



DESSC 2019

Rob Munier

**NDSF** NATIONAL  
DEEP SUBMERGENCE  
FACILITY



# People

Mark Abbott

Rick Murray

Dutch Wegman

Jon Howland

# HOV *Alvin* 6500 M Upgrade

Complete 2018-2019

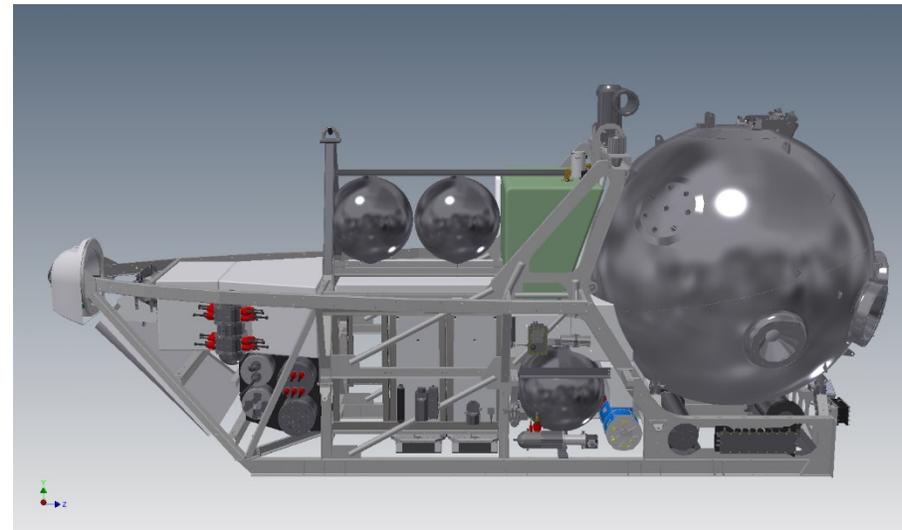
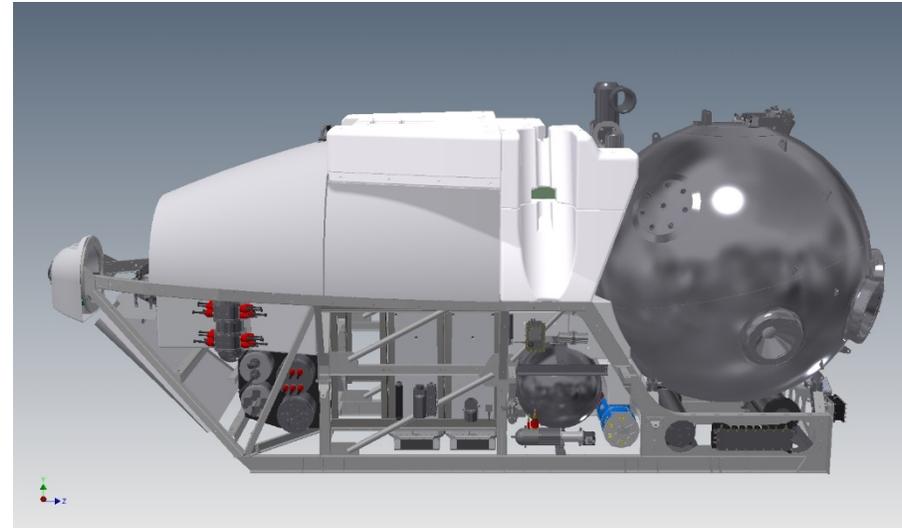
- Engineering
- Fabrication and testing of syntactic foam blocks, motor controller, salt water pump and thrusters

Planned 2019-2021

- Foam shape fabrication
- Ballast sphere fabrication
- Life support system testing
- NAVSEA approval of designs
- Assembly, testing, sea trials
- Science verification

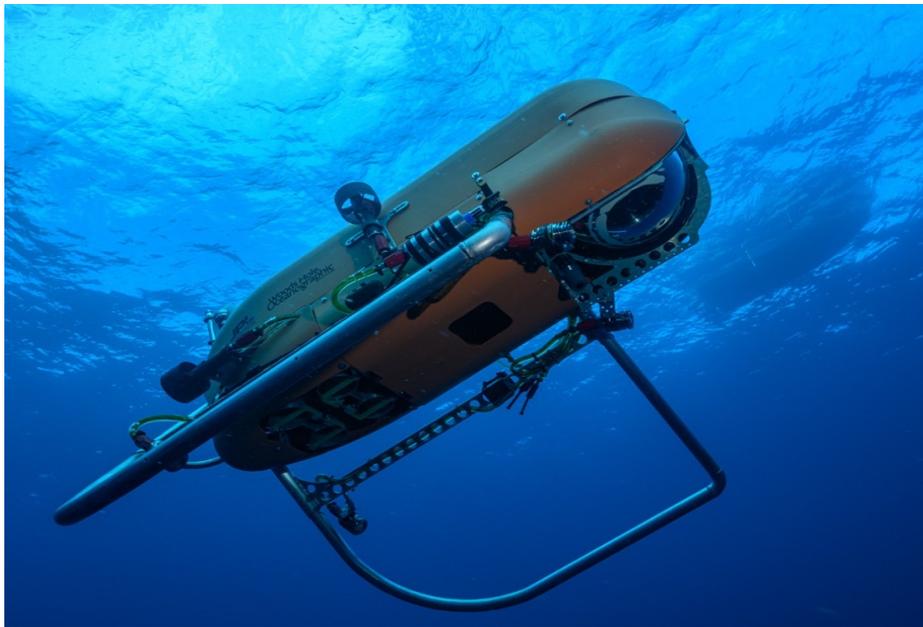
Budget

- Funding \$8.4 million



# Technology

## *Orpheus*



- A new class of AUV developed in partnership with NASA JPL
- Designed to explore and sample full ocean depth
- Lightweight, modular, inexpensive design
- Eventually capable of working in conjunction with other vehicles and seafloor systems

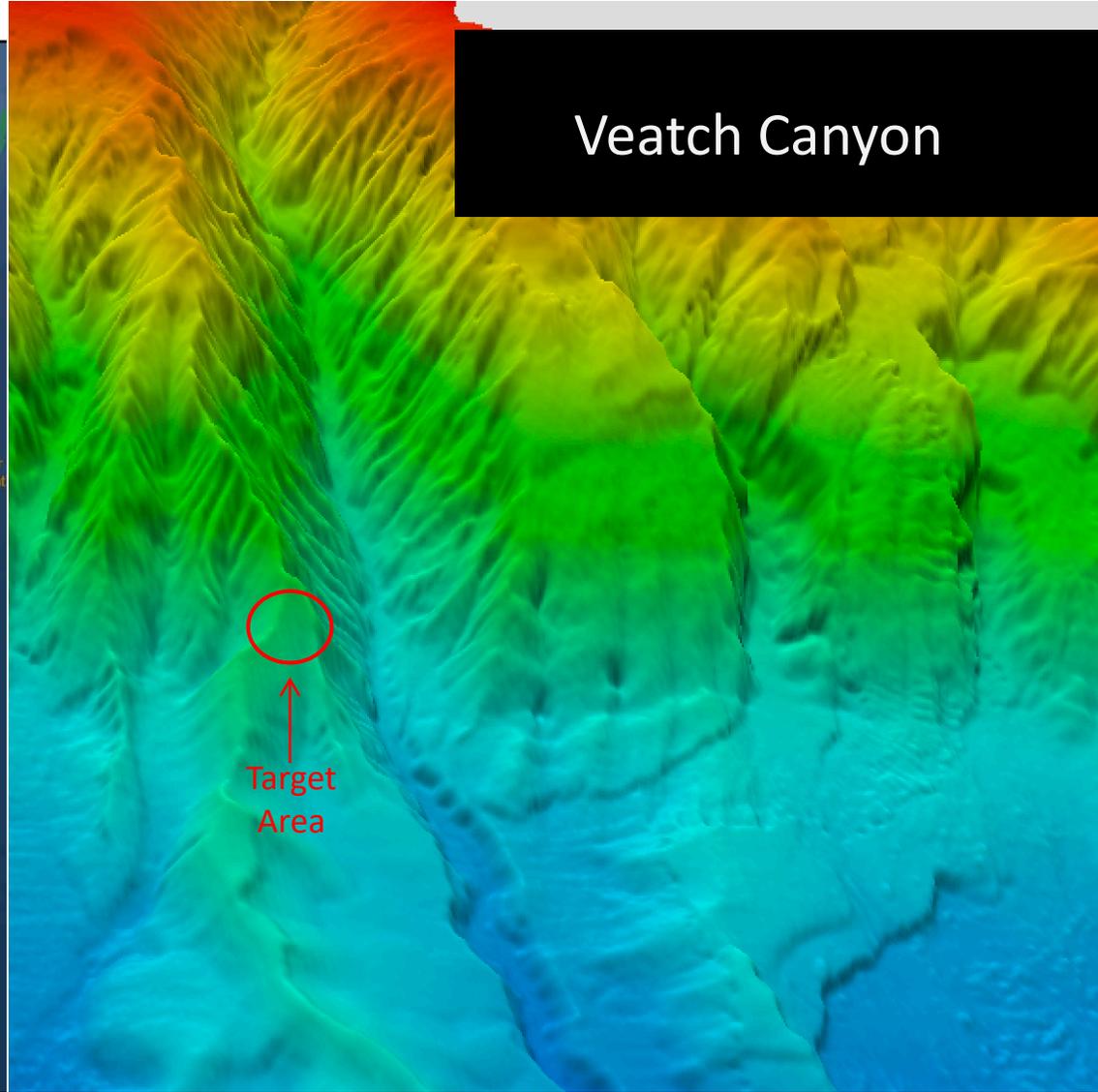
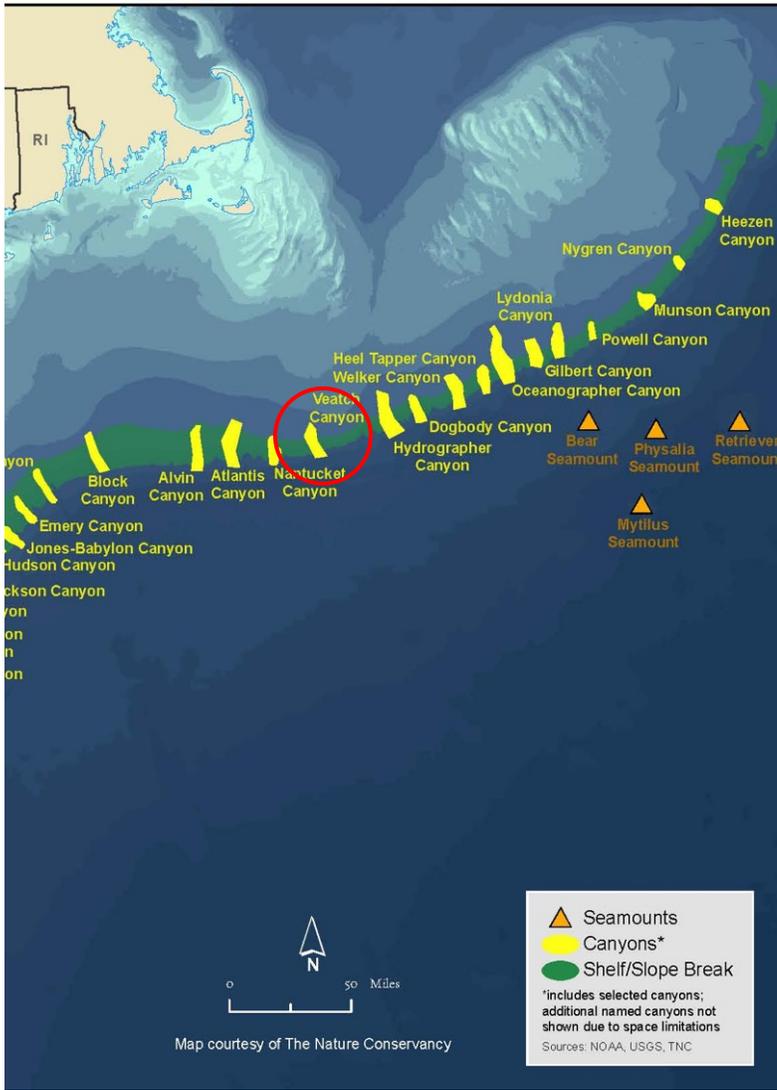
Future sea trials planned for April 2020  
Puerto Rico Trench and Fall Mariana  
Trench (T. Shank lead)

# *Orpheus*

# Sea Trial



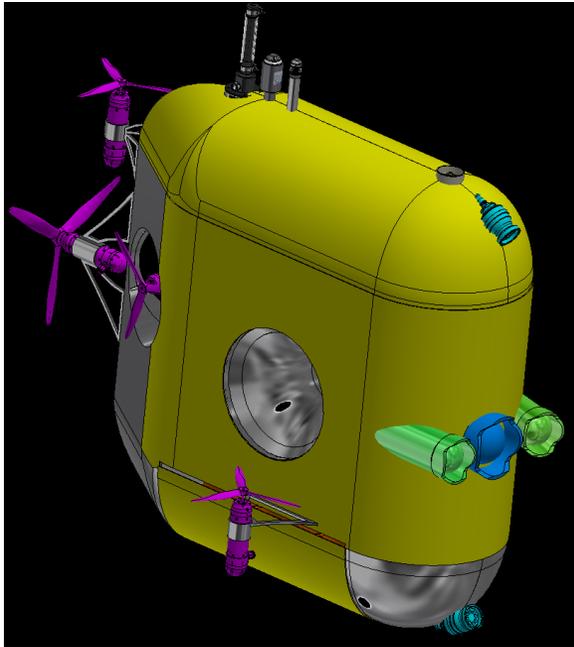
- September 11-15, 2019
- Mission: test new AUV at Veatch Canyon
- Made possible by the R/V *Neil Armstrong* Ship Time Endowment





# Technology

# *Mesobot*



- Hovering, profiling, horizontal surveys to 100 m
- Hybrid: LW tether or autonomous
- Vision-based tracking of slow targets
- Standard and specialized (eDNA and geochemical) sensor package

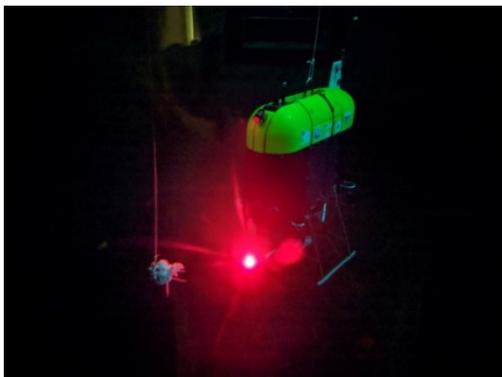
**Collaborators:**

MBARI

Stanford

U Texas Rio Grande Valley

# Mesobot Trials Summer/Fall 2019



Tank testing at WHOI and MBARI

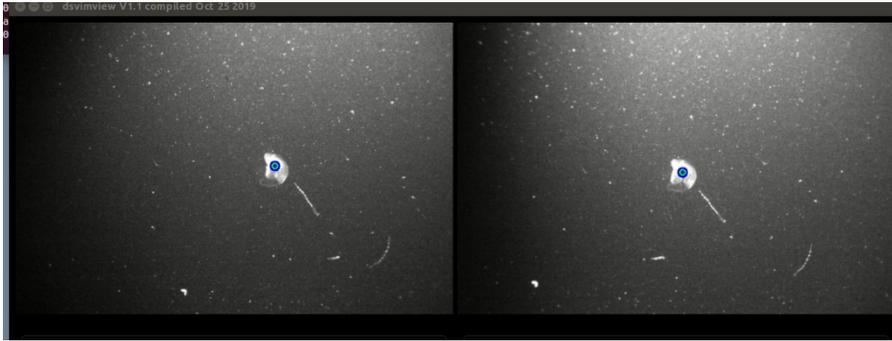


Tethered ops  
RV Rachel Carson  
(Yoerger, Howland, Katija, Hobson, Rock)



Autonomous eDNA sampling  
RV Manta, Gulf of Mexico  
(Herrera, Govindarajan, Yoerger)





Real-time Stereo tracking display,  
larvacean, 200m depth



Real-time tracking of a larvacean and  
“inner house”



Real-time tracking of *Solmissus* with a  
siphonophore

**Credits for tracking work:**

WHOI Mesobot group (Yoerger, Howland)

MBARI (Katjia, Hobson, Risi)

Stanford University (Rock)



## *Nereid* Under Ice

- Internally (WHOI) funded upgrade
- Deployments to Arctic and Med this fall

# 5 Deeps Expedition

## THE FIVE DEEPS

### EXPEDITION OVERVIEW

The Five Deeps Expedition is the first to attempt to reach the deepest point in each of the Earth's five oceans: the Puerto Rico Trench in the Atlantic, South Sandwich Trench in the Southern Ocean, Java Trench in the Indian Ocean, Challenger Deep in the Pacific and Molloy Deep in the Arctic.



- The expedition will traverse 40,000 nautical miles / 74,000 km in 11 months
- By the end of the expedition the sub will have descended through at least 72,000 m / 236,220 ft of water
- Up to 50 scientific lander deployments will be undertaken alongside the submersible dives
- No human has ever been to the bottom of the Java, Puerto Rico\* or South Sandwich trenches
- No one has ever been to the bottom of Molloy Deep
- No manned submersible has ever been to Challenger Deep more than once
- No person has ever been to the summit of Mount Everest and also been to the bottom of the ocean at Challenger Deep, which could occur on this expedition



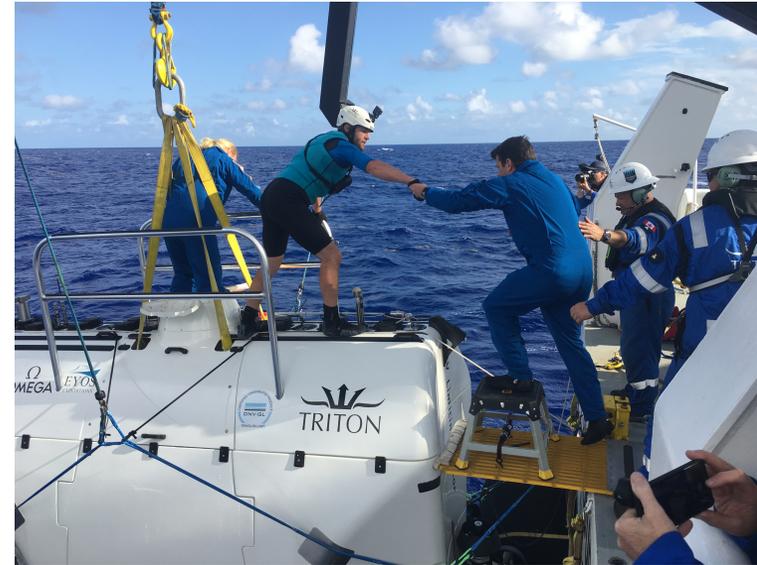
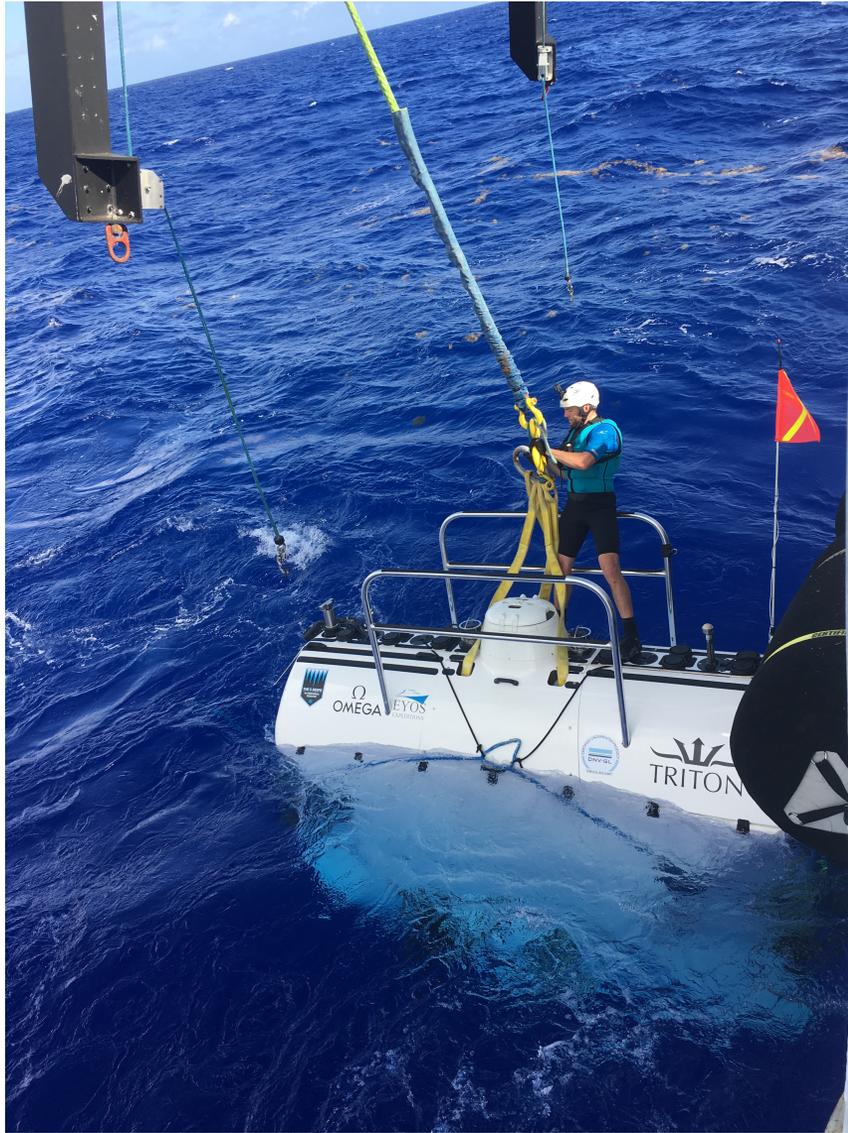
\* The French Bathyscape L'Archimede achieved 8,300m in the Puerto Rico Trench on May 6<sup>th</sup> 1964.



# 5 Deeps Hadal Exploration System (HES)



# 5 Deeps HES



# HES Opportunity?

# Hadal Science

- Demonstrated track record
- Classed by internationally recognized DNV-GL
- Certified to full ocean depth
- Potential for routine human access to hadal depths
- Capable of upgrading science payload
- Could provide unique and strategic US capability





# NOAA

## *Ocean Exploration Cooperative Institute*

### Themes

- US EEZ
- Exploration
- Mapping
- Twilight Zone
- Innovation

### Tools

- ROVs
- AUVs
- ASVs

### Ships

- Okeanos Explorer
- Nautilus
- Resolution

### Media

- National Geographic
- Innerspace Center

# R/V *Atlantis* Mid-Life Upgrade



## Purpose

- Modernize
- Extend service life

## Commercial

- Primary funding by ONR
- Managed by WHOI

## Scope

- Repower
- New controls/power mgmt
- New bow thruster
- Upgrade key systems
- EK 80 sonar system



**Timing: Mid 2020-Mid 2021**

**Budget: \$37+ million**

# MAJOR WORKS

- NEW MAIN SENSITS CAT 2-C32s 2-3516s EPA TIER 3
- SIEMENS PROPULSION SOLUTION SWITCHGEAR AC MOTORS 690V ALTERNATORS SWITCHBOARDS DRIVES TRANSFORMERS
- ZF AZIMUTHING BOW THRUSTER SIEMENS AC MOTORS
- MARPOL UPGRADES OWS - GEA SEWAGE - EVAC BWTS – OPTIMARIN
- ACCOMODATION UPGRADES LIGHTING OVERHEADS HVAC FIRE DETECTION NAV LIGHTS PROPULSION CONTROLS MAST MODS
- PIPING RENEWALS BALLAST FIREMAIN DRAINS
- STRUCTURE UTM #6 BW TANKS
- FRESH WATER GENERATION UPGRADES
- OVERHAUL OF Z-DRIVES 5 YR CYCLE
- SCIENCE UPGRADES EK80 UPGRADED DP SYS CABLING SERVER ROOM COMPUTER OVHLS / UPGRADES

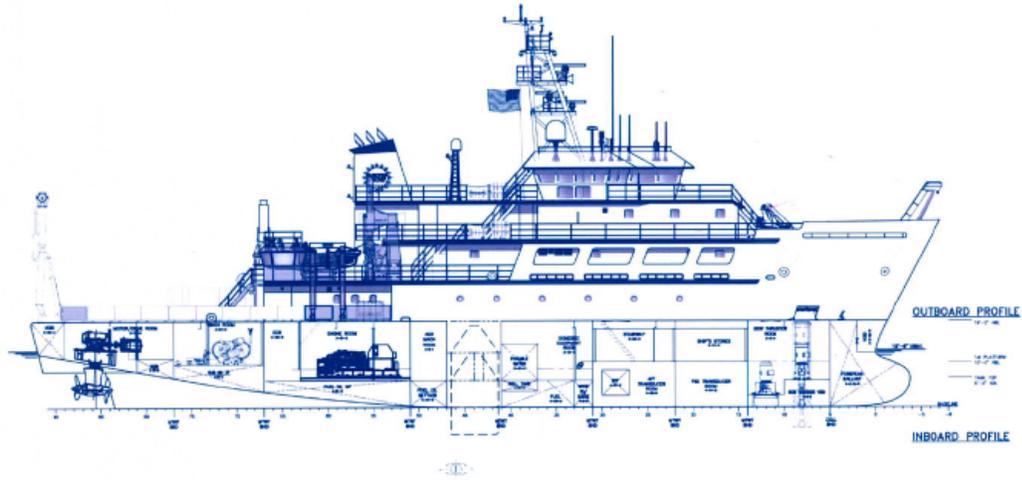
# INITIAL YARDS - RFP SEND OUT

- 1. International Ship Repair – Tampa
- 2. Tampa Ship – Tampa – Chouest
- 3. Gulf Marine – Tampa – Hendry Marine
- 4. VT Halter Marine – Pascagoula
- 5. Detyens – Charleston
- 6. Conrad Shipyard – Morgan City
- 7. Gulf Copper – Houston
- 8. Thoma-Sea Marine Construction – Lockport LA
- 9. Gulf Island Shipyards - Houma, LA – RCRV project
- 11. EPIC – Formally BAE Mobile Alabama DD
- 12. Vigor – Portland, OR
- 13. Bollinger – Lockport, LA - Chouest
- 14. Colonna's – Norfolk, VA
- 15. Bay Ship – Oakland, CA
- 16. BAE – Jacksonville, FL
- 17. Dakota Creek Industries Inc. – Anacortes, WA
- 18. MARRS – Mobile, Alabama
- 19. Fincantieri Bay Ship – Green Bay, WI

# TIMELINE

- RFP OUT 20 MAY 2019
- BIDDER CONFERENCE / SHIPCHECK / NEWPORT OR 30 MAY 2019
- BIDS DUE 17 SEPT 2019
- WHOI INTERNAL / ONR REVIEW / FINAL VISITS SEP – OCT 2019
- AWARD TARGET 22 NOVEMBER 2019
- TRANSIT PANAMA CANAL EBOUND EARLY JAN 2020
- GULF Caribbean Ops JAN – MARCH 2020
- SHIPCHK ONBOARD MTG OPPORTUNITIES GULFPORT MS 6,9,21 FEB 2020
- ALVIN OFF FOR 6500 M UPGRD / INITIAL STRIP SHIP 16 MAR – 10 APRIL 2020
- LONG LEAD TIME MATERIALS TARGET DELIVERY AT YARD MAY 2020
- LAST CRUISE DEMOB MAY 31 – 1 JUNE 2020
- OFF-SPOOL TRAWL, .681, .322, ¼ HYDRO WIRE / SCIENCE EQUIP 2-6 JUNE 2020
- DEPART WOODS HOLE APPROX 06-7 JUNE 2020
- ENTER YARD TARGET June/July 2020 TBD
- TESTING / SEA TRIALS APRIL / JUNE 2021
- REDELIVERY JULY 2021
- ALVIN BACK ONBOARD TARGET Q3 2021

# East Coast Oceanographic Consortium (ECOC)



Regional Class R/V *Resolution*



- **URI UNH WHOI**
- **URI as lead operator**
- **Joint planning, scheduling**
- **Technical support**
- **Ship time**
- **Associate members**

# *OceanXplorer<sup>1</sup>*



- Owned by OceanX
- Ex-Volstad Surveyor
- Conversion at Damen Rotterdam
- WHOI technical support

- Science & Media
- BBC and Discovery Channel series
- Indian Ocean Q3 2020



# CWATER

## Complex for Waterfront Access to Exploration & Research



### Goal: Rebuild WHOI's waterfront research complex

- New dock and laboratory complex
- Accommodate activities requiring direct access to the sea (ships, AUV labs, test wells, small boats, shop, high bays)
- Resiliency a key design requirement
- Complex to serve WHOI and the greater community
- Feasibility study complete: \$75 million (2018) and 7 years
- Working Phase II planning, design, engagement and permitting