

NDSF Facility Update

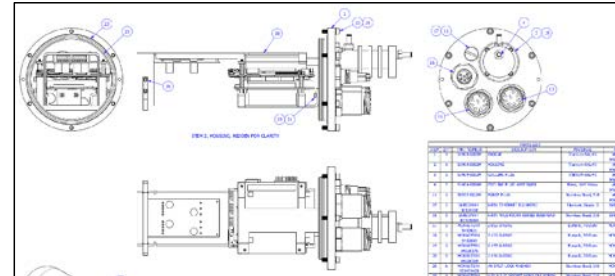
NDSF NATIONAL
DEEP SUBMERGENCE
FACILITY



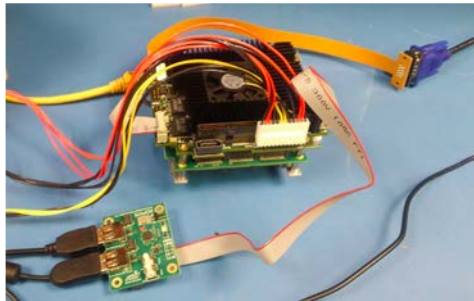
Datapod Upgrade



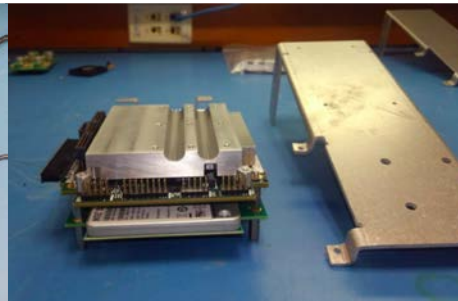
- 10 times CPU performance
- 8 time more RAM
- Easier to spare as it is now identical to main stack
- Replaces 6x 1TB mech. Disks with 1 4 TB
- Free'd up 50% of housing for additional equipment
- Lower power consumption
- Upgraded OS distribution



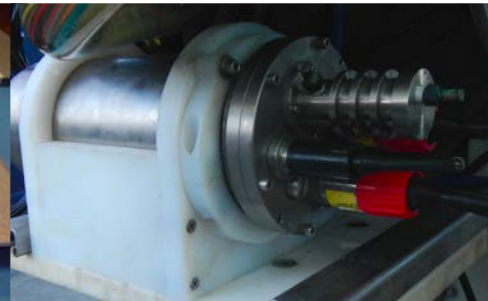
Datapod mechanical design schematics



OS installation



XR Electronics Design Progress

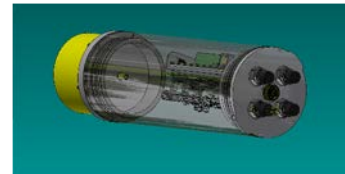


Legacy hardware on the AUV

Sentry XR Upgrade



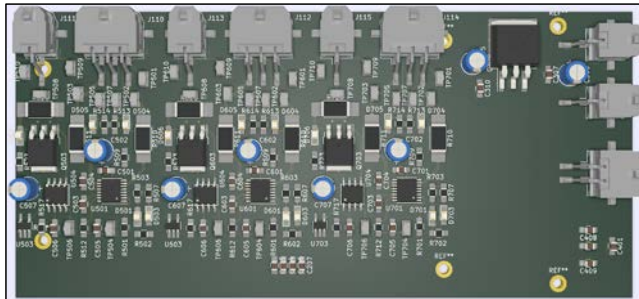
- Replacing End of life hardware
- Added modem capability's 15kb/s capable modem
- Lighter weight
- Newer electronics technology
- Release weight sensing



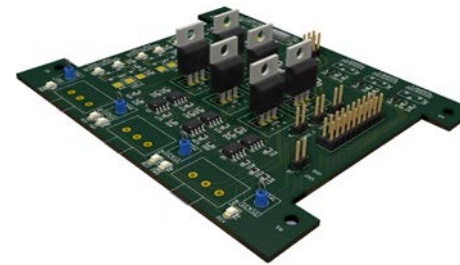
Test housing Design



Existing Housing to be replaced



Electronics and PCB Design

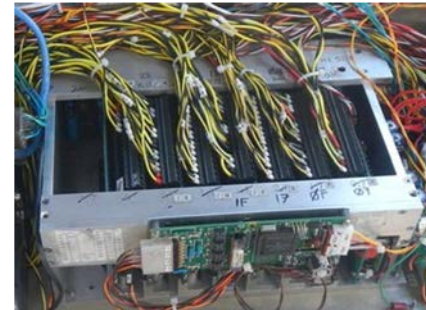


Proto test PCB for bench Testing

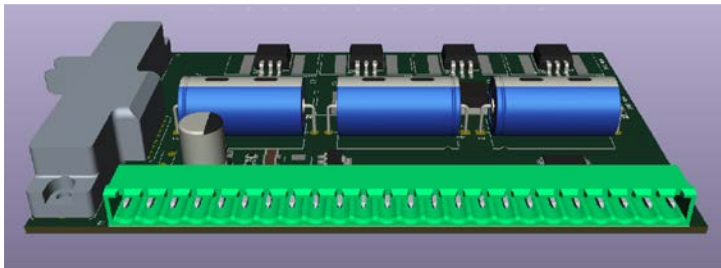
Electrical Switches



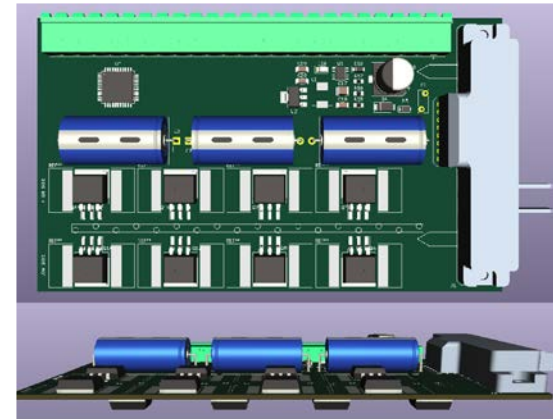
- Built on existing Switch Design
- Replaces end of life hardware
- Add current and voltage measurements (critical for AUV operations and remote introspection through acomms)
- Increases available power on each channel
- Reduces hotel load with increased efficiency in total



Existing Electrical Switches



Electrical Switch mechanical model



Electrical Switch mechanical design

DC/DC Converters



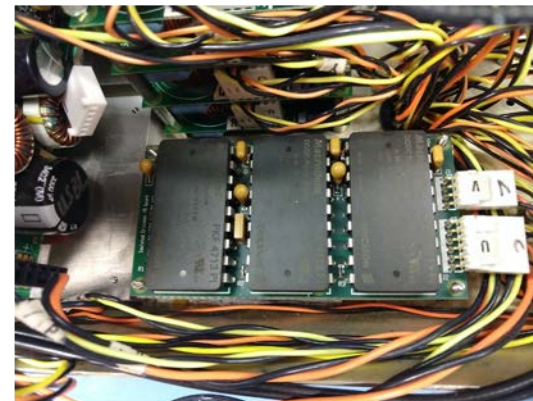
- Replaces DC/DC converters that are >15 years old
- Ties into switches design with added ground detection
- Improved space savings
- Improved efficiency from home made converters still in use in Sentry



Existing DC/DC converters inside the main housing



One of many replacement DC/DC converters

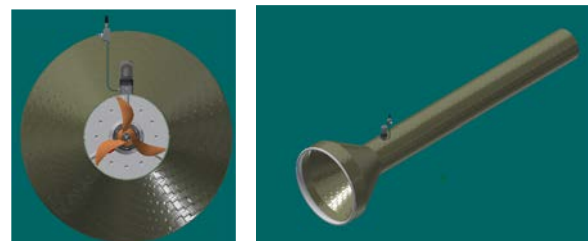
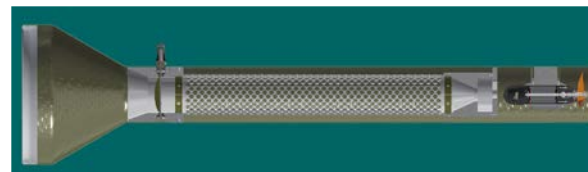


DC/DC to be replaced

SyPRID Sampler upgrades



- Flow sensors purchased and integrated into design
- Valve control and mechanical improvements
- Software driver ported to ROS
- Ti Thrusters built for the system



Model and Design of SyPRID sampler

3
2

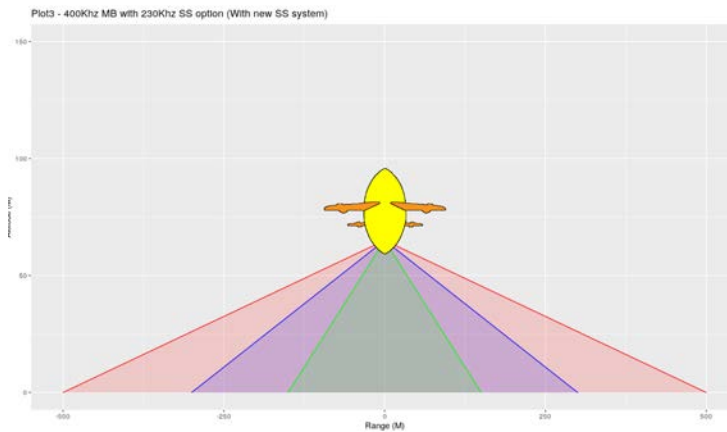
Edgetech Upgrade



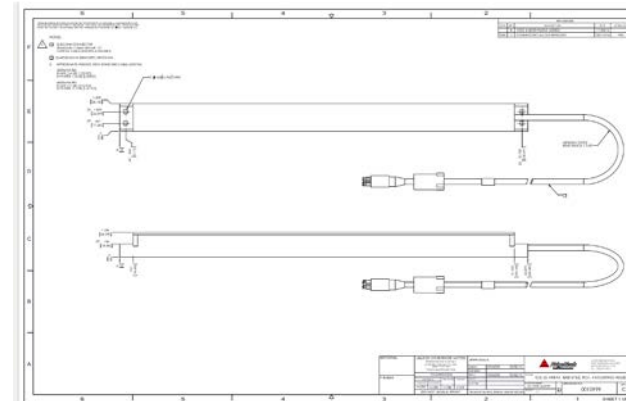
- Replacing 10 year old system with newer components
- Tri-Frequency with the highest freq. Channel to be increased to 540Khz (Increasing resolution)
- Improved processing and hardware design
- No loss in max coverage.



Edgetech 2205 system



Three channel configurations (Can run any two at the same time)

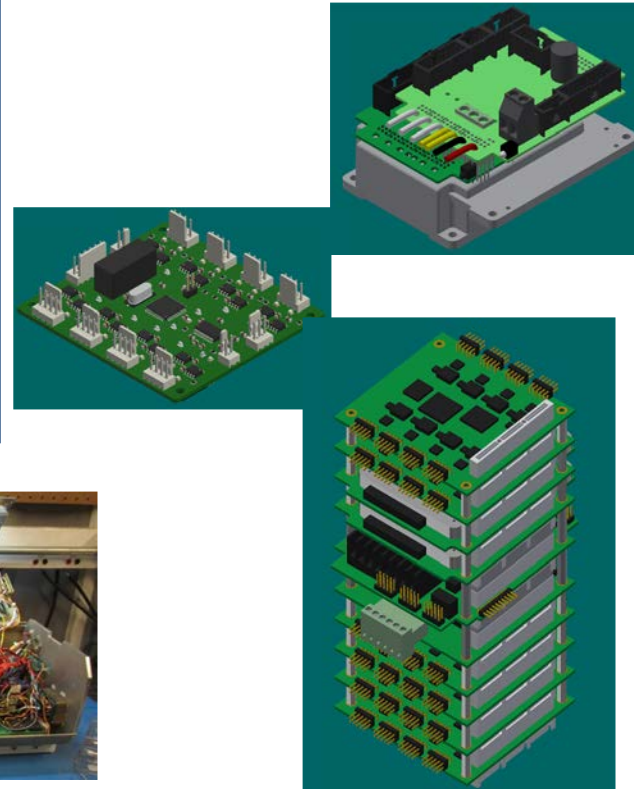


New transducer - Reduced size

Chassis Upgrade



- Replacing 10 year design
- Improved heat dissipation and thermal properties to reduce on deck 'over heating'
- Improved space layout for additional instrumentation
- Improved maintenance and overall easier to work on.



Existing chassis currently used in system

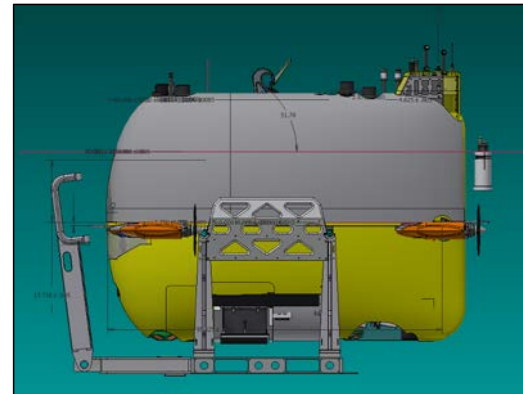
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4

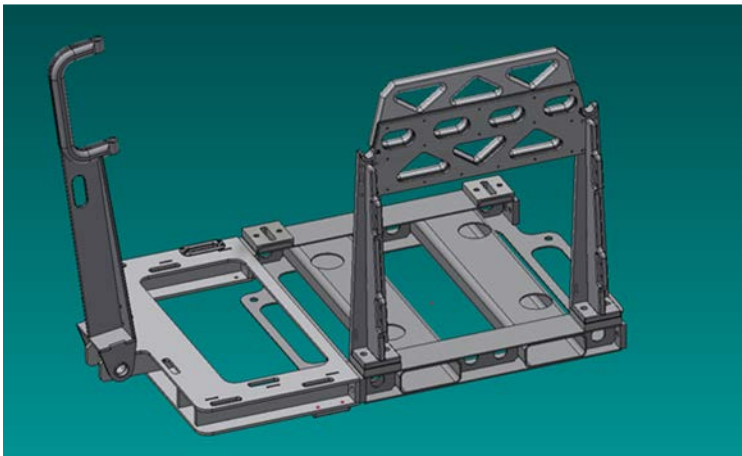
Sentry Cradle Re-design



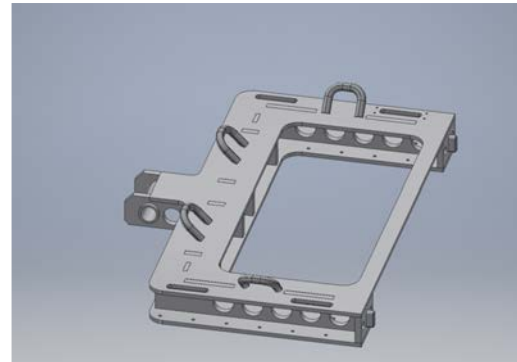
- Reduced weight for shipping
- Improved picking and lifting pockets
- Modular design
- Improved vehicle access
- Reduced ship integration, with additional tie down points



Chassis Design model



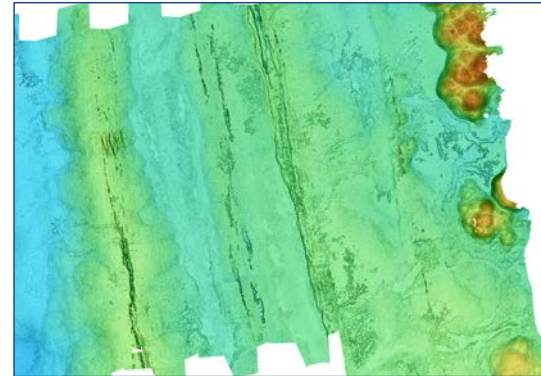
Modular chassis design



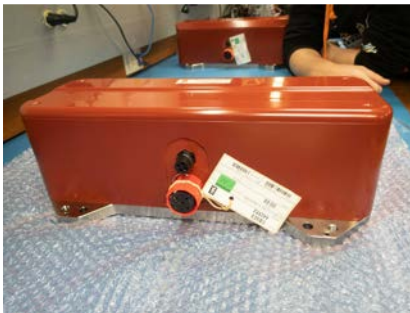
Kongsberg EM2040



- Much better coverage than Reson system
 - Reson coverage: ~170
 - Kongsberg Coverage: >200m
- Integrated 200Khz and 600Khz will make this a very powerful system. Spectral mode coming with a new software update (200/400/600Khz ping cycle)
- Opening up new survey patterns and possibilities for survey's



Example MB data from Sylvan 2019 Cruise

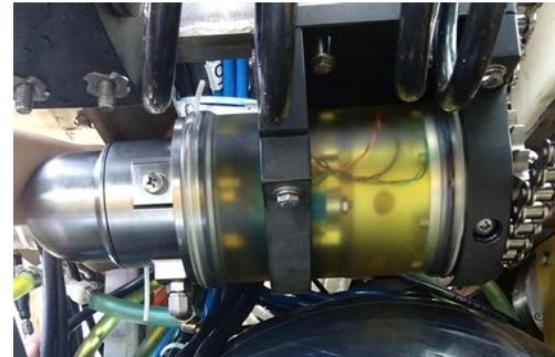


Installed transducers

Sentry Servo Development



- Existing parts no longer available for legacy hardware
- Improved resolution
- Improved control loops and performance
- Zero backlash gear box
- Working on replacement position sensor for final design



HD Servo installed during 2019 Engineering trials



Incremental encoder testing (At home due to COVID)

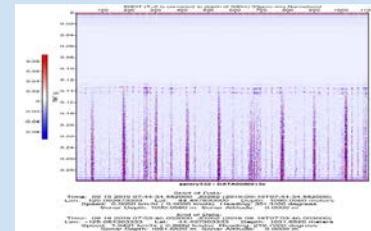


General Project updates



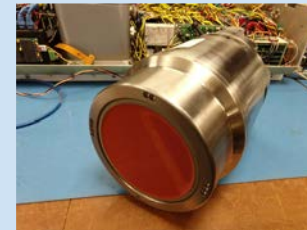
Sub - Bottom pipeline: (PCAR-2019)

Software pipeline replacement and improved processing and ingesting and data presentation. Project on hold, will plan to pick back up this fall when staffing can support the effort.



Pioneer DVL upgrade:

Mechanical and Software complete, waiting to test on the vehicle. Unit was sent back for repair and has not had the opportunity to test since last summer. Looking to test this summer



2020 Maintenance items



Sentry 2020 Maintenance

Three months of maintenance at WHOI, following the delivery of the vehicle from Fiji. Maintenance will focus on a mix of general vehicle upkeep and testing new systems and equipment.

- Move all repos to git
- Software updates ROS/Ubuntu
- Replacing charge cables
- MX testing
- Camera Driver ported to ROS
- Blueview testing
- Battery Maintenance
- Battery Housing inspection
- Skin and wing root repair
- Servo/Thruster Maintenance.
- Electrical Wiring Mapping
- Data processing HD upgrades.
- DC/DC testing and qualification
- Camera testing and qualification
- Plankzooka testing and fit test
- Endeavor Integration
- Well testing and validation



Sentry Staffing Update



Active Team Members

Sean Kelley - program manager
Justin Fujii - Completed first cruise as EL
Zac Berkowitz - At sea electrical support/EL
Stefano Suman - At sea software support
Ian Vaughn - Minimal software support
Mike Skowronski - At sea and on shore EE support
Isaac Vandor - continued software support Software engineer
Mike McCarthy - Fill in mechanical help

No longer with us...

Laura Lindzay - Moved on from institution
Manyu Belani - Moved on from institution
Jennifer Vaccaro - Moving on this fall.

Interns/Summer students

Alec Hewitt - Summer EE intern

New Hires

Amanda Sutherland - Mechanical engineer
Joseph Garcia - Software engineer

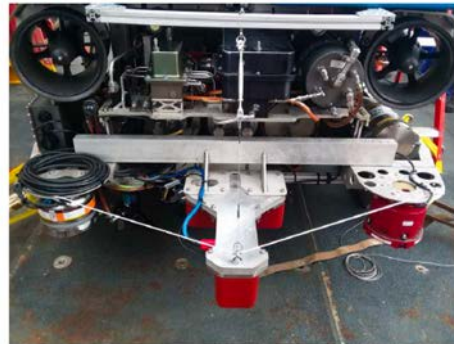
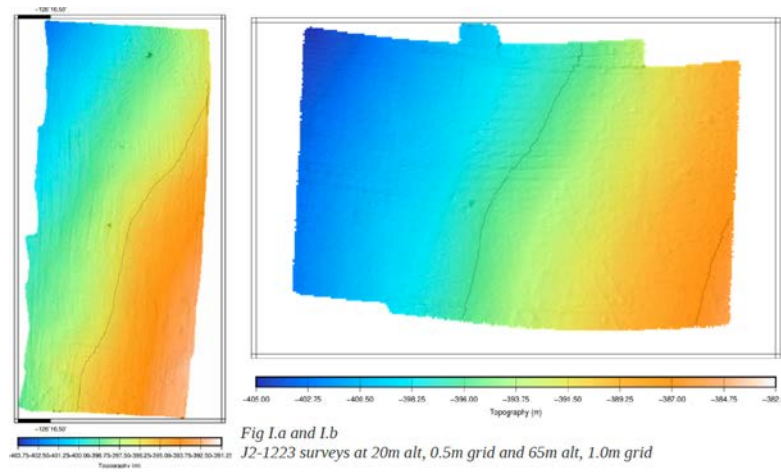


Jason update: Staffing



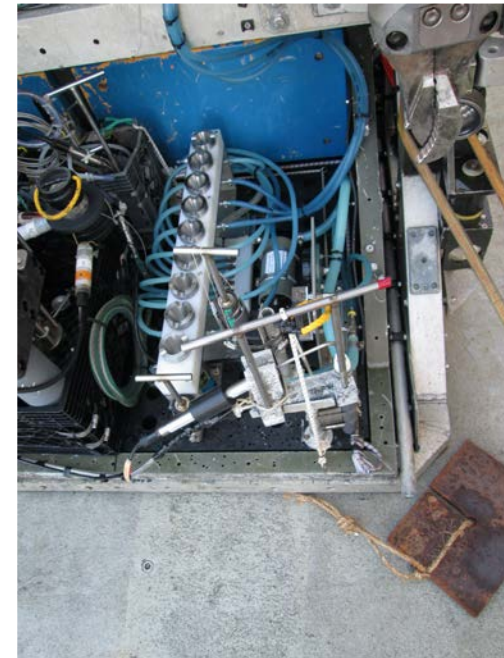
- Contractors
 - Summer Ferrel, experienced OET ROV operator, mechanical/Navigation
 - Lost Jim Convery, experienced oil field ROV operator
 - COVID-19 loss of Jason ops, took another position
 - Jim Varnum to retire end of 2020, or early 2021
- Ben Tradd EL and RCA Project Manager
- Tina Haskins Data
 - Joined Jason ops from WHOI
- Andy Billings Mechanical Engineer
 - Moved to Jason from Sentry
- Addressing need for gender, **pcar 2020**, and diversity balance

Kongsberg EM2040 multi beam (2019 tests Jason)



JASON Highlights NDSF fluid sampler

- NDSF engineers built a fluid sampler in response to community request
- Constrain development by using preexisting items and systems
- Manipulator operated discrete valves providing range of valving logic
- Mechanical pressure and flow gage
- Polyurathane Polyvinyl alloy tubing 100 C rated, can be replaced as Rq'd
- Off the shelf Palagic pump, pos. disp. Correlating shaft speed with flow
- Variable speed controller
- Easily connected to user supplied filters and bags
- Temp measured at inlet using existing temp probe
- Will be tested on upcoming cruises, available 2020



1st use
NDSF fluid sampler on
Jason basket with IGT's etc.
Seewald/Lang/Rogers 2020

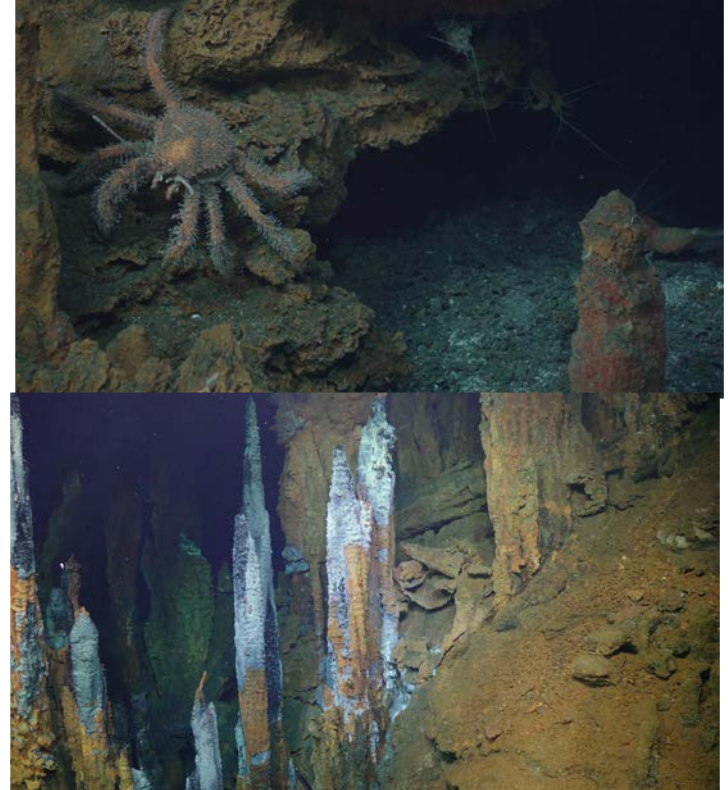
Jason system upgrades

- New Jason power system (AFX) continued to plague us with power outages in 2019 and is being replaced **pcar 2018/19**
- Permanent solution, New Jetway received 2019
 - Will be used full time summer 2020 cruises
 - Weather use unit, will reside in hanger
- Jetway to be repacked to fit into power compartment in CV A winter 20/21



Jason system upgrades – 4K Camera

- Subsea Sulis Z70 4 k (highest quality subsea cam available at time of purchase) **pcar 2019**
- Provides both stills and video in one camera (**pcar 2018**)
 - Faster still storage in still mode
 - Possible to capture stills in video mode with delay
- Full res 4 k recorded in highlights and HD 24/7
- Stills in full res to separate hard drive
- Redesigned GUI with P&T control integral (**pcar 2018**)



Jason system upgrades – Manipulator training

Providing more manipulator training and practice with ODI connectors to assure ease of connections pcar 2018

- Purchased topside additional T4 controller and built HPU for at WHOI manip training pcar 2018
- ODI connector problems have been identified in other industries
- Working with RCA personnel to assure implementation of all possible solutions (from industry) to avoid ODI issues



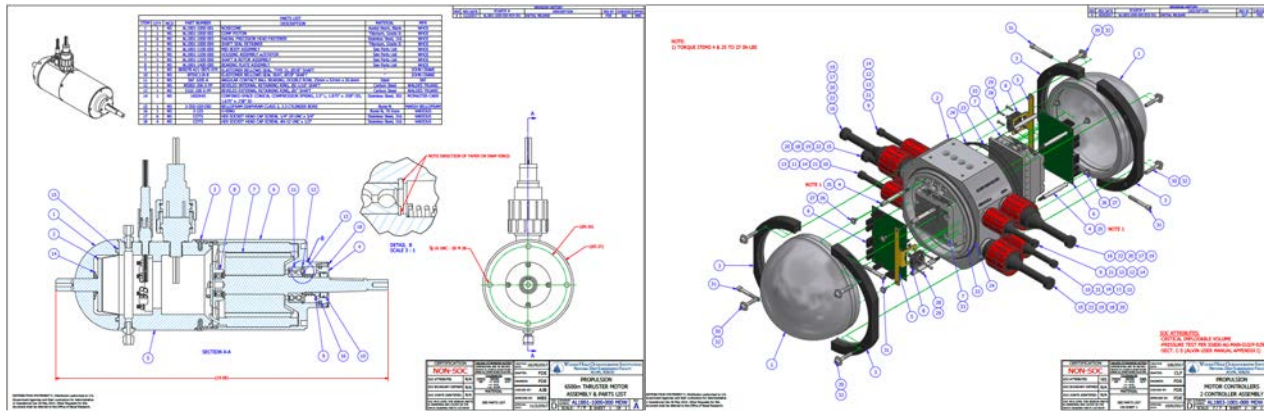
Jason system upgrades

- Rapp winch and NPC crane at WHOI annual maintenance to address level wind and general upkeep concerns [pcar 2019](#)
- Implemented elevator tracking to prevent loss if weather prevents immediate recovery [pcar 2018](#)
- Weather limits have been reviewed with Els, must consider personnell, equip saftey, Pls have strong driver to maximize dive time, Els are trained to make a safe weather call. These are at odds. [Pcar 2019](#)
- MRU data and Commanders weather being used to assist EL in weather call. [Pcar 2019](#)
- Used Vessel MRU on one cruise for Active Heave and weather
- Successful 12/12 ops on RCA cruises, pursuing 12/12 on other cruises [pcar 2019](#)

Jason system upgrades

- System Shipping
 - ✓ NDSF and WHOI shipping office are addressing single source freight forwarder **pcar 2019**
 - ✓ NDSF personnel receiving additional training ref Intrn'l shipping procedures **pcar 2019**
 - ✓ NDSF and Vehicle schedulers will continue to work closely to assure contingency in the schedule
- NDSF is developing new heat flow probes due to increased demand, will address data quality **pcar 2018**
 - Will seek funds to complete
- SeaLog system replacing VirtualVan getting mostly praised **pcar 2019**
- Tool van approaching end of life
 - Will seek funds in 2020 budget to build replacement
- Researching PRIZM telemetry system replacement
- Development of new thruster motor and controller underway

Jason system upgrades propulsion



Jason short maintenance period June 2020

- While Jason is at WHOI
 - Test of new Jetway, (main power system for Jason) result of AFX failures
 - Test of new UNOLS .681 EO cable via new Jetway and Jason
- Assembly and test of prototype thruster motor to replace the units which are original to Jason
- Test of new telemetry components for impending telemetry upgrade
- Numerous hardware and software upgrades in the Rapp power van
- Post shipment repairs in control vans and on Jason
- Reorganize system for shift to single body ops from 2-body ops
- Repair CV air conditioners
- Clean mold that resulted from extended sit in Suva

Jason single-body LARS maintenance:

- NPC crane docking head rebuild and testing
- NPC crane testing after maintenance
- Rapp winch repairs and testing, including new brake HPU motors, R/R of main drive motor, level wind maintenance, and numerous smaller efforts
- Numerous hardware and software upgrades in the Rapp power van



Winter 2020/21 Jason maintenance period

- Repackage Jetway into control van-A power compartment
 - Increase reliability
- Build new thrusters after testing of prototype
 - Old thrusters have reached end of life, become increasingly less reliable and are obsolete
- Build new tool van
 - End of life due to rust and at sea and shipping wear and tear
- Rust maintenance to control vans
 - To increase life cycle
- Replace control van air conditioning systems **pcar 2020**
 - Current system has very poor reliability and replacement with more suitable for shipboard will increase reliability
- Integrate new telemetry system into Jason sub-sea and topside systems
 - Current telemetry system is at end of life and no longer supported by the manufacturer
- Remove, weigh, and repair flotation block
 - Normal maintenance to facilitate frame inspection and repairs, and to increase life cycle of flotation

Winter 2020/21 Jason maintenance period

- Replace door seals in control vans to address mold **pcar 2020**
- Reorganize rigging van
 - Normal, get rid of obsolete spares
- Data entry into Inventory management system
 - For better equipment tracking, sparring, failure tracking, to increase reliability
- Continue ICL replacement effort **pcar 2020**
 - Researching optical and acoustic link alternative to ICL
- Single-Body LARS
 - Rapp winch maintenance
 - NPC crane maintenance
 - Docking head maintenance
 - Airline HPU maintenance
- Sea log system remote operation via tele-presence
 - Enable remote button control to offload personnel from the vessel
 - Potentially reduce ops team via remote data processing

Alvin Staffing Updates



Major Personnel Milestones

- Danik Forsman – Promoted to Mech Section Lead
- Drew Bewley – Completes Pilot qualifications, promoted to Elec Section Lead
- Rose Wall – Joins Operations team
- Rick Sanger – Includes Ops Team support along with Alvin engineering support, nearing completion of Pilot qualification
- Stefano Suman – Assumes lead on Alvin C&C and navigation software taking over for Jon Howland
- Mike Skowronski – leading project to upgrade Alvin data/imaging system, shipboard archiving, access and duplication system

Novel Operational Concepts (in trial)

- Science Liaison – Provides direct support to Sci-Party, Well received on Hansel, Sylvan and Young cruises
- Alvin Data Person - Provides Data expertise, support & QA, regular part of team starting in 2021



Program Goals –

- Provide improved support to science party
- Increase appropriate expertise into the Ops Team
- Improve data & sampling product to Science Party
- Merge Engineering and Operations resources
- Enable cruise specific opportunities for novel personnel participation
- Expand cruise participation with only positive impacts on Science Party - use of Alvin bunks

Alvin Data System Upgrades



Goal – Improve overall data system capabilities, products and program support (**PCAR 2019**) :

- **Upgrade data system hardware**
 - Primary submersible systems
 - Shipboard data handling system
- **Define daily data products**
 - Clarify routine products
 - Enable specialty data needs
 - Manage expectations
- **Integrate data expertise into operations**
 - Define position roles and responsibilities
 - Refine resource needs & duties
- **Mirror other NDSF vehicles' systems**
 - Incorporate beneficial aspects
 - Align data product deliverables



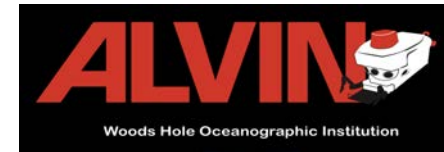
Alvin Imaging System Upgrades



- 6,500 meter capability
- Integrate 4K video
- Maintain HD & still image capability
- Integrate MISO imaging concepts
- Upgrade camera controls
- Upgrade video display & recording
- Reduce observer/pilot task loading to optimize imaging efforts during dives
- Improve exterior lighting selection, control and separation
- Improve camera/lighting mounting and positioning versatility
- Incorporate ability to better adjust lighting/camera position real-time
- Improve user camera info display
- Improve overall system 'usability' and ergonomics in-hull



Alvin Data System Upgrades **(PCAR 2019)**



Submersible Data System

- Finalize new computer installation
- Upgrade LINUX versions
- Install F/O network connector to improve post dive data transfer
- Implement improved observer metadata display
- Finalize 'Sea-log' integration
- 'Frame-grabber' officially retired

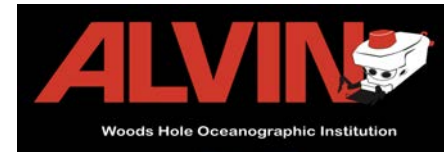
Shipboard Data/Image Handling System

- Upgrade network hardware
- Upgrade duplication hardware
- Upgrade storage hardware
- Upgrade access point hardware
- Improve transfer rates
- Improve access times
- improve ease of access
- incorporate routine post-dive data Q/A

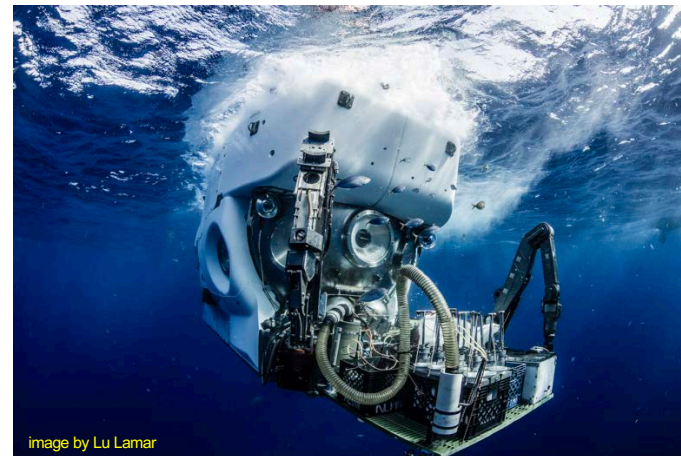


- Annual budgeting/expense for progressive component upgrades to stay aligned with advances in technology

Alvin Data System Upgrades



- **Program & Community Considerations**
 - Additional recorder dedicated to full-time front end recording (fixed-focus wide shot)
 - 4K (and higher) imaging plan
- Alvin stand-alone shipboard data network, unique Alvin system (similar to other NDSF vehicles)
- Creation of post dive data access 'GUI'
- Review of video access/transfer expectations including training videos -



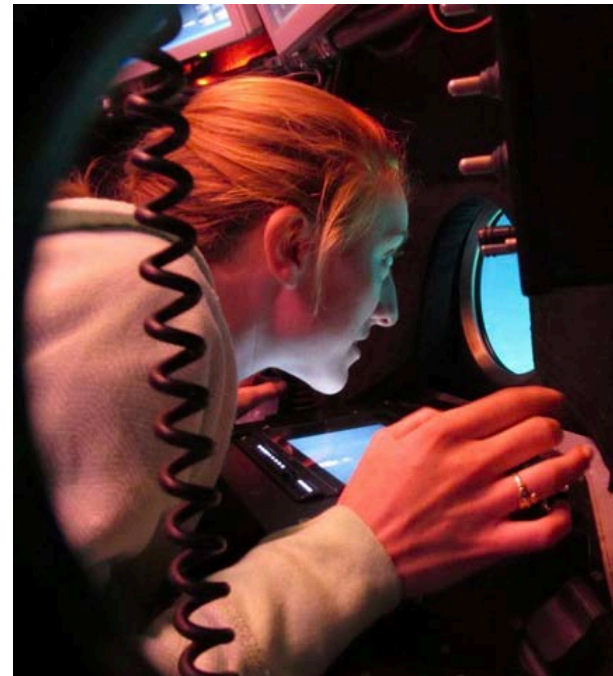
- Post-processing expectations
- Expectations for data record integration and Q/A of data from unique, science supplied sensors

Alvin Additional Upgrades

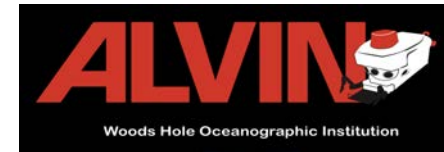


Planned Improvements

- **New Temperature Instrument Suite**
 - Hi, Low and Heat-flow probe capabilities
 - Better accuracy and range resolution
 - Reduced implodable concerns – pressure tolerant electronics and probes
(PCAR Sylvan 2019)
- **New wireless optical data transfer system**
 - under development to replace ICL's
(PCAR Sylvan 2019)
- **Acoustic data/image transmission**
 - under development to provide metadata and image transfer capabilities
 - will complete 'Science Observer Station' in main lab



Alvin Current Efforts

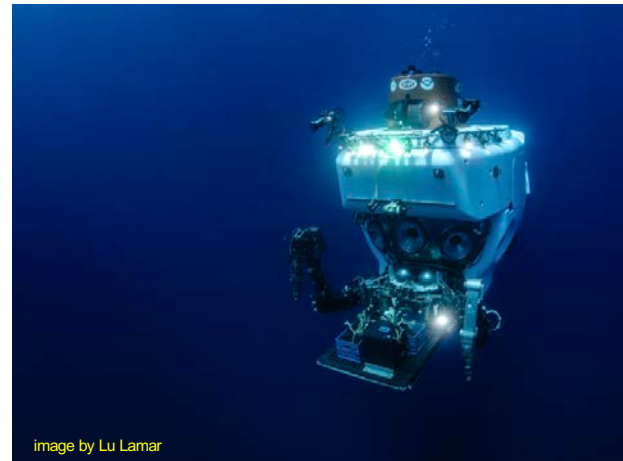


Alvin Overhaul Begins March 2020

- Off-load and Hi-bay setup completed by April 6th
- Team stand-down till May 8th
- Systematic disassembly begins
- Disassembly completed June 19th
- Primary maintenance work underway

COVID-19 Consideration

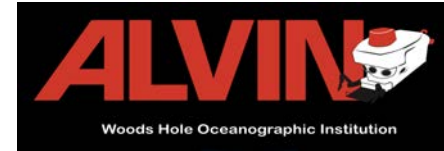
- Arrival, off-load and disassembly in the midst of March – June Covid peak
- Team creates and adopts proactive measures to ensure personnel safety
- Evolving plan working directly with WHOI leadership
- Many team members working remotely
- On-site team complement minimized as much as possible
- Alvin leads working with other groups to incorporate best practices and any 'lessons learned'



Program Goals –

- Ensure team member safety
- Follow US, MA and WHOI guidelines
- Maintain planned overhaul schedule
- Minimize overall impact in preparation for 2021 return to operations

Alvin Overhaul

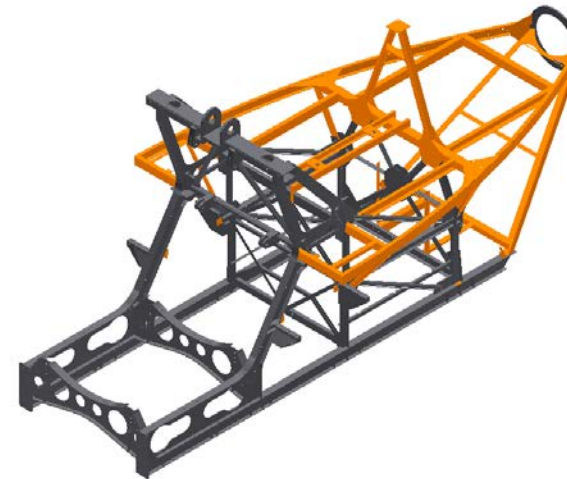


Overhaul Phases

<i>Disassembly phase</i>	<i>May 2020 - Jun 2020</i>
<i>Maintenance & mods phase</i>	<i>Jun 2020 - Jul 2021</i>
<i>Reassembly phase</i>	<i>Mar 2021 - Jul 2021</i>
<i>Testing phase</i>	<i>Jul 2021 - Aug 2021</i>

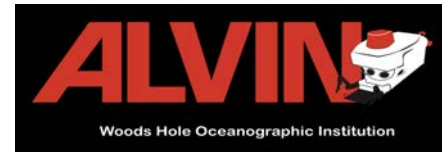
Overhaul Major Milestones

<i>Atlantis mid-life refit</i>	<i>July 2020 - July 2021</i>
<i>Atlantis transit to WHOI</i>	<i>July 2021 - Aug 2021</i>
<i>Alvin post overhaul system testing</i>	<i>July 2021 - Aug 2021</i>
<i>Alvin on-load</i>	<i>Aug 2021 - Aug 2021</i>
<i>Alvin dockside testing</i>	<i>Aug 2021 - Aug 2021</i>
<i>Sea Trials 1</i>	<i>Aug 2021 - Sep 2021</i>



Modified Frame

Alvin Overhaul



Ballast Sphere Milestones

<i>Ballast sphere machining/welding</i>	<i>June 2020 - Nov 2020</i>
<i>Post weld heat treat</i>	<i>Nov 2020 - Nov 2020</i>
<i>Final machine</i>	<i>Nov 2020 - Dec 2020</i>
<i>Tech Readiness Review</i>	<i>Jan 2021 - Jan 2021</i>
<i>Hydro test</i>	<i>Jan 2021 - Jan 2021</i>
<i>Post hydro NDT</i>	<i>Jan 2021 - Feb 2021</i>
<u><i>Ship spheres to WHOI</i></u>	<u><i>Feb 2021 - Feb 2021</i></u>



6,500 Meter H.P. Ballast Sphere