Consolidated Additional Observations

This questionnaire combines all standard Additional Observation Questions in one condensed questionnaire.
1. SOx Emissions Controls
2. Ballast Water Project
3. Combustion Source Project
4. Food Waste Project
5. Sea Intake Project

Findings can be reported in the spaces provided for each item; feel free to use additional space for notes and information. Sketches, diagrams, photos of handwritten notes, or copies of schematics are welcome.

Several questions are checks on previous Additional Observations, check these against the previous observations. If a ship is required to have an additional observation project on a section below, skip the section below. For example if a combustion source project is required leave the section in this project blank.

A: General Information

Report Start Date:	Jun 2, 2018
Ocean Ranger starting report:	todd.stafford
Ship Name:	Royal Caribbean Radiance
Ship Code:	RRA
Is this a revision of a previous report (Y/N)?	No

1: SOx Emissions Controls

1.1 Describe the SECA compliance plan.	SECA compliance requirements are maintained consistently throughout the vessel and fleet due to communications amongst the EO,Bridge team,Engineer crew and the Miami office. On RRA there is a "Itinerary Matrix" created and maintained week to week by the EO. This matrix is updated and shared with pertinent crew with information relative to specific locations and regulations as to discharge restrictions, incinerator operations and opacity obligations. Another tool utilized by RRA and the entire RC fleet is the "Regional Environmental Binders" which specifically outline requirements and restrictions with detail for every region the fleet vessels visit. This program appears to be straight forward and user friendly. The ESIMS program: "Environmental Stewardship Information Management System" is also a fleet wide accessible tool that maintains log entries that encompasses all these requirements.
1.1 Completed by:	Todd Stafford (todd.stafford)
1.2 How does the vessel control SOX emissions in the ECA? Provide description. If the vessel used low sulfur fuels in AK describe the fuel switches and which combustion sources are operated on low fuel sulfur, and when.	RRA has two GT's that only use LS MGO. These units are in service when underway or during maneuvering. One GT only is normally online. As vessel approaches ports to begin maneuvering operations the DG is online with either IFO normally. MGO would only be used in DG if there are Scrubber issues. If

	DG is burning IFO the Scrubber system will be in the closed loop operations inside 4nm. Outside 4nm the Scrubber May be operating in the open loop configuration. When vessel is dockside the DG (11.2MW) is sufficient to run vessels power requirements. 6.5 Mega Watts is a typical dockside load. Fuel switches to the DG generally can be completed within 2 minutes according to the Chief of Staff.
1.2 Completed by:	Todd Stafford (todd.stafford)
1.3 Is the vessel operating or installing an exhaust gas scrubber system in the 2018 Alaska Cruise Season? If yes, complete section 1A. Otherwise skip to section 2.	Yes

1.a: SOx Emissions Controls

1.4 Which combustion sources are coupled with the EGCS system?	One Wartzilla Diesel Generator has a EGS system coupled with the unit. The scrubber treats one (1) Wartsila 16V38 B 4 stroke Diesel engine. MCR-11,600 KW running on IFO-380 with a Wartsila, 16V38B, 11.2 MW@1800 RPM. Unit practical top Kw production is 10.5 MW.
1.4 Completed by:	Todd Stafford (todd.stafford)
1.5 EGCS units make, number, model, locations, fuel limitations (sulfur %).	maximum sulphur content of 3.5%. The scrubber manufacturer is CR Ocean Engineering. Model No.- 2400T- 4S Serial No.- M00906R-3 EGC Type - Hybrid Open and Closed Loop DNV Approval Reference - D21562-1/3-33B DNV Certificate No.- 21562 Date of issue- 2017-03-30 Bahamas Maritime Authority - Equivalent arrangements accepted on 3 February 2017. Regulation 5 of Annex VI.
1.5 Completed by:	Todd Stafford (todd.stafford)
1.6 Scrubber type (closed, reagent cycle, combination or hybrid open-loop effluent to seawater)?	Hybrid closed or open available. Closed loop is treated with Caustic Soda. Unit is operated usually with IFO 380 closed loop inside 4nm. Outside 4nm it may be operated with an open loop configuration. Normally underway the vessel will utilize 1 of the 2 GT's onboard by themselves. At the discretion of the Chief Engineer the DG May be operational as well.
1.6 Completed by:	Todd Stafford (todd.stafford)
1.7 System status (operational, commissioning, under construction)?	Operational.
1.7 Completed by:	Todd Stafford (todd.stafford)
1.8 Provide a process description and waste flow/chemicals used (Gaseous emissions, waste effluent, ash, spent reagents, etc.).	The scrubbing system is based on one (1) Hybrid CROE marine scrubber capable of reducing 3.5% sulphur fuel emissions to less than 0.1% equivalent sulphur in compliance with the IMO ECA regulations regarding the use of exhaust gas cleaning systems. The scrubber is designed for caustic assisted operation. The engine exhaust gas enters the in Eat duct at the scrubber bottom and is distributed radially through the inlet distributor. Once it enters the vessel, it is immediately quenched to adiabatic

	saturation temperature by the scrubbing liquor. The quenched gas flows upward in the tower. Counter current flow of the scrubbing liquor through the scrubber provides the most efficient mass transfer and intimate gas / liquid contact for high SO2 removal. A chevron mist eliminator located at the top of the scrubber ensures removal of residual droplets before the gas exits through the stack. The CROE marine scrubber uses the alkalinity of the seawater as a once through system to scrub SO2 from the engine exhaust gas. The scrubber can operate in open loop mode in areas where the seawater has sufficient alkalinity and where the used sea water can be discharged. The used sea water is directly discharged via the scrubber drain piping which includes a loop seal. For areas with restrictive discharge rules and in ports, the system will operate in closed loop mode. During closed loop mode, the scrubbing medium is fresh water and caustic soda. During the scrubbing process, the caustic will react with the sulphur in the exhaust stream, producing salts and increasing conductivity. The effluent will be purged from circulation in order to keep conductivity below a set threshold. The Effluent will be purged from circulation will go to the zero discharge tank where it will be monitored for turbidity and pH. When the vessel is at port or outside the ECA zone, the zero discharge tank effluent can be sent overboard through the wash water monitor where the pH, PAH, and turbidity will be recorded.
1.8 Completed by:	Todd Stafford (todd.stafford)
1.9 What scrubber process parameters are monitored (flow capacities, pH, other)?	Fuel oil presently used in the Diesel engine is: IFO-380 with a sulphur content of 2.5% or less Most recent IFO 380 sulfur content was 2.18%. The scrubber system is designed to operate within limits with fuel oil with max 3.5% sulphur. When burning HFO, the scrubber will be in operation and the SO2/CO2 ratio measured by the Continuous Emission Monitor (CEM) shall be less than 4.3 (ppm/vol%) which is equivalent to 0.1% m/m sulphur. pH ,PAH and Turbidity are also monitored.
1.9 Completed by:	Todd Stafford (todd.stafford)
1.10 For seawater intake/effluent, please provide port locations (PS/STB Frame number, etc.). Additional notes can include distance below waterline and angles.	1)- Sea Water Inlet is located in compartment 15, deck 30 (tank top level) in the engine room centerline at frame 77-78. 2)- Sea Water Outlet is through two (2) pipe connections 4-8 meters apart at compartment 16, deck 30 (tank top level) at frame 59 starboard side of engine room. 3)- Sea Water Cooling overboard is located in compartment 15, deck 30 (tank top level) at frame 80 on centerline. Suction is approximately 6m below the waterline. Frame 77-80 Discharge is approximately 4m below the waterline. Frame 65-68
1.10 Completed by:	Todd Stafford (todd.stafford)

2: Ballast Water

2.1 Check the previous Additional Observation Reports (section 1.1) list of tanks used for Ballast Water storage. Including volumes and locations. List any changes.	BW TK 1-657.47m3. BW TK 2-64.94m3 BW TK 6P-323.43m3 BW TK 6S-353.45m3 BW DB-10 outer port-115.75m3 BW DB-10 inner stbd. 179.76m3 BW/GW DB 11P-128.91m3 BW/GW DB 11S-128.91m3 BW/GW DB 12P-138.76m3 BW/GW DB 12S-138.76m3 BW DB 12/13 P-180.55m3 BW DB 12/13S-180.55m3 BW DB 13P-179.85m3 BW/GW 13S-174.66m3 BW DB 16 Ctr 117.59m3 BW TK 17P-104.53m3 BW DB 16-19 SKEG-580.21m3 BW TK 17S-92.91m3 Heeling TK 11P-208.82m3 Heeling TK 11S- 208.82m3 Heeling TK 16P-193.27m3 Heeling TK 16S-193.27m3 All Ballast tanks were cleaned and coated
2.1 Completed by:	Todd Stafford (todd.stafford)
2.2 Are ballast water tanks used for wastewater storage?	Yes. Combined use tanks are: GW/BW DB 11P. GW/BW DB 11S. GW/BW 13P GW/BW 13S. These tanks may be filled with untreated WW. can be used if needed. The following tanks may only be filled with AWP during the Alaska season. AWP only: B2,B10,B11,B73,B28,B74,B29,B50,B56,B91,B19,B96.
2.2 Completed by:	Todd Stafford (todd.stafford)
2.3 Ballast Water system: brief description of the combined piping system if tanks used for both.	The Ballast tanks are connected by a common line. The Pumps used are: PP1 250m3/h @ 2.5 bar. PP2 250m3/h @ 2.5 bar. Heeling pump #1- 400m3/h @ 0.7 bar. Heeling pump #2-400m3/h @ 0.7 bar. There is a computer on the Bridge listing all tanks, levels, valves etc. This is being used anytime the ship does any Ballast water transfers.
2.3 Completed by:	Todd Stafford (todd.stafford)
2.4 Ballast Water treatment installation? If yes, describe operation/system specifics.	Hyde Guardian Gold system is not yet commissioned. Expected to be in service by August 2018.
2.4 Completed by:	Todd Stafford (todd.stafford)
2.5 Ballast Water operations in AK waters (overboard intake/discharge, etc.)? Include the last date of ballast water discharges. Typically in the ballast water logs.	Yes. Last AK discharge was June 5 2018. Last AK intake was June 6 18:18.
2.5 Completed by:	Todd Stafford (todd.stafford)

3: Combustion Sources

3.1 Are there any changes from the previous Additional Observation projects (Section 2.1) on the propulsion system question on brief description of propulsion and power systems used on board (Diesel direct/reduction gears/PTO's DE, FP, CPP Azipod, etc.)?	No Changes to Propulsion or combustion source equipment appears to have been done within last year.
3.1 Completed by:	Todd Stafford (todd.stafford)
3.2 Are there any changes from the previous Additional Observation projects (Section 1.1) on the list of the combustion equipment used for Power/Propulsion (make/model/output)?	No changes to this equipment appears to have been done within the last year. 1 - Item Type Gas Turbine engine 1 - Make/Model GE/LM 2500 1 - Year 2001 1 - Serial Number/Unique Identifier GTG 1 1 - Maximum Rating 25000 KW 2 - Item Type Gas Turbine Engine 2 - Make/Model GE/LM 2500

	2 - Year 2001 2 - Serial Number/Unique Identifier GTG 2 2 - Maximum Rating 25000 KW 3 - Item Type Diesel Generator Engine 3 - Make/Model Wartzilla 16v 38 B. 3 - Year 2007 3 - Serial Number/Unique Identifier DG1 PAAE 054182 3 - Maximum Rating 11.6 MW 4 - Item Type DG-AVK 4 - Make/Model AVK 4 - Year 2001 4 - Serial Number/Unique Identifier SHL91822 4 - Maximum Rating 3750 KVA
3.2 Completed by:	Todd Stafford (todd.stafford)
3.3 Are there any changes from the previous Additional Observation projects (section 3) on the incinerators make, model, fuel used, capacity?	7 - Item Type Incinerator 7 - Make/Model Norsk Inova AS/Type NH 1400 7 - Year 2001 7 - Serial Number/Unique Identifier INC 1 7 - Maximum Rating 5000 kg/h 8 - Item Type Incinerator 8 - Make/Model Norsk Inova AS/Type NH 1400 8 - Year 2001 8 - Serial Number/Unique Identifier INC 2 8 - Maximum Rating 2100 kW
3.3 Completed by:	Todd Stafford (todd.stafford)
3.4 Average Hotel power (kW) in port and underway?	In port and underway power consumption are relatively similar. Between 5-5.5 in AK.MW appears to be the average for each mode. Hotel load is somewhat reduced in Alaska due to the lack of required Air conditioning load.
3.4 Completed by:	Todd Stafford (todd.stafford)
3.5 Average fuel consumption in port and underway?	OR was unable to obtain a in port and underway difference of fuel consumption. From the weekly voyage reports though it may be possible to calculate the differences. Voyage beginning May 25: IFO 380-188t, MGO-389t. 1533nm/ 7 days. Voyage beginning June 1: IFO 380-183.6t, MGO-493.1t. 1547.6nm. / 7 days.
3.5 Completed by:	Todd Stafford (todd.stafford)

4: Food Waste Garbage Handling

4.1 How is food waste handled and disposed of?	Food waste separation begins at each galley area. Bones,shells,pineapple husks, and banana peels are separated and not intentionally introduced into the food Waste processing machinery to avoid damage or clogging. These wastes are incinerated. From the galley stations food wastes are processed through pulpers/grinder and then travel to screen presses to remove excess water. The solid food wastes are stored in two separate food waste storage bins (7.5m3 each) until vessel is outside 12nm where the wastes are discharged. The excess water is sent through grease traps to remove oils and grease. The cleaned water is then stored in galley waste water

	tanks to be discharged outside 12nm. These waters are not treated by the AWTS.
4.1 Completed by:	Todd Stafford (todd.stafford)
4.2 Average food waste production per day (kgs/day)?	2m3 per day currently for the AK summer season. Amount stated by the Chief of Staff.
4.2 Completed by:	Todd Stafford (todd.stafford)
4.3 Is the food waste de-watered? If yes, provide dewatering volumes and handling information.	Yes, food waste is dewatered. Food waste separation begins at each galley area. Bones,shells,pineapple husks, and banana peels are separated and not intentionally introduced into the food Waste processing machinery to avoid damage or clogging. These wastes are incinerated. From the galley stations food wastes are processed through pulpers/grinder and then travel to screen presses to remove excess water. The solid food wastes are stored in two separate food waste storage bins (7.5m3 each) until vessel is outside 12nm where the wastes are discharged. The excess water is sent through grease traps to remove oils and grease. The cleaned water is then stored in galley waste water tanks to be discharged outside 12nm. These waters are not treated by the AWTS. Vessel does have an exemption to discharge outside 4nm but prefers to discharge outside 13nm.
4.3 Completed by:	Todd Stafford (todd.stafford)
4.4 How are glass bottles, broken crockery, and ceramics handled?	These items are sorted throughout the vessel waste collection process beginning with specifically labeled receptacles and in the garbage room. Wastes are separated and stored for offloads. RRA does offload non hazardous waste in Seward during the 2018 season.
4.4 Completed by:	Todd Stafford (todd.stafford)
4.5 How is food waste monitored and/or recorded?	Val marine electronic system in the ECR monitors food waste tank levels. Volumes discharged are calculated from the tank levels observed between discharges. These volumes are documented in the Garbage Record Book.
4.5 Completed by:	Todd Stafford (todd.stafford)

5: Sea Water Intakes

5.1 List all of the seawater intakes (chests); include the locations, frame, side (PS/SB) or compartment.	Filtration for each sea water intake systems are metal strainers. At compartment 16 frame 72-75 is the largest sea water intake called the crossover that goes the width of the vessel. Main Engine, Diesel Generator and Chiller cooling is taken from the crossover. These strainers are cleaned every two weeks. Sea growth from the strainers is collected and incinerated. Fresh water production units, Evaporators and RO systems take suction from compartment 13 on the Starboard side frames 109-112. This strainer is cleaned every 2 months. Swimming pools and emergency fire pump

	take suction from the strainer located at frames 235-236. This strainer is cleaned every 3 months. The newest sea water suction is located at frames 77-78 for the Exhaust Scrubber system. This strainer is cleaned monthly. Cleaning intervals are subject to change per geographic location,sea temperatures and differential pressures indicated within the specific systems. All Sea Chest are fitted with Cathelco ICCP systems with aluminum and copper anodes. All anodes were replaced at last dry dock period in May 2016.
5.1 Completed by:	Todd Stafford (todd.stafford)
5.2 List filtration systems for each intake. Describe how filter systems are maintained. What is the frequency of cleaning? Is this performed in Alaska?	Filtration for each sea water intake systems are metal strainers. At compartment 16 frame 72-75 is the largest sea water intake called the crossover that goes the width of the vessel. Main Engine, Diesel Generator and Chiller cooling is taken from the crossover. These strainers are cleaned every two weeks. Sea growth from the strainers is collected and incinerated. Fresh water production units, Evaporators and RO systems take suction from compartment 13 on the Starboard side frames 109-112. This strainer is cleaned every 2 months. Swimming pools and emergency fire pump take suction from the strainer located at frames 235-236. This strainer is cleaned every 3 months. The newest sea water suction is located at frames 77-78 for the Exhaust Scrubber system. This strainer is cleaned monthly. Cleaning intervals are subject to change per geographic location,sea temperatures and differential pressures indicated within the specific systems. All Sea Chest are fitted with Cathelco ICCP systems with aluminum and copper anodes. All anodes were replaced at last dry dock period in May 2016.
5.2 Completed by:	Todd Stafford (todd.stafford)
5.3 How is debris and mud from filtration/strainers handled?	These collected wastes are disposed of in the incinerators.
5.3 Completed by:	Todd Stafford (todd.stafford)
5.4 Marine Growth Protection Systems in the sea intakes. Description of the control systems and information on checmicals if used.	Cathelco ICCP units are installed on each of the sea chests. These units each have copper and aluminum sacrificial anodes that retard marine growth and ships metal degradation. No chemicals are used within the sea water systems.

5.4 Completed by:	Todd Stafford (todd.stafford)
5.5 Hull cleaning in place in Alaska 2018?	Last hull cleaning was in Auckland 29 December 2017. No scheduled hull cleaning are to be done in Alaska 2018.
5.5 Completed by:	Todd Stafford (todd.stafford)

6: General

6.1 Is vessel crew cooperative on this project?	Yes. All crew involved with this report were helpful and friendly.
6.1 Completed by:	Todd Stafford (todd.stafford)
6.2 Do you feel the vessel has a clear understanding of compliance requirements?	Yes
6.2 Completed by:	Todd Stafford (todd.stafford)
6.3 Are there other remarks/ comments the OR wants to share?	It appears RRA status has not been altered much since 2017. The addition of the Ballast water treatment system is nearly complete but not expected to be commissioned until August 2018. The most pertinent change to RRA operational status is not from machinery changes but due to impending regulatory changes to WW tank flushing requirements. Currently vessel must flush 1time to 20% but will soon be changed to 3x's to 20%. EO and other RRA officers have made trial runs for new requirements and are unable to comply on this itinerary. A itinerary change appears to be needed once new requirements are implemented according to EO and other ships Officers.
6.2 Completed by:	todd.stafford

Z: Signature & Submit

Ocean Rangers contributing to this report:	Todd Stafford (todd.stafford)
Ocean Ranger Signature: