Alvin Upgrades
Personnel

New *Alvin* Expedition Leader – Todd Litke

- Retired Navy DSV pilot with 28 years experience in operations, team management and maintenance of deep submergence systems
- Quickly qualifying on various operational positions – expect completion of *Alvin* pilot qualifications in 2018

Two new ETs to join group in 2018

- Recruiting for solid electronic and data technical experience
- Helps address issues noted in *Alvin* PCAR

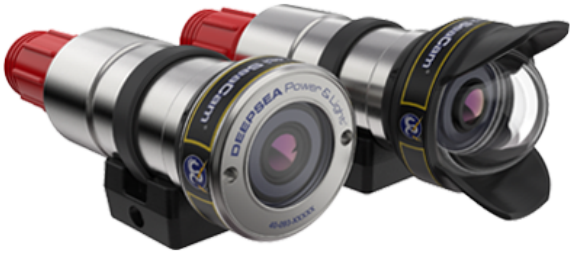
Alvin Upgrades
Imaging

Imaging system evaluation and improvements underway

- Camera control (noted in *Alvin* PCAR)
- Frame grabber (new Teradek fixed issues noted in PCAR)

New DSPL FlexLink HD cameras (two full systems)

- Fixed focus, wide angle provides excellent forward imaging



FlexLink image acoustically sent to surface

Alvin Upgrades
Imaging

Additional New Cameras

Spare Kongsberg PATZ Camera

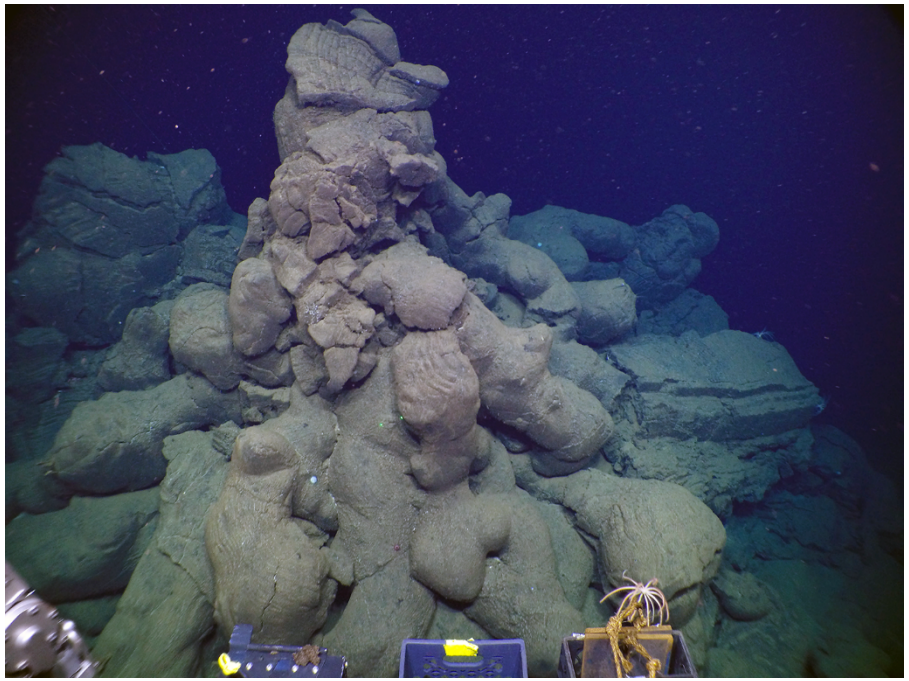
- Available for use on *Alvin* or Observation Vehicle

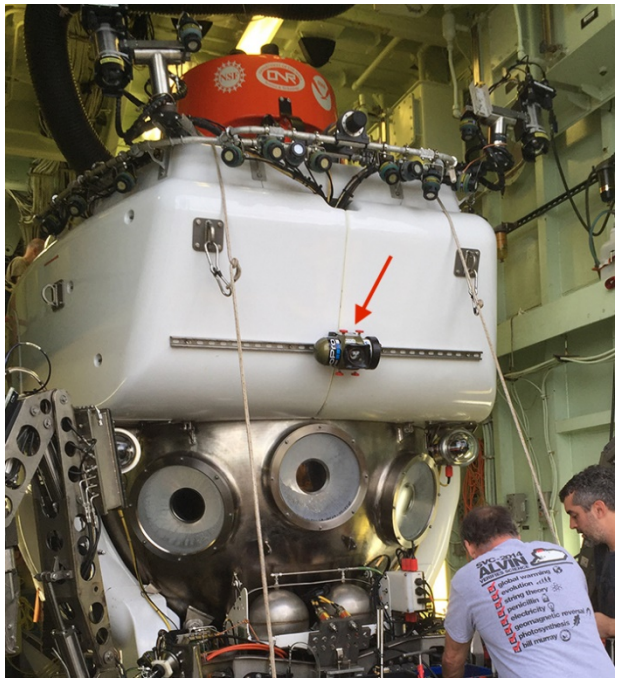
DSPL Low Light Cameras (2)

- Fixed focus, wide angle, small size
- Excellent imaging in normal or very low lighting
- Provides down-looking imaging capability
- Available for use on *Alvin* or Observation Vehicle

Alvin Upgrades
Imaging

Additional New Cameras

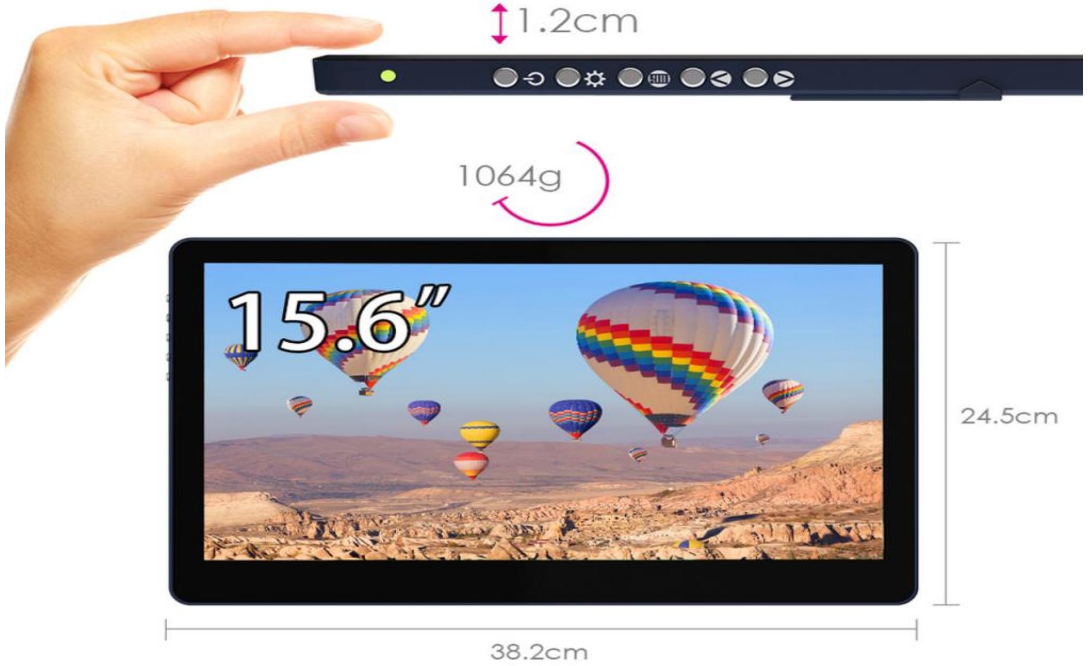




MISO GoPro Camera

- Proven simple and useful addition to dives
- Collects 1,000's of stills per dive
- Interval images throughout dive
- Requested by users in the 2017 PCARs

Alvin Upgrades
Imaging



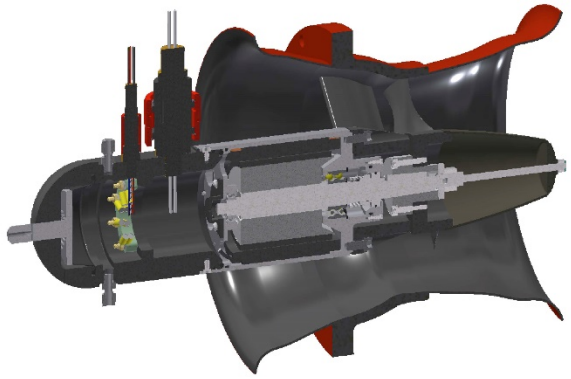
New Capacitive Touchscreen Interface/HD Video Monitors

- **Replaces existing forward 15" computer touch screen monitors**
- **Enables display of all video sources (external HD cameras)**
- **10" version will replace existing observer video monitor ("head-bonkers")**
- **Enables observer touchscreen interface with data system**
- **Helps address PCAR comments**

Alvin Upgrades
Propulsion

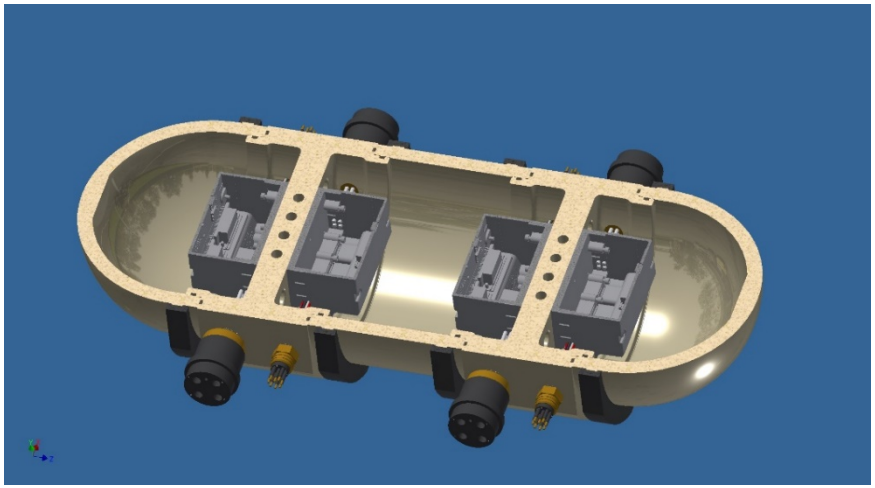
New Thrusters

- Improved efficiency and available thrust
- New efficient motor controller
- Progressive installation in 2018
- Helps address PCAR comments



Motor	Controller	# Blades	Power @ 50lbs Thrust (W)	Max Efficiency (%)	Thrust @ Max Efficiency (lbs)	Max Thrust
OLD (obsolete)	MOOG (obsolete)	3	540	45	86	158
NEW	ELMO (programmable)	5	485	55	149	218

Alvin Upgrades
Equipment Replacement

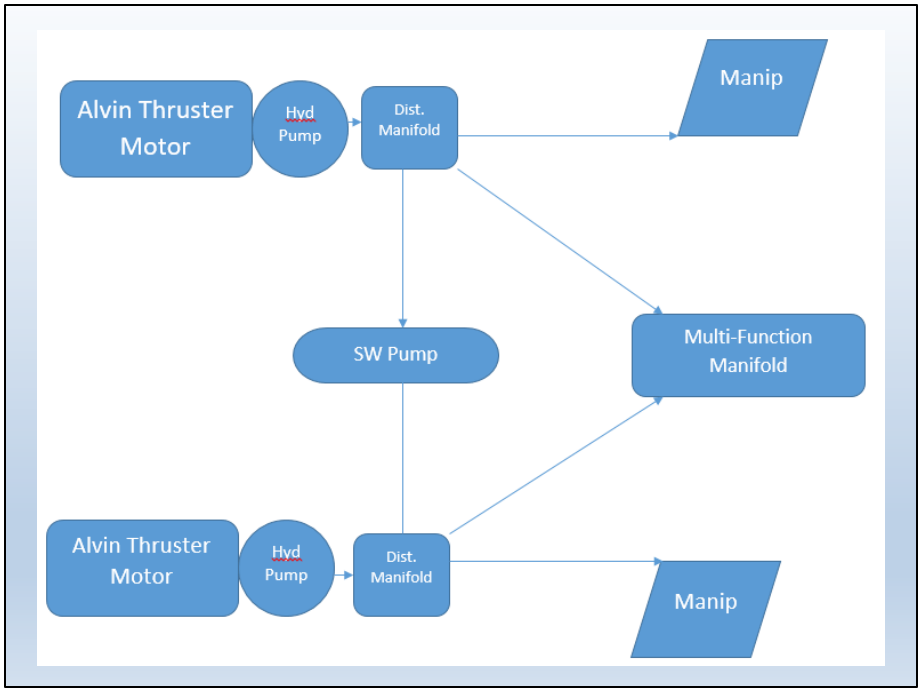


6,500m Motor Controller Housings

- Modular, 2 or more controllers
- Procurement underway

New Dual Hydraulic System

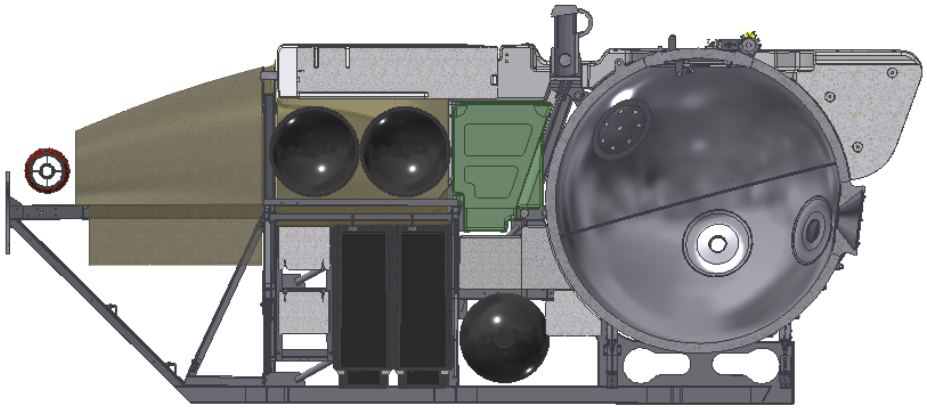
- Improved performance/efficiency
- Uses new thruster motors
- Enables two Schilling manips
- Helps address PCAR comments



Alvin Upgrades
Equipment Replacement

New VB-HP Air Spheres

- Four new 6,500m spheres, procurement in 2018
- Increases ballasting to 500 lbs, replaces eight existing tanks



New Seawater Pump

- Hydraulically powered
- Target performance: 10 lbs/min @ 6,500 meters
- Testing in 2018

Jason Upgrades

4K Cameras Tested
(PCAR comment)

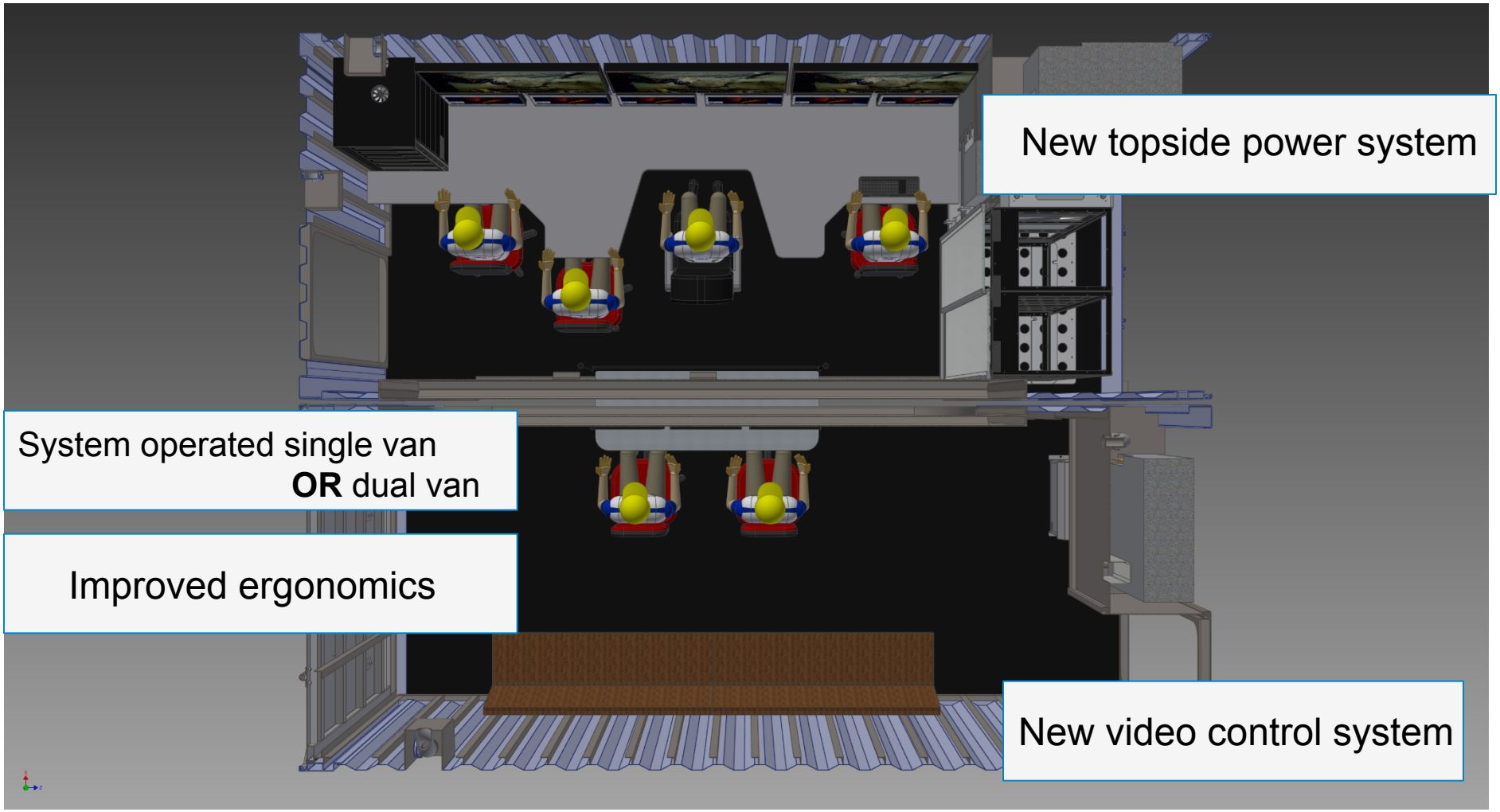
Feature:	Sulis:	SubC:
•Video	UHD, HD	UHD, HD
•Stills	20 mpixel	16.6 mpixel
•Zoom	12x	20x
•FOV	93	83 (with liquid optics)
•Chip size	1"	1/2.5"
•Control	Full manual, handbox	Software

Jason Upgrades

4K Camera Sulis 4K Selected

- Video features are equivalent
- Still capability of the Sulis is better (doesn't interrupt video to get stills)
- Control/usability of the Sulis is judged far superior
- Subjective video/imagery quality is better with Sulis (anecdotal)
- Control integrates to our ROS P&T's

Control Vans Upgrade



New topside power system

System operated single van
OR dual van

Improved ergonomics

New video control system

New Control Vans

- More viewable video real estate
- Center 55” science screen quad view of multiple cameras at 1080p or one camera to 4K imagery
- Video system upgraded to distribute and display up to 4K video imagery
- Integrated KVM system allows controlled access to all computers associated with operations

Winch Actions

- Replacing the lead screw and lead nut
  - Rapp manufacturing defect found -> Rapp recall
- Further investigating high frequency noise in encoder as possible root cause of LW crash
- Proximity switches to be set up to stop LW before any conceivable hard stop
  - New PLC code by Rapp for this has recently been tested on other electric Rapp winches in the fleet
  - Will be tested during 2018 engineering dives
- Turret's internal fluid/electrical slip ring failed on Wheat, will not be replaced
- Instead, direct hose and cable runs to turret managed by a curved energy chain outside turret

Maintenance

- Better tracking and recordkeeping via a Computerized Maintenance Management System (CMMS) by *Fiix*
  - More regular maintenance following written procedures
  - More system inspections
- Every cruise to have a designated responsible OHS lead person
- Will work to have additional engineering when swapping single- to two-body

Collaborations

- WHOI has a partnership with OET that we're expanding
  - WHOI providing engineering services to develop a portable system to be used by OET and WHOI
  - We've been providing operators to OET on a limited basis; will expand that effort for the portable system, and make it a two-way exchange
- WHOI communicated with numerous operators (MBARI, ROPOS, SOC, NOC, OET) in the development of the upgrade. Looking to expand collaborations to learn from others.

Regional Cabled Array (RCA) Proposed Improvements

Continue engaging in seamless communication with users and collaborative, successful *Jason* operations/services

Personnel

- Assign RCA project *Jason* manager

Cruise planning

- More advance trips to RCA facilities by the RCA project *by key Jason team members*
- Three pre-cruise meetings: 6 months, 3 months, and 1 month in advance of the cruise with requirements tracking
- Review previous task times to refine planned activities
- Work with RCA to include contingency time for weather and expected vehicle down time early in STR
- Engage RCA to identify areas for improvements to equipment design and procedures for installation
- Define the *Jason* team in advance (2-3 months), considering qualified individuals
- Develop training aids to ensure ops team proficiency

Regional Cabled Array (RCA)
Proposed Improvements *(cont.)*

During Cruises

- *Jason* will operate with two 12-hour shifts to alleviate crew rest concerns
  - 4 people; one operator in rest
  - 2X expedition leaders will run deck ops on the two watches to facilitate more flexibility with vehicle LARS
  - To increase pilot bandwidth, we'll identify 2 watch leaders to include 1 EL
  - We'll distribute pilot tasking more routinely and simultaneously control manipulators, joy box, and control screen with multiple pilots

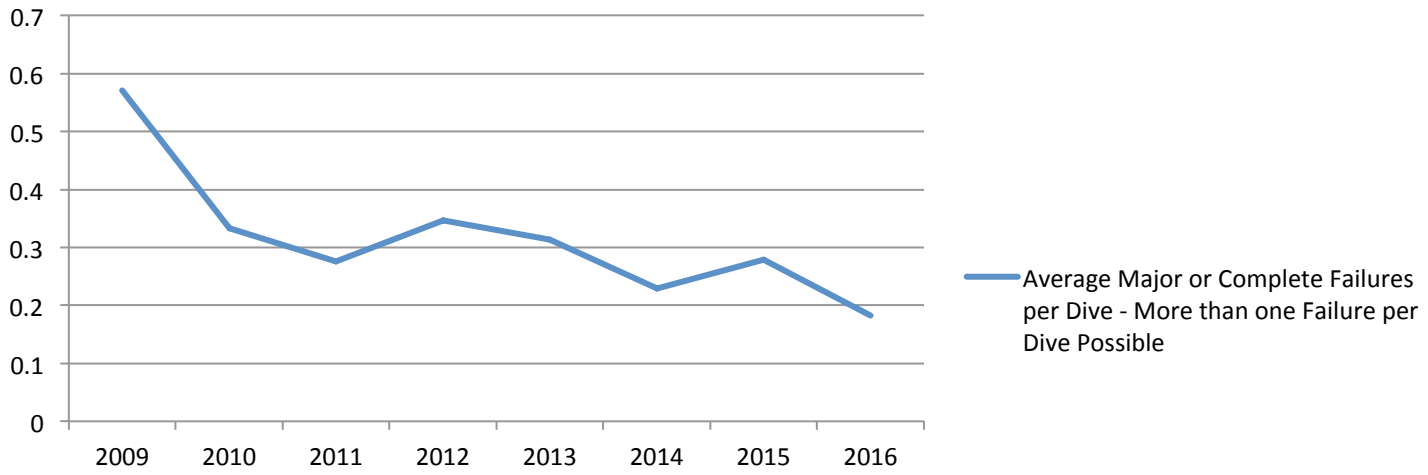
- Develop daily reporting templates -- procedures RCA & *Jason* derived

Sentry Upgrades
Staffing

- Sean Kelley now "*Sentry* Operations Manager"
  - ~1/3 of his time
  - Carl Kaiser retains program management but will scale back time by ~ 1/3 as Sean comes up to speed
- Zac Berkowitz now an EL
- Ian Vaughn fast tracked towards an additional EL
- Jennifer Vaccaro – new grad software engineer
- Masako Tominaga taking on logistics and pre-cruise coordination roles
- Hiring additional mechanical and software engineers (not just for *Sentry*)

Sentry Upgrades
Progress Check

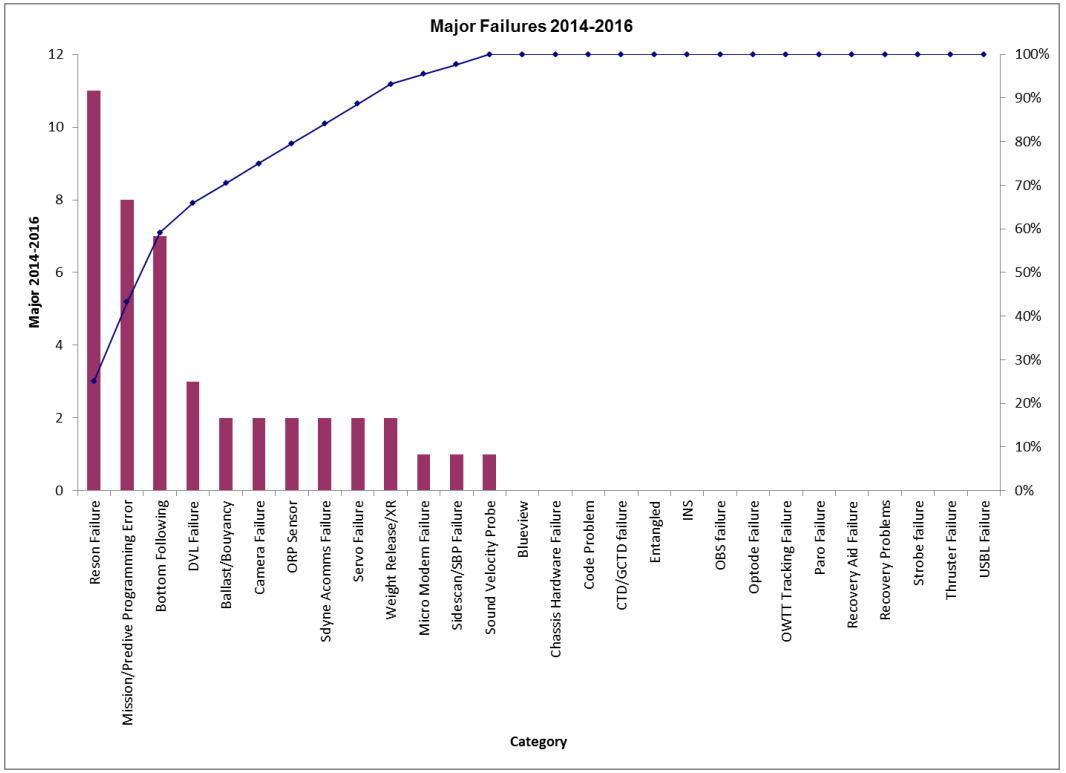
- Many upgrades over the years have led to steadily declining failure rate while dramatically improving capability
- Full historical failure analysis underway
  - Major failure defined to include any major impact to science
  - 2016 = far more capability/complexity for 1/3 the failure rate of 2009



Sentry Upgrades
Focus

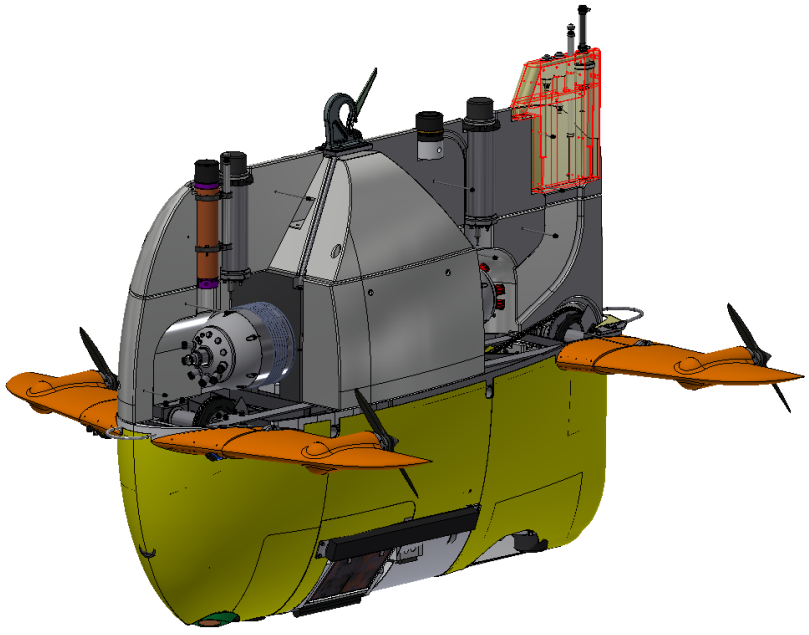
- Aside from new capability, where do we need more work to improve problems?
- 60% of major failures last three years due to 3 things:
  - *Reson – HW/SW*
  - *Predive automation*
  - *Bottom following*

Much more in-depth analysis to be published soon



Sentry Upgrades
Mechanical

- Increasing max current to thrusters by 20%. Estimated to increase vehicle top speed to ~2.3 kts. Higher current tested now; new top speed established in Nov 2017.
- Replacing all remaining salvaged foam (c. 1980's and cracking badly). Should add significant payload capacity (PCAR 2016).
- New wing servo design underway. Largest remaining mechanical failure on vehicle.
  - *Direct drive and high reliability*
  - *Smaller and lighter*



Sentry Upgrades
Data and Reporting

- Moving toward mission block concept (addresses frequent PCAR confusion about origin of data)
  - Each segment of the dive is assigned a globally unique ID and meta-tag
  - These tags follow the block all the way through post processing
  - Auto-generated figures in all dive reports
- Update to *Sentry* metadata website on line this year – attempts to make *Sentry* data more discoverable (DeSSC recommendation c. 2016)

Name	Start / End	Hours	Description
autogenerated	2017/06/05 01:49:03 2017/06/05 02:14:23	0.42	Descent to start of mission
multibeam	2017/06/05 02:15:29 2017/06/05 02:32:16	0.28	Multibeam Crossing line
multibeam	2017/06/05 02:32:16 2017/06/05 06:27:53	3.93	Initial multibeam coverage of area
photo	2017/06/05 06:27:53 2017/06/05 09:54:02	3.44	Habitat characterization photo survey at Northern targets, 10 550m lines at 40 meter spacing
multibeam	2017/06/05 09:54:02 2017/06/05 10:31:39	0.63	Transit to mb survey #2 on wall edge
multibeam	2017/06/05 10:31:39 2017/06/05 11:21:39	0.83	Multibeam on wall edge
Ascent	2017/06/05 11:21:39 2017/06/05 11:44:45	0.39	Ascent from end-of-mission abort to the surface

Table 1: Mission blocks during dive sentry439

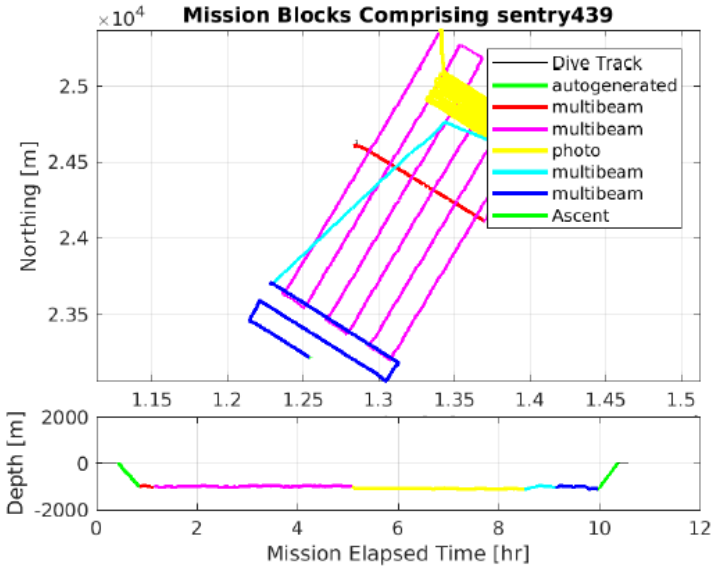


Figure 1: Mission Blocks in Sentry 439

Sentry Upgrades
Major Command and Control Upgrade

Undertaking a complete rewrite of current on-vehicle control system (currently most code derived from a 1999 effort for J2)

- Basic vehicle control on line for April 2018 engineering cruise
- ROS based, leverages HUGE open source robotics community
- We will likely begin open sourcing elements of our code by Q4 2018
- Should make adding new science capabilities much easier and more streamlined and system much more maintainable (addresses c. 2014 – 2016 PCAR feedback about new flight modes and bottom following)
- Much better simulation environment for faster development

Sentry Upgrades
Sensing

- Adding fill flashes to camera system improve lighting (PCAR 2017)
- Reson is now quite old, continues to be unreliable, and needs replacement soon (PCAR 16/17). Reson support has become untenable!
- We recommend slowly using up parts within the facility while:
    - Currently conducting a technology and needs assessment
    - We should purchase a new unit from a different vendor when funds allow