



Background

General Information

Ocean Ranger Name:	thomas.guiney and chris schneider
Report Date:	Jul 26, 2018
Ship:	Princess Emerald
Ship Code:	PEM

Section 1: Scrubber Installation and Operation

1. Is the vessel operating or installing an exhaust gas scrubber system in the 2017 Alaska Cruise Season? Yes

If you answered Yes, continue to the next page.
If you answered No, answer the next 3 questions and submit the report.

Section 1: Scrubber Installation and Operation, ctd.

2. Physical location of the scrubber system, and if applicable, list the "removed" engine / sundries / stack equipment to accommodate the scrubber installation?

The scrubber system is primarily located in the incinerator room. The removal of one incinerator was necessary to accommodate the system. The physical location of the below deck equipment is starboard side decks one and two, fire zone 6, frame 20. The below deck equipment includes pumps, piping and controls. The DeSox towers extend from Deck 11 to Deck 16.

3. What is the location and source that the scrubber system is installed to treat? Include design capacity etc. of the fuel oil combustion equipment (include maximum power rating).

DG 2 and DG 3 are located in the forward DG room of the Engine Room spaces. The scrubbers are installed to process exhaust from the Wartsila 12V46CR, 12,600kW with an Exhaust Gas Flow Rate at Full Load: 82,800 (kg/h).

4. Brand, make, model, or other identification information for the scrubber system. Who installed the system? Certification of the system IMO ANNEX VI certification? Classification?

The EGCS is manufactured by EcoSpray/Nordicmade. DG 2, EGC Tower number: 15-027-APC-SC-0100. DG 3, EGC Tower number: 15-027-APC-0200.

5. Scrubber type, e.g. closed, reagent cycle, combination or hybrid, or open-loop effluent to seawater?

The basic design of the scrubber system is 'open loop' effluent to seawater.

6. System status, i.e.: operational, commissioning, under construction, etc.? Expected install date?

The system is operational having been commissioned in 2016. It is in service when HFO is used in DG 2 and DG 3. This may occur in port with the filtration equipment installed. However, the scrubber system is not used in sensitive areas such as Glacier Bay.

7. Process description and waste flow (gaseous emissions, waste effluent, ash or spent reagent, etc.)?

Sea water is drawn from the sea chest through suction strainers to the main SW pump and dilution pump. The suction strainers have automatic back flushing functionality. The main flow of the SW pump supplies SW to the tower nozzle banks where SOx absorption takes place. A demister is installed at the top of the tower to minimize mist/droplets carryover. After the nozzle, exhaust gas direct contact has taken place, the SW and SOx mixture (essentially a weak sulfuric acid) drains by gravity and is collected at the bottom of the tower where it enters the discharge line. A level sensor in the collection portion of the lower tower will

8. Additives used for the scrubber process? (De-sludge's etc.) If so full description.	trigger a shut down at high level. At this point the effluent stream is analyzed. In order to obtain the desired final pH, the variable frequency drive dilution pump output is automatically adjusted. This automatic process is based on the SO ₂ /CO ₂ ratio as determined by the Gas analyzer and Engine load. A touchscreen control panel is located next to the dilution pump allowing the operator to set parameters, monitor the process, review alarms, etc..
9. Describe the materials used in the piping systems.	No chemical additives are used. Piping is made of reinforced Fiberglass.
10. System capacities and mode of operations, bottlenecks, etc.? E.g. pump(s) capacity and control (constant or variable speed), systems energy consumption, etc.	Available pump information: SW Pump, 800 m ³ , 200kW, Garborino, variable frequency drive. Dilution Pump, 1200 m ³ , 73kW, Garborino, variable frequency drive.
11. Discharge volume(s) for pumps in (m ³ /hr)? Note: if pump speed varies pending on operation include the capacities by each speed setting, including the max cap and low cap, etc. -If applicable, include the intake volume of the pump(s) system. See previous Note.	Pumps are variable frequency drive. SW Pump. Min. 0m ³ /hr, 8.7kW. Max. 750 m ³ /hr, 200kW. Dilution Pump. Min. 550m ³ /hr, 3.3kW. Max. 1300m ³ /hr, 88.8kW.
12. Ash/ sludge removal or catchment in the system and how disposed of? Average waste production 24-hrs, etc.	Any ash/sludge collected by filter is handled as non-hazardous material and offloaded outside of Alaska.
13. Fuel use? Fuel specification limits for the scrubber system? How is fuel tracked or monitored to determine removal efficiency and compliance status?	The scrubbers are used with DG 2 and DG 3 using HFO. The most recent fuel has a sulfur content of 1.73%. The desired SO ₂ /CO ₂ ratio (must be <4.3).
14. General notes on scrubber operations & maintenance, instructions, logs, etc?	There is a designated scrubber Engineer onboard to oversee the scrubber operation. He is experienced and has demonstrated his knowledge with good record keeping and documentation. A dedicated 'compliance computer' maintains records of operational parameters. In addition, a compliance/spot check log/binder is maintained and checked every four hours. In the cold Alaska waters, maintenance of the sea water strainers requires above average attention to cleaning more frequently than in warmer waters.
15. For seawater intake/effluent, please provide port locations (PS/STB Frame number, etc.)? Additional notes can include distance below waterline or vertical angle.	EGCS discharge ports; starboard side, aft, frames 40-48, vertically 2.9 and 3.6m below waterline. Inlet piping and pumps are one deck below.

Section 2: Compliance and Auxiliary Monitoring - Water & Solid Waste

16. Pursuant requirements of EPA VGP 2.2.26, 40 CFR 110, and section 10 for Exhaust Gas Cleaning (EGC) Systems under IMO (resolution MEPC.184(59)), does the vessel monitor scrubber system parameters for the following items, (Notes: include sampling schedule or monitoring interval (e.g. twice per second, once per minute, etc.,) you may circle Yes (Y), No (N), or units measured where applicable,);	Fluid Monitoring is done by the Analyzer Racks, of which there are 3. Analyzer Rack One is located at the SW inlet. Analyzer Rack Two is located at the scrubber tower outlet. Analyzer Rack Three is located at the effluent overboard discharge
16.a pH	
16.a.1 Is intake monitored?	Yes
16.a.2 How?	Rack 1
16.a.3 Is effluent monitored?	Yes
16.a.4 How?	Racks 2 & 3 sensors

16.b PAHs (Polycyclic Aromatic Hydrocarbons) µg/L PAHphe (phenanthrene equivalence)

16.b.1 Is intake monitored?	Yes
16.b.3 Is effluent monitored?	Yes
16.b.4 How?	Racks 2 & 3 sensors
16.c Oily discharges or sheens	
16.c.1 Is effluent monitored?	Yes
16.c.2 How?	Oily discharges or sheens must be monitored visually which is undertaken by the dedicated EGCS engineer.
16.d Sludge or residues generated in treatment	
16.d.1 Is effluent monitored?	Yes
16.d.2 How?	PEM EGCS has reportedly not generated substantial sludge or residue.
16.e Flow rate t/hr	
16.e.1 Is intake monitored?	Yes
16.e.2 How?	Flow rates are recorded for each scrubber using electronic flow meter. EGCS automation determines and adjusts the flow rate, based on effluent pH and DG load. Intake flow meters are installed in the vicinity of Analyzer Rack One.
16.e.3 Is effluent monitored?	Yes
16.e.4 How?	Flow rates are recorded for each scrubber using electronic flow meter.
16.f Scrubber system power consumption MWH.	
16.f.1 Present?	Yes
16.g Turbidity in any of the following units: FNU (Formazin Nephelometric Units), NTU (Nephelometric Turbidity Units), or equivalent units.	
16.g.1 Are other equivalent units used?	Yes
16.g.2 What kind?	FNU is the unit used.
16.g.3 How?	Intake turbidity is monitored by Analyzer Rack One.
16.g.4 Is intake monitored?	Yes
16.g.5 How?	Intake turbidity is monitored by Analyzer Rack One.
16.g.6 Is effluent monitored?	Yes
16.g.7 How?	Turbidity of wash water prior to dilution is analyzed by Analyzer Rack Two.
16.h mg/L nitrate + nitrite	
16.h.1 Is effluent monitored?	No
16.h.2 How?	Nitrate is not monitored.
16.i Temperature	
16.i.1 Is intake monitored?	Yes
16.i.2 How?	Digital temperature sensors at DeSOx tower inlet.
16.i.3 Where?	At sea chest
16.i.4 Is effluent monitored?	Yes
16.i.5 How?	Digital temperature sensors at DeSOx tower outlet.
16.i.6 Where?	Upstream of static mixer.

17. How are monitoring systems secured, data collected, e.g. white-box, etc?

The compliance computer retains data for minimum of 3 years. From the technical manual: "The data from this computer can be accessed and viewed at any time and either a process or compliance report can be generated." No device similar to a white box is in place.

18. Do the monitoring systems have alarms or warnings in place for non-compliance?

Yes, several alarms are included in the compliance package. Interface with IMACS automation in ECR for compliance values.

19. Are sensors calibrated? Certified and to what standard (Note: critical for pH electrode and turbidity monitors) How often? Records or instructions? Generic notes for monitoring system "robustness"?

After commissioning sensors are calibrated for pH electrode and turbidity monitors through AMOS work orders.

20. Are their vessel procedures for system switch-over between operational modes, startup, shut-down, docking/maneuvering, etc. and how is this done?

Fuel switch overs are done by the Engineer of the Watch from the ECR. It is a highly automated process.

21. How and where does the vessel intend to satisfy compliance with receiving water monitoring requirements for EGCs under the EPA VGP 2.2.26.2.3 and if conducted, are reports, or documentation available for 2.2.26.2.4 (Annual EPA VGP DMR, due by February 28 of the following year)?

According to scrubber engineer, vessel procedures, including record keeping and reporting, are consistent with and will lead to compliance with VGP requirements. Requirements of EPA VGP DMR are understood.

Section 3: Compliance and Auxiliary Monitoring - Air

23. Are there after-burners in the exhaust stack for scrubber emissions? Where? If so, what is the fuel consumption and operational control of this system?

No after burners are installed.

24. Economizer / Heat Recovery, how is "boiler (air side) washing performed? Soot blowing operations? Details include the frequency used equipment etc.

Economizer is cleaned with a water hose and nozzle, this is done as scheduled by a regular work order.

25. Pursuant requirements of MEPC 59/24/Add.1 ANNEX 9, how and where is the SO₂ (ppm)/CO₂ (%) ratio monitored? -Additionally, how is fuel use in the associated combustion equipment tracked?

Fuel consumption is not tracked by the scrubber engineer but is tracked through other methods.

26. How are monitoring systems secured, data collected, e.g. white-box, etc?

Alarms were set through the Automation systems as appropriate. Data is stored in the compliance computer that is uploaded to company servers every three minutes.

27. Do the monitoring systems have alarms or warnings in place for non-compliance?

Alarm for Gas Analyzer SO₂/CO₂ is 3.8; alarm limit is 4.3.

28. Are sensors calibrated? Certified and to what standard? How often? Records or instructions?

Equipment is calibrated and certified by third party CONSILIUM.

29. Are there vessel procedures for system switch-over between operational modes, startup, shut-down, docking/maneuvering, etc. and how is this done?

Additionally, weekly calibration of gas analyzer is performed by scrubber engineer.

Section 4: General Observations

30. Is vessel crew cooperative on this project?

Yes, crew was cooperative.

31. Do you feel the vessel has a "good grip" on compliance requirements; how difficult is this survey to complete?

The Scrubber Engineer is very knowledgeable on EcoSpray EGCS systems.

32. Are there other remarks/ comments the OR wants to share?

System is very similar to other EcoSpray EGCSs that I have written reports on for other Princess ships.

Photos and Comments

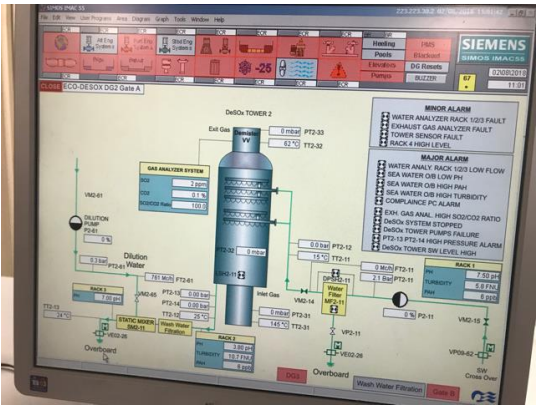
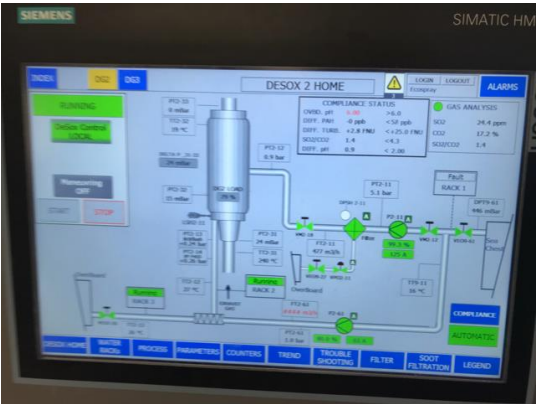


Photo 1 Caption

Photo 2

Two different screenshots of EGCS for DG 2 showing layout of system.



Complete

Is this report complete?

Yes

If this report is complete, tap on Send now. Do not make a selection in the next field. The report will be submitted for final review.