CROWLEY
People Who Know

Background

General Information

Ocean Ranger Name:	tim.nelick
Report Date:	Jul 12, 2018
Ship:	Norwegian Bliss
Ship Code:	NBL

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.	
1.a. Describe the vessel's compliance plan with the North American Emissions Control Area (ECA) limits for sulfur	N/A
1.b Are there plans to install scrubber systems in the future? If yes, what are those plans?	N/A
1.c. Is there space set aside for potential scrubber installation?	N/A

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?	Compartment 18, lower level engineroom, port side, frame station 92.
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).	Five scrubbers are installed to clean the exhaust in each of the five SSDGs. Two SSDGs are rated at 16.8 mW; three are rated at 14.4 mW. All five SSDGs are located lower level engineroom. The units can be crossed over.
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?	Langhtech Hybrid type SWCU, installed at Meyerwerf Shipyard during newbuilding.
5. Scrubber type, e.g. closed, reagent cycle, combination or hybrid, or open-loop effluent to seawater?	Sodium Hydroxide hybrid loop exhaust system.
6. System status, i.e.: operational, commissioning, under construction, etc.? Expected install date?	The EGCS is operational.
7. Process description and waste flow (gaseous emissions, waste effluent, ash or spent reagent, etc.)?	In closed loop operation, scrubbing water is drawn from the process tank. The process tank level is maintained by replenishment of technical water as necessary. The process water is pumped to the scrubbing tower, during which process NaOH is added to dilute the SOx in the exhaust stream. Booster pumps are installed in series with the supply to the towers. Scrubbing takes place in the towers where the NaOH dilutes the acidic SOx. Process water is drained from the tower and collects in the scrubber overflow box and returns to the process tank. A level control sends process water from the process tank to the backflush tank, which is maintained at 100% capacity. The backflush tank overflows into the dirty water tank. The water treatment unit draws process water from the dirty water tank and utilizes a membrane filtration technique to process the scrubbing water. When the effluent from the water

	treatment / membrane filtration unit renders the process water within specified pH, turbidity, & PAH, the water is pumped to the purified water tank, from which it can be used to replenish the process tank and be re-utilized in the tower scrubbing circuit, or, in closed loop / bleed-off mode, the purified water tank can be discharged. If the effluent of the water treatment / membrane filtration unit is outside the pH, PH, and turbidity parameters, it is returned to the backflush tank for further treatment & membrane filtration. In open loop operation, the cycle above is also utilized up to the water filtration / membrane filtration process. (In closed loop, the water leaves the membrane filtration unit and is pumped either to the backflush tank or the purified water tank, depending on pH, PH, and turbidity). In open loop, the water treatment / membrane filtration unit pumps water within the parameters to the belt filtration unit, which has a mixing tank for mixing polymer with the effluent, which aids in the aggregation of particulate matter on the belt filter screen medium. Once this belt filtration is complete, the water flows to a drain tank from which it can be discharged >12 nm. A backflush process is provided for the water treatment / membrane filtration unit. Fouled belt filtration media, which are rolls of filter material, are consumed at the rate of 2 rolls, ~2 m3, every week, and are offloaded outside AKH2O as regulated non-permitted vessel-hazardous Waste.
8. Additives used for the scrubber process? (De-sludge's etc.) If so full description.	NaOH (sodium hydroxide) is added to the process water to increase the pH and counteract the H2SO4 which is produced by the combination of nitrates and process water. A polymer is added to the treated water prior to being filtered by the belt filtration unit. The polymer aids the aggregation of filtered particulate matter.
9. Describe the materials used in the piping systems.	The piping for the system is 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.	The system is designed to be able to handle vessel exhaust volume at full sea speed. This is usually accomplished with three of the five DGENs on line. Because the five process pumps can be crossed over, additional flow can be achieved to hand three DGENs on line at full sea speed load.
11. Discharge volume(s) for pumps in (m3/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.	The main process water pumps capacities are: For the 14.3 mW DGENs, 590 m3/hr For the 16.8 mW DGENs, 690 m3/hr These pumps are variable frequency drive, coupled to 170 kW motors.
12. Ash/ sludge removal or catchment in the system and how disposed of? Average waste production 24-hrs, etc.	The belt filter unit traps sludge on disposable media which are offloaded in Victoria. Approximately two belt filter elements are sent ashore each voyage as Nonhazardous waste.

13. Fuel use? Fuel specification limits for the scrubber system? How is fuel tracked or monitored to determine removal efficiency and compliance status?	The ship is currently burning RMG 380, with a sulfur content of 1.8 ppm. The EGCS is designed to be effective with fuel having a sulfur content of up to 3.5 ppm.
14. General notes on scrubber operations & maintenance, instructions, logs, etc?	Initial Ocean Ranger observations were brief, although note was made that the EGCS operation did not appear to ensure a 100% clear stack.
15. For seawater intake/effluent, please provide port locations (PS/STB Frame number, etc.)? Additional notes can include distance below waterline or vertical angle.	Compartment 18, port side, frame station 92.

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,);	Yes; EGCS equipped with G6100 Washwater Monitoring System (inlet and outlet) that monitors PAH, turbidity, pH, and temperature. System is fully compliant with IMO resolution MEPC 184 (59).
16.a pH	
16.a.1 Is intake monitored?	Yes
16.a.2 How?	Type G6130 pH/Temperature sensor, located in G6100 Washwater Monitoring System
16.a.3 Is effluent monitored?	Yes
16.a.4 How?	Type G6130 pH/Temperature sensor located in G6100 Washwater Monitoring System
16.b PAHs (Polycyclic Aromatic Hydrocarbons) µg/L PAHphe (phenanthrene equivalence)	
16.b.1 Is intake monitored?	Yes
16.b.2 How?	Sensor type G6110 located in G6100 Washwater Monitoring System.
16.b.3 Is effluent monitored?	Yes
16.b.4 How?	Sensor type G6110 located in G6100 Washwater Monitoring System
16.c Oily discharges or sheens	
16.c.1 Is effluent monitored?	Yes
16.c.2 How?	Visual inspection by Deck/Bridge Watch of overboard discharge.
16.d Sludge or residues generated in treatment	
16.d.1 Is effluent monitored?	Yes
16.d.2 How?	Sludges and solids collected in bags via belt filtration system, and offloaded outside AK waters.
16.d.3 Where offloaded?	Sludge is collected by the belt filtration unit. The filter media are offloaded in Victoria, at the approximate rate of two rolls permitted vessel week.
16.e Flow rate t/hr	
16.e.1 Is intake monitored?	Yes
16.e.2 How?	Type 2536 Rotor-X sensor; Flow rate monitored of water going to towers.
16.e.3 Is effluent monitored?	No
16.f Scrubber system power consumption MWH.	
16.f.1 Present?	Yes
16.f.2 How?	Dependent on how many DGs and Scrubbers are online.

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?	No
16.g.4 Is intake monitored?	Yes
16.g.5 How?	Sensor type G6120 located in G6100 Washwater Monitoring System.
16.g.6 Is effluent monitored?	Yes
16.g.7 How?	Sensor type G6120 located in G6100 Washwater Monitoring System.
16.h mg/L nitrate + nitrate	
16.h.1 Is effluent monitored?	No
16.i Temperature	
16.i.1 Is intake monitored?	Yes
16.i.2 How?	Type G6130 pH/Temperature sensor located in G6100 Washwater Monitoring System.
16.i.3 Where?	At inlet side.
16.i.4 Is effluent monitored?	Yes
16.i.5 How?	Type G6130 pH/Temperature sensor located in G6100 Washwater Monitoring System
16.i.6 Where?	At discharge side.
17. How are monitoring systems secured, data collected, e.g. white-box, etc?	A data logger is installed for the purpose of data collection. Logger is tamper proof.
18. Do the monitoring systems have alarms or warnings in place for non-compliance?	Alarms for the EGCS are built in to the integrated engineering monitoring system Valmarine.
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"?	Sensors are calibrated. Yearly calibration is done via third party; internal calibration is undertaken by engineers.
20. Are their vessel procedures for system switch-over between operational modes, startup, shut-down, docking/maneuvering, etc. and how is this done?	Vessel's EGCS is totally automatic, with System starting/stopping simultaneously as DGs.
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)?	Vessel had two samplings done in shipyard in April 2018; Vessel has not yet received results of those samplings, and inquiry has been made regarding those results. The next annual sampling is TBD (to be determined) as to when and where.

Section 3: Compliance and Auxiliary Monitoring - Air

22. Describe or provide a diagram of exhaust air flow and stack emissions. Mark and describe the sensors / measurement points installed to collect and monitor exhaust flow data. Diagram may be scanned as a photo.	See attached page in Photo #3 of the "Photos Section" of this report.
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
24. Economizer / Heat Recovery, how is "boiler (air side) washing performed? Soot blowing operations? Details include the frequency used equipment etc.	Company policy is to do soot blowing operations outside 12 nautical miles. However, vessel has exemption with the following parameters: *To be done at night only *Vessel must be doing more than 6 knots *Favorable winds should be available *Done at point furthest from land *Not done within 12 nautical miles from Special Areas or Glaciers Boiler washwater is sent to holding tanks, and discharged outside 12 nautical miles. Vessel currently performing soot blowing operations about two times per week in AK waters, while underway and over 6 knots.

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?	SO2/CO2 is monitored continuously with vessel's CEMS (Continuous Emissions Monitoring System) system. Sensor is located on Deck 16. Fuel use is monitored and logged for DGs in use.
26. How are monitoring systems secured, data collected, e.g. white-box, etc?	A data logger is installed for the purpose of data collection. Logger is tamper proof.
27. Do the monitoring systems have alarms or warnings in place for non-compliance?	Alarms for the EGCS are built in to the integrated engineering monitoring system Valmarine.
28. Are sensors calibrated? Certified and to what standard? How often? Records or instructions?	Sensors are calibrated. Yearly calibration is done via third party; internal calibration is undertaken by engineers.
29. Are there vessel procedures for system switch-over between operational modes, startup, shut-down, docking/maneuvering, etc. and how is this done?	Vessel's EGCS is totally automatic, with System starting/stopping simultaneously as DGs.

Section 4: General Observations

30. Is vessel crew cooperative on this project?	For initial Ocean Ranger inquires, only part of one day was available. Scrubber engineer & Environmental Officer discussed the EGCS with Ocean Ranger in the office, where access to the technical manual was provided but the manual could not leave the office. In the ECR, monitor screens are available, but Chief Engineer policy is no photographs allowed in ECR. This Ocean Ranger sensed that crew was as cooperative as they were allowed to be.
31. Do you feel the vessel has a "good grip" on compliance requirements; how difficult is this survey to complete?	The crew seem to be knowledgeable in the operation of the EGCS. However, this survey, at least initially, presents some difficulty due to some limitations in access.
32. Are there other remarks/ comments the OR wants to share?	The Initial Ocean Ranger observations (limited time available) submitted here are highly subject to insights gained by following Ocean Rangers.

Photos and Comments

Photo 1

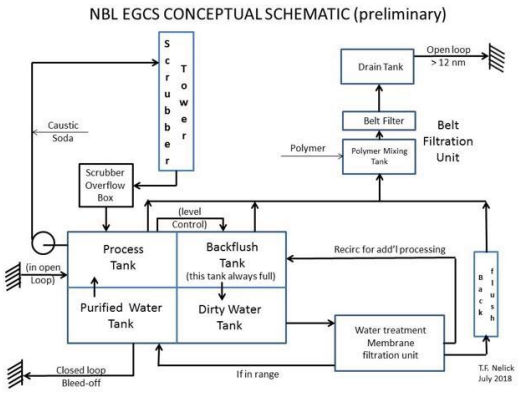

Photo 1 Caption

This is an initial "field notes" version of the NBL EGCS installation. Ocean Ranger reviewed the technical Manual with the scrubber engineer, but could not take the manual out of the office, thus had to devise this schematic based on notes and discussion. It is a preliminary version, subject to verification / correction.

Photo 2

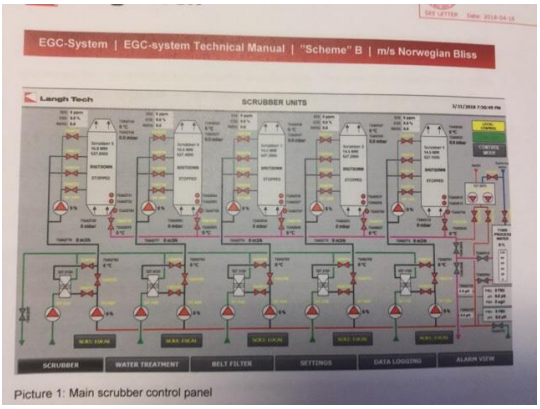

Photo 2 Caption

Page of tech manual showing the scrubber control panel. Photographs of the actual control screens in the ECR not currently allowed by NBL Chief Engineer.

Photo 3

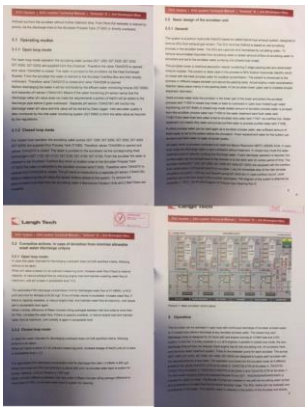

Photo 3 Caption

Pertinent pages photographed from EGCS technical manual, viewed in office with scrubber engineer & Environmental Officer. Ocean Ranger asked to see the "theory of operation" section of the manual - these pages were as closely related as the scrubber engineer could find. Policy is not to release any manual from the office.

Photo 4

Photo 4 Caption

Upper right: Scrubber overflow box
Upper left: Bank of five motors driving the scrubbing water pumps
Lower right: turbidity sensor read-out
Lower left: Sodium Hydoxide dosing station

Photo 5

Photo 5 Caption

Upper right: pH read-out (pH = 6.3)
Upper left: turbid sensing unit
Lower right: heavy, sooty particulate matter collects in belt filtration unit, aided by polymer additive
Lower left: "end result" of belt filtration process

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.