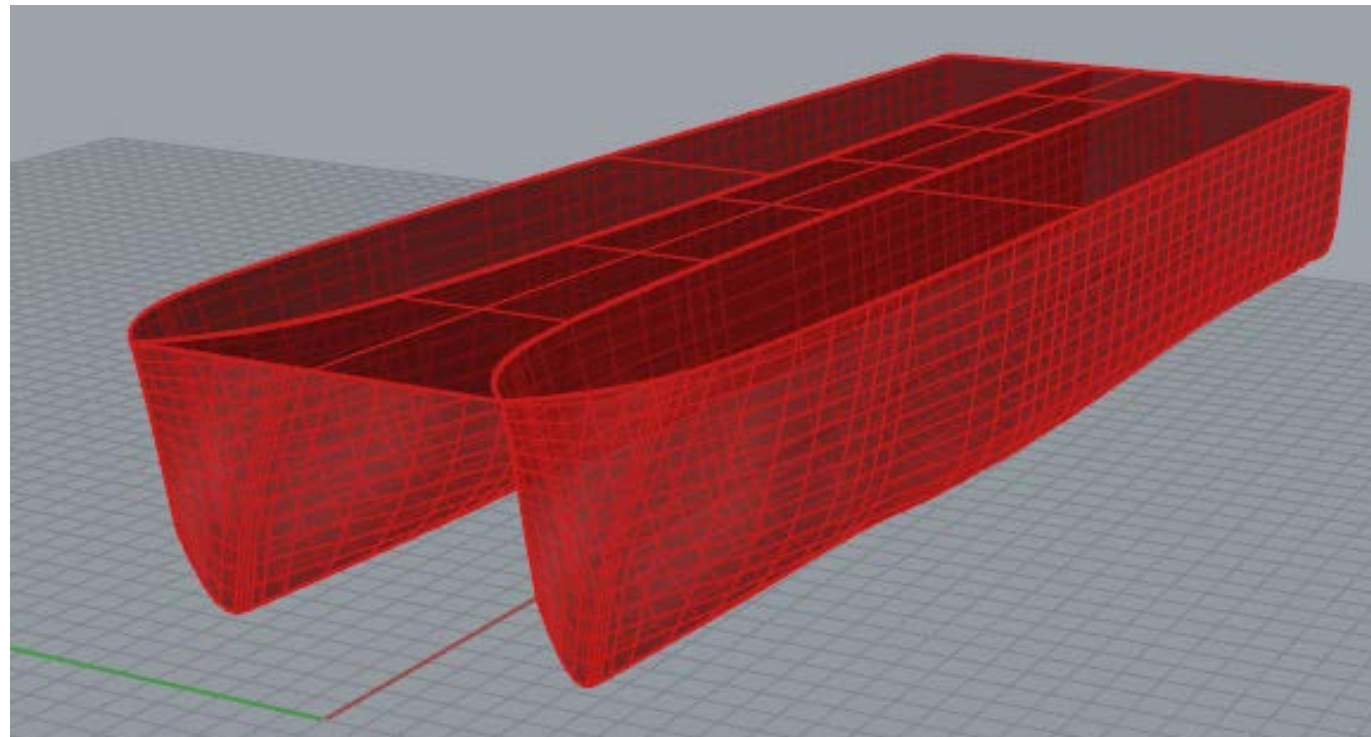
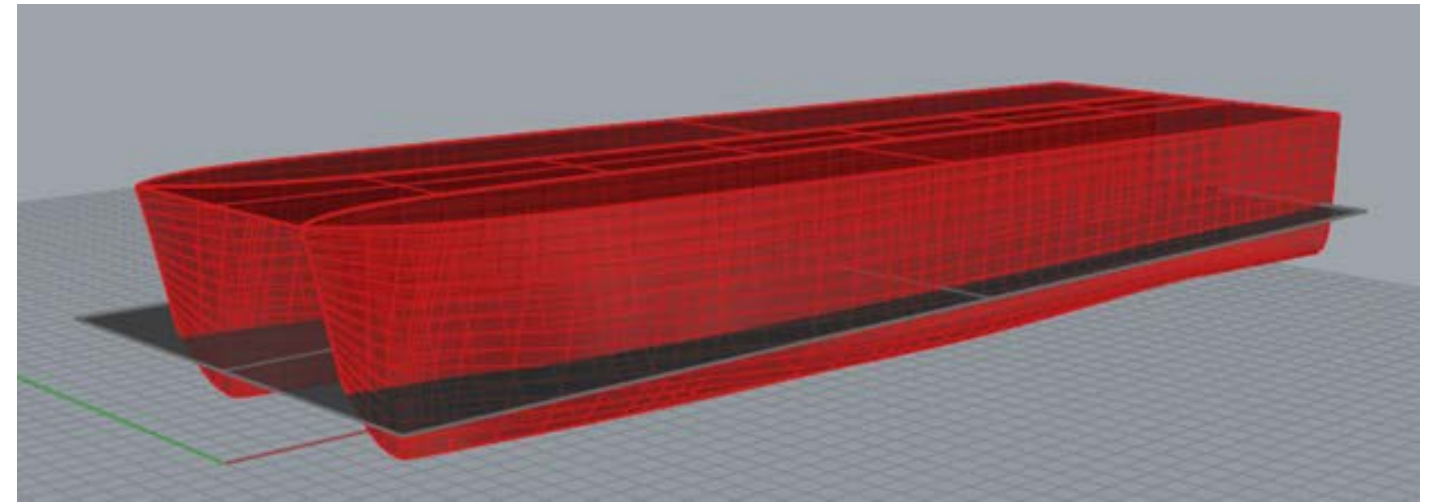
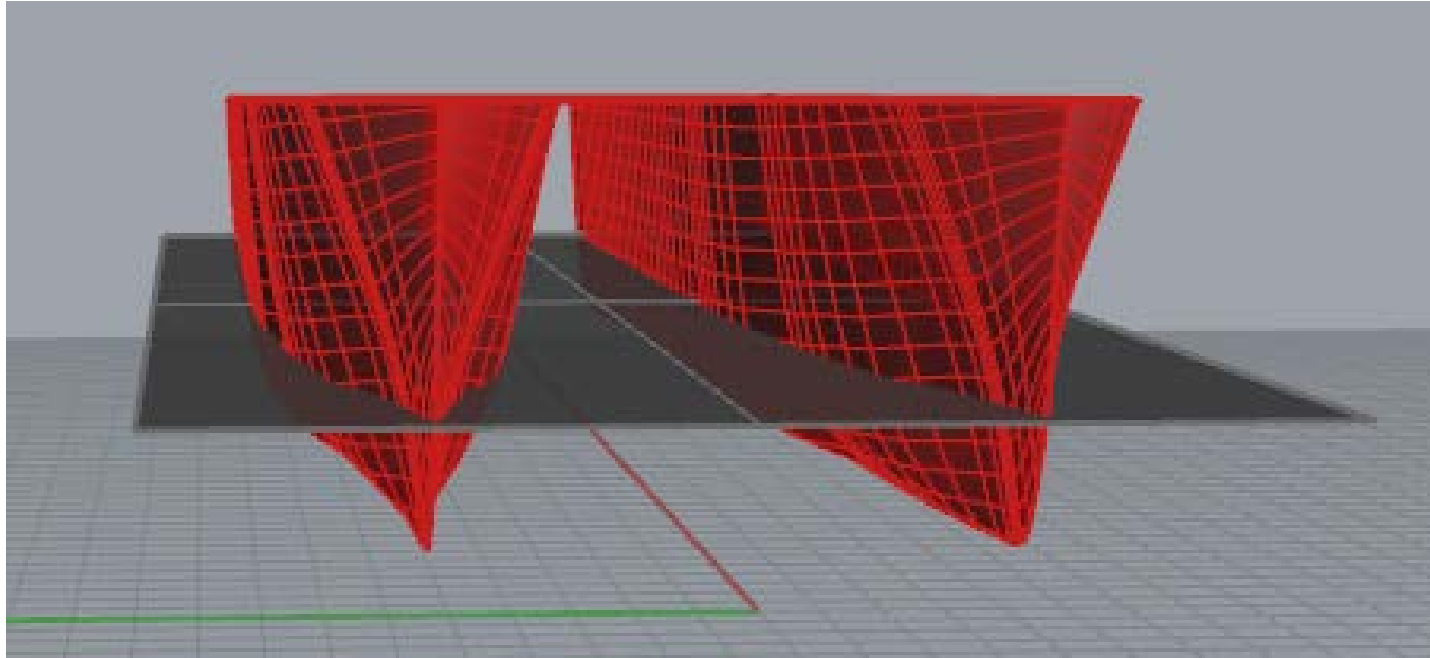


Design Attributes

Attribute	Dimensions
Length Overall (LOA)	51 ft.
Maximum Beam	16 ft.
Length on Waterline (LWL)	49.18 ft.
Beam on Waterline (BWL)	15.5 ft.
Prismatic Coefficient (Cp)	0.742
Block Coefficient (Cb)	.378
Displacement	19,042 kgf
Bare hull Draft (T)	2.25 ft.
Maximum Depth Overall (D)	8.2 ft.



Hull Form Development



Hydrogen System Concept

- (4) PEM (Proton Exchange Membrane) Hydrogen fuel cells
 - Ballard HD 100, 100kW Output Each
- Clean energy and silent and operation
 - Generator operation on site no longer a constraint
 - Battery pack sized for peak handling only
 - (3) Corvus 6.7kWh batteries per side
- Based on the findings and discussions about “Nemo H2” and “FCS Alsterwasser”
- Hydrogen Storage below deck with replaceable composite cylinders
 - Compact carbon tanks reduce weight, easy to refuel
 - Hydrogen storage is provided in dedicated compartment
 - Ventilation and airlock is provided
 - Hydrogen void is not under lab space, open to weather deck
- Op Tempo and charge program for HFC option:
 - Fuel Cells are allowed to cool during harbor re-entry and cool down - operation on battery alone
 - Batteries provide peak handling otherwise

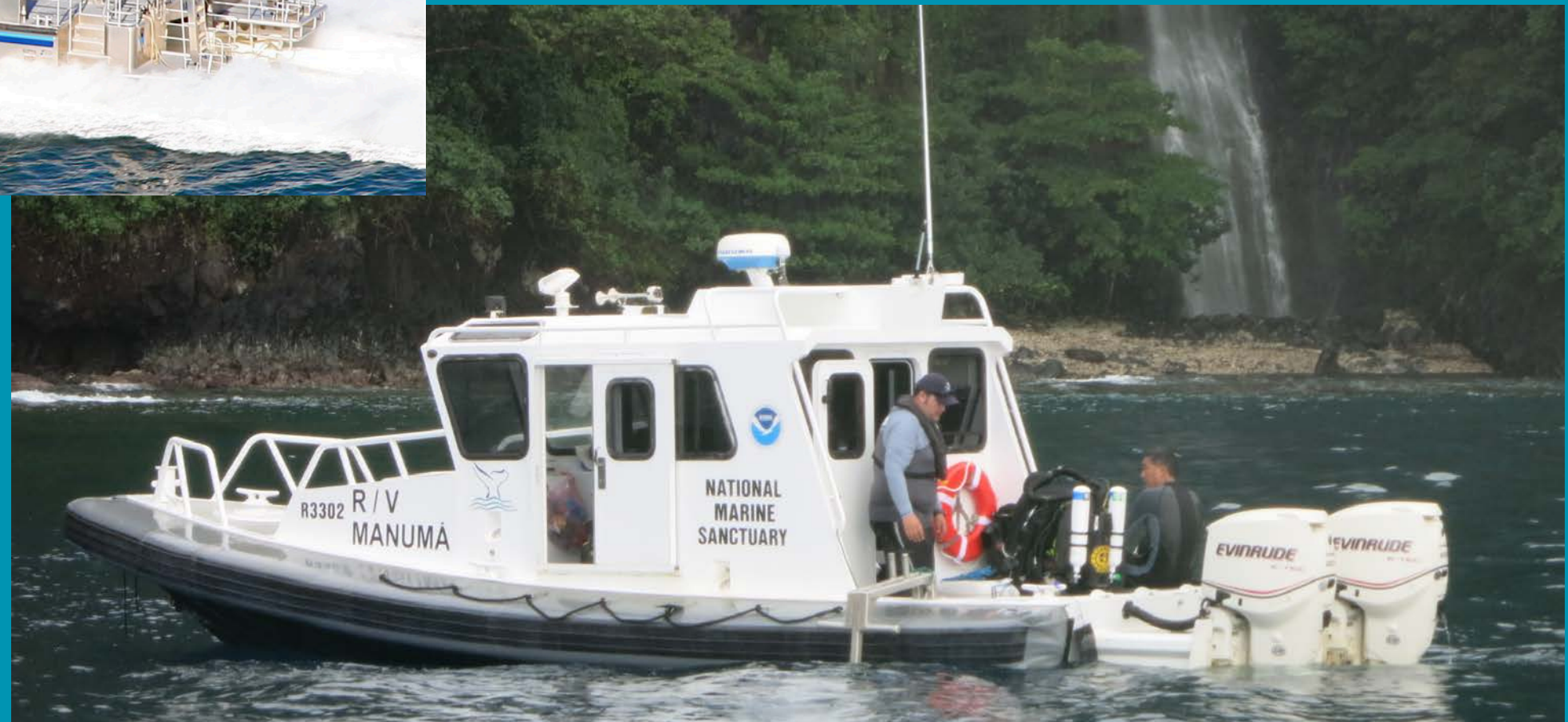


ONMS Vessel Fleet



RV Manta
Galveston TX

RV Manuma
Pago Pago AS



ONMS Vessel Fleet



RV Fulmar
Monterey CA



RV Auk
Scituate MA

Electric Prototype Testing



Future Concepts

