R/V Sally Ride Cruise SR1603 Chief Scientist's Report

James H. Swift, UCSD Scripps Institution of Oceanography
11-20 August 2016

Ship's Complement:

R/V Sally Ride (20)	
Desjardins, Tom	Master
Lawrence, Ian	Chief Mate
Kirby, Jeff	2nd Mate
Barnes, Jonathan	3rd Mate
Grimes, Dave	Boatswain
Purves, Rod	AB
Doucet, Chris	AB
Putnam, Aaron	AB
Kenter, Daris	OS
Maerki, George	Sr. Cook
Smith, Mark	Sr. Cook
Bueren, Paul	Chief Eng
Peer, Matt	1st Asst Eng
Meehan, Martin	2nd Asst Eng
Street, Colin	3rd Asst Eng
Elliott, Manny	Electrician
Goodbody, Adam	Oiler
Bautista, Eddie	Oiler
Samson, Buck	Oiler
Brownfield, Chris	Oiler

Science (9)	
Durham, Matt	research tech
McDermott, T.J.	Markey rep.
Murray, Ross	Markey rep.
Prince, Mike	ONR contractor
Reimers, Clare	scientist (OSU)
Sutherland, Woody	STS Project Manager
Swift, Jim	scientist (SIO)
Turnbull, Jay	research tech
Tuttle, Scott	Navy rep.

R/V Sally Ride left Oregon State University's pier across from the Hatfield Marine Science Center, Newport, OR, on schedule for cruise SR1603 at 0800 Friday 12 August 2016 in dense fog.

The ship made good time (ca. 5 hours) to the location (44.3609N 124.9379W) requested by Dr. Clare Reimers, Oregon State University, to deploy a "benthic microbial fuel cell/sensor/acoustic modem node" instrument near an OOI site in about 580 meters of water, in the oxygen minimum zone. This instrumentation has been developed with funding from the Office of Naval Research, and ONR was supportive of highlighting this research in connection with science trials on R/V Sally Ride. With the ship holding the location with dynamic positioning, the 3/8" hydro wire and articulating over-the-side handling system (the one without a docking head and motion compensation) was used to lower the package (with an acoustic release) to a few meters above the bottom. The plan was to use another acoustic transponder mounted on the wire (just above the package) along with the ship's HiPAP 3-D acoustic transceiver to help place the package, but technical troubles with HiPAP meant that, instead, the package was placed using its acoustic modem’s range feature and transmissions to a hydrophone lowered over the side. At the appropriate time the acoustic release was triggered with a separate hydrophone and deckbox, and the package free fell a short distance to the bottom. The HiPAP system never came on line during this deployment, but responses from the instrument’s acoustic modem showed that it was functioning properly. Dr. Reimers was able to communicate with her instrument and receive sensor data records after it was released. This is believed to be the first science operation on R/V Sally Ride.

[Dr. Reimers plans to use future cruises of opportunity to retrieve data (including hourly oxygen, temperature and conductivity sensor measurements and energy harvesting data) and possibly to inspect the instrumentation by ROV or AUV. The deployment site is adjacent to an OOI cabled node (1C) where the science team might eventually be able to connect another modem for continuous communications for many years.]

The ship arrived at the deep water test site over the Mendocino Fracture Zone about 0400 on Saturday 13 August. (Cruise speed was ≈11 knots.) Water depth was approximately 4000 meters. (6000 meters would have been ideal but deeper bottoms were not available in the region.)

The first winch tests addressed Navy ship construction/testing interests regarding operation and performance of the traction winch system with 9/16" trawl wire and 0.681" hybrid fiber optic, electrical, mechanical cable. After pre-cast winch control tests and adjustments, the trawl wire was deployed first, with a 800-lb weight, and 3900 meters of wire deployed. These deployments also tested A-frame operations which went very well. The winch was stopped for one hour with maximum wire out, then the weight brought up to 100 meters and redeployed to 3900 meters and returned to deck. During a portion of this second deployment the ship moved forward to tow the cable and weight, in order to deliberately increase cable tension until values over 10,000 lbs were achieved. (Maximum observed tension ≈12,000 lbs.) There was also a successful test of the emergency stop function. The cable was switched and the procedure repeated with the hybrid cable. The trawl winch tests were regarded as successfully completed. [However, there was an issue that a "90° reduction gear" associated with each drum reached a temperature near the manufacturer's maximum value on one drum and exceeded that maximum on the other drum (which was in use longer). SIO will follow up on this post-cruise.]

The night previous to carrying out the trawl winch tests there had been a sewage tank backflow/leak into the hospital, which subsequently spread through a significant portion of the main deck interior. Many of the crew had to put in long hours overnight cleaning, disinfecting, and drying the areas affected by this untoward event. So instead of moving straight into the next phase of winch tests overnight, Woody Sutherland (SIO/STS) carried out multibeam sonar tests and calibration procedures (which do not involve the deck and winch crew) to provide the bulk of the crew a good night's sleep.

Winch tests with the aft-mounted Cast-6 winch and articulating boom system, with 3/8" hydro wire and 800-lb weight, began Sunday morning (8/14). The weight was launched without incident and lowered to 3900 meters. The winch was stopped for one hour with maximum wire out, and then the weight was hauled up at 60 meters per minute (slower in the upper 100 meters). The test was then repeated, without recovering and relaunching the weight in between, and without the 1-hour soak at depth. During this second cast, observations were made of winch performance with the winch render/recover feature switched in and out of operation. No problems were noted. (The recover feature permits maintaining a user-set maximum tension on the wire. For example, if one were dragging a dredge, the recover tension could be set to 5000 lbs and the winch would deploy cable if the dredge hung up and wire tension climbed to 5000 lbs.) There were also successful tests of the emergency stop function. This winch is not outfitted with motion compensation. Tests of this winch and articulating boom system were regarded as successfully completed, with the system ready for science operations. (Indeed, successful science operations with this system had been carried out earlier during this test cruise.)

Tests with the forward-mounted Cast-6 winch (with the 0.322" CTD wire), with the forward-mounted articulating boom and docking head, began after dinner Sunday (8/14), using the 800 lb weight attached to a steel frame constructed to engage the docking collar on the boom. Tests focused on fine tuning and verification of performance for launch and recovery. After adjustments, the system was working well. For example, the system successfully launched and recovered the weight in automatic mode. Tests resumed Monday morning (8/15) with a suite of full-depth casts and trials of the motion compensation system with the 800 lb. weight. The first full-depth cast included an hour-long stop at maximum wire out (3900 meters). The up cast of the second full depth cast included a towing and tow-yo (up and down over a specified depth range) simulation with 2000 meters of wire out to check the swivel action of the sheave, and other aspects of the performance of the boom head under side load. The heavy docking head did not swivel aft to the degree needed to match the wire angle, nor did it fully return to vertical at the cessation of towing. [SIO will follow up on the fore-aft docking head behavior issue post-cruise.]

The next test with the 0.322" wire and 800 lb weight included a trial of the forward boom's motion compensation features, at this point mainly to note any surprises when these were engaged (between 100 and 1000 meters) in both at-rest and payout winch modes. No unusual winch or control behavior was noted by observers, thus the 800 lb weight was removed and stowed, and a small rosette with an older CTD and no bottles was attached to the 0.322" CTD cable.

The ship's engineers had noted, however, that this winch (the one with the 0.322" CTD cable installed) exhibited a suspicious noise in a bearing area. Further inspection showed that a winch drum grease seal ring had come out of position. After discussions with the winch manufacturer, and a repeat test cast on Tuesday morning (8/16) with the 800 lb weight, it was determined that there was no significant problem, and that tests could continue. [SIO will follow up on the seal issue post-cruise.]

Two CTD casts were then made with the rosette frame on which was installed a standard SeaBird 911+ CTD. The first cast, to 3900 meters wire out (cast 00101), was made without use of the motion compensation system. This cast was apparently trouble free: the CTD data looked reasonable at all times and there were no modulo errors. There were no winch or control anomalies. Deployment and recovery were trouble free in automatic mode. During the second cast (to 1200 meters; cast 00102), various tests were made of the motion compensation system, including stops at several levels for 5 minutes with MOCOMP off and 5 minutes with MOCOMP on, and trials of deploying and hauling with MOCOMP on, for example between 1000 and 1200 meters wire out, and for half of the haul up to the surface. Again, the CTD data looked reasonable at all times and winch and control performance was normal. The plots on the CTD display included pressure versus time (P vs. t) and deploy rate versus time (dP/dt vs. t). The first showed no significant evidence of package drift up or down when the winch was stopped with MOCOMP on (or off). Neither plot suggested that there was any significant reduction of pressure swings when the winch was stopped at any tested level when the MOCOMP system was switched on (these were stops with 5 minutes off and 5 minutes on). The lack of effect was speculated to be in part due to the light weight of the test CTD-rosette package. [It is possible that there was a small reduction in pressure swings, but proof will need to wait for data processing.] There were no faults or untoward behavior of any aspect of the CTD/winch/boom system in any tested mode, and the MOCOMP system did not make anything noticeably worse.

The rosette was recovered, additional weights were added, and the CTD was swapped out with a newer SeaBird 911+ CTD which was outfitted with added compass, pitch, roll, and 3-axis acceleration sensors. This was the configuration planned for the final series of test casts.

The first cast with this system (00103) was a standard full-depth cast to 3900 meters, with the MOCOMP system off at all times. (Automatic launch was used, as was the winch's computer control.) The cast proceeded normally in all respects except that the CTD compass data were suspect, chattering noisily in the 200's (very rapid numerical changes, suggesting physically impossible rosette motions), and showing zero rotations of the instrument. The cast was terminated when the rosette was returned to 10 meters, and the rosette left in the water.

The second cast with this system (00104) was a repeat of 00103, but with the MOCOMP system on when the rosette was below 100 meters. At ca. 1500 meters wire out on the up cast, the winch was halted a few minutes so that the Markey representative could try a software change related to MOCOMP performance. The software was then reverted to its previous configuration, the up cast was continued, and the rosette was recovered.

Overnight the ship transited ca. 10 hours to a location for shallower-water multibeam testing. Wednesday morning (8/17) the ship moved to a point where water depth was ca. 2700 meters for further testing of the CTD winch with the instrumented SeaBird 911+ CTD. Cast 00201 was a test of the system with the motion compensation features on and off. This was the most thorough test planned for the system. Launch and recovery were to be in automatic mode, and all pay out and haul below 100 m was to be in automatic mode. The test included these events (column 1 shows CTD file markers inserted into the data file at the start of a listed activity):

	Launch rosette in automatic mode, mo-comp OFF
	0 to 100m - pay out at 30 m/min
	100m to 500m - pay out at 60 m/min ()
1	500m to 550m: mo-comp ON, out at 10 m/min
	550m to 500m: mo-comp ON, in at 10 m/min
2	adjust mo-comp, then 500m to 550m: mo-comp ON, out at 10 m/min

550m to 500m: mo-comp ON, in at 10 m/min
3 500m to 550m: mo-comp OFF, out at 10 m/min
550m to 500m: mo-comp OFF, in at 10 m/min
4 500m to 600m: mo-comp ON, out at 20 m/min
600m to 500m: mo-comp ON, in at 20 m/min
5 500m to 600m: mo-comp OFF, out at 20 m/min
600m to 500m: mo-comp OFF, in at 20 m/min
6 adjust mo-comp, then 500m to 600m: mo-comp OFF, out at 20 m/min
600m to 500m: mo-comp OFF, in at 20 m/min
7 500m to650m: mo-comp ON, out at 30 m/min
650m to 500m: mo-comp ON, in at 30 m/min
8 500m to 650m: mo-comp OFF, out at 30 m/min
650m to 500m: mo-comp OFF, in at 30 m/min
9 500m to700m: mo-comp ON, out at 40 m/min
700m to 500m: mo-comp ON, in at 40 m/min
10 500m to 700m: mo-comp OFF, out at 40 m/min
700m to 500m: mo-comp OFF, in at 40 m/min
11 500m to750m: mo-comp ON, out at 50 m/min
750m to 500m: mo-comp ON, in at 50 m/min
12 500m to 750m: mo-comp OFF, out at 50 m/min
750m to 500m: mo-comp OFF, in at 50 m/min
13 500m to 800m: mo-comp ON, out at 60 m/min
800m to 500m: mo-comp ON, in at 60 m/min
14 500m to 800m: mo-comp OFF, out at 60 m/min
800m to 500m: mo-comp OFF, in at 60 m/min
15 500m to max cast depth (2500m) - pay out at 60 m/min, mo-comp OFF
16 adjust mo-comp parameters (assume mo-comp was switched back on)
17 return mo-comp parameters to previous values
18 ?
19 Stopped at 2500m. Sit for 5 minutes with mo-comp OFF
20 Sit for 5 minutes with mo-comp ON
21 2500m to 1000m - haul in wire at 60 m/min, mo-comp OFF
22 Stopped at 1000m. Sit for 5 minutes with mo-comp OFF
23 Sit for 5 minutes with mo-comp ON
24 1000m to 500m - haul in wire at 60 m/min, mo-comp OFF
25 Stopped at 500m. Sit for 5 minutes with mo-comp OFF
26 Sit for 5 minutes with mo-comp ON
27 500m to 100m - haul in wire at 60 m/min, mo-comp OFF
100m to surface - haul in wire at 30 m/min, mo-comp OFF
Recover rosette in automatic mode, mo-comp OFF.

Note: All test CTD data from this cruise have "11 AUG 2016" in the SeaBird file name. This was due to a file name error JHS made on 00101, and it was decided to keep file name nomenclature the same for the remainder of the CTD cast tests.

The CTD itself continued to perform well throughout the test (for example the data were modulo error free) except for the continued unexpected data from the CTD's compass sensor. There were also no anomalies exhibited by the winch/boom system during any portion of the test.

Discussions during cast 00201 helped to clarify the Chief Scientist's understanding of the functions of the motion compensation system. [No documents were available regarding the intended functions of this system, or the similar systems on R/V Revelle (not yet used by the Chief Scientist) or on R/V Sikuliaq (used by the Chief Scientist on a test cruise).] Prior to this test cruise his concept of the desired performance of a motion compensation system was based on CTD performance issues: It is well known that uneven CTD/rosette motion through the water column (usually caused by uncompensated ship roll) generates CTD data anomalies. Also, uncompensated ship roll causes CTD cable tension fluctuations, especially during launch and recovery. In the upper 100 meters roll induced cable tension fluctuations can be so severe as to generate slack wire followed by cable snap, which in worst cases can part the CTD cable. As a scientist who uses CTD data in his research, he had assumed that the aim of the motion compensation feature was to improve (ideally to eliminate) CTD/rosette speed-through-the-water fluctuations, especially when the instrument was being lowered - this could dramatically improve the quality and simplify the processing of CTD data. This assumption underlies that the choice of real-time data plots on this cruise was CTD pressure versus time (P vs. t) and CTD fall rate versus time (dP/dt vs. t), each in auto-scrolling plot windows that permitted a close look at the real-time data. Those plots - on both this test cruise and the Sikuliaq test cruise - failed to indicate that appreciable changes in either of these plotted parameters occurred when the motion compensation system was switched on and off, whether the winch was deploying cable, at rest, or recovering cable. (It is feasible, of course, that a statistical analysis of the CTD data will reveal valid differences.) But discussions with Markey technical specialists on board this test cruise touched on **reduction of cable tension fluctuations** as the primary goal of the installed motion compensation systems. Winch tension is recorded and displayed digitally on R/V Sally Ride, but the data were not available real time in any usable form to the science team. (The winch data may, however, be provided post-cruise to the Chief Scientist for examination.) The Markey representative on this test cruise reported a "75 lb." reduction in cable tension fluctuations. It is not known to the Chief Scientist what amount of cable tension fluctuation reduction would result in improved cable life. Also, at present the operators are not permitted to engage the motion compensation system when there are less than 100 meters of cable deployed. (Yet the upper 100 meters is the most dangerous point in a cast for slack/snap cable tension fluctuations.) It may be that to a degree yet to be determined the motion compensation system is achieving some of the goals behind its installation on R/V Sally Ride. Post-cruise statistical analyses of the CTD and winch tension data from this cruise - especially for cast 00201 - would be worthwhile and are intended.

Note should also be made of the performance of the articulating boom/head systems on R/V Sally Ride. Despite some concerns about the close clearances of the heads above the deck and rail (especially for the more complex, larger CTD boom head), those clearances were never a problem on this test cruise. For the CTD boom head, additional deck safety procedures should be developed and enforced for the times when the last bit of extra CTD cable is being slowly hauled in prior to launch. (There is potential to have a hand in an unsafe place.) But the automatic deployment and recovery features of both boom systems worked reliably during the test cruise. No tag lines were needed for the rosette, and all operations were smooth and safely completed. As noted previously, however, the boom head's fore-aft swing (to adjust for cable angle, for example when towing) did not work as fully as intended and needed. That will be examined further by SIO.

The automatic features of the winches themselves worked well. When the winch was in automatic mode a desired wire out was entered into the system and the winch safely and expeditiously deployed or hauled in cable. Performance was excellent. As a rule in future cruises, manual control will likely be used only when less than 100 meters of cable is deployed and in near-bottom operations. After all the planned tests were completed, members of the crew practiced controlling winch and over-the-side handling systems further as time permitted.

Weather during the cruise up through completion of the winch tests was generally favorable, with light to moderate seas and swell (though not calm). Seas picked up overnight on Wednesday (8/17) to the point to interfere with sleep for some persons, and to land some unsecured items on the deck. Sea conditions improved Thursday (8/18).

R/V Sally Ride arrived at the dock at the Exploratorium Museum in San Francisco, CA, at 1345 on Friday, 19 August, 2016, ending cruise SR1603.

Conclusions:

- The trawl winch system - used with either the 9/16" wire or the 0.681" hybrid fiber optic, electrical, mechanical cable deployed via the A-frame - is ready for science use, with the caveat that there is a gear temperature issue under investigation by SIO.
- The automatic deploy/recover features of the starboard articulating boom/winch systems work safely, consistently, and well. These can be used routinely.
- The automatic render/recover features of the starboard articulating boom/winch systems passed the tests made during SR1603. Other than their role in automated deployment and recovery, their scientific utility is not entirely clear, though these features may be useful to avoid over-tensioning in situations where drag can raise tension above safe cable operation limits.
- The motion compensation system - which during SR1603 was part of the forward articulating winch/boom system with the 0.322" conducting cable - functions in its present configuration without anomalies or increased risk to deployed instruments or cables. There was casual evidence that its use may help to reduce cable tension fluctuations. Documentation of its effectiveness in that or in making CTD package fall or rise rate more nearly constant awaits post-cruise data processing. Tests and adjustments of the motion compensation feature of the CTD winch will continue.
- The aft-mounted articulating boom/winch system with its 3/8" hydro wire is ready for science use. The winch is not presently outfitted for motion compensation.
- The forward-mounted articulating boom/winch system with its 0.322" CTD cable is ready for science use with or without utilization of its motion compensation feature, with the caveat that there is a docking head fore-aft motion response issue under investigation by SIO.

- While incremental improvements and adjustments will be made, the ship's winches, deployment systems, controls, *and operators* are ready to begin science operations.

Final comments: As with any new ship it takes time for the operator to fully settle in, for science systems to be fully installed and tested, and of course there are items requiring correction ("warranty items"). But R/V Sally Ride is in highly capable, well motivated hands, and already in good order to begin appropriate science. The ship works well, is well equipped for modern science operations, and it is comfortable and quiet. On this cruise the food was excellent, and all hands contributed strongly. Captain Tom Desjardins, Chief Engineer Paul Bueren, and their officers and crew are outstanding, exhibiting at all times remarkable professionalism, expertise, care, and foresight. They worked long, hard, and smart every day. SIO's Shipboard Technical Support group, led by Woody Sutherland, has worked wonders. On this cruise, Woody and STS research techs Matt Durham and Jay Turnbull performed admirably at all times. This was a great team to sail with, on this test and first science voyage of what is destined to be a very well regarded research ship.

Observations re R/V Sally Ride August 2016

J. Swift (SIO) and Clare Reimers (OSU) sailed aboard R/V Sally Ride on winch test cruise SR1603 11-19 August 2016. Swift drafted comments based on observations made during that time. Reimers provided edits to his comments and some of the photos. She also supplied her own observations, included here an Appendix. There are quirks to the ship, of course, but one should not get the wrong impression from a recital of these ... R/V Sally Ride has the hallmarks of a well built research ship with a very bright future ahead.

R/V Sally Ride has a traditional exterior layout (Figure 1). Notable features include a relatively clear fantail with (mostly) removable rails, a somewhat narrow starboard forward extension of the fantail deck, a large A-frame, two articulating/extending booms, a large crane, a staging bay with aft- and starboard-facing entrances, van hook ups, and a winch control station. The winch control station is large and comfortable, but its size and placement impede bridge views, and is inconvenient for crane operations. A winch operator in this station has at times a somewhat surprising less than ideal view of starboard operations.

The interior layout is well thought out, for example with most science, galley, etc. on the main deck (along with a 3-person ADA stateroom). Living quarters (and library) are on the two decks above. First impressions are strongly favorable in terms of the ship being well built and appropriately outfitted. Well-placed fittings, a good finish quality, and neatly laid out cable, pipe, and hose runs are indicative of professionalism in construction and outfitting. Those positive impressions are continually reinforced as one goes through any area of the ship.

My stateroom (FD-1) was spacious, quiet, and comfortable (Figure 2) as were all others. It was one of the quietest staterooms I have yet experienced on a research ship. It was a pleasant surprise to find wooden furniture in the stateroom (no rattling metal), and carpeted floor. Throughout the ship, false ceilings and attractive, neutral-colored wall panels add to the comfortable, well-finished ambience. But the stateroom was short on storage space: There was only one storage drawer per person in the stateroom (under the bunks), plus a closet unit (for hanging, with shelf above, but no drawers in it). While there is a desk, there are no drawers with it. There is a mini-fridge (why is this needed?) under the desk that should have been desk drawers. The (nice) three shelf bookcase unit (which has some provision to block items from falling out during rolls) will have to do for most storage. The mirrored cabinet above sink is adequate for toiletries. There is a bungee cord to secure the desk chair. There are no tie-down fittings to use to secure luggage and boxes, though there was adequate space in that stateroom to store such items.

There was a decent-sized toilet/shower space with a ceramic tile floor. The toilet was bulkhead mounted, which makes floor cleaning easier. The dual shower water controls - one for temperature and one for volume - worked well. There were places for soap & shampoo, etc. in the shower. The shower drain worked well and was appropriately located. The shower floor was a small bit lower than the toilet floor, with full length, full-width shower curtain. Under the sea conditions experienced, there was only a little "leakage" of water from the shower area to the toilet area. There were adequate towel racks there and at the sink for two persons. There needs to be one more grab bar serving the area between the toilet and shower, because there is nothing secure to reach in that portion of the toilet/shower area when one steps out of the shower. One oddity: There was no separate switch for the toilet/shower heat lamp (in addition to the normal light fixture) - both were on the same switch. (I removed and stored the heat lamp bulb for my stay on board.)

There was good, quiet air circulation in the stateroom, with a well designed, highly effective temperature control. In fact this was by far the best stateroom temperature control I have yet experienced on a research ship.

The mattress was very firm. There was a fitted bottom sheet (only the second time I have encountered this on a research ship), which made it much easier to make up the bunk and keep it made. The towels were medium sized and very rough, almost abrasive. Spare pillowcases were in short supply (but a new box of them was opened at cruise end).

In my room there were no cleaning materials (sponge, toilet brush, spare trash bags, paper towels) for cleaning the stateroom and head. I obtained a sponge from one of the cooks, and paper towels from a dispenser in the mud room. I borrowed a toilet brush from a public head. The cleaning gear locker near my stateroom had a vacuum cleaner and a dust brush and dust pan, but no other cleaning supplies. Neither in my stateroom nor in that cleaning gear locker were there any cleaners (such as Windex or 409). I found some cleaning supplies in the laundry room, used them, and returned them.

The mess room is spacious and welcoming (Figure 3), and can seat 24 at a time. It appears to have extra (unused) space. (Could extra seating be added?) It is well outfitted in the SIO style. The food on board is to the usual excellent SIO standard, meaning cheerfully prepared hearty, tasty, fresh, wholesome meals (and tasty treats) much enjoyed by all hands. The variety, quality, and quantity of food prepared and served by the two cooks (George and Mark) was excellent. They have use of a dumbwaiter which serves the mess room and the food storage area below the main deck. There was a vast array of foods available 24/7 including drinks, leftovers, cereal, sandwich makings, snack foods, ice cream treats, etc. There was no soda dispensing machine (as there was on R/Vs Melville and Revelle), but considering health concerns, that may be a step in the right direction. A more serious omission is that there was no sink: hand washing must take place in a public head opposite (slightly forward) of the mess room door, and there is no place to dump extra drinks from mugs and glasses. There was no hand sanitizer station in the mess room. (Ideally there should be one placed before one touches anything else in the mess room.) There is only one normal service door into the mess room, at the galley (aft) end of the room. If a serious galley fire erupted during a meal, rapidly pouring smoke into the mess room, would that pose a safety (exit) hazard? If I recall correctly there was only one EBBD in the mess room. On looking hard, I did find that there is an emergency ladder (a vertical ladder) from a dry stores room reached through a door at the forward end of the mess room. There was a very small "Escape" sign on the door leading to it from the mess room. It is too small to be seen in an emergency. If this is indeed an intended emergency exit from the mess, there should be a large, easily seen, glow-in-the-dark "emergency exit" sign on the door leading to that ladder.

Regarding EBBDs, I recommend that one per passenger be placed in the staterooms. I also recommend that each interior space on the ship be evaluated for ease of egress to the exterior during a smoky fire, with an eye to placing additional EBBDs where there might be concentrations of personnel who would not have direct/rapid access to the exterior.

There was very little vibration or noise from the engines. (I could not tell when they were on from most living areas of the ship, including from my stateroom.) Vis-a-vis other research ships my stateroom was comparatively noise and vibration free at all times except for some noise on station as usual from the bow thruster. Bow thruster noise and vibration was acutely felt in the galley.

The ship has an odd deck numbering scheme, with what is normally called the "01" deck being named the forecastle deck, with the normal "02" being named the "01", etc. A standard crew of 20, in single staterooms, and 22 science team members in double-occupancy staterooms, are accommodated on the forecastle and 01 decks. There is also a 3-person ADA stateroom on the main deck (for a maximum science party size of 25; crew size is 20 persons).

The ship's stairwells were sturdy and well lit, the rails were strong and easy on the hands, and the doors were easy to use. The one exception is the first (lower) portion of the stairs up from the 02 deck to the bridge, which during daylight hours on SR1603 seemed dark, and especially so if one has just come in from outside. Going up that portion was not a problem - there was just enough light at the base to get a good start - but hitting that portion coming down during daylight while we were at sea, I always had to stop and then feel with my feet to be sure I found the first stair correctly. During the tours in San Francisco after completion of SR1603, these lower stairs were illuminated by a red overhead light. Thus lighting for this stairway *is* available, only it was not used in daytime during SR1603. I advise that it be used routinely during daytime at sea.

The bridge layout is mostly good, and appears to serve the captain and officers well. One exception is visibility of deck work areas from the bridge, especially those on the fantail proper, and there is no control station convenient to the points of best visibility to the aft deck work areas. There is a portable control station which, with a longer tether, might help the officers view the work area and control the ship at the same time, but it is not clear its use would be favored by the officers. Visibility of starboard side operations from a point near the starboard bridge control station may be adequate. (But one should ask the officers about that.)

Lab space overall is good for a 25-person maximum science party, with the exception of a lack of an appropriate temperature-controlled chemistry/salinometer space. The labs are attractive (paneled bulkheads, false ceiling), good sized, well lit, well ventilated, and well equipped. There are cable trays in all lab areas and in other areas where they might be needed. However, the fluorescent lighting is very bright at all times. It would be better to have dimmable LED lighting that could be customized to time of day and activities.

Instead of the versatile, easily customized "erector set" lab benches with quickly-replaced plywood tops which are typical on SIO's research ships, the labs as delivered have less practical, nicely-finished, heavy duty pressed/manufactured wood bench tops which do not invite drilling for tie downs (and might not stand up to repeated wetting). SIO has had to cover the bench tops in areas in use with clamped-on plywood to provide tie-downs. The bench tops should either have bolt holes built in on a grid (with a supply of eye bolts provided to the science team), or be replaced. (But with bolt holes, would monitors be difficult to secure without drilling into the bench tops?) The labs have a lot of cabinets and drawers under the benches, resulting in much less space than one would expect for storage of science team equipment and frequent-use boxes (usually stored underneath the "erector set" benches on other SIO ships). This situation is exacerbated by the poor access to the science hold when the ship is underway.

The main lab (Figure 4) is good sized. There is adequate room for personnel to move around any portion of the lab when the lab is full and busy, with wider passages in the areas of the lab where personnel would be traversing to the fantail, wet lab, or staging bay. (The ship's central corridor does not extend through the lab areas. To reach the fantail from the forward areas of the main deck one must go through the mud room - which has aft exits to the starboard fantail deck and to the wet lab - or the main lab, with the main lab route more practical for many purposes.) There are two hoods (mounted on phenolic bench tops), a side-by-side pair of deep stainless sinks (mounted on a pressed/manufactured wood bench top and adjacent to one of the hoods), two pairs of outlets & drains for the uncontaminated seawater system (one pair of which is adjacent to both a hood and the double sink), over 135 feet of benches, numerous (too numerous?) cabinets above and under the benches, ubiquitous 2-foot unistrut and deck bolt fittings, cable trays, many power outlets, many data ports, wireless, a flammable liquid storage cabinet, and compressed air outlets. There is a metal tank (unknown lining material, if any) for storage of distilled water which is pumped from a small evaporator in the engine room. The science information and control center, with its many monitors, has not yet been installed, but will go into the forward portion of the main lab. That space should work well for it in terms of utility to the science team. There is a cluster of four special power outlets: two 208-volt and two 240-volt. There is a rack for 4 gas cylinders. There is access to a ≈6'x7' walk-in refrigerator (or freezer - user can set any temperature within a useful range; with a light and an emergency call button but no power outlets, data ports, etc.) with ample wire-type shelving (which preserves good air circulation). The doors to the fantail from the main lab are two separate single doors, nearly flush to deck, each with usable size ca. 36" W by 78" H. There are also doors to the staging bay, wet lab, and main corridor. The watertight doors from the main lab to the fantail have dogging levers that can be a real challenge to operate - is this a possible safety issue for science personnel in emergency situations?

The computer/electronics lab (Figure 5) is small for its many functions, and has large electronics cabinets filling much of its interior, blocking the center of the lab. While this makes for easy access to the electronics in the cabinets, it does not make the lab an inviting place to work. It will be a tight space for any cluster of science team members gathered to see the latest data real time (for example to make sampling decisions). (If there are repeater displays in the forward end of the main lab that may suffice for that purpose.) There are approximately 34 feet of bench, plus numerous cabinets above and under the benches. There are many power and data outlets, good lighting, bulkhead paneling, etc. as in the main lab. There is a temperature control similar to the ones in staterooms, which is useful for keeping the computer lab cool. (The computer lab was appropriately cool, yet not uncomfortably cold as it is on the Revelle and many other ships.) There are a pair of lip-free 40" "one-and-a-half" doors across the main corridor between the computer and main labs, and a standard 3' door to the lounge.

The wet lab (Figure 6) is similar in many respects of its outfitting and appearance to the main lab (though smaller), except that its doors to other ship's spaces are watertight doors, and its stainless sink (single) and hood (single) are mounted on a long stainless bench top. The wet lab has a large open area (ca. 8' x 9' useable deck space) adjacent to an aft-deck-facing double doorway with usable size ca. 72" W and 78" H and 5" lip, and a now-sealed-off opening to the starboard deck approximately 88" W x 78" tall. (It is not clear if that opening would be flush to the deck if that seal panel were removed, but it appears that it would not be flush, i.e. that there would be a small (2"?) sill.) There is a roll down "garage door" for the now-closed-off opening. There is a nearly flush-to-deck single watertight door from the wet lab to the main lab with usable size ca. 40" W and 78" H, and a no-lip 36" watertight door to the mud room (which has a no-lip door to the main corridor). There is no special deck drain near the large open area where wet equipment might be brought in, or, conceivably, water sampling might take place, only the small deck drain at the sink (as in the main lab). (This could be a significant problem.) There are ≈26' of wooden bench tops and ≈14' of stainless bench top (not including the large, deep stainless sink built into that bench, or the bench top under the hood). There are numerous cabinets (too numerous?) above and below the bench tops. Power outlets (ample) are covered. Lighting, unistrut, deck bolt holes, compressed air, data ports, ceiling, and bulkhead paneling are similar to those in the main lab. There are two pairs of special electrical outlets: each has one 208-volt and one 240 volt outlet. There is access to a ≈6'x7' walk-in refrigerator (or freezer) identical the one off the main lab. (Each of the two is independently controlled.)

The two-deck-high staging bay is ≈27 feet long, with a useable width varying ca. 9'-11' (or a little more in places). Its outfitting includes a fore-aft traveling hoist, a data port, 2 duplex standard 120 volt power outlets with watertight covers, 2 240 V and 4 480 V heavy duty marine power points, and several compressed air outlets. There are deck drains across the full width of both the aft and starboard openings to the fantail. There are 2-foot center bolt holes in the deck. There is, however, no bench, no sink, no sink drain connection, no fresh water line, and no unistrut (and no free bulkhead space to add unistrut). It would be tight and difficult to install a bench to facilitate work in the staging bay (such benches can be very useful), let alone to install a sink. There is a fresh water line immediately outside the aft end of the staging bay. Night lighting in the staging bay is excellent: white, bright, even, and nearly shadow free.

There is a mud room (forward of the wet lab, which in turn is forward of the staging bay) for boots and weather gear (Figure 7), but much of its bulkhead space is taken by five lockers and other permanent installations such as a chemical eye bath and shower. If the lockers are claimed by the crew and research techs (which seems likely and appropriate), it is not clear there will be any space there for the science team's boots and foul weather gear. There are few places in the labs to place these items. Adding such places should be considered. There is a small public head off the mud room.

The lack of permanent sills between the fantail and main lab interior - and between lab spaces which are normally dry and the wet lab - brings potential for entry of water into some supposed-to-be-dry main deck interior areas, such as the dry lab and the ship's main corridor, electrical shop, and perhaps even the hospital. SIO is experimenting with silicone sealed semi-temporary barriers at critical points, but these bring extra risk of being trip hazards, in that the hatches themselves are full height. It will be interesting to see how this plays out. For now, I would recommend that mops and buckets be stationed prominently in all the supposed-to-be-dry areas adjacent to the can-get-wet areas, and that science teams be advised to put nothing on the deck in the dry labs that cannot sit on a wet deck.

There are outlets, each with a drain (e.g., Figure 8), for the uncontaminated seawater system in the wet lab, main lab (2), and for each of the three van connections on the fantail. There is a separate seawater pumping system for incubators with outlets on the fantail and on a forward deck area (drainage for those would be via hoses over the side).

The forward deck incubator area (ahead of the bridge on the 01 level) has a seawater outlet and both 120 volt and 480 volt power outlets (and maybe a data port), but the deck there is not yet outfitted for supporting incubators or other equipment, because there are no tie downs and no bolt holes on 2-foot centers.

The ship's science hold/storeroom is primitive at present, at the time of SR1603 holding mainly items from construction and testing being transported to SIO. But it is outfitted with attachment points (the usual 2-foot spacing on all surfaces) for cages, shelves, or whatever storage and organizational scheme SIO chooses to install. Scientist access underway to the science storeroom is restricted to a stairway down from the fantail, reached from a 32"W x 53"H watertight hatch with very tall (24") stepover sill (followed by a tight turn to the stairs), then across a corridor and through a 35" x 78" standard interior doorway. To reach the science storeroom from the interior of the ship one must go through the off-limits area of the main engine room. Therefore, there would be essentially no access to the science storeroom when the fantail is closed due to heavy weather. And even in the best of conditions at sea, access is to the science hold is difficult, especially if one is burdened with boxes. (JHS regards this difficulty of underway access to science storage as a significant weak point in the ship's design. This is exacerbated by the large number of deck mounted cabinets in the labs, which reduces storage in the labs themselves, as compared to labs with "Erector set" benches similar to those on Melville and Revelle.)

The van arrangements on the fantail are interesting. There are spaces and fittings for two vans on the fantail (port side forward; Figure 9), with fittings for a third van on top of one of the other two, with a work boat on its tie-down frame placed on top of the other van. But UNOLS lab (and berthing?) vans have their required emergency exits on the top of the vans - nothing can be placed on top of them. The configuration of one UNOLS lab van and one work boat is easily supported. If a storage van is added, it could be placed under either the work boat frame or the UNOLS lab van. To use two lab vans and one storage van, one lab van would be on top of the storage van, and the work boat would need to be installed elsewhere on the ship. The ship cannot currently support three vans with emergency exits on their tops. Each van hook-up point on the fantail (including the one on the forecastle deck just above the main deck van points) has data port, potable hot and cold water, grey water drain, uncontaminated seawater outlet and drain, and marine outlets for 120-volt (1), 240 volt (2), and 480-volt (1) electrical power.

The fantail is large enough to meet the needs of many programs, though may constrain those who bring large amounts of bulky gear or long items to store on deck. There is a large aft A-frame that worked smoothly and well during SR1603 trawl winch tests. It can lay forward onto the fantail deck - this was done without difficulty for routine work during the winch test cruise (Figure 10). The fantail deck wraps around the starboard side of the ship to the launch/recovery points for the two articulating booms. There is some deck space on the starboard side for small winches and other temporary items. There are bolt holes on 2-foot centers throughout fantail areas where one would expect them. There are hatch covers over each of the trawl winch drums underneath the fantail, and a hatch cover over the engine room on the forward portion of the starboard side fantail extension. There is also a hatch cover just aft of that, over the science storeroom. There are two well-placed winch "scoreboard" screens that display wire out, wire speed and tension. In addition to the van service points, on other areas of the fantail there are fresh water and compressed air outlets, an outlet for the incubator water line, and marine outlets for 120-volt (at least 4), 240 volt (4), and 480-volt (4) electrical power. Night lighting on the fantail was very good to excellent: white, bright, relatively even in most locations, and relatively shadow free in most locations. The A-frame lights illuminated the deck well whether the boom was in standard inboard position or in outboard position, and illuminated the sea surface well in the outboard position, without being overly bright to eyes on the bridge in either A-frame position.

The ship is equipped with one large, centrally-mounted articulating crane serving the entire fantail area, and with capacity sufficient to handle a loaded 20-foot container. This comes at the cost of the crane blocking a significant portion of the view of the working deck from the bridge, and also means there is one complicated crane which has no back-up. The crane can in principle serve science overboard operations, such as casts with science cables reeved appropriately, but at the present time lacks a serviceable boom crutch for such operations.

The deck-to-head vertical clearances for the two starboard articulating science booms are short due perhaps to the way these are mounted on the sides of the superstructure rather than on top of it. That distance is especially short (75 inches) for the CTD boom (Figure 11), which does not eyeball to be sufficient for a large rosette, especially it is landed on a pallet or cart as usual. (Even the small rosette used on the winch test cruise was a tight squeeze underneath the CTD boom when it was on its pallet.) The rail-to-boom-head vertical clearances also seem tight, but were not a problem with the small rosette used for the winch test cruise. The rail-to-boom-head clearance issue, if it developed, could be solved with rail modifications, such as a swing-opening double gate. It should be noted that the automatic launch and recovery features of the boom/winch systems performed flawlessly during the test cruise, as did the automated features of the winch in deploying and hauling in the science cables. There is a potential safety issue regarding hand-guiding the final few feet of extra CTD cable into the boom head when slack is taken up prior to rosette launch: a hand could get squeezed. This can (and will) be addressed via procedural changes and/or use of a hook or guide rather than a hand.

At present it may be necessary store and sample a large rosette outside, on the deck, which is clearly not ideal nor up to present community standards. A short (6.5 feet max height, but wide enough) portal into the wet lab from the deck has presently been walled off due to unsuitability of the initially-proposed closure. If the CTD boom were switched with the hydro boom (but that would put it farther aft from the ship's pitch center), it may be feasible to build a cart and tracks to move a large rosette into the staging bay for sampling. That bay is a bit on the narrow side for a large rosette with 360-degree access for water sampling. (The staging bay effective/usable maximum width in the mostly likely spot for staging/sampling starboard operations is ≈11 feet, with the usable width closer to a little more than 9 feet in the likely spot for an instrument used in stern operations. If memory serves, those widths are comparable to those of the Melville and Knorr forward bays, which were regarded as narrow for sampling large rosettes.) As with the Thompson and Revelle, the roll-up "garage" doors to the staging bay cannot be lowered at sea below whatever height a wave might reach. To provide some protection from seas strong boards are provided to be installed across the lower portions of the staging bay openings to the deck.

The ship's suite of acoustic and other installed scientific instrumentation goes beyond impressive. (The underside of the hull must be a complex maze of transducers!) This is all well and good, but when these are added to the high-tech communications gear, and the vast amount of oceanographic equipment, interfaces, network, and displays which must be maintained, this looks to be a ship that could require 3 or 4 research and computer technicians at sea, rather than the present NSF-supported maximum of 2.

The ship's acoustic transducer support room is unique and impressive. One of the largest interior spaces on the ship, it has already invited construction of a carefully-placed gym floor with weight bench and exercise bike. (One must traverse a watertight door and climb down a ladder one or two decks to reach it, however.)

There are no meaningful comments here about the ship's communications, intranet, science displays, data network, etc., because the intended science and scientist support systems of this nature are not yet installed. [We had primitive Fleet Broadband internet over the ship's wireless network, operated without user management, which together with antenna-blocking issues on a common heading, meant no or glacially slow internet access much of the time.]

A thorough tour of the engine room complex, led by Chief Engineer Paul Bueren, revealed care and consideration in construction and outfitting, what in some ways could be described as an engineering work of art (Figure 12). It is an engine room of the 21st century with twin AC motors controlled electronically by four Siemens variable frequency drive generator systems and propelling two controllable pitch propellers, stern and bow thrusters, and a pair of rudders. The engine room/machinery space also houses the essential elements of a modern marine sanitation device, an oily water separator, a UV ballast water treatment system, reverse osmosis fresh water maker and a small workshop area. Piping throughout these spaces appeared of high quality, but space around devices and control panels was limited.

The ship has a carefully thought out waste and discharge control plan with a number of appropriate systems in place to handle wastes and discharges. These include (among others) a ballast water treatment system, sewage system, and an incinerator that can also be used to burn oily wastes. Engine cooling water is discharged on the port side, away from science operations.

Appendix - *R/V Sally Ride* August 12-19, 2016 - C. Reimers, Observer.

Reported or Observed Ship deficiencies on (Based on discussions with captain, crew and scientists on board)

- Intermittent DP controller problem to starboard thruster.
- Propeller cavitation around ice strengthened blades - may need to replace blades. Withholding $2M payment to shipyard.
- Stern thruster in skeg is noisy, especially at high power. [JHS adds: blades have significant gap with side walls (should be near-zero gap), which increases cavitation and noise]
- Rudder hydraulics work very quickly and can overheat.
- Night of 8/12 black water backed up and flooded most of main deck, main source was in hospital (low point), apparently plumbing to this drain is incorrect.
- Ship is at least 100 tons too light so rides too high (lots of pitching) and also affects sonar performance (bubbles). Glosten study recommends adding 380 tons fixed ballast so no matter the fuel level, the ship will be properly ballasted. Concern that final fuel consumption will be as high as on globals.
- Cruising speed is less than 12 kts.
- Delivered crane crutch supports are unworkable will need to be redesigned.
- Lab bench tops made of HD particleboard - looks nice but will not hold up when wet.
- Cummings engines (Captain would have preferred Caterpillar).
- No clear view of aft deck from bridge. Captain pondering removing or scaling back winch house. Would prefer to operate CTD from forward control now open on 01 deck.
- Debate over which of the two over the side handling systems and winches should be used for CTD due to different views from bridge and winch house. Debate over best position for and way to move CTD into hanger.
- Hanger doors not designed to withstand wave impacts.
- Captain would have preferred two cranes. Concerned the massive one will fail and they have no workable crutch yet.
- Vacuum Head flushers can be hard to activate, made of plastic-may break easily.
- Cooling water discharge on port side directly under rescue boat, needs to be moved aft so not to flood the boat when launching.
- Captain wants to put a small winch up on the A-frame itself- helpful during mooring recoveries for example.
- Fluorescent lighting very bright everywhere-dimmers needed.
- Bow thruster vibration and noise felt in galley area, thruster creates clouds of bubbles next to ship.
- Science stores not easily assessable, must go through restricted engine room spaces.
- 8/18 engineering had to shut down controls to one of the main propulsion systems due to a hose breaking and ejecting water on the electronics. Major headache for chief engineer.
- Sr. cook reported a steamer kettle in galley is installed in a way that is unusable.

Observed and reported positive features

- Large digital winch read out displays on deck.
- DP works very well.
- Comfortable staterooms.
- Very high quality piping- some brass- will last forever.
- Quiet ship internally.
- Nice galley layout, stores serviced by dumbwaiter.
- Laundry space laid out well.
- Cleaning and linen supply closets on focsle deck handy.
- Nice lab layouts with built-in science freezer/refrigerators.
- Callenberg air circulation/climate control system really nice. Can control temperature anywhere on the ship from engine room computer. Individual controls in staterooms with rapid cool down option (20 min).
- Filtered and UV treated ballast water.
- Incinerator, can be used to burn separated oil and other wastes.

Figure 1. Exterior layout of R/V Sally Ride. Note on the aft view the winch control station (large and comfortable, but impeding bridge views, inconvenient for crane operations, and with a less than ideal view of starboard operations), and the aft and starboard staging bay entrances.

Figure 2. The stateroom assigned to the chief scientist. (There is not a constructed "chief scientist's stateroom". This one was selected on the basis of its having a private head.) Note the wooden furniture, carpeted floor, and finished ceiling. The 3-shelf bookcase unit and the closet are the primary storage areas. There is one drawer per person under the bunks. There are no desk drawers or other drawers.

Figure 3. The mess room. There is seating for 24, a refrigerator and a freezer for general use, drink and snack supplies, plus 24/7 leftovers, sandwich makings, cereal, etc.

Figure 4. The main lab. Note that although the lab furniture is attractive and sturdy, it is less versatile than the easily customized "erector set" lab benches with quickly-replaced plywood tops which are typical on SIO's research ships. SIO has had to cover the bench tops in present use with clamped-on plywood to provide tie-downs.

Figure 5. The computer/electronics lab. Large electronics cabinets fill much of its interior, blocking the center of the lab.

Figure 6. The wet lab is similar to the main lab (though smaller), except that its stainless sink and hood are mounted on a long stainless bench top. The wet lab features a 8'x9' open area adjacent to an aft-deck-facing double doorway and a now-sealed-off, flush-to-deck opening to the starboard deck. There is no deck drain in that open area.

Figure 7. The "mud room" for boots and weather gear. It is not clear if there will be any space there for the science team's boots and foul weather gear.

Figure 8. Example of an outlet/drain pair for the uncontaminated seawater system. There is a separate seawater pumping system for incubators with outlets on the fantail and on a forward deck area (drainage for those would be via hoses over the side).

Figure 9. Illustration of the fittings for laboratory vans on the fantail. Each van hook-up point on the fantail (including the one on the forecastle deck just above the main deck van points) has data port, potable hot and cold water, grey water drain, uncontaminated seawater outlet and drain, and marine outlets for 120-volt (1), 240 volt (2), and 480-volt (1) electrical power.

Figure 10. The aft A-frame, showing inboard, outboard, and down-to-deck positions.

Figure 11. The deck-to-head vertical clearances for the two starboard CTD boom is only 75". (Even the small rosette used on the winch test cruise would not fit underneath the CTD boom when it was on its pallet.) The rail-to-boom-head vertical clearances also may be tight for larger-diameter equipment, though clearances were fine for the small diameter rosette used during the

winch test cruise. Rail modifications, such as a swing-opening double gate, may be needed for larger diameter equipment.

Figure 12. R/V Sally Ride engine room, including one of the ship's generators and a propulsion system display.

Figure 1. R/V Sally Ride exterior layout.

Figure 2. The stateroom assigned to the chief scientist.

Figure 3. Mess Room

Figure 4. Main Lab (including detail of aft doors).

Figure 5. Computer/Electronics Lab

Figure 6. Wet Lab

Figure 7. Mud Room

Figure 8. Outlet and Drain for the Uncontaminated Seawater System

Figure 9. Laboratory Van Fittings

Figure 10. Aft A-Frame in Normal and Lay-Down Positions.

Figure 11. CTD Articulated/Extending Boom with Swivel Docking Head.

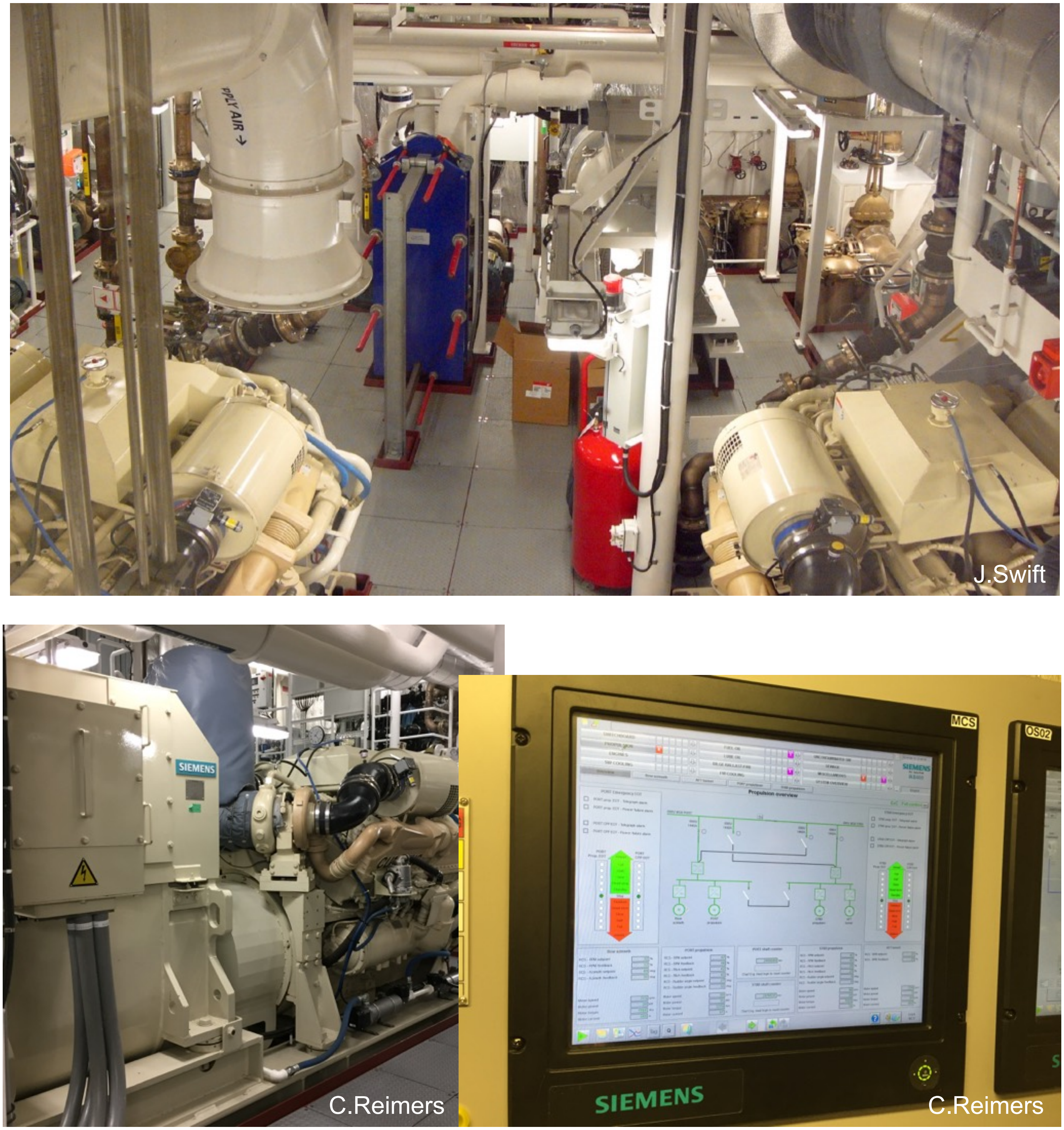

Figure 12. Engine Room