



State of Washington Department of Ecology  
**Cruise Ship Memorandum of Understanding, Cruise Operations in Washington State Inspection Report**

Northwest Regional Office  
 3190 160<sup>th</sup> Ave SE  
 Bellevue, WA 98008  
 Phone: (425) 649-7000  
 Fax: (425) 649-7098

Inspection Date June 19, 2018	Permit Number NA	County King	Receiving Waters Marine Waters	Ecology Inspector Amy Jankowiak
Entry Time 10:11 am	Photos Taken <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Samples Taken <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Inspection Announced <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Discharges to: <input checked="" type="checkbox"/> Surface Water <input type="checkbox"/> Ground Water <input type="checkbox"/> Dewater <input type="checkbox"/> POTW
Exit Time 12:21 pm				
Name and Location of Site Inspected: CARNIVAL LEGEND, Carnival Cruise Line Pier 91, Seattle, Washington				Additional Participants/Inspectors: Gretchen Onstad, Ecology
On-Site Representative(s): <i>Name/Title/Phone/e-mail</i> Evangelos Voutsis, Environmental Officer e: <a href="mailto:LEENVOFF@carnival.com">LEENVOFF@carnival.com</a>				
Responsible Official(s): <i>Name/Title/Address/Phone/e-mail</i> Benton Lobo, Director, Environmental Operations Compliance, Environmental & Occupational Safety – Marine Operation Carnival Cruise Line 3655 NW 87 <sup>th</sup> Avenue, Miami, FL 33178  e: <a href="mailto:BLobo2@carnival.com">BLobo2@carnival.com</a>				Other Facility Data: Notification made to Brigett Potts on June 14, 2018  Flag: Malta

**Section A: Areas Evaluated**

<input checked="" type="checkbox"/> Black/Gray Wastewater System	<input checked="" type="checkbox"/> Residual Solids	<input checked="" type="checkbox"/> Records/Reports	<input checked="" type="checkbox"/> Hazardous Waste/ Solid Waste	<input type="checkbox"/> Sampling/Monitoring
<input checked="" type="checkbox"/> Discharge Locations	<input checked="" type="checkbox"/> Operation & Maintenance	<input checked="" type="checkbox"/> Sludge Handling/ Disposal	<input checked="" type="checkbox"/> Oily Bilge Water	<input checked="" type="checkbox"/> Other

**Section B: For Vessels Discharging ≥ 1nm from Berth and ≥ 6 Knots Only [2.1.3(A)]**

<input type="checkbox"/> Schematics Match Black/Gray Wastewater System	
<input type="checkbox"/> Operations as Described in Submitted Documentation	
<input type="checkbox"/> Daily 24-hour Continuous Monitoring for Turbidity or Equivalent Monitoring	
<input type="checkbox"/> Turbidimeter or Equivalent Monitoring Equipment Functioning Properly	
<input type="checkbox"/> Auto Shut Down or Operational Controls to Insure System Shut Down if High Turbidity Occurs	
Turbidity or Equivalent: Last Calibration: Trigger Level for Early Alarm: <span style="font-size: 2em; opacity: 0.5;">NOT APPLICABLE</span> Trigger Level for Shutdown: Recorded Turbidity/Equivalent Levels Above Triggers:	
<input type="checkbox"/> Daily 24-hour Continuous Monitoring for Disinfection Effectiveness	
<input type="checkbox"/> Disinfection Effectiveness Monitoring Equipment Functioning Properly	
Disinfection Effectiveness Monitoring:	
<input type="checkbox"/> Auto Shut Down or Operational Controls to Insure System Shut Down if Disinfection System Upset Occurs	
<input type="checkbox"/> Disinfection System Operated and Maintained Properly	
Disinfection System:	

**Section C: For Vessels Discharging Continuously [2.1.3(B)]**

<input type="checkbox"/>	Schematics Match Black/Gray Wastewater System	
<input type="checkbox"/>	Operations as Described in Submitted Documentation	
<input type="checkbox"/>	Daily 24-hour Continuous Monitoring for Turbidity or Equivalent Monitoring	
<input type="checkbox"/>	Turbidimeter or Equivalent Monitoring Equipment Functioning Properly	
<input type="checkbox"/>	Auto Shut Down or Operational Controls to Insure System Shut Down if High Turbidity Occurs	
Turbidity or Equivalent: Last Calibration: Trigger Level for Early Alarm: _____ Trigger Level for Shutdown: _____ Recorded Turbidity/Equivalent Levels Above Triggers:		
<input type="checkbox"/>	Daily 24-hour Continuous Monitoring for Disinfection Effectiveness	
<input type="checkbox"/>	Disinfection Effectiveness Monitoring Equipment Functioning Properly	
Disinfection Effectiveness Monitoring: <b>NOT APPLICABLE</b>		
<input type="checkbox"/>	Auto Shut Down or Operational Controls to Insure System Shut Down if Disinfection System Upset Occurs	
<input type="checkbox"/>	Disinfection System Operated and Maintained Properly	
Disinfection System:		

**Section D: General (Approved to Discharge)**

<input type="checkbox"/>	No Discharges Within ½ Miles From Shellfish Beds/ Protocol (President's Point, Apple Tree Cove, Tyee Shoal, Middle Point (near Pt Townsend))	
<input type="checkbox"/>	Discharges Immediately Stopped When High Turbidity Occurs	
<input type="checkbox"/>	Discharges Immediately Stopped When Disinfection System Upset Occurs	
<input type="checkbox"/>	Immediate Notifications Made to WA Department of Health for Disinfection System Upset	
<input type="checkbox"/>	Sampling Conducted 2/month, 1/month in Seattle (BOD, TSS, Fecal Coliform, pH, Chlorine Residual)	
<input type="checkbox"/>	Whole Effluent Toxicity Testing 1 per 2 Years (Homeported) or 1/40 Calls for Continuous	

**Section E: General**

<input checked="" type="checkbox"/>	Wastewater Discharge Records Review	Discharge records were reviewed (blackwater/graywater/residual solids) and are maintained properly. No discharges found to be in the OCNMS, MOU waters or Washington state waters (MOU related waters). Further review will be done following the end of the season.
<input checked="" type="checkbox"/>	Wastewater Discharges protocol per MOU and managed properly	The discharge protocols are consistent with MOU requirements to not occur in MOU related waters.
<input checked="" type="checkbox"/>	Residual Solids Managed Properly/Disposal Protocol per MOU	Residual solids protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/>	Hazardous Waste Managed Properly	Hazardous protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/>	WA Hazardous Waste Guidelines Followed (Appendix vii)	Hazardous waste protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/>	Solid Waste Managed Properly (zero garbage discharge)	Solid waste protocols are consistent with MOU requirements. Solid waste discharge records were reviewed and are maintained properly. No

	discharges or releases of solid wastes were found to be inconsistent with MOU requirements.	
<input checked="" type="checkbox"/>	Photo/X-Ray Waste Managed Properly (fluids, cartridges,...) and landed ashore	Photo and x-ray waste protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/>	Dry-Cleaning Wastes and Byproducts (fluids, sludge, filter materials...) Managed Properly (PERC – haz waste – landed ashore)	No dry cleaning is done on board and therefore dry cleaning waste products are managed per MOU requirements.
<input checked="" type="checkbox"/>	Unused/Outdated Pharmaceuticals Managed Properly (safely disposed of)	Unused or outdated pharmaceuticals are sent to the medical drains, logged with witness.
<input checked="" type="checkbox"/>	Fluorescent and Mercury Vapor Lamp Bulbs Managed Properly (prevent release of mercury)	Fluorescent and mercury vapor lamp bulbs protocols for management are consistent with MOU requirements.
<input checked="" type="checkbox"/>	Waste Reduction/Reuse/Recycling Opportunities Maximized (glass, cardboard, aluminum & steel cans)	Waste reduction/reuse/recycling opportunities appear to be maximized per MOU requirements.
<input checked="" type="checkbox"/>	Batteries Managed Properly (recycled, reclaimed, disposed of properly)	Batteries management protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/>	Incinerator Ash Managed Properly and minimized volume (haz waste segregation and annual testing)	Incinerator ash management is consistent with MOU requirements.
<input checked="" type="checkbox"/>	Oily Bilge Water Managed Properly (<15 ppm, no visible sheen and underway)	Oily bilge water protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/>	Ballast Water Managed Properly (per Wash regs –reporting, treated or if open sea exchange >200 nm from outside EEZ, 50nm if not EEZ)	Ballast water is managed with graywater and blackwater holding and no exchanges are necessary.
<input checked="" type="checkbox"/>	OCNMS rules and regs followed	The discharge protocols are consistent with MOU requirements and are to not occur in OCNMS waters.

**Additional General Questions**

<input checked="" type="checkbox"/>	How is deck runoff and hull cleaning handled (scuppers...) (non-toxic/phosphate free cleaners, biodegradable)	Deck runoff and hull cleaning protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/>	How is maintenance performed on the outside of the vessel (paint chipping, painting, etc)	Outside vessel maintenance protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/>	Sculleries and Galleys – type of detergents and degreasers used (phosphate free and non-toxic)?	Restaurants and galleys use detergents and degreasers that are non-toxic and phosphate free.
<input checked="" type="checkbox"/>	How are food waste discharges handled (prevention of erroneous materials)?	Food waste discharge protocols are consistent with MOU requirements and records reviewed show no discharges in MOU related waters.
<input checked="" type="checkbox"/>	Medical sinks/floor drains, chem. stor areas wastes go where (plugged, blackwater, bilge)?	Medical sinks/floor drains are reported as connected to blackwater.
<input checked="" type="checkbox"/>	Where is pool and spa water discharged? Dechlorinated/debrominated and underway?	Pool and spa water protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/>	What type of fuel is used and percent sulfur content?	<0.1% sulfur content is used throughout the route. (MGO 0.00061% sulfur used in May; June combination of MGO and new wet scrubber)

Other:

**Section F: Sampling Results**

Parameter	Results
Biochemical Oxygen Demand 5-Day (BOD <sub>5</sub> )	NOT APPLICABLE
Total Suspended Solids (TSS)	
Fecal Coliform	
Residual Chlorine	
pH	
Ammonia, Nitrogen	

**Section G: Summary of Findings/Comments**

## Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program (NWRO-WQ) conducted the inspection of the Carnival Cruise Line CARNIVAL LEGEND on June 19, 2018, along with Gretchen Onstad, NWRO-WQ. The main contact on board the CARNIVAL LEGEND was Evangelos Voutsis, Environmental Officer (EO) for the vessel. Prior notification of the visit was given on June 14, 2018 for security protocol. There was a delay of about 25 minutes at security before boarding the vessel due to Ecology staff names not being on the early boarding list. The purpose of the inspection was to evaluate compliance with the *Memorandum of Understanding Cruise Operations in Washington State* (MOU), as amended. The CARNIVAL LEGEND is not approved to discharge wastewater in MOU waters.

The CARNIVAL LEGEND was put into service in August of 2002 and is 963 feet long with 12 decks. Passenger capacity is currently about 2100, with about 930 crew.

The CARNIVAL LEGEND is scheduled for 17 calls in Seattle between May 25, 2018 and September 5, 2018. The vessel visits Victoria on its way into Seattle and heads north through the Haro Strait on the way out to Alaska.

## Inspection

We arrived and boarded the ship (photo #01) at 10:11 am and began with introductions and a plan for the day with Evangelos Voutsis, EO. We headed to the Engine Control Room (ECR) and discussed various waste streams and discharge protocols. We reviewed the electronic logs for blackwater and graywater discharges. We then toured the blackwater marine sanitation devices, the oily bilge treatment, and the water production systems with the Safety Engineer. We then headed to the garbage room and wet scrubber filters, and the crew galley/food pulper. We then went to the Bridge to review navigation and discharge protocol plans, and finished with the garbage record review and receipts. The inspection was then finalized with a brief debriefing and we disembarked the vessel at 12:21 pm.



Photo #01 6/19/18 Image: IMG-050  
By: Jankowiak  
Description: CARNIVAL LEGEND vessel

Photo #02 6/19/18  
Image: IMG-0552  
By: Onstad  
Description: Discharge matrix on Bridge

Discharge Types and Protocols in MOU waters, Washington State waters or the Olympic Coast National Marine Sanctuary (OCNMS) (MOU related waters):

The discharge protocols start with voyage plans for each itinerary prior to that route. A matrix (photo #02) is developed for each route upon a detailed review of locations for allowed discharges. The matrix for the Seattle/Alaska route details no discharges in MOU related waters, for

- bilge water;
- blackwater;
- graywater;
- food waste;
- ballast water; and
- pool and spa water.

The matrix also shows that Puget Sound is a designated No Discharge Zone for sewage with a link to our website.

The protocol for discharges is a closed-loop process. There is communication between the ECR Officer on Watch and the Bridge staff for approval from the Bridge that the vessel is in an area authorized for discharge. The overboard valves are padlocked with the keys in the ECR. All discharges are electronically logged in the NAPA system. Any change to the logs shows who made the change by staff passcode. Any changes are reviewed by the Bridge. The GPS system is connected to the log for accurate logging of the discharge location. The discharges all to occur outside of MOU related waters (Washington State waters, the Strait of Juan de Fuca up to the border with Canada and the OCNMS). For black water and gray water, the latitude and longitude coordinates are recorded in the NAPA system along with all other logs. The date, time and location of both the start and the stop of the discharges are recorded, along with port location, effluent type, speed, tank name and volume, valve name, and status of valve. The maker of the entry and reviewer/signer is also included, along with any notes. The ECR displays the discharge ports, such as the four blackwater overboard valves and four graywater overboard valves (photo #03). The vessel protocol is to not discharge blackwater or graywater in Canadian waters on this route. Navigation on the bridge shows clearly marked electronic maps indicating discharges to stop 13 miles outside the OCNMS (12 miles from shore and a one mile buffer).

**Discharge Types:**

Blackwater includes toilet waste and medical drains and is sent by vacuum/jet to one of four separate Triton marine sanitation devices (photo #04) each with 91 cubic meters (m<sup>3</sup>)/day capacity. Description paraphrased from the schematic on the MSD system: Black water enters from the inlet into the aeration tank where the bacteria present in this section decomposes the blackwater in the presence of oxygen which is supplied by the aeration nozzles. A continuous supply of oxygen is necessary. The blackwater then enters into the settling section where settling takes place and flocs of activated sludge settles down along with other settleable matter. Sludge is returned back to the aeration section. The settled blackwater then enters into the disinfection section where chlorine is added (photo #05). Flow then goes to dedicated holding tanks if not in an

area of discharge (photo #06). Blackwater is not discharged in MOU related waters and all blackwater is treated. Settleable solids are monitored periodically and chlorine availability checked. Once per year, each MSD is taken off-line for a full maintenance cleaning. Solids are removed at this time, drummed and sent ashore in Seattle on this route.

Graywater, which includes accommodation and crew sink and shower water, galley water, laundry and possibly spa water is held untreated and discharged outside of MOU related waters.

Dirty bilge water collected and is sent to one of two oily bilge tanks. Liquid moves to one of two new static oily water separators (OWS). One of the two is in standby and rotated use and each has a capacity of 5 cubic meters per hour (m<sup>3</sup>/hr), double the previous system capacity. The system includes two stages of filtration and recirculates at >5 parts per million (ppm) oil content with the oily content meter (photo # 07 0533). Oily sludge is collected from the system and sent ashore by truck. Maintenance on the OWS's includes regular cleaning of the filters and other regular checks and maintenance. Prior to

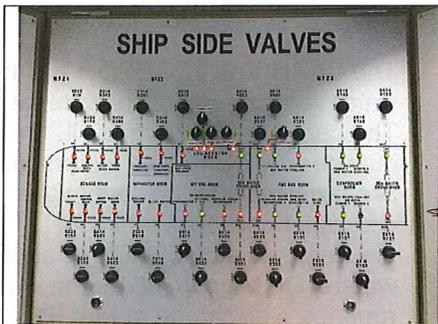


Photo #03 6/19/18 Image: IMG-0526  
By: Onstad  
Description: Valve monitoring in ECR



Photo #04 6/19/18  
Image: IMG-0528  
By: Onstad  
Description: Triton Marine Sanitation Device panel



Photo #05 6/19/18 Image: IMG-0530  
By: Onstad  
Description: MSD chlorine pumping and blowers



Photo #06 6/19/18  
Image: IMG-0531  
By: Onstad  
Description: MSD overboard

discharge, the liquid is sent through a white box which only allows discharges <15 ppm. The discharge protocol for this route is outside the MOU related waters. The white box (photo #08 0536) is also new. The Chief Engineer and the EO have the two separate keys and both need to be present to open the white box. There is a record each time the white box door is opened and a video camera on OWS equipment. The chief Engineer and the Captain have the ability to review camera recordings. All portable pumps are logged and only used for certain equipment. The EO confirmed that he is not aware of any rerouting of oily bilge. Carnival Corporation vessels (including Holland America Line) have been conducting trainings related to various wastestreams including oily bilge. The OWS was off and recirculating during the inspection and not discharging. If graywater tanks overflow or come in contact with oily bilge, the content is considered as oily bilge and treated through the OWS and the Captain and Chief Engineer are notified. On May 20, 2018, the vessel had a leak of grey water into the bilge due to a broken manhole gasket seal. The water was transferred to the dirty bilge tank and offloaded in Seattle as oily bilge water by truck.

The CARNIVAL LEGEND uses graywater in various tanks and blackwater tanks for ballast and therefore does not do ballast water exchanges. Stability has not been an issue.

The CARNIVAL LEGEND has 4 fresh water Jacuzzis and 2 saltwater pools. The pools are discharged >12nm and outside of MOU related waters and the Jacuzzi water can be sent to the graywater collection tanks for discharge outside of MOU related waters. On May 15, 2018, the line reported a discharge at Pier 91 in Seattle of approximately 0.5 m<sup>3</sup> of chlorinated water from a ship pool that lasted about five minutes due to a drainage blockage. The chlorine concentration was reported at an estimated 0.64 ppm chlorine.



Photo #07 6/19/18 Image: IMG-0533 By: Onstad  
Description: OWS oil content meter



Photo #08 6/19/18 Image: IMG-0536 By: Onstad  
Description: OWS White Box

Food waste is sent to pulpers in the galleys (photos #09 and #10). There are twelve in total. Food waste goes to 2 food waste tanks is then pulped food waste is discharged outside of MOU related waters. Water from the pulpers goes to the graywater tanks. Solid food waste that cannot be pulped such as bones, egg shells, coffee grounds and rinds is either incinerated or sent ashore in Victoria. Used cooking oil (photo #11) is sent ashore for recycling. The EO and staff inspect the galley pulpers typically daily. Tanks are inspected weekly. There is no food chute on board.

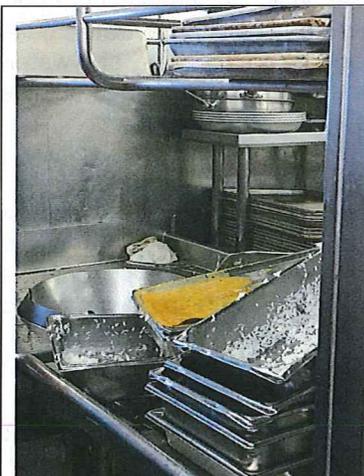


Photo #09 6/19/18 Image: IMG-0545 By: Onstad  
Description: Galley pulper



Photo #10 6/19/18 Image: IMG-0546 By: Onstad  
Description: Galley pulper/filter

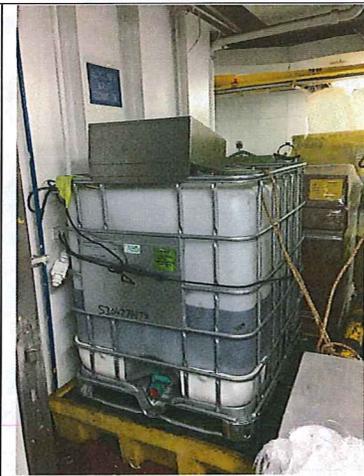


Photo #11 6/19/18 Image: IMG-0544 By: Onstad  
Description: Used cooking oil

Deck runoff goes directly overboard. The VGP requirements are followed for prevention of any materials off the deck. Only non-toxic, phosphate free cleaners are used. Outside vessel maintenance such as paint chipping and painting is sometimes done at the Port of Seattle. Touch up painting was occurring upon arrival of the inspection (photo # 12). The cherry picker being used was draped in a collection tarp and was positioned with smaller length rollers to prevent any drips to water. Work does not occur if too windy and is done with permission of the Port.

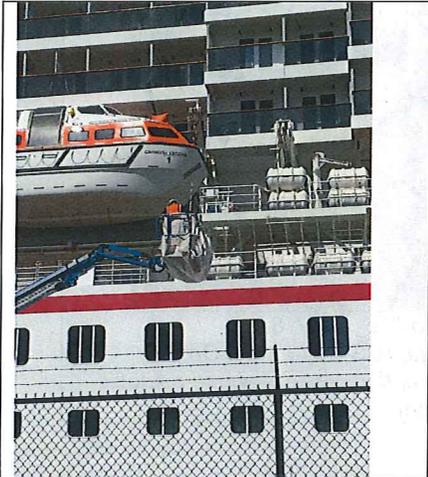


Photo #12 6/19/18 Image: IMG-051  
By: Jankowiak  
Description: Paint touch-ups with cherry picker

Laundry water is sent to the graywater collection tanks and discharged outside MOU related waters. Dry cleaning is not done on the vessel. Therefore, no chemical such as perchloroethylene (Perc) are used on the vessel.

Photo waste goes through a silver recovery unit with offloads when silver is less than 5 ppm. X-rays are done digitally without any waste. Fluorescent bulbs are not crushed on board, and held for offloading ashore as hazardous waste. Hazardous waste materials are stored separately in various dedicated locations throughout the vessel and include items such as paints, thinners, oily rags and debris, incinerator ash, chemicals, aerosols photo waste, and some batteries. Bio-medical waste is incinerated with sharps being offloaded as biomedical waste ashore. Hazardous waste is offloaded in Seattle on this route.

Unused or outdated pharmaceuticals and narcotics are sent to the medical drains which goes to the blackwater system and discharged outside MOU related waters. Such discharges to the medical drains in the medical facility are done with witness and logged. Cruise Line International Association (CLIA) waste management best practices and procedures, which are agreed to in the MOU, include this language:

“CLIA Members are to employ one or more of the following practices when disposing of pharmaceuticals:

- establish a reverse distribution system for returning unexpired, unopened non-narcotic pharmaceuticals to the original vendor;
- appropriately destroy narcotic pharmaceuticals onboard the ship, in a manner that is witnessed and recorded;
- offload listed pharmaceuticals in accordance with local regulations. Listed pharmaceuticals are hazardous wastes with chemical compositions that prevent them from being incinerated or disposed of through the ship’s wastewater treatment plant; and/or
- dispose of other non-narcotic and non-listed pharmaceuticals through onboard incineration or landing ashore.”

While the vessel practice of destroying the narcotic pharmaceuticals onboard the ship with witness and record is allowed by the CLIA practices, the vast majority of lines are employing a practice to not discharge any medication to water. The narcotics are typically incinerated with witness and record and medications are typically sent back to the vendor or incinerated.

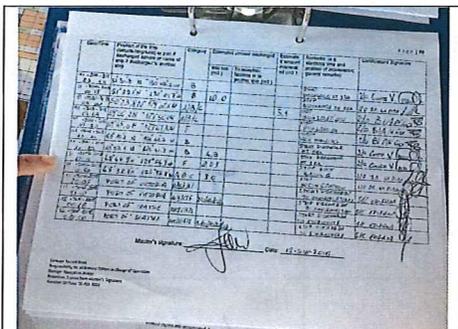


Photo #13 6/19/18  
Image: IMG-0549 By: Onstad  
Description: Paint touch-ups with cherry picker

Garbage such as domestic and operational waste is offloaded in Seattle. Some USDA wastes, some food waste, biomedical bagged waste, some plastics, food contaminated cardboard, and some paper is incinerated with one incinerator. Ash is tested annually and offloaded as hazardous waste. The garbage record book was reviewed (photo # 13) and showed consistency with requirements.

Glass, heavier plastics, most cardboard, aluminum, tin and steel cans, batteries, used cooking oil and other items are recycled in Victoria.

A wet scrubber for exhaust was just recently installed and was partially operational in June 2018 while in route. MGO fuel was used in May at < 0.00061% sulfur. The vessel is not equipped for shore power. The new wet scrubber uses filters (photo #14) and discharges are diluted and monitored. Water is produced on board with an evaporator system (photo #15) and a reverse osmosis system (photo #16) as well as being bunkered in Seattle.



Photo #14 6/19/18 Image: IMG-0541  
By: Onstad  
Description: Wet Scrubber filters



Photo #15 6/19/18  
Image: IMG-0537 By: Onstad  
Description: Water evaporator system



Photo #16 6/19/18  
Image: IMG-0540 By: Onstad  
Description: Water reverse osmosis system

The vessel has a clear process for notifications for any non-compliance incident.

Conclusions and Recommendations

The protocols for discharges are clear. Records were orderly and appeared consistent with the MOU. I recommend that Carnival Cruise Line consider preventing medications from water discharges on the CARNIVAL LEGEND.

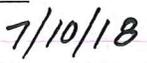
Attachments:

Environmental Operations contractor/vendor brochure provided on boarding

Copies to:

- Evangelos Voutsis, Environmental Officer, CARNIVAL LEGEND
- Mark Toy, Health
- Greg Wirtz, CLIA-NWC
- Stephanie Jones Stebbins, Port of Seattle
- Laura Fricke, Ecology
- Amy Jankowiak, Ecology
- Gretchen Onstad, Ecology
- Central Files: Carnival Cruise Line – CARNIVAL LEGEND; WQ 6.1

**Section H: Signatures**

Name and Signature of Inspector:	Agency/Office/Telephone:	Date
Amy Jankowiak, Compliance Specialist 	Department of Ecology Northwest Regional Office Water Quality Program Municipal Compliance Specialist 425-649-7195	
Laura Fricke, Municipal Unit Supervisor 	Department of Ecology Northwest Regional Office Municipal Unit Supervisor 425-649-7103	



## CARING FOR OUR AWESOME PLANET



### GARBAGE SEPARATION AND DISPOSAL

- For any waste to be disposed, seek guidance from shipboard department head or ship's Environmental Officer.
- For general garbage disposal, see below guidance:

RED BIN	- Food Waste Only
BLUE BIN	- Aluminum Only
YELLOW BIN	- Glass
WHITE BIN	- Broken China ware
GREY BIN	- Paper and Plastic

### CONSERVE WATER

- Do not leave water running
- Report leaking faucets/pipes to shipboard department head
- Wash full clothes of laundry

### CONSERVE ENERGY

- Turn of lights when not in use
- Close deck doors

CARNIVAL CRUISE LINE

# ENVIRONMENTAL OPERATIONS

CONTRACTOR AND VENDOR BROCHURE

The purpose of this

brochure is to encourage

and ensure that all

vendors, technicians,

and other non-

crewmembers follow

requirements regarding

pollution prevention

and environmental

protection as required

by the Environmental

Compliance Plan, all

applicable environmental

laws and regulations, and

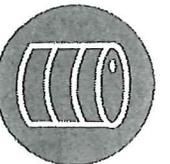
Carnival's Environmental

Management System.



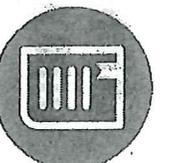
## **COMPLY WITH RULES**

- Do not throw or discharge anything over board.
- Do not drain or pour any chemicals products into the ship drains.
- If working in engine spaces, do not drain anything into the bilges without first receiving permission from the Chief Engineer.
- Immediately report any non-compliance and/or Environmental incidents to shipboard department head or Environmental Officer.



## **WORKING WITH CHEMICALS**

- All chemical products must be pre-approved by CCL before use.
- All chemical products must be labeled and have a Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS).
- A copy of MSDS/SDS must be handed over to your Sponsoring shipboard department head before starting the job.
- It is prohibited to use chemical products without MSDS.
- All unused chemical products must be disposed of in accordance with CCL policy. Contact shipboard department head for further Guidance.



## **ENVIRONMENTAL COMPLIANCE**

- It is your responsibility to ensure that you adhere to Carnival Cruise Line's Environmental Policy and follow all requirements regarding pollution prevention and Environmental protection.
- For questions relating to your work and any environmental procedures, the Environmental Management System, and compliance under the Environmental Compliance Plan please contact Department Head or the Environmental Officer on board.

Environmental Officer:  
Ship: Carnival Legend  
Email: [leenvoff@carnival.com](mailto:leenvoff@carnival.com)  
Office #: 0064  
Call #: 7850



State of Washington Department of Ecology  
**Cruise Ship Memorandum of Understanding, Cruise Operations in Washington State Inspection Report**

Northwest Regional Office  
 3190 160<sup>th</sup> Ave SE  
 Bellevue, WA 98008  
 Phone: (425) 649-7000  
 Fax: (425) 649-7098

Inspection Date Sept 26, 2018	Permit Number NA	County King	Receiving Waters Marine Waters	Ecology Inspector Amy Jankowiak
Entry Time 10:11 am	Photos Taken <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Samples Taken <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Inspection Announced <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Discharges to: <input checked="" type="checkbox"/> Surface Water <input type="checkbox"/> Ground Water <input type="checkbox"/> Dewater <input type="checkbox"/> POTW
Exit Time 1:03 pm				

<b>Name and Location of Site Inspected:</b> GRAND PRINCESS, Princess Cruises Pier 91 Seattle, Washington		<b>Additional Participants/Inspectors:</b> Jonathan Turvey, Holland America Group <a href="mailto:JTurvey@HollandAmericaGroup.com">JTurvey@HollandAmericaGroup.com</a> Cady Moris, Holland America Group Chris Dudenhoeffer, Ecology Alexander Adams, Port of Seattle
<b>On-Site Representative(s): Name/Title/Phone/e-mail</b> Marijo Slade, Environmental Officer <a href="mailto:GPDEVOF1@princesscruises.com">GPDEVOF1@princesscruises.com</a>		
<b>Responsible Official(s): Name/Title/Address/Phone/e-mail</b> Jim Peschel, Senior Director of Environmental Regulatory Operations Holland America Group 300 Elliott Ave. West, Seattle WA 98119 206-281-3535 <a href="mailto:JPeschel@hollandamericagroup.com">JPeschel@hollandamericagroup.com</a>		<b>Other Facility Data:</b> Notification made to Jonathan Turvey and Jim Peschel on Sept 24, 2018  Flag - Bermuda

**Section A: Areas Evaluated**

<input checked="" type="checkbox"/> Black/Gray Wastewater System	<input checked="" type="checkbox"/> Residual Solids	<input checked="" type="checkbox"/> Records/Reports	<input checked="" type="checkbox"/> Hazardous Waste/ Solid Waste	<input checked="" type="checkbox"/> Sampling/Monitoring
<input checked="" type="checkbox"/> Discharge Locations	<input checked="" type="checkbox"/> Operation & Maintenance	<input checked="" type="checkbox"/> Sludge Handling/ Disposal	<input checked="" type="checkbox"/> Oily Bilge Water	<input checked="" type="checkbox"/> Other

**Section B: For Vessels Discharging ≥ 1nm from Berth and ≥ 6 Knots Only [2.1.3(A)]**

<input type="checkbox"/> Schematics Match Black/Gray Wastewater System	
<input type="checkbox"/> Operations as Described in Submitted Documentation	
<input type="checkbox"/> Daily 24-hour Continuous Monitoring for Turbidity or Equivalent Monitoring	
<input type="checkbox"/> Turbidimeter or Equivalent Monitoring Equipment Functioning Properly	
<input type="checkbox"/> Auto Shut Down or Operational Controls to Insure System Shut Down if High Turbidity Occurs	
<b>Turbidity or Equivalent:</b> Last Calibration: Trigger Level for Early Alarm: <b>NOT APPLICABLE</b> Trigger Level for Shutdown: <b>NOT APPLICABLE</b> Recorded Turbidity/Equivalent Levels Above Triggers:	
<input type="checkbox"/> Daily 24-hour Continuous Monitoring for Disinfection Effectiveness	
<input type="checkbox"/> Disinfection Effectiveness Monitoring Equipment Functioning Properly	
<b>Disinfection Effectiveness Monitoring:</b>	
<input type="checkbox"/> Auto Shut Down or Operational Controls to Insure System Shut Down if Disinfection System Upset Occurs	
<input type="checkbox"/> Disinfection System Operated and Maintained Properly	
<b>Disinfection System:</b>	



	discharges or releases of solid wastes were found to be inconsistent with MOU requirements.
<input checked="" type="checkbox"/> Photo/X-Ray Waste Managed Properly (fluids, cartridges,...) and landed ashore	Not evaluated
<input checked="" type="checkbox"/> Dry-Cleaning Wastes and Byproducts (fluids, sludge, filter materials...) Managed Properly (PERC – haz waste – landed ashore)	Not evaluated
<input checked="" type="checkbox"/> Unused/Outdated Pharmaceuticals Managed Properly (safely disposed of)	Unused or outdated pharmaceuticals management protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> Fluorescent and Mercury Vapor Lamp Bulbs Managed Properly (prevent release of mercury)	Not evaluated
<input checked="" type="checkbox"/> Waste Reduction/Reuse/Recycling Opportunities Maximized (glass, cardboard, aluminum & steel cans)	Not evaluated
<input checked="" type="checkbox"/> Batteries Managed Properly (recycled, reclaimed, disposed of properly)	Not evaluated
<input checked="" type="checkbox"/> Incinerator Ash Managed Properly and minimized volume (haz waste segregation and annual testing)	Incinerator ash management is consistent with MOU requirements.
<input checked="" type="checkbox"/> Oily Bilge Water Managed Properly (<15 ppm, no visible sheen and underway)	Oily bilge water protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> Ballast Water Managed Properly (per Wash regs –reporting, treated or if open sea exchange >200 nm from outside EEZ, 50nm if not EEZ)	Ballast water is treated on board.
<input checked="" type="checkbox"/> OCNMS rules and regs followed	The discharge protocols are consistent with MOU requirements and are to not occur in OCNMS waters.

**Additional General Questions**

<input checked="" type="checkbox"/> How is deck runoff and hull cleaning handled (scuppers...) (non-toxic/phosphate free cleaners, biodegradable)	Not evaluated
<input checked="" type="checkbox"/> How is maintenance performed on the outside of the vessel (paint chipping, painting, etc)	Not evaluated
<input checked="" type="checkbox"/> Sculleries and Galleys – type of detergents and degreasers used (phosphate free and non-toxic)?	Not evaluated
<input checked="" type="checkbox"/> How are food waste discharges handled (prevention of erroneous materials)?	Food waste discharge protocols are consistent with MOU requirements and records reviewed show no discharges in MOU related waters.
<input checked="" type="checkbox"/> Medical sinks/floor drains, chem. stor areas wastes go where (plugged, blackwater, bilge)?	Medical sinks/floor drains are reported as connected to black water.
<input checked="" type="checkbox"/> Where is pool and spa water discharged? Dechlorinated/debrominated and underway?	Pool and spa water protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> What type of fuel is used and percent sulfur content?	<0.1% sulfur fuel content or EGCS treated equivalent is used throughout the route.

Other:

**Section F: Sampling Results**

Parameter	Results
Biochemical Oxygen Demand 5-Day (BOD <sub>5</sub> )	<b>NOT APPLICABLE</b>
Total Suspended Solids (TSS)	
Fecal Coliform	
Residual Chlorine	
pH	
Ammonia, Nitrogen	

**Section G: Summary of Findings/Comments**

## Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program (NWRO-WQ) conducted the inspection of the Princess Cruises GRAND PRINCESS on September 26, 2018. The main contact on board the GRAND PRINCESS was Marijo Slade, Environmental Officer (EO) for the vessel. Jonathan Turvey, Director, Environmental Compliance Program for Holland America Group (HAG), Cady Moris, with HAG, Christopher Dudenhoeffer, with Ecology, and Alexander Adams with the Port of Seattle also joined us for the inspection. Prior notification of the visit was given on September 24, 2018 for security protocol. The purpose of the inspection was to evaluate compliance with the *Memorandum of Understanding Cruise Operations in Washington State* (MOU), as amended. The GRAND PRINCESS is not approved to discharge wastewater in MOU waters.

The GRAND PRINCESS was launched in 1998, and is 951 feet long. The passenger capacity is approximately 3100 with a crew capacity of about 1100.

The GRAND PRINCESS is scheduled for 2 port calls in Seattle on September 26, 2018 and October 10, 2018. The vessel was in Astoria prior to this call in Seattle, and is then off to Vancouver B.C.

## Inspection

We arrived and boarded the ship (photo #01) at 10:11 am and began with introductions and a plan for the day with the Captain. We discussed navigation and environmental planning on the Bridge, followed by a discussion of various waste streams and discharge protocols. We reviewed some records electronically. We then went to the Engine Control Room (ECR) prior to viewing the Exhaust Gas Cleaning System (EGCS), oily bilge treatment system, the incinerator and food chute (photo #07). We also viewed the shore power hookup. The inspection was then finalized with a brief debriefing and we disembarked the vessel at 1:03 pm.

Discharge Types and Protocols in MOU waters, Washington State waters or the Olympic Coast National Marine Sanctuary (OCNMS) (MOU related waters):

The discharge protocols start with an Environmental Schedule (photos #02-#03) that is planned out for the voyage, but is also subject to change according to traffic and navigation circumstances. Confirmation must be obtained from the Bridge prior to opening any overboard valve or conducting environmental activities. The Environmental Schedule is developed for each route upon a detailed review of locations for allowed discharges, holding ability of the various wastestreams, and other requirements. The plan that includes the MOU related waters details no discharges for:

- Treated bilge water;
- Treated black water or grey water;
- MBR de-sludging (biomass),
- food waste;
- pool/recreational water,
- untreated grey water,
- boiler blow down, and
- additional restrictions.

The Bridge and the ECR staff communicate prior to any discharge and the bridge provides a ½ hour notice prior to being in an area to stop discharges. All discharges are stopped before entering the OCNMS including the EGCS system. Fuel switching is conducted prior to EGCS shut-down to assure Emission Control Area (ECA)-compliant fuel is being used. The NAPA system is used to electronically log all discharges and there is an electronic recording of certain discharge ports opening and closing. A deck log is also used to record activities. For black water and grey water, the latitude and longitude coordinates, along with other discharge information is recorded in the NAPA *Permeate as their Sewage and Graywater Discharge Record Book*, which is electronic. Discharge ports are padlocked with the keys held in in the ECR (photo #04) with the Engineer on Watch in charge of key distribution. Electronic recordkeeping requires logins and passwords and date and time stamps each entry with a specific name.

## Discharge Types

Black water/Grey water:

Black water which includes medical drains and toilet waste is usually collected and treated by a Wartsila Hamworthy System Membrane Bio-Reactor (MBR) # 1 port side. Accommodation grey water ( sinks and showers ) goes into collecting tanks and then into grey water double bottom buffer tank from where is fed to MBR # 1 port side or MBR # 2 stbd side. MBR # 2 usually treats accommodation grey water only, but it can be used to treat black water as well. MBR # 3 is usually a backup unit for MBR 1 and 2 and can be used to treat black water and grey water or only grey water.

The effluent from the MBR's in operation is pumped overboard through a permeate tank outside of the MOU related waters or held into double bottom holding tanks. Laundry grey water is collected into two laundry water double bottom holding tanks and then can be treated by MBR's or discharged overboard when outside MOU waters.

The vessel is approved to discharge Hamworthy permeate in Alaska which includes required monitoring twice a month, depending on the schedule and itinerary. The vessel also conducts its own monitoring on the vessel to assure optimal operation of the Wartsila Hamworthy system. Turbidity, pH, coliform (quanti-tray), chlorine (free and total) and chemical oxygen demand (COD) testing is done on board regularly (at least weekly) by the ship's staff in an on-board laboratory.

MBR's operation: Grey water and black water is fed to MBR's. The first phase of the process is the Screen Press which filters paper and other solids (screenings) out of the waste stream. The screenings are collected from waste outlet and into the bagging unit. These bags are manually removed and transported for disposal by incineration.

The feed then flows into the first stage of the Bio-reactor which operates as an aerobic biological treatment system. Incoming feed enters into a high strength biomass within which there is a diverse microbial ecology that breaks down and consumes the raw sewage and grey water mix. The by-products of the process are water and carbon dioxide. The carbon dioxide is vented to atmosphere (outside the ECR) along with the air that is used for the aeration of the biomass.

The mixed liquor is then transferred from the first stage to the second via the Interstage Filter System and it is returned from the second stage to the first via an internal overflow. Mixed liquor from the first stage enters the Interstage Filter where it is thrown out against the tensioned 200 micron filter bags by a rotating screw. The clean filtrate exits the outside of the filter bags and drops into the filtrate tank. The filtrate is transferred to the second stage by a float controlled pump where further aeration takes place. The filtered solid waste from the Interstage Filter is redirected back to the Screen Press for reprocessing. There are two Interstage Filters for each MBR.

The liquor from the second stage is treated through the membranes via crossflow pumps with high flow and high pressure, causing the water to break down to permeate as a final effluent. The final effluent from all MBR's in operation is then pumped from the membranes into a permeate tank from where is directed to double bottom tanks for holding or discharged overboard outside MOU waters.

There is no ultraviolet disinfection or other type of disinfection method, relying on the membranes to remove bacteria and pathogens. Ecology notes that it is an unusual practice to not have a disinfection system such as ultraviolet light and there may be concerns that membranes may not remove all types of pathogens. Ecology also notes that the discharges are not occurring in MOU related waters.

Turbidity is monitored on the permeate. The system is operated, maintained and monitored by the ship's staff and the system performance checks are done on regular basis by Wartsila - Hamworthy engineer. All system parameters can be checked from the local panels. The essential alarms plus Turbidity can be seen in ECR.

#### Bilge Water:

Dirty bilge water collected and is sent to the oily bilge settling tank. Liquid moves to one of two static oily water separators (SOWS) (photos #19 and #20) where it is treated to less than 15 parts per million (ppm) oil content. Treated bilge then goes through the bilge control discharge box (BCDB), also known as the "white box" (photo #17). The three-way valve sends treated bilge at less than 15 ppm overboard in areas where allowed or recirculates back for treatment. A Centrifugal oily water separator (COWS) (photo #21) is used for internal transfers and not for overboard discharge. Liquid is sent to the clean bilge at less than 15 ppm or is recirculated back. The clean bilge then goes through the SOWS. There is an emergency bypass (photo #22) that has not been used according to the EO, and is logged and notifications made if it is. Maintenance on the COWS and SOWS is triggered with the AMOS maintenance system and includes regular cleanings, overhauls, and filter changes. The oily sludge is collected to a sludge box, drummed and offloaded in Victoria on this route. Discharges of clean bilge and offloads of oily sludge are recorded in the Oil record Book. The overboard discharge port (photo #18) is padlocked and seals are on key pieces of equipment. All bilge equipment is labeled to prevent tampering and the area is monitored and video recorded. All seals, padlocks, fittings and portable pumps (38) are inventoried and checked regularly as part of the Environmental Compliance System by the Chief Engineer and EO and advised of portable pump usage. As part of the vulnerability assessment, fittings and parts are checked for appropriate seals, welds, or padlocks. If other tanks such as grey water overflow and contact with any bilge, it is then considered bilge and treated as bilge or offloaded. Any such overflow is to be reported to the company. The EO confirmed that he is not aware of any rerouting of oily bilge.

#### Ballast Water:

Ballast water is treated on board with two AMS systems. One includes filtration and UV (mid-ship) and the other (front) only uses UV which then routes to the mid-ship system for treatment.

#### Pools/whirlpools:

There are three big pools, one smaller and about six whirlpools. They all use freshwater and discharges are to occur outside of MOU related waters. The treatment chemicals are used - Sodium Hypochlorite, Brominating tablets, PH Increaser, Pool Clarifier, Sodium Thiosulfate, Sodium Bicarbonate, Sterilex Ultra-Kleen Liquid Solution 1, Sterilex Ultra-Kleen Liquid Solution 2 & Pool and SPA hardness. All discharges are performed outside MOU waters. If a pool or whirlpool had to be dumped due to contamination the facility is kept closed until the ship is outside MOU waters.

#### Food Waste:

Food waste is sent to a pulper in the galleys with some materials being sorted and collected for compost or as non-comminuted to the food chute. Comminuted food waste after location is confirmed with the Bridge and to occur outside MOU related waters. Food waste for compost is collected and binned in the cold room and offloaded in Victoria on this route. Used cooking oil is collected and recycled. Any food sent to the food chute is done with a key that the EO or delegated engineer have. Prevention of non-food materials to pulpers and the food chute is done by training and double checks. Discharges of food waste are logged in the NAPA system. Galley grey water is not treated by MBR's - first it goes to collecting tanks and then it is stored into double bottom tanks and then discharged overboard outside MOU waters.

#### Waste:

Hazardous waste and garbage is not offloaded in Seattle on this route. This is typically done in Victoria. The garbage record log was reviewed for this route and showed consistency with the MOU. The vessel has one incinerator (photo #05) which is used up to one-hour before coming in to port and 1-hour after leaving port. Ash (photo #06) is tested regularly and offloaded in Victoria.

#### Medical:

Unused or outdated pharmaceuticals and narcotics are typically incinerated and sometimes returned to the supplier. The medical facility staff records any incineration with witness or offloads. Red bag waste is incinerated and sharps are offloaded as hazardous waste. No medications going to black water. Drains from the medical facility go to the black water tanks.

#### Air Emissions and EGCS:

ECA fuel-sulfur compliance is achieved either through the use of 0.1% sulfur content fuel, or with higher sulfur heavy fuel oil (HFO) treated by the EGCS to achieve equivalent emissions. The vessel uses Ecospray Technologies wet scrubbers on board which is a wet open-loop system to minimize the sulfur oxide emissions (SOx). The volume is about 500-600 cubic meters per hour depending on the load of the engine and the buffering pump flow rate can go up to 1,500 cubic meters per hour dilution at overboard. There are four scrubbers, the DG1 which was installed in 2015, and the other three installed in 2016 and commissioned in 2017. DG #2 and #6 (photo #08) include wash water which is filtered (photos #09 and #10) to help mitigate any appearance in the wash water. The EGCSs are not used in Port when the ship is same side alongside as where there are overboard discharge ports, which is starboard side on the Grand Princess. Seawater is pumped (photo #13) from a sea chest (photo #16) into the vessel and is filtered with an additional filter after the pump to prevent the nozzles in the tower from becoming blocked. Seawater is sent to the top of the exhaust towers where nozzles spray the air emissions. The nozzles allow the seawater to be sprayed into the exhaust gas stream from the engine. The wash water from the tower then flows to a static mixer, where a dilution pump (photo #12) is used to buffer the wash water before discharge overboard. Continuous meters (photo #15) monitor polycyclic aromatic hydrocarbons (PAH), and turbidity in the inlet and out of the filter. pH is measured continuously at the inlet and the overboard. All the compliance parameters, date and ship position are recorded every three minutes on the compliance computer and stored. PAH, turbidity, and pH sensors continuously monitor the system. All sensors are calibrated annually by the manufacturer (HACH). pH sensors are additionally calibrated monthly onboard the ship by the EGCS engineer. A gas analyzer is located just above the tower and continuously monitors the CO2 and SO2 ratio. Changing over from EGCS to lesser fuel content oil takes approximately 1.5 hours.

The vessel was on shore power during the inspection, though Ecology noticed some air emissions upon arriving for the inspection prior to shore power starting up.

#### Conclusions and Recommendations

The protocols for discharges are clear. Records were orderly and appeared consistent with the MOU. The treatment systems appear to be operating well.

#### Attachments:

Photographs  
Environmental Schedule  
EGCS diagrams

Copies to:  
 Jim Peschel, Holland America Group  
 Jonathan Turvey, Holland America Group  
 Cady Moris, Holland America Group  
 Marijo Slade, Environmental Officer, GRAND PRINCESS  
 Mark Toy, Health  
 Greg Wirtz, CLIA-NWC  
 Donna Spalding, CLIA-NWC  
 Joseph Gellings, Port of Seattle  
 Alexander Adams, Port of Seattle  
 Laura Fricke, Ecology  
 Amy Jankowiak, Ecology  
 Chris Dudenhoeffer, Ecology  
 Central Files: Princess Cruises – GRAND PRINCESS; WQ 6.1

**Section H: Signatures**

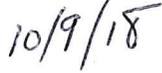
<u>Name and Signature of Inspector:</u>	<u>Agency/Office/Telephone:</u>	<u>Date</u>
Amy Jankowiak, Compliance Specialist 	Department of Ecology Northwest Regional Office Water Quality Program Municipal Compliance Specialist 425-649-7195	
<u>Name and Signature of Reviewer:</u> Laura Fricke, Municipal Unit Supervisor 	<u>Agency/Office/Telephone:</u> Department of Ecology Northwest Regional Office Municipal Unit Supervisor 425-649-7103	<u>Date</u> 





PHOTO #:01 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0953  
DESCRIPTION: GRAND PRINCESS VESSEL



PHOTO #:02 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0181  
DESCRIPTION: BRIDGE – VOYAGE NAVIGATION PLAN

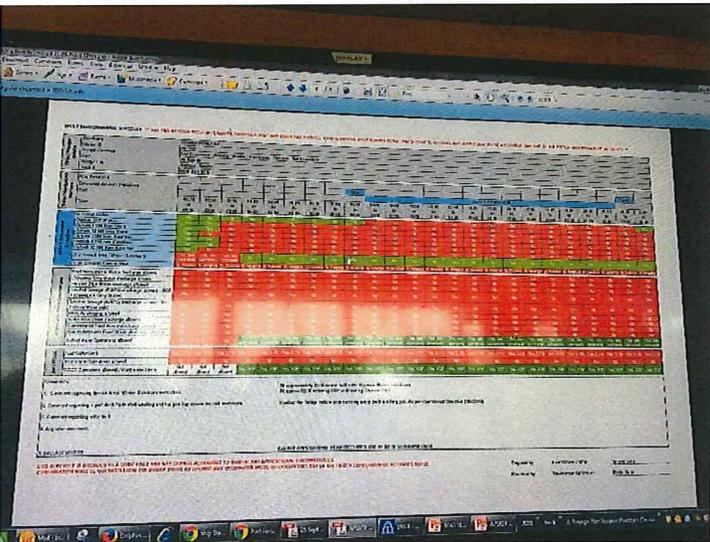


PHOTO #:03 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0182  
DESCRIPTION: BRIDGE – ENVIRONMENTAL SCHEDULE ON SCREEN



PHOTO #:04 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0183  
DESCRIPTION: ENGINE CONTROL ROOM DISCHARGE PORT KEYS



PHOTO #:05 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0189  
DESCRIPTION: INCINERATOR

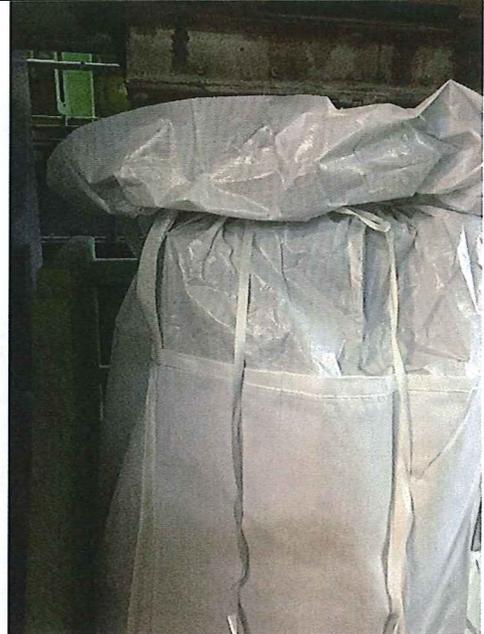


PHOTO #:06 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0198  
DESCRIPTION: INCINERATOR ASH



PHOTO #:07 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0199  
DESCRIPTION: FOOD CHUTE (GREEN ON FLOOR)



PHOTO #:08 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0184  
DESCRIPTION: EGCS – ENGINE 2 & 6 FILTERS



PHOTO #:09 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0185  
DESCRIPTION: EGCS – FILTER FOR ENGINE 2 & 6



PHOTO #:10 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0186  
DESCRIPTION: EGCS – BAG FILTERS FOR ENGINE #2



PHOTO #:11 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0190  
DESCRIPTION: EGCS – MAIN CONTROL EQUIPMENT



PHOTO #:12 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0191  
DESCRIPTION: EGCS – BUFFERING PUMPS



PHOTO #:13 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0192  
DESCRIPTION: EGCS – MAIN PUMPS

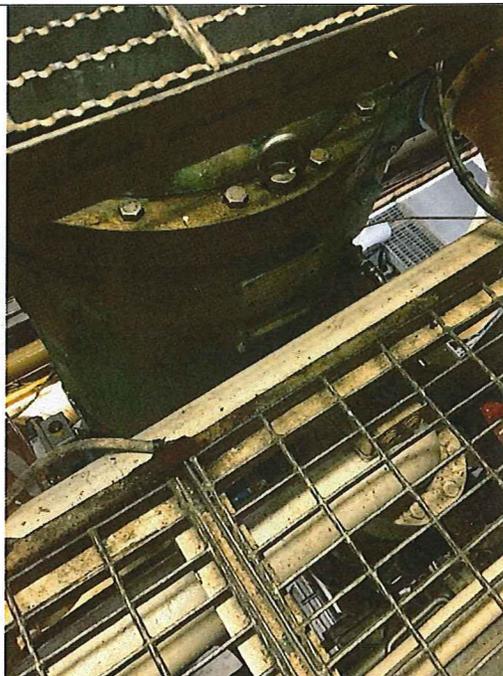


PHOTO #:14 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0193  
DESCRIPTION: EGCS – FILTER (BACKFLUSHED) FOR SEA WATER  
GOING UP



PHOTO #:15 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0195  
DESCRIPTION: EGCS – MONITORING RACKS

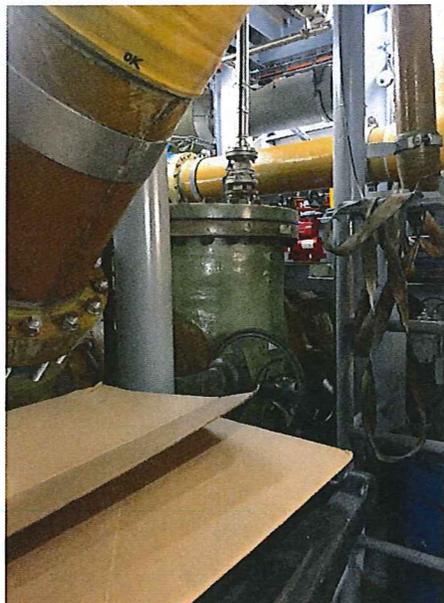


PHOTO #:16 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0196  
DESCRIPTION: EGCS SEACHEST (GREEN)



PHOTO #:17 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0200  
DESCRIPTION: BILGE WHITE BOX



PHOTO #:18 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0202  
DESCRIPTION: BILGE DISCHARGE PORTS



PHOTO #:19 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0207  
DESCRIPTION: STATIC OILY WATER SEPARATOR (SOWS)



PHOTO #:20 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0208  
DESCRIPTION: SOWS (2)

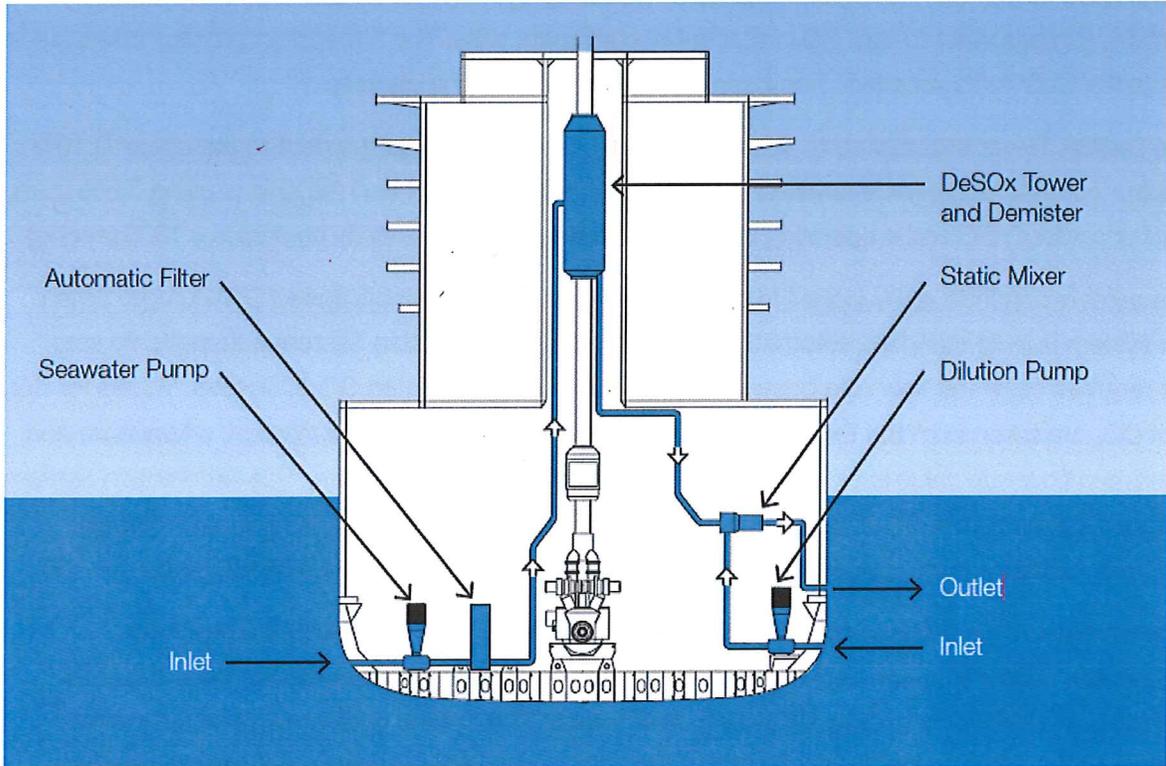


PHOTO #:21 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0209  
DESCRIPTION: CENTRIFUGAL OWS (COWS)



PHOTO #:22 DATE: SEPTEMBER 26, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0211  
DESCRIPTION: BILGE EMERGENCY BYPASS

A diagram of the system is shown below.



**Figure 1.** Components of Exhaust Gas Cleaning System

## 2.1 DeSOx Tower

The DeSOx Tower is a Wet Open-loop Type Absorbing System that utilizes the natural alkalinity contained in seawater to turn SOx into neutral carbonate salts. The absorption process takes place inside the DeSOx Tower which has been installed in place of the silencer.

The DeSOx Tower is designed to achieve an SO<sub>2</sub>/CO<sub>2</sub> ratio of 4.3 (equivalent to the use of 0.10% sulphur content fuel oil) or less when the engine load is 85% MCR and the ship is using 3.5% m/m sulphur content HFO and is operating in areas where the seawater alkalinity content is = 1300 μmol kg<sup>-1</sup>.

Seawater is continuously supplied to the DeSOx Tower by the variable speed SW Pumps. When the system is in its standard automatic control mode the Automation System automatically sets the required seawater flow rate based on the DG load and calculated SO<sub>2</sub>/CO<sub>2</sub> ratio. Values for SO<sub>2</sub> and CO<sub>2</sub> are taken from the Exhaust Gas Analyzer readings. For each installation, a Minimum and Maximum flow rate value is set during commissioning of the EGC System. This Automation System not only maintains the SO<sub>2</sub>/CO<sub>2</sub> ratio as required at all engine loads (including transient loads), but also maintains both the pH and PAH values within the required IMO MARPOL limits.

Downstream of the SW Pumps, fully Automated Seawater Filters are installed. The Filters automatically go into back-washing mode when the differential pressure across them exceeds 0.3 barg. In addition, a back-wash timing cycle independent of the differential pressure can be set by the Operator at the Ecospray PLC Setting Page; the interval can be adjusted as needed for environmental conditions or in the event of a failure of the differential pressure function.

**Note:** When the filter is in back-washing mode, the flow of wash-water to the DeSOx Tower is not affected and thus the EGC System will maintain compliance throughout the back-washing cycle.

The DeSOx Towers are fitted with nozzle banks which spray seawater into the exhaust gas stream.

A Static Demister is fitted at the top of each DeSOx Tower to remove water droplets and mist to avoid carry-over. The water removed by the Demister is drained back to the main body of the Towers by gravity.

Differential pressure across the Demister is measured in order to monitor the pressure drop.

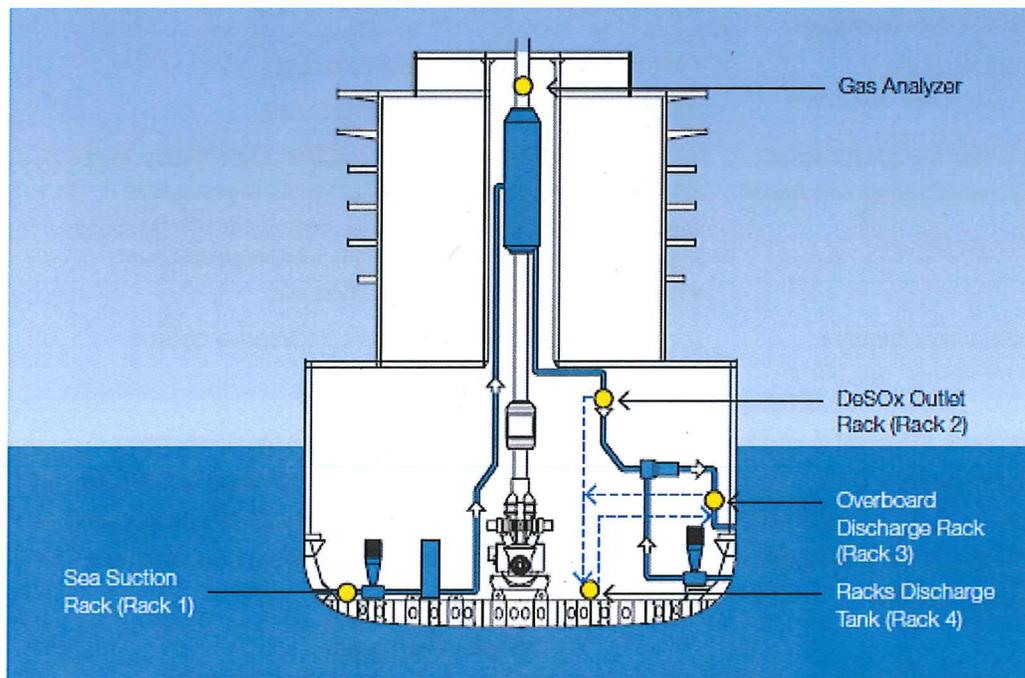
In the dry condition no SW is pumped into the DeSOx Tower and the Tower operates as a silencer only. The DeSOx Tower is designed to withstand dry hot conditions for extended periods. When in the dry hot condition, and when the ship is sailing within Emission Control Areas (ECAs or EU Ports), the engine shall burn a fuel oil in compliance with the regulations.

The principal compliance monitoring equipment consists of the following:

- The **gas analyzer** is located between the DeSOx Tower and the Funnel and monitors the SO<sub>2</sub> and CO<sub>2</sub> content of the exhaust gases which allows the SO<sub>2</sub>/CO<sub>2</sub> ratio to be calculated.
- The **Sea Suction Rack (Rack 1)** is located between the sea suction and the DeSOx Tower and monitors the PAH, Turbidity and Conductivity of the incoming wash-water (only the first two are regulatory requirements and the conductivity sensor may not be fitted on all vessels).
- The **DeSOx Outlet Rack (Rack 2)**, which monitors the PAH, Turbidity and pH of the wash-water discharge from the Tower (only the first two are regulatory requirements and this pH sensor may not be fitted on all vessels), is located between the DeSOx Tower and the Static Mixer (it is located here in order to analyze the wash-water quality before it is mixed with the dilution water).
- The **Overboard Discharge Rack (Rack 3)**, which monitors the pH and Dissolved Oxygen content of the diluted wash-water (only the pH is a regulatory requirement, the dissolved oxygen content sensor may not be fitted on all vessels), is located between the Static Mixer and the overboard discharge.
- The **Racks Discharge Tank (Rack 4)**, which collects water from Rack 2 and Rack 3 and pumps it to the Overboard. No analysis is performed in this Rack.

**Note:** If more than one DeSOx Tower is installed, there may be duplicates of these racks and also some racks maybe common to more than one DeSOx Tower.

A diagram showing the location of the monitoring equipment is shown below.



**Figure 3.** Wash-water Racks and Gas Analyzer

## 2.2 Wash-water System

- Wash-water is drained from the DeSOx Tower by gravity
- Wash-water monitoring for PAH and Turbidity compares the values after the DeSOx Tower to the DeSOx Tower inlet values in order to derive the difference between outlet and inlet readings ( $\Delta$ PAH and  $\Delta$ Turbidity)
- Wash-water is mixed in the Static Mixer with additional SW to control the pH of water discharged overboard
- No additional water treatment is applied

### Design Requirements of Wash-water System

The pH of the water discharged overboard is controlled and managed by mixing SW (the pH of which corresponds to that of the local SW) and the low pH water discharged from the DeSOx Tower. Therefore the only component of wash-water treatment is the Static Mixer unit. This Static Mixer is fitted with internal baffles to ensure the complete mixing of the two input streams thereby resulting in a homogenous outlet stream.

### Regulatory Requirements of Wash-water System

The Ecospray EGC System is designed to fulfil the wash-water discharge requirements detailed in the IMO Resolution MEPC 259(68) and US EPA Vessels General Permit (VGP), as a minimum:

*Wash-water SW PAHphe at DeSOx Tower discharge	$\Delta$ PAHphe < 50 $\mu$ g/L or less at 45 t SW/MWh
**Wash-water SW Turbidity at DeSOx Tower discharge	$\Delta$ Turbidity <25 FNU or NTU
Wash-water SW pH at the overboard discharge	***IMO – not less than 4.0 at overboard
	US EPA – not less than 6.0 at overboard
Wash-water SW pH differential during maneuvering and transit	US EPA and IMO also allow for the limit to be determined as a maximum difference of 2.0 pH units measured at inlet and overboard discharge (excluding excepted US States). This is normally applicable when operating in areas of low alkalinity (Baltic, Alaska etc)
****Wash-water Nitrates at the overboard discharge	The nitrates limit ( $c(\text{NO}_3)$ ) is to be calculated each time a sample is taken, see note

- \* Limit Value of 50  $\mu$ g/l (equivalent to 50 ppb) in concentration limit between the Sea Suction (Rack1) and the DeSOx Outlet (Rack 2) is normalized for wash-water flow through the DeSOx Tower of 45 tonnes/MWh where the MW refers to the MCR of the DG. The limit therefore varies according to the wash-water flow rate and can be calculated at any operating point using the following formula:

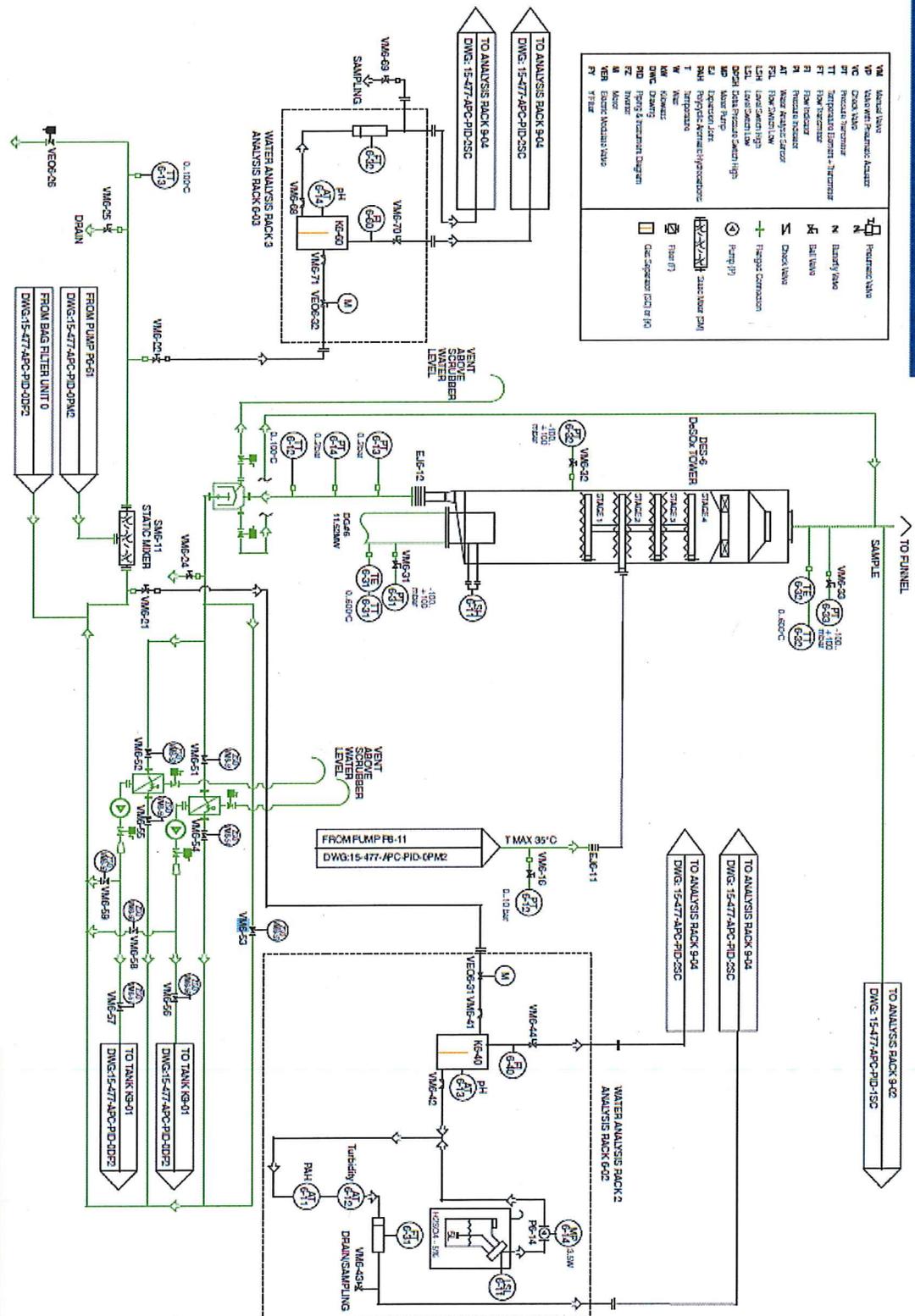
$$\text{PAHphe Limit } (\mu\text{g/L}) = 2250 \times \frac{\text{Engine MCR (MW)}}{\text{Actual SW flow rate (m}^3/\text{h)} \times \text{Density SW (t/m}^3\text{)}}$$

Density of SW is to be taken as 1.025 t/m<sup>3</sup>



1.4 DG#6

VM	Virtual Valve	VP	Virtual Pressure Actuator
VC	Check Valve	VT	Pressure Transmitter
VT	Pressure Transmitter	TI	Temperature Element - Temperature
TI	Temperature Element - Temperature	FI	Flow Indicator
FI	Flow Indicator	AT	Water Analytic Control
AT	Water Analytic Control	FL	Flow Switch Low
FL	Flow Switch Low	LH	Level Switch High
LH	Level Switch High	LD	Level Switch Low
LD	Level Switch Low	DP	Differential Pressure Switch High
DP	Differential Pressure Switch High	DT	Differential Temperature
DT	Differential Temperature	RAH	Refrigerant Alarm/High Temperature
RAH	Refrigerant Alarm/High Temperature	T	Temperature
T	Temperature	W	Water
W	Water	AW	Alarm
AW	Alarm	DWG	Drawing
DWG	Drawing	PI	Piping & Instrumentation Diagram
PI	Piping & Instrumentation Diagram	PS	Pressure Switch
PS	Pressure Switch	VEB	Water Analytic Valve
VEB	Water Analytic Valve	PT	Pressure Transmitter







**DAILY ENVIRONMENTAL SCHEDULE \*\*\* THE TIMES LISTED ARE FOR PLANNING PURPOSES ONLY AND TIMES MAY CHANGE. OOW APPROVAL MUST ALWAYS BE OBTAINED PRIOR TO OPENING ANY OVERBOARD VALVE OR CONDUCTING ANY OF 1**

Ship Name	GRAND PRINCESS													
Voyage ID	AP1827													
Voyage Overview	San Francisco - Astoria - Seattle - Vancouver - Victoria - San Francisco													
Date	23-Sep-18													
Voyage Leg	San Francisco - Astoria													
Track #	0100 SFO-AST CARB													

Way Point(s) # Estimated Arrival / Departure Port	SAN FRANCISCO 0600 - 1600														FAOP						
	00:00 to 01:00	01:00 to 02:00	02:00 to 03:00	03:00 to 04:00	04:00 to 05:00	05:00 to 06:00	06:00 to 07:00	07:00 to 08:00	08:00 to 09:00	09:00 to 10:00	10:00 to 11:00	11:00 to 12:00	12:00 to 13:00	13:00 to 14:00		14:00 to 15:00	15:00 to 16:00	16:00 to 17:00	17:00 to 18:00	18:00 to 19:00	
<b>Ships' Estimated Location</b>	In Port/Vat Anchor																				
	Outside VGP Waters																				
	Outside 4 NM from Shore																				
	Outside 12 NM from Shore																				
	Outside 3 NM from Baselines																				
	Outside 4 NM from Baselines																				
	Outside 12 NM from Baselines																				
	In a Special Area / Marine Sanctuary																				
	In an Emission Control Area																				

Water and Food Discharges	SAN FRANCISCO 0600 - 1600																				
	00:00 to 01:00	01:00 to 02:00	02:00 to 03:00	03:00 to 04:00	04:00 to 05:00	05:00 to 06:00	06:00 to 07:00	07:00 to 08:00	08:00 to 09:00	09:00 to 10:00	10:00 to 11:00	11:00 to 12:00	12:00 to 13:00	13:00 to 14:00	14:00 to 15:00	15:00 to 16:00	16:00 to 17:00	17:00 to 18:00	18:00 to 19:00		
Pool/Recreational Water discharge allowed																					
Untreated Grey Water discharge allowed																					
Treated Bilge Water discharge allowed																					
Treated Sewage (AWPS) discharge allowed - MBR																					
1 (Sewage + Grey Water)																					
2 (Grey Water only)																					
MBR de-sludging allowed																					
Boiler Blow Down discharge allowed																					
Comminuted Food Waste discharge allowed																					
Non-comminuted Food Waste discharge allowed																					
Ballast water Operations allowed																					

Air / EGCS	SAN FRANCISCO 0600 - 1600																				
	00:00 to 01:00	01:00 to 02:00	02:00 to 03:00	03:00 to 04:00	04:00 to 05:00	05:00 to 06:00	06:00 to 07:00	07:00 to 08:00	08:00 to 09:00	09:00 to 10:00	10:00 to 11:00	11:00 to 12:00	12:00 to 13:00	13:00 to 14:00	14:00 to 15:00	15:00 to 16:00	16:00 to 17:00	17:00 to 18:00	18:00 to 19:00		
Fuel Sulfur Limit	Yes	0.1%	Yes	0.1%	Yes	0.1%	Yes	0.1%	Yes	0.1%	Yes	0.1%	Yes	0.1%	Yes	0.1%	Yes	0.1%	Yes	0.1%	Yes
Incinerator Operations allowed																					
EGCS Operations allowed / Washwater Limits	Not allowed		Not allowed		Not allowed		Not allowed		Not allowed		Not allowed		Not allowed		Not allowed		Not allowed		Not allowed		Not allowed

**Comments:**

- Comment regarding Special Area / Marine Sanctuary restrictions
  - Comment regarding in port deck / side shell washing and hull painting allowances and restrictions
  - Comment regarding sulfur limit
  - BALLAST WATER
- INSIDE GREATER FARALLONES & CORDELL MARINE SANCTUARY (ALL O/B CLOSED, INC OFF, EGCS OFF, DGCS ON MGO, NO DECK WASHING)**
- Contact the Bridge before commencing every deck washing job. As per Operational Directive ENV/03/18.
- BALLAST OPERATIONS PERMITTED ALONGSIDE SAN FRANCISCO WITH USE OF HYDE GUARDIAN BWMS**









State of Washington Department of Ecology  
**Cruise Ship Memorandum of Understanding, Cruise Operations in Washington State Inspection Report**

Northwest Regional Office  
 3190 160<sup>th</sup> Ave SE  
 Bellevue, WA 98008  
 Phone: (425) 649-7000  
 Fax: (425) 649-7098

Inspection Date September 8, 2018	Permit Number NA	County King	Receiving Waters Marine Waters	Ecology Inspector Amy Jankowiak
Entry Time 9:01 am	Photos Taken <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Samples Taken <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Inspection Announced <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Discharges to: <input checked="" type="checkbox"/> Surface Water <input type="checkbox"/> Ground Water <input type="checkbox"/> Dewater <input type="checkbox"/> POTW
Exit Time 11:36 am				
Name and Location of Site Inspected: NORWEGIAN BLISS, Norwegian Cruise Line Pier 66 Seattle, Washington				Additional Participants/Inspectors:
On-Site Representative(s): <i>Name/Title/Phone/e-mail</i> Alexander Barnas, Environmental Officer Env418@ncl.com				
Responsible Official(s): <i>Name/Title/Address/Phone/e-mail</i> Sarah Ferguson-Brown, Director, Environmental Operations Norwegian Cruise Line Holdings, Ltd. 7665 Corporate Center Drive Miami, FL 33126 305-436-4349; <a href="mailto:sbrown@nclcorp.com">sbrown@nclcorp.com</a>				Other Facility Data: Notification made to Sarah Ferguson-Brown and James Mitchell on September 5, 2018  Flag: Bahamas

**Section A: Areas Evaluated**

<input checked="" type="checkbox"/> Black/Gray Wastewater System	<input checked="" type="checkbox"/> Residual Solids	<input checked="" type="checkbox"/> Records/Reports	<input checked="" type="checkbox"/> Hazardous Waste/ Solid Waste	<input type="checkbox"/> Sampling/Monitoring
<input checked="" type="checkbox"/> Discharge Locations	<input checked="" type="checkbox"/> Operation & Maintenance	<input checked="" type="checkbox"/> Sludge Handling/ Disposal	<input checked="" type="checkbox"/> Oily Bilge Water	<input checked="" type="checkbox"/> Other

**Section B: For Vessels Discharging ≥ 1nm from Berth and ≥ 6 Knots Only [2.1.3(A)]**

<input type="checkbox"/>	Schematics Match Black/Gray Wastewater System	
<input type="checkbox"/>	Operations as Described in Submitted Documentation	
<input type="checkbox"/>	Daily 24-hour Continuous Monitoring for Turbidity or Equivalent Monitoring	
<input type="checkbox"/>	Turbidimeter or Equivalent Monitoring Equipment Functioning Properly	
<input type="checkbox"/>	Auto Shut Down or Operational Controls to Insure System Shut Down if High Turbidity Occurs	
	Turbidity or Equivalent: Last Calibration: <b>NOT APPLICABLE</b> Trigger Level for Early Alarm: <b>NOT APPLICABLE</b> Trigger Level for Shutdown: <b>NOT APPLICABLE</b> Recorded Turbidity/Equivalent Levels Above Triggers: . . .	
<input type="checkbox"/>	Daily 24-hour Continuous Monitoring for Disinfection Effectiveness	
<input type="checkbox"/>	Disinfection Effectiveness Monitoring Equipment Functioning Properly	
	<u>Disinfection Effectiveness Monitoring:</u>	
<input type="checkbox"/>	Auto Shut Down or Operational Controls to Insure System Shut Down if Disinfection System Upset Occurs	
<input type="checkbox"/>	Disinfection System Operated and Maintained Properly	
	Disinfection System:	



<input checked="" type="checkbox"/>	Solid Waste Managed Properly (zero garbage discharge)	Solid waste appears to be managed per MOU requirements.
<input checked="" type="checkbox"/>	Photo/X-Ray Waste Managed Properly (fluids, cartridges,...) and landed ashore	Photo and x-ray waste appears to be handled per MOU requirements.
<input checked="" type="checkbox"/>	Dry-Cleaning Wastes and Byproducts (fluids, sludge, filter materials...) Managed Properly (PERC – haz waste – landed ashore)	Dry cleaning appears to be handled per MOU requirements.
<input checked="" type="checkbox"/>	Unused/Outdated Pharmaceuticals Managed Properly (safely disposed of)	Unused or outdated pharmaceuticals appear to be managed per MOU requirements.
<input checked="" type="checkbox"/>	Fluorescent and Mercury Vapor Lamp Bulbs Managed Properly (prevent release of mercury)	Fluorescent and mercury vapor lamp bulbs appear to be managed per MOU requirements.
<input checked="" type="checkbox"/>	Waste Reduction/Reuse/Recycling Opportunities Maximized (glass, cardboard, aluminum & steel cans)	Waste reduction/reuse/recycling opportunities appear to be maximized per MOU requirements.
<input checked="" type="checkbox"/>	Batteries Managed Properly (recycled, reclaimed, disposed of properly)	Batteries appear to be managed per MOU requirements.
<input checked="" type="checkbox"/>	Incinerator Ash Managed Properly and minimized volume (haz waste segregation and annual testing)	Incinerator ash appears to be managed per MOU requirements.
<input checked="" type="checkbox"/>	Oily Bilge Water Managed Properly (<15 ppm, no visible sheen and underway)	Oily bilge water appears to be managed per MOU requirements.
<input checked="" type="checkbox"/>	Ballast Water Managed Properly (per Wash regs –reporting, treated or if open sea exchange >200 nm from outside EEZ, 50nm if not EEZ)	Ballast water appears to be managed properly per MOU requirements.
<input checked="" type="checkbox"/>	OCNMS rules and regs followed	The discharge protocol appears to be consistent with MOU requirements to not occur in the OCNMS.

**Additional General Questions**

<input checked="" type="checkbox"/>	How is deck runoff and hull cleaning handled (scuppers...) (non-toxic/phosphate free cleaners, biodegradable)	Deck runoff and hull cleaning appears to be handled per MOU requirements.
<input checked="" type="checkbox"/>	How is maintenance performed on the outside of the vessel (paint chipping, painting, etc)	Outside vessel maintenance appears to be handled per MOU requirements.
<input checked="" type="checkbox"/>	Sculleries and Galleys – type of detergents and degreasers used (phosphate free and non-toxic)?	Galleys appear to use phosphate free and non-toxic detergents and degreasers.
<input checked="" type="checkbox"/>	How are food waste discharges handled (prevention of erroneous materials)?	Food waste appears to be handled per MOU requirements.
<input checked="" type="checkbox"/>	Medical sinks/floor drains, chem. stor areas wastes go where (plugged, blackwater, bilge)?	Medical sinks/floor drains appear to be handled per MOU requirements.
<input checked="" type="checkbox"/>	Where is pool and spa water discharged? Dechlorinated/debrominated and underway?	Pool and spa water appears to be handled per MOU requirements.
<input checked="" type="checkbox"/>	What type of fuel is used and percent sulfur content?	Fuel sulfur content meets requirements with EGCS.

Other:

**Section F: Sampling Results**

Parameter	Results
Biochemical Oxygen Demand 5-Day (BOD <sub>5</sub> )	<b>NOT APPLICABLE</b>
Total Suspended Solids (TSS)	
Fecal Coliform	
Residual Chlorine	
pH	
Ammonia, Nitrogen	

**Section G: Summary of Findings/Comments**

## Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program (NWRO-WQ), conducted the inspection of the Norwegian Cruise Line NORWEGIAN BLISS on September 8, 2018. The main contact on board the NORWEGIAN BLISS was Alexander Barnas, Environmental Officer (EO) for the NORWEGIAN BLISS. Prior notification of the visit was given on September 6, 2018 for security protocol. The purpose of the inspection was to evaluate compliance with the *Memorandum of Understanding Cruise Operations in Washington State* (MOU), as amended. The NORWEGIAN BLISS is not approved to discharge wastewater in MOU waters.

The NORWEGIAN BLISS was launched in April of 2018, and is 1,082 feet long with a width of 136 feet. The passenger capacity is approximately 4,990 with 1,700 crew.

The NORWEGIAN BLISS is scheduled for 19 calls in Seattle on Saturday's between May 30, 2018 and September 29, 2018 for one-week cruises to Alaska.

## Inspection

I arrived and boarded the ship (photo #01) at 9:01 am and first met with Alexander Barnas, EO. We briefly discussed the purpose and plan for the inspection. We first went to the EO's office and discussed discharge protocols and records review. We then briefly met with additional staff before visiting the Engine Control Room (ECR) and onto the systems below deck. We viewed the oily bilge water systems (OWS), discharge ports, parts of the Exhaust Gas Cleaning System (EGCS) and the ballast water treatment system. We then toured the Scanship Advanced Wastewater Treatment System (AWTS). We viewed the potable water Reverse Osmosis system, the incinerators, and the garbage room and hazardous waste storage. We also viewed the Scanship laboratory. We concluded with a brief debriefing. I disembarked the vessel at 11:36 am.

### Discharge Types and Protocols:

An environmental voyage plan is prepared for various discharge types including the EGCS. Discharge ports for the wastestreams listed below are closed 12 miles before entering the Washington State waters and the Olympic Coast National Marine Sanctuary (OCNMS) (MOU related waters).

- bilge water;
- blackwater;
- graywater;
- food waste;
- ballast water; and
- pool and spa water.

If a discharge is to occur, the process includes a communication for approval from the Engine Control Room (ECR) from the Bridge. This is done verbally. There is an electronic log called NAPA where the communications are logged and acknowledged. The communication occurs an hour before any change in discharge or location. The discharge ports are padlocked with the keys in the ECR. Some ports record electronically when the port or valve is opened or closed, others are entered into the NAPA system. For black water and gray water, the latitude and longitude coordinates, date, time and location of both the start and the stop of the discharges are recorded, along with port location, effluent type, and volumes are recorded in the *Sewage and Graywater Discharge Record Book* on paper. The basic information is also recorded in NAPA and checked for consistency each day. Records were reviewed during the inspection and of those reviewed, no discharges occurred in MOU related waters.

### Discharge Types:

**Black water and Gray water System:** Black water, which includes toilet waste, and infirmity drains and gray water which includes sink and shower water, galley water and laundry water is treated with a Scanship advanced wastewater treatment system and is discharged per the above protocol. Residual solids from the AWTS are collected in and then sent to the sludge tank and discharged outside of MOU related waters, at sea, along with biomass from the AWTS.

Black water moves by vacuum to a collection tank. From the collection tanks, it goes to the drum screens. There are two drum screens which provide pre-screening. Liquid flow from the drum screens then enters the mixing tank where it combines with the gray water. Gray water consists of sink, shower, galley water and laundry water. From the mixing tank, the liquid moves to the biostep for biological treatment (biofilm on rotating plastic pieces – 2 tanks in series, air added) (photo #15). Defoamer can be added at the beginning of the biostep as needed.

After the biostep, polymers and coagulants are added. Liquid then moves to the flotation tanks (photo #16) for clarification. An air and water mixture is added to the bottom of the flotation tanks to keep turbulence at the bottom and to allow the solids to rise to the top, along with the help of the chemical addition. Skimmers on the top skim the solids

into a sludge pocket which is then pumped to the sludge tank. Liquid flow then moves to the polishing filters (photo #17) for ultrafiltration.

Flow then moves to ultraviolet (UV) light disinfection (photo #12). There are two large UV units, which one can be in standby for cleaning. The UV system is alarmed for bulb failure and intensity. Flow from the UV units is either discharged directly overboard via the discharge port (photo #13), or is re-circulated to the mixing tanks. Grease is well prevented from entering the Scanship AWTS.

The cruise line uses a maintenance system for work orders and maintenance. Manufacturer recommendations for maintenance of each piece of equipment is included in the system which triggers staff when maintenance is required. Total suspended solids (TSS) (equivalent to turbidity) is monitored continuously at UV disinfection. If TSS exceeds 30 mg/l, the system automatically stops discharging and holds. PH is also monitored for adjustments. There are several monitors throughout the system that are used to access controls as well as in the ECR (photo #04). Coliform (Quantitray), chlorine, COD, BOD, TSS, and pH is monitored regularly on board the vessel with their laboratory (photo #27) for system optimization and sampling is done regularly for Alaska's requirements. The vessel is approved to discharge continuously in Alaska. Discharges are recorded in the Sewage and Graywater Record Book. Recent records were reviewed and showed no concerns.

Oily bilge water is collected to the dirty bilge tank and is first treated with a Marinfloc oily water separator system (OWS) (photos #05 and #06). The oily bilge is treated to less than 15 part per million (ppm) oil content. Treatment then occurs with a RWO OWS (photo #07) to the treated bilge tank and it is then treated again with a second MarinFloc OWS. Prior to discharge, the clean bilge is sent through "white box" (photo #08) which can't be bypassed and doesn't allow discharges of greater than 15 ppm. The treated oily bilge water is then discharged outside of MOU related waters at a maximum of 15 ppm, but typically 5-10, and outside of MOU related waters. The Chief Engineer has the one key to the white box, and discharges of clean bilge and offloads of oily sludge are recorded in the Oil record Book. The record book is reviewed and signed by the Master and the Chief. No bypasses or re-routing around the OWS or white box has been known to occur. If there is any water other than bilge that overflows to the bilge, it would only occur in emergency conditions for safety and would be sent overboard. Offloads of collected oil sludge occur every 3-4 weeks at about 60 cubic meters per month on average. The oil book was reviewed and did not show any concerns.

The vessel usually doesn't keep ballast on board, and instead uses tanks including black and graywater as ballast and stability control. There is an Alfa Laval ballast treatment system (photo #14) on board if needed. The system includes filtration and UV disinfection at about 600 cubic meters output.

There are two deep salt water swimming pools and 12-13 fresh water spas (hot tubs) on the vessel. Pool water and spa water discharges occur outside MOU related waters, but can be sent to ballast tanks if needed.

Food waste is sent to pulpers in each galley. Pulped waste is discharged outside of MOU related waters. Bones and other materials that can't be pulped are sent to the bone crusher (photo #26) and then discharged by food chute (photo #25) outside. The food chute is locked and only opened by the EO. Grease collected by traps are drummed and offloaded. Cooking oil is collected (photo #24) and recycled. Freshwater is produced on board via reverse osmosis (photo #18), evaporators or bunkering.

Paint chipping is not done in Seattle, but painting is done as needed with best management practices such as using canvas and with Port approval. Only vessel washing with water was observed during the inspection (photo #02).

Dry cleaning is done on board and uses a system with hydrogen peroxide. This system does not produce volumes of Perchloroethylene (PERC) solvent.

Photo waste that is collected (photo #22) and treated via a silver recovery system is then offloaded to shore as non-hazardous after testing to less than 5 ppm. Fluorescent bulbs are crushed with a "bulb crusher" (photo #23) that removes mercury vapors and then the lamps are offloaded for recycling and the mercury cartridges and LED bulbs are offloaded as hazardous waste. Hazardous waste materials include items such as oily sludge, incinerator ash, some aerosols which are punctured with an aerosol removal system (photo #21), sharps, used cartridges and filters, paints and thinners, sealants, some batteries, and electronics and are all stored before offloading. All hazardous waste for this route is offloaded in Victoria, Canada by EnviroSystems and Waste Management in Seattle is only on hand as back-up. Hazardous waste logs were reviewed and appear to be consistent with MOU requirements.

Unused or outdated pharmaceuticals and narcotics are incinerated and logged by the medical facility. No medications or narcotics are sent to the blackwater or Scanship system. Red bagged medical waste is incinerated. All drains in the medical facility go to the blackwater tanks for AWTS treatment. Sharps are off-loaded as bio-hazardous waste. Some cardboard, paper, oily rags, dry garbage and soft plastics are incinerated. There are two incinerators (photos #19 and

#20) which are used outside of MOU related waters. Incinerator ash is collected and offloaded as hazardous waste with regular testing passing.

Solid waste (garbage, recyclables, etc) is collected, sorted (photo #20) and either reused, recycled, incinerated or offloaded to shore as appropriate. The garbage record book was reviewed and showed consistency with requirements.

Crushed glass, broken china, used cooking oil, some plastics, scrap metals, some batteries, aluminum, some cardboard, wood pallets and other items are recycled with receipts (photo #03). Waste minimization efforts are tracked. Shipboard energy efficiency is optimized.

Heavy fuel oil (HFO) is used alongside an exhaust gas cleaning system (EGCS) to meet international and federal emissions requirements and meet sulfur oxide emissions (SOx). Marine gas oil (MGO) is used for the boilers and the incinerators only. The vessel was bunkering fuel during the inspection. Filtered soot (photo #09) is collected and offloaded at about two cubic meters per week. The EGCS is a hybrid system that is generally closed until outside 3 miles from shore. There are five EGCS stacks that suction water (photo #11) from the process tank, is sent up where spray nozzles clean the exhaust and send the water back to the process tank. Water is taken from the process tank and sent to the backflush tank, to the dirty water tank (photo #10), to membrane filtration and onto the purified water tank before any discharge. Technical water (distilled) is used as a source water for the process tank. The volume of water bled off is about 10-20 cubic meters per day. Typically one EGCS is used while in port with 3-4 while underway. Monitoring is done for pH, PAH, temperature and turbidity with on-line monitors that take readings about every minute and a half. The pH is alarmed at 6.2 or 6.1 and then the discharge is closed if it goes lower. The discharge port has a three-way valve that closes when limits are not met. The meters are calibrated on a schedule. This ECGS system has not shown any foam or concerning appearance from the discharge as some other systems have.

#### Conclusions and Recommendations

The protocols and procedures for discharge are clear and inclusive of verification.

The records were very organized, with electronic securities and complete with details.

The staff was very knowledgeable of the systems and procedures related to compliance with the MOU.

Attachments:  
Photographs

Copies to:  
Alexander Barnas, Environmental Officer, NORWEGIAN BLISS  
James Mitchell, Norwegian Cruise Line  
Mark Toy, Health  
Greg Wirtz, CLIA-NWC  
Donna Spalding, CLIA-NWC  
Joseph Gellings, Port of Seattle  
Laura Fricke, Ecology  
Amy Jankowiak, Ecology  
Central Files: Norwegian Cruise Line – NORWEGIAN BLISS; WQ 6.1

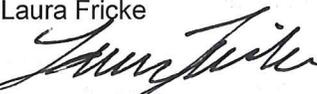
<u>Name and Signature of Inspector:</u> Amy Jankowiak 	<u>Agency/Office/Telephone:</u> Department of Ecology Northwest Regional Office Water Quality Program Municipal Compliance Specialist 425-649-7195	<u>Date</u> 9/20/18
<u>Name and Signature of Reviewer:</u> Laura Fricke 	<u>Agency/Office/Telephone:</u> Department of Ecology Northwest Regional Office Municipal Unit Supervisor 425-649-7103	<u>Date</u> 9/21/18



PHOTO #:01 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0138  
DESCRIPTION: VESSEL

PHOTO #:02 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0140  
DESCRIPTION: VESSEL WASHING

**ENVIROSYSTEMS™**  
**CERTIFICATE OF SOLID WASTE RECEIVED**

Client Name: Norwegian Cruise Line  
Client Address: Norwegian Cruise Line  
Client City: Seattle, WA  
Client State: WA  
Client Zip: 98101  
Client Phone: 206.461.1234  
Client Fax: 206.461.1234  
Client Email: ncl@ncl.com

Envirosystems Inc. 18000 1st Ave. SE, Everett, WA 98203  
Envirosystems Inc. 18000 1st Ave. SE, Everett, WA 98203  
Envirosystems Inc. 18000 1st Ave. SE, Everett, WA 98203

Waste Description	Quantity	Unit	Waste Type	Estimated Volume (cu yd)
High Density Polyethylene (HDPE) 55 Gallon Drum	8	Pallet		42 m <sup>3</sup>
Low Density Polyethylene (LDPE) 55 Gallon Drum	6	Pallet		9 m <sup>3</sup>
Styrofoam	1	Pallet		1.5 m <sup>3</sup>
Cardboard Boxes	10	Bag		16.5 m <sup>3</sup>
Aluminum	1	Pallet		1.5 m <sup>3</sup>
Plastic - Various	3	Pallet		1.5 m <sup>3</sup>
Plastic - Various #2	3	Pallet		1.5 m <sup>3</sup>
Plastic - Various	3	Pallet		1.5 m <sup>3</sup>
Styrofoam	2	Pallet		1.5 m <sup>3</sup>
Flux Paste	1	Pallet		1.5 m <sup>3</sup>
Aluminum Cans	2	Pallet		1.5 m <sup>3</sup>
Non-Ferrous Scrap Metal	1	Pallet		1 m <sup>3</sup>
Wood Pallets	1	Pallet	22	Each
Styrofoam	1	Pallet		1 m <sup>3</sup>
Other	1	Pallet		1 m <sup>3</sup>

RECEIVER'S ACKNOWLEDGMENT

Signature: *ALDWINA J. GARD* Date: 02 Sept 18  
Signature: *Jonathan Wolf* Date: 18-Sept-7

1 CUSTOMER COPY - WHITE 2 OFFICE COPY - YELLOW 3 TRANSPORTATION COPY - PINK

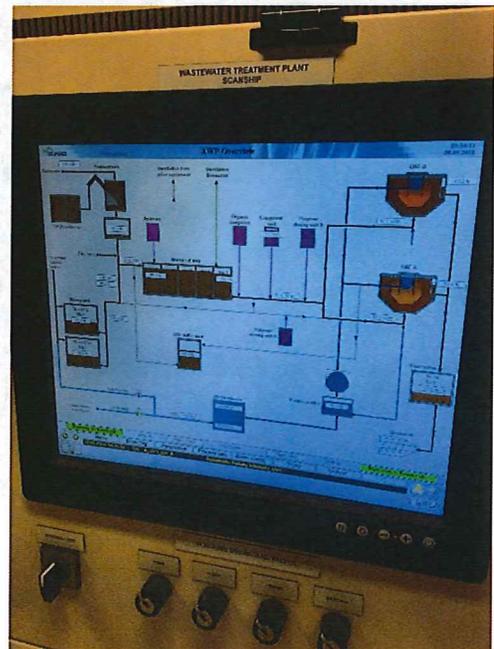


PHOTO #:03 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0141  
DESCRIPTION: WASTE OFFLOAD RECORDS

PHOTO #:04 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0147  
DESCRIPTION: SCANSHIP AWTS DIAGRAM IN ECR

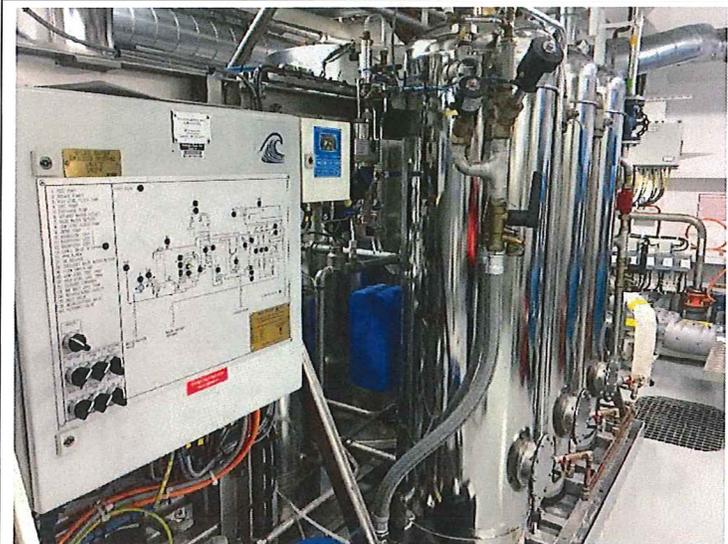


PHOTO #:05 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE NO.: IMG\_0149  
DESCRIPTION: MARIN FLOC OWS (2 of 2)

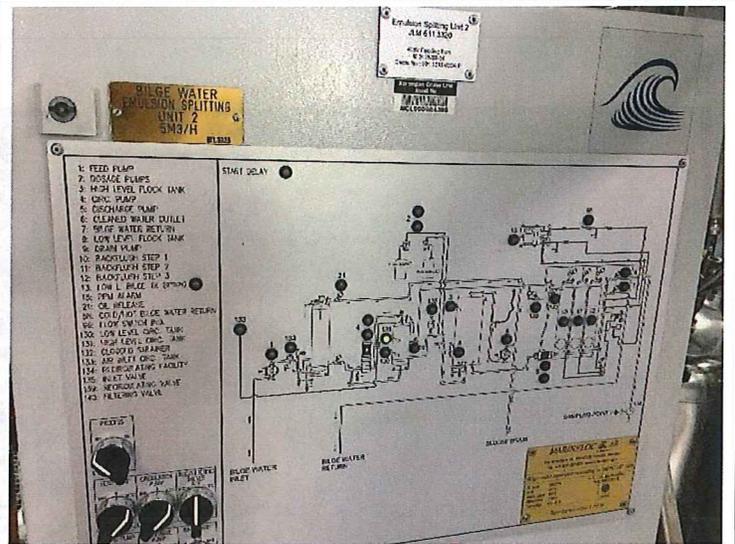


PHOTO #:06 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE NO.: IMG\_0150  
DESCRIPTION: MARIN FLOC OWS



PHOTO #:07 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE NO.: IMG\_0151  
DESCRIPTION: RWO OWS



PHOTO #:08 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE NO.: IMG\_0153  
DESCRIPTION: BILGE WHITE BOX



PHOTO #:09 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0155  
DESCRIPTION: EGCS SOOT SLUDGE (PHOTO BRIGHTENED)



PHOTO #:10 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0156  
DESCRIPTION: EGCS DIRTY WATER TANK



PHOTO #:11 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0157  
DESCRIPTION: EGCS PROCESS TANK PUMP



PHOTO #:12 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0159  
DESCRIPTION: SCANSHIP AWTS UV



PHOTO #:13 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0160  
DESCRIPTION: SCANSHIP TREATED SEWAGE GRAYWATER  
OVERBOARD DISCHARGE PORT



PHOTO #:14 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0162  
DESCRIPTION: BALLAST TREATMENT (FILTER AND UV)



PHOTO #:15 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0163  
DESCRIPTION: SCANSHIP BIOSTEP TANK (#2 OF 5)



PHOTO #:16 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0166  
DESCRIPTION: SCANSHIP FLOTATION TANK (1 OF 2)



PHOTO #:17 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0167  
DESCRIPTION: SCANSHIP POLISHING FILTERS



PHOTO #:18 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0169  
DESCRIPTION: WATER REVERSE OSMOSIS



PHOTO #:19 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0171  
DESCRIPTION: INCINERATORS (MID-LEVEL)



PHOTO #:20 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0172  
DESCRIPTION: INCINERATOR (BLUE FAR LEFT) AND GARBAGE ROOM

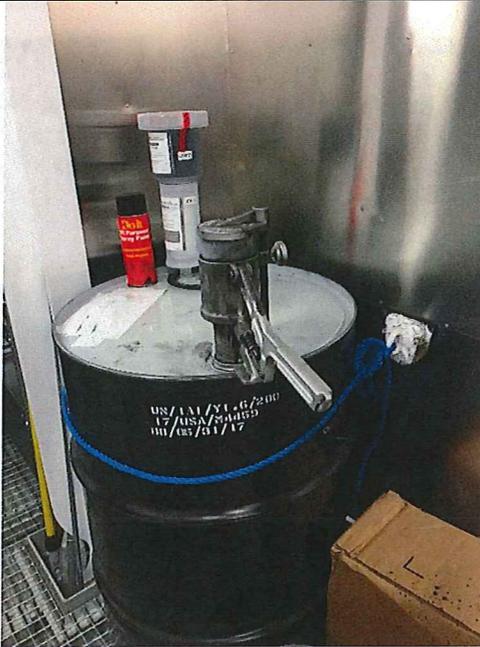


PHOTO #:21 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0174  
DESCRIPTION: AEROSOL PUNCTURER (HAZARDOUS WASTE STORAGE ROOM)

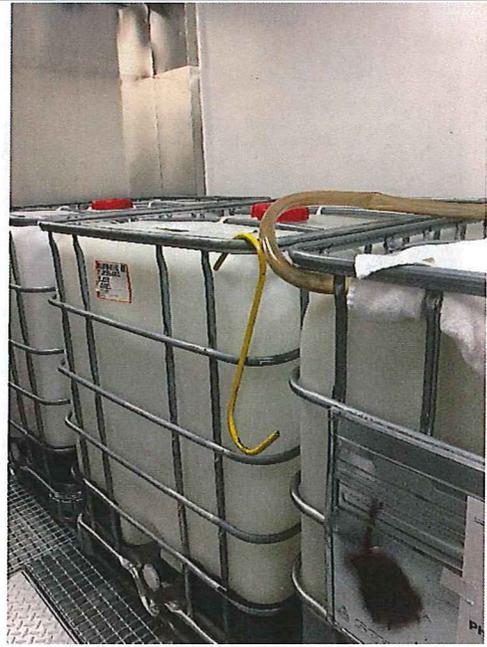


PHOTO #:22 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0175  
DESCRIPTION: PHOTO WASTE BINS (HAZARDOUS WASTE STORAGE ROOM)



PHOTO #:23 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0176  
DESCRIPTION: BULB CRUSHER (HAZARDOUS WASTE STORAGE ROOM)



PHOTO #:24 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0177  
DESCRIPTION: USED COOKING OIL (GARBAGE ROOM)

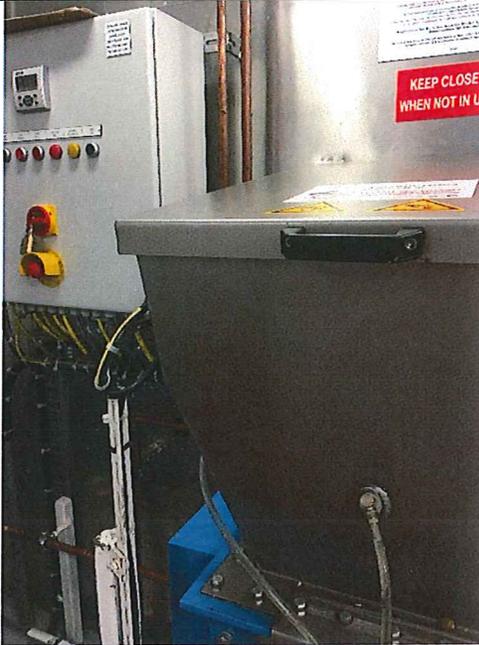


PHOTO #:25 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0178  
DESCRIPTION: FOOD CHUTE (GARBAGE ROOM)



PHOTO #:26 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0179  
DESCRIPTION: FOOD BONE CRUSHER (GARBAGE ROOM)

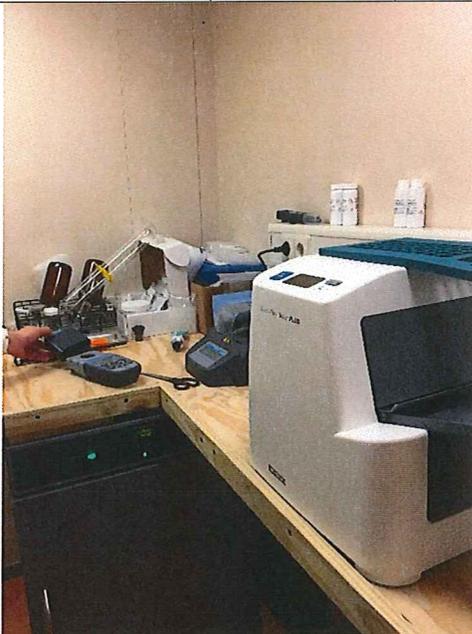


PHOTO #:27 DATE: SEPTEMBER 8, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0180  
DESCRIPTION: SCANSHIP LABORATORY





State of Washington Department of Ecology  
**Cruise Ship Memorandum of Understanding, Cruise Operations in Washington State Inspection Report**

Northwest Regional Office

3190 160<sup>th</sup> Ave SE  
 Bellevue, WA 98008

Phone: (425) 649-7000  
 Fax: (425) 649-7098

Inspection Date June 27, 2018	Permit Number NA	County King	Receiving Waters Marine Waters	Ecology Inspector Amy Jankowiak
Entry Time 10:01 am	Photos Taken <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Samples Taken <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Inspection Announced <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Discharges to: <input checked="" type="checkbox"/> Surface Water <input type="checkbox"/> Ground Water <input type="checkbox"/> Dewater <input type="checkbox"/> POTW
Exit Time 11:25 am				

<b>Name and Location of Site Inspected:</b> STAR LEGEND, Windstar Cruises Pier 66, Seattle, Washington	<b>Additional Participants/Inspectors:</b> Mohit Vyas, 2 <sup>nd</sup> Engineer, STAR LEGEND
<b>On-Site Representative(s): Name/Title/Phone/e-mail</b> Knut Lier, Chief Engineer Mike Inman, Director, Risk Management & Compliance e: <a href="mailto:mike.inman@windstarcruises.com">mike.inman@windstarcruises.com</a>	
<b>Responsible Official(s): Name/Title/Address/Phone/e-mail</b> John Delaney, President Windstar Cruises 2101 4 <sup>th</sup> Ave Suite 210 Seattle, WA 98121 e: <a href="mailto:john.delaney@windstarcruises.com">john.delaney@windstarcruises.com</a>	<b>Other Facility Data:</b> Notification made to Mike Inman on June 22, 2018 and June 25, 2018  Flag: Bahamas

**Section A: Areas Evaluated**

<input checked="" type="checkbox"/> Black/Gray Wastewater System	<input checked="" type="checkbox"/> Residual Solids	<input checked="" type="checkbox"/> Records/Reports	<input checked="" type="checkbox"/> Hazardous Waste/ Solid Waste	<input type="checkbox"/> Sampling/Monitoring
<input checked="" type="checkbox"/> Discharge Locations	<input checked="" type="checkbox"/> Operation & Maintenance	<input checked="" type="checkbox"/> Sludge Handling/ Disposal	<input checked="" type="checkbox"/> Oily Bilge Water	<input checked="" type="checkbox"/> Other

**Section B: For Vessels Discharging ≥ 1nm from Berth and ≥ 6 Knots Only [2.1.3(A)]**

<input type="checkbox"/> Schematics Match Black/Gray Wastewater System	
<input type="checkbox"/> Operations as Described in Submitted Documentation	
<input type="checkbox"/> Daily 24-hour Continuous Monitoring for Turbidity or Equivalent Monitoring	
<input type="checkbox"/> Turbidimeter or Equivalent Monitoring Equipment Functioning Properly	
<input type="checkbox"/> Auto Shut Down or Operational Controls to Insure System Shut Down if High Turbidity Occurs	
Turbidity or Equivalent: Last Calibration: Trigger Level for Early Alarm: <span style="font-size: 2em; opacity: 0.5;">NOT APPLICABLE</span> Trigger Level for Shutdown: Recorded Turbidity/Equivalent Levels Above Triggers:	
<input type="checkbox"/> Daily 24-hour Continuous Monitoring for Disinfection Effectiveness	
<input type="checkbox"/> Disinfection Effectiveness Monitoring Equipment Functioning Properly	
Disinfection Effectiveness Monitoring:	
<input type="checkbox"/> Auto Shut Down or Operational Controls to Insure System Shut Down if Disinfection System Upset Occurs	
<input type="checkbox"/> Disinfection System Operated and Maintained Properly	
Disinfection System:	

**Section C: For Vessels Discharging Continuously [2.1.3(B)]**

<input type="checkbox"/>	Schematics Match Black/Gray Wastewater System	
<input type="checkbox"/>	Operations as Described in Submitted Documentation	
<input type="checkbox"/>	Daily 24-hour Continuous Monitoring for Turbidity or Equivalent Monitoring	
<input type="checkbox"/>	Turbidimeter or Equivalent Monitoring Equipment Functioning Properly	
<input type="checkbox"/>	Auto Shut Down or Operational Controls to Insure System Shut Down if High Turbidity Occurs	
Turbidity or Equivalent: Last Calibration: Trigger Level for Early Alarm: _____ Trigger Level for Shutdown: Recorded Turbidity/Equivalent Levels Above Triggers:		
<input type="checkbox"/>	Daily 24-hour Continuous Monitoring for Disinfection Effectiveness	
<input type="checkbox"/>	Disinfection Effectiveness Monitoring Equipment Functioning Properly	
Disinfection Effectiveness Monitoring: <div style="font-size: 48px; opacity: 0.5; font-weight: normal;">NOT APPLICABLE</div>		
<input type="checkbox"/>	Auto Shut Down or Operational Controls to Insure System Shut Down if Disinfection System Upset Occurs	
<input type="checkbox"/>	Disinfection System Operated and Maintained Properly	
Disinfection System:		

**Section D: General (Approved to Discharge)**

<input type="checkbox"/>	No Discharges Within ½ Miles From Shellfish Beds/ Protocol (President's Point, Apple Tree Cove, Tyee Shoal, Middle Point (near Pt Townsend))	
<input type="checkbox"/>	Discharges Immediately Stopped When High Turbidity Occurs	
<input type="checkbox"/>	Discharges Immediately Stopped When Disinfection System Upset Occurs	
<input type="checkbox"/>	Immediate Notifications Made to WA Department of Health for Disinfection System Upset	
<input type="checkbox"/>	Sampling Conducted 2/month, 1/month in Seattle (BOD, TSS, Fecal Coliform, pH, Chlorine Residual)	
<input type="checkbox"/>	Whole Effluent Toxicity Testing 1 per 2 Years (homeported) or 1/40 Calls for Continuous	

**Section E: General**

<input checked="" type="checkbox"/>	Wastewater Discharge Records Review	Discharge records were reviewed (blackwater/graywater/residual solids) and are maintained properly. No discharges found to be in the OCNMS, MOU waters or Washington state waters (MOU related waters). Further review will be done following the end of the season.
<input checked="" type="checkbox"/>	Wastewater Discharges protocol per MOU and managed properly	The discharge protocols are consistent with MOU requirements to not occur in MOU related waters.
<input checked="" type="checkbox"/>	Residual Solids Managed Properly/Disposal Protocol per MOU	Residual solids protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/>	Hazardous Waste Managed Properly	Hazardous protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/>	WA Hazardous Waste Guidelines Followed (Appendix vii)	Hazardous waste protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/>	Solid Waste Managed Properly (zero garbage discharge)	Solid waste protocols are consistent with MOU requirements. Solid waste discharge records were reviewed and are maintained properly. No

	discharges or releases of solid wastes were found to be inconsistent with MOU requirements.
<input checked="" type="checkbox"/> Photo/X-Ray Waste Managed Properly (fluids, cartridges,...) and landed ashore	Photo and x-ray waste protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> Dry-Cleaning Wastes and Byproducts (fluids, sludge, filter materials...) Managed Properly (PERC – haz waste – landed ashore)	No dry cleaning is done on board and therefore dry cleaning waste products are managed per MOU requirements.
<input checked="" type="checkbox"/> Unused/Outdated Pharmaceuticals Managed Properly (safely disposed of)	Unused or outdated pharmaceuticals are sent shore for disposal.
<input checked="" type="checkbox"/> Fluorescent and Mercury Vapor Lamp Bulbs Managed Properly (prevent release of mercury)	Fluorescent and mercury vapor lamp bulbs protocols for management are consistent with MOU requirements.
<input checked="" type="checkbox"/> Waste Reduction/Reuse/Recycling Opportunities Maximized (glass, cardboard, aluminum & steel cans)	The cruise line is in the process of starting up their recycling program and developing waste minimization opportunities.
<input checked="" type="checkbox"/> Batteries Managed Properly (recycled, reclaimed, disposed of properly)	Batteries management protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> Incinerator Ash Managed Properly and minimized volume (haz waste segregation and annual testing)	Incinerator ash management is consistent with MOU requirements.
<input checked="" type="checkbox"/> Oily Bilge Water Managed Properly (<15 ppm, no visible sheen and underway)	Oily bilge water protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> Ballast Water Managed Properly (per Wash regs –reporting, treated or if open sea exchange >200 nm from outside EEZ, 50nm if not EEZ)	Ballast water is managed with graywater and blackwater holding and no exchanges are necessary.
<input checked="" type="checkbox"/> OCNMS rules and regs followed	The discharge protocols are consistent with MOU requirements and are to not occur in OCNMS waters.

**Additional General Questions**

<input checked="" type="checkbox"/> How is deck runoff and hull cleaning handled (scuppers...) (non-toxic/phosphate free cleaners, biodegradable)	Deck runoff and hull cleaning protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> How is maintenance performed on the outside of the vessel (paint chipping, painting, etc)	Outside vessel maintenance protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> Sculleries and Galleys – type of detergents and degreasers used (phosphate free and non-toxic)?	Restaurants and galleys use detergents and degreasers that are non-toxic and phosphate free.
<input checked="" type="checkbox"/> How are food waste discharges handled (prevention of erroneous materials)?	Food waste discharge protocols are consistent with MOU requirements and records reviewed show no discharges in MOU related waters.
<input checked="" type="checkbox"/> Medical sinks/floor drains, chem. stor areas wastes go where (plugged, blackwater, bilge)?	Medical sinks/floor drains are reported as connected to blackwater.
<input checked="" type="checkbox"/> Where is pool and spa water discharged? Dechlorinated/debrominated and underway?	Pool and spa water protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> What type of fuel is used and percent sulfur content?	<0.1% sulfur content is used throughout the route.

Other:

**Section F: Sampling Results**

Parameter	Results
Biochemical Oxygen Demand 5-Day (BOD <sub>5</sub> )	<b>NOT APPLICABLE</b>
Total Suspended Solids (TSS)	
Fecal Coliform	
Residual Chlorine	
pH	
Ammonia, Nitrogen	

**Section G: Summary of Findings/Comments**

Introduction

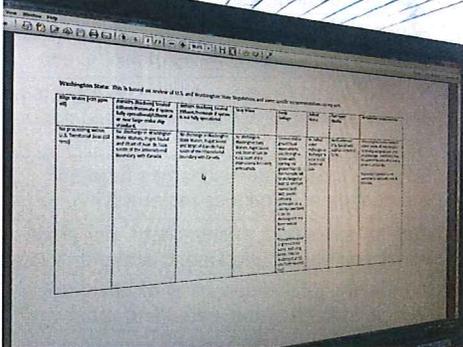
Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program (NWRO-WQ) conducted the inspection of the Windstar Cruises STAR LEGEND on June 27, 2018. The main contact on board the STAR LEGEND was Knut Lier, Chief engineer for the vessel. Prior notification of the visit was given on June 22, 2018 by voice mail and on June 25, 2018 by email for security protocol. There was a delay of about 20 minutes at security before boarding the vessel due to Ms. Jankowiak not being on the early boarding list. The purpose of the inspection was to evaluate compliance with the *Memorandum of Understanding Cruise Operations in Washington State* (MOU), as amended. The STAR LEGEND is not approved to discharge wastewater in MOU waters.

The STAR LEGEND was commissioned in 1992 and was owned by other lines prior to 2015 when the vessel entered into service for Windstar Cruises. The vessel is 440 feet long and 63 feet wide. Passenger capacity is currently about 212, with about 150 crew.

The STAR LEGEND is scheduled for one call in Seattle on June 27, 2018. The vessel to Seattle at Pier 66, then a sailing through the Ballard Locks into Lake Union and then back through the locks and up to Vancouver, B.C. for sailings to Alaska.

Inspection

I arrived and boarded the ship (photo #01) at 10:01 am and began with introductions and a plan for the day with Mr. Inman and Mr. Lier on the Bridge. We discussed various waste streams and discharge protocols on the bridge and reviewed the oil record book. We then went to the Engine Control Room (ECR) and reviewed the logs for blackwater and graywater discharges. We then toured the oily bilge treatment and the Rochem Advanced Wastewater Treatment System (Rochem) for blackwater and graywater with the systems' engineer. We then stopped near the medical facility and completed the inspection with a review of the garbage record books. The inspection was then finalized with a brief debriefing and I disembarked the vessel at 11:25 am.

		
<p>Photo #01 6/27/18 Image: IMG-0053          By: Jankowiak          Description: STAR LEGEND vessel</p>	<p>Photo #02 6/27/18 Image: IMG-0055          By: Jankowiak          Description: Bridge navigation</p>	<p>Photo #03 6/27/18 Image: IMG-0057          By: Jankowiak          Description: Discharge matrix</p>

Discharge Types and Protocols in MOU waters, Washington State waters or the Olympic Coast National Marine Sanctuary (OCNMS) (MOU related waters):

Navigation maps (photo #02) on the bridge indicate the areas beyond 12 miles and show no discharges in MOU related waters. The discharge protocols start with voyage plans for each itinerary prior to that route. A matrix (photo #03) is developed for each route upon a detailed review of locations for allowed discharges. The matrix for the Seattle/Alaska route details no discharges in MOU related waters, for

- bilge water;
- blackwater and biomass;
- graywater;
- food waste; and
- ballast water.

The protocol for discharges includes clear communications between the Bridge and the ECR staff. A briefing is held daily which includes plans for discharges. The position and time are confirmed on the bridge prior to any allowance of a discharge. An email is sent to the ECR and a discharge is started. The bridge calls the ECR 15 minutes prior to being in a location to stop a discharge. The ECR calls the bridge confirming the discharge is stopped. Discharges are logged and reviewed. The overboard valves are padlocked with the keys in the ECR. The discharges all to occur outside of MOU related waters (Washington State waters, the Strait of Juan de Fuca up to the border with Canada and the OCNMS). For black water and gray water, as well as sludge or "biomass", the latitude and longitude coordinates are recorded in the *Black and Grey Wastewater Disposal Log* (photo #04). The date, time and location of both the start and the stop of the discharges are recorded, along with effluent type, speed, volume, and officer responsible.

**Discharge Types:**

Blackwater includes toilet waste and medical drains and is sent to the SWECO pre-filter. Solids are sent to the solids tank and liquids to the Rochem bioreactor (photo #05). The bioreactor has three tanks for biological treatment (photo #06). From there the liquid is sent to the membranes (photo #08) for further filtration and then to the ultraviolet disinfection. The UV system (photo #09) is checked each month and cleaned at least once every 3 months or as needed. Tanks are also regularly cleaned and membranes are backwashed at least weekly or as performance indicates. Treated permeate is sent to one of the treated holding tanks or overboard (photo #10) if in an area allowing discharge. Blackwater is not discharged in MOU related waters. The solids (also called sludge, or biomass) from the filters and bioreactor are sent to a solids tank and discharged outside of MOU related waters. The Rochem system is monitored on-line for pH and has a dedicated engineer for operations. Operations panels (photo #07) are located in multiple locations.

Photo #04 6/27/18 Image: IMG-0065  
By: Jankowiak  
Description: Black and Grey Wastewater Disposal Log



Photo #05 6/27/18  
Image: IMG-0066 By: Jankowiak  
Description: Rochem SWECO filter (back), solids tank (front), liquid tank (right)



Photo #06 6/27/18 Image: IMG-0070  
By: Jankowiak  
Description: Rochem bioreactor



Photo #07 6/27/18  
Image: IMG-0072 By: Jankowiak  
Description: Rochem operations panel



Photo #08 6/27/18  
 Image: IMG-0073 By: Jankowiak  
 Description: Rochem membrane filters



Photo #09 6/27/18  
 Image: IMG-0075 By: Jankowiak  
 Description: Rochem UV disinfection



Photo #10 6/27/18  
 Image: IMG-0077 By: Jankowiak  
 Description: Rochem overboard port

The Rochem permeate is also sampled by Admiralty at least twice a season. Sample results have fluctuated with recent results being very good (<15 mg/l BOD). Graywater, which includes accommodation and crew sink and shower water, galley water, and laundry water is combined into the Rochem system after the SWECO filtration or is occasionally held untreated and offloaded in Alaska.

Dirty bilge water collected and is sent to a dirty bilge tank and then to the static Turbulo oily water separator (OWS) (photo #11). An oil content meter measures oil content on the OWS. Clean bilge water then moves through the white box (photo #12) and recirculates back through the OWS if > 15 parts per million (ppm) oil content. If less than 15 ppm, the water goes to the clean bilge tank for overboard discharge (photo #13) if in an area of allowed discharge. The pipe routing appeared correct. The Oil Record Book was reviewed and confirmed no discharges of bilge water in MOU related waters. The white box has two padlocks with the Chief Engineer and the Captain having the keys. If any other tanks overflow and contact with oily water, it is treated as oily bilge water and offloaded by truck. They have not had such overflows. Staff confirmed that there has not been any rerouting of oily bilge to discharge without proper treatment. The OWS was off and recirculating during the inspection and not discharging. The OWS will be replaced soon with two new OWSs.



Photo #11 6/27/18  
 Image: IMG-0058 By: Jankowiak  
 Description: OWS



Photo #12 6/27/18  
 Image: IMG-0062 By: Jankowiak  
 Description: OWS White Box



Photo #13 6/27/18  
 Image: IMG-0063 By: Jankowiak  
 Description: OWS discharge port

The STAR LEGEND uses various tanks for ballast and therefore does not do ballast water exchanges. Stability has not been an issue.

The STAR LEGEND has two fresh water Jacuzzis and one fresh water pool. No discharges are to occur in MOU related waters. If a discharge occurs, it is dechlorinated first.

Food waste is sent to pulpers and is discharged outside MOU related waters and is comminuted to less than 25 millimeters, along with large bones outside of 12 miles. Food is sorted in the galleys and then again in the garbage room prior to pulping. There is no food chute on the vessel. Grease traps (photo #14) are cleaned daily. Sculleries and galleys use phosphate free and non-toxic detergents and degreasers.

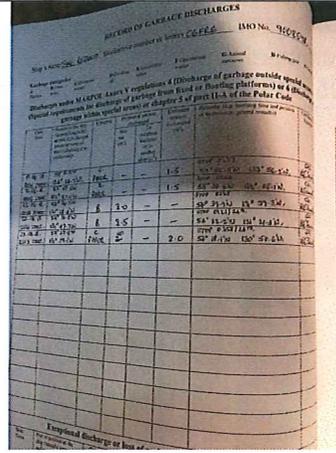
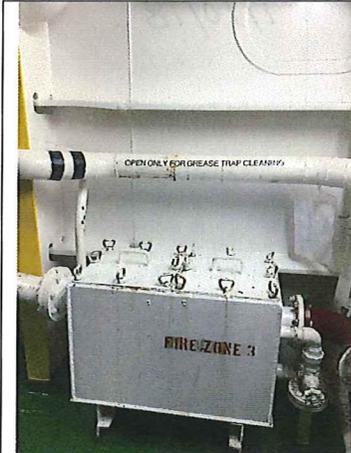


Photo #14 6/27/18  
Image: IMG-0064 By: Jankowiak  
Description: Grease trap

Photo #15 6/27/18  
Image: IMG-0080 By: Jankowiak  
Description: Garbage log

Deck runoff goes directly overboard. The VGP requirements are followed for prevention of any materials off the deck. Only non-toxic, phosphate free cleaners are used. Outside vessel maintenance such as paint chipping and painting is not done at the Port of Seattle.

Laundry water is sent to the graywater collection tanks and discharged outside MOU related waters. Dry cleaning is not done on the vessel. Therefore, no chemical such as perchloroethylene (Perc) are used on the vessel.

Photos are done digitally without any silver recovery on board. X-rays are done digitally without any waste. Fluorescent bulbs are not crushed on board, and held for offloading ashore as hazardous waste. Hazardous waste materials are stored separately and include items such as

paints, thinners, oily rags and debris, chemicals, and some batteries. Offloads are done only in Vancouver, B.C. on this route approximately every 14 days. Bio-medical waste is offloaded with sharps as biomedical waste ashore.

Unused or outdated pharmaceuticals and narcotics are offloaded to shore. Recycling on board is new and a work in progress. There is a bin sorting system for food waste, bottles, paper, oily rags, and plastic.

Garbage such as domestic and operational waste is either incinerated or d in Alaska. Cardboard is mostly incinerated with the one incinerator on board. Incineration does not occur in MOU related waters. Ash is sampled yearly and shows not hazardous and is offloaded as garbage. The garbage record book was reviewed (photo # 15) and showed consistency with requirements.

MGO of 0.0003% sulfur content was used on this route. The vessel was not bunkering fuel in Seattle nor were there any offloads of materials. There is no wet scrubber. The vessel is not equipped for shore power.

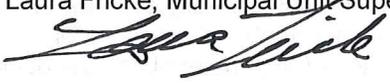
Conclusions and Recommendations

The protocols for discharges are clear. Records were orderly and appeared consistent with the MOU. I recommend that Windstar cruises continue to develop their waste minimization efforts.

Copies to:

- Knut Lier, STAR LEGEND
- Mike Inman, Windstar Cruises
- Mark Toy, Health
- Greg Wirtz, CLIA-NWC
- Stephanie Jones Stebbins, Port of Seattle
- Laura Fricke, Ecology
- Amy Jankowiak, Ecology
- Central Files: Windstar Cruises – STAR LEGEND; WQ 6.1

**Section H: Signatures**

<p><u>Name and Signature of Inspector:</u> Amy Jankowiak, Compliance Specialist</p> 	<p><u>Agency/Office/Telephone:</u> Department of Ecology Northwest Regional Office Water Quality Program Municipal Compliance Specialist 425-649-7195</p>	<p><u>Date</u> 7/5/2018</p>
<p><u>Name and Signature of Reviewer:</u> Laura Fricke, Municipal Unit Supervisor</p> 	<p><u>Agency/Office/Telephone:</u> Department of Ecology Northwest Regional Office Municipal Unit Supervisor 425-649-7103</p>	<p><u>Date</u> 7/10/18</p>



State of Washington Department of Ecology  
**Cruise Ship Memorandum of Understanding, Cruise Operations in Washington State Inspection Report**

Northwest Regional Office

3190 160<sup>th</sup> Ave SE  
 Bellevue, WA 98008

Phone: (425) 649-7000  
 Fax: (425) 649-7098

<b>Inspection Date</b> July 30, 2018	<b>Permit Number</b> NA	<b>County</b> King	<b>Receiving Waters</b> Marine Waters	<b>Ecology Inspector</b> Amy Jankowiak
<b>Entry Time</b> 9:18 am	<b>Photos Taken</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<b>Samples Taken</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<b>Inspection Announced</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<b>Discharges to:</b> <input checked="" type="checkbox"/> Surface Water <input type="checkbox"/> Ground Water <input type="checkbox"/> Dewater <input type="checkbox"/> POTW
<b>Exit Time</b> 12:26 pm				

<b>Name and Location of Site Inspected:</b> ZAANDAM, Holland America Line Pier 91 Seattle, Washington	<b>Additional Participants/Inspectors:</b> Jim Peschel, Holland America Group JPeschel@HollandAmericaGroup.com
<b>On-Site Representative(s): Name/Title/Phone/e-mail</b> David Cooper, Environmental Officer <a href="mailto:ZADM-Environmental_Officer@HollandAmerica.com">ZADM-Environmental_Officer@HollandAmerica.com</a>	Richard Johnson, 3 <sup>rd</sup> Engineer - EGCS
<b>Responsible Official(s): Name/Title/Address/Phone/e-mail</b> Jim Peschel, Senior Director of Environmental Regulatory Operations Holland America Group 300 Elliott Ave. West, Seattle WA 98119 206-281-3535 <a href="mailto:JPeschel@hollandamericagroup.com">JPeschel@hollandamericagroup.com</a>	<b>Other Facility Data:</b> Notification made to Jim Peschel on July 25, 2018  Flag - Netherlands

**Section A: Areas Evaluated**

<input checked="" type="checkbox"/> Black/Gray Wastewater System	<input checked="" type="checkbox"/> Residual Solids	<input checked="" type="checkbox"/> Records/Reports	<input checked="" type="checkbox"/> Hazardous Waste/ Solid Waste	<input checked="" type="checkbox"/> Sampling/Monitoring
<input checked="" type="checkbox"/> Discharge Locations	<input checked="" type="checkbox"/> Operation & Maintenance	<input checked="" type="checkbox"/> Sludge Handling/ Disposal	<input checked="" type="checkbox"/> Oily Bilge Water	<input checked="" type="checkbox"/> Other

**Section B: For Vessels Discharging ≥ 1nm from Berth and ≥ 6 Knots Only [2.1.3(A)]**

<input type="checkbox"/> Schematics Match Black/Gray Wastewater System	
<input type="checkbox"/> Operations as Described in Submitted Documentation	
<input type="checkbox"/> Daily 24-hour Continuous Monitoring for Turbidity or Equivalent Monitoring	
<input type="checkbox"/> Turbidimeter or Equivalent Monitoring Equipment Functioning Properly	
<input type="checkbox"/> Auto Shut Down or Operational Controls to Insure System Shut Down if High Turbidity Occurs	
<b>NOT APPLICABLE</b> Turbidity or Equivalent: Last Calibration: Trigger Level for Early Alarm: <input type="checkbox"/> Trigger Level for Shutdown: <input type="checkbox"/> Recorded Turbidity/Equivalent Levels Above Triggers:	
<input type="checkbox"/> Daily 24-hour Continuous Monitoring for Disinfection Effectiveness	
<input type="checkbox"/> Disinfection Effectiveness Monitoring Equipment Functioning Properly	
Disinfection Effectiveness Monitoring:	
<input type="checkbox"/> Auto Shut Down or Operational Controls to Insure System Shut Down if Disinfection System Upset Occurs	
<input type="checkbox"/> Disinfection System Operated and Maintained Properly	
Disinfection System:	



	discharges or releases of solid wastes were found to be inconsistent with MOU requirements.
<input checked="" type="checkbox"/> Photo/X-Ray Waste Managed Properly (fluids, cartridges,...) and landed ashore	Photo and x-ray waste protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> Dry-Cleaning Wastes and Byproducts (fluids, sludge, filter materials...) Managed Properly (PERC – haz waste – landed ashore)	Dry cleaning protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> Unused/Outdated Pharmaceuticals Managed Properly (safely disposed of)	Unused or outdated pharmaceuticals management protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> Fluorescent and Mercury Vapor Lamp Bulbs Managed Properly (prevent release of mercury)	Fluorescent and mercury vapor lamp bulbs protocols for management are consistent with MOU requirements.
<input checked="" type="checkbox"/> Waste Reduction/Reuse/Recycling Opportunities Maximized (glass, cardboard, aluminum & steel cans)	Waste reduction/reuse/recycling opportunities appear to be maximized per MOU requirements.
<input checked="" type="checkbox"/> Batteries Managed Properly (recycled, reclaimed, disposed of properly)	Batteries management protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> Incinerator Ash Managed Properly and minimized volume (haz waste segregation and annual testing)	Incinerator ash management is consistent with MOU requirements.
<input checked="" type="checkbox"/> Oily Bilge Water Managed Properly (<15 ppm, no visible sheen and underway)	Oily bilge water protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> Ballast Water Managed Properly (per Wash regs –reporting, treated or if open sea exchange >200 nm from outside EEZ, 50nm if not EEZ)	The vessel employs ballast water exchange and does not de-ballast in MOU related waters.
<input checked="" type="checkbox"/> OCNMS rules and regs followed	The discharge protocols are consistent with MOU requirements and are to not occur in OCNMS waters.

**Additional General Questions**

<input checked="" type="checkbox"/> How is deck runoff and hull cleaning handled (scuppers...) (non-toxic/phosphate free cleaners, biodegradable)	Deck runoff and hull cleaning protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> How is maintenance performed on the outside of the vessel (paint chipping, painting, etc)	Outside vessel maintenance protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> Sculleries and Galleys – type of detergents and degreasers used (phosphate free and non-toxic)?	Restaurants and galleys use detergents and degreasers that are non-toxic and phosphate free.
<input checked="" type="checkbox"/> How are food waste discharges handled (prevention of erroneous materials)?	Food waste discharge protocols are consistent with MOU requirements and records reviewed show no discharges in MOU related waters.
<input checked="" type="checkbox"/> Medical sinks/floor drains, chem. stor areas wastes go where (plugged, blackwater, bilge)?	Medical sinks/floor drains are reported as connected to blackwater.
<input checked="" type="checkbox"/> Where is pool and spa water discharged? Dechlorinated/debrominated and underway?	Pool and spa water protocols are consistent with MOU requirements.
<input checked="" type="checkbox"/> What type of fuel is used and percent sulfur content?	<0.1% sulfur fuel content or EGCS treated equivalent is used throughout the route.

Other:

**Section F: Sampling Results**

Parameter	Results
Biochemical Oxygen Demand 5-Day (BOD <sub>5</sub> )	<b>NOT APPLICABLE</b>
Total Suspended Solids (TSS)	
Fecal Coliform	
Residual Chlorine	
pH	
Ammonia, Nitrogen	

**Section G: Summary of Findings/Comments**

Report Revision: This report was revised from the 8/14/18 version to correct errors.

### Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program (NWRO-WQ) conducted the inspection of the Holland America Line ZAANDAM on September 30, 2017. The main contact on board the ZAANDAM was David Cooper, Environmental Officer (EO) for the vessel. Jim Peschel, Senior Director of Environmental Programs for Holland America Group (HAG) also joined us for the inspection. Prior notification of the visit was given on July 25, 2018 for security protocol. The purpose of the inspection was to evaluate compliance with the *Memorandum of Understanding Cruise Operations in Washington State* (MOU), as amended. The ZAANDAM is not approved to discharge wastewater in MOU waters.

The ZAANDAM was dedicated in 2000, and is 781 feet long. The passenger capacity is approximately 1430 with a crew capacity of about 615.

The ZAANDAM is scheduled for 11 port calls in Seattle for weekly cruises to Alaska between May 7, 2018 and September 24, 2018.

### Inspection

I arrived and boarded the ship (photo #01) at 9:18 am and began with introductions and a plan for the day with David Cooper, EO and was later joined by Jim Peschel, HAG. We discussed various waste streams and discharge protocols. We then viewed the garbage room material sorting, food waste, recycling, and photo waste handling. We then went to the Engine Control Room (ECR) prior to viewing the Zenon Advanced Wastewater Treatment System (AWTS) for blackwater and graywater, the oily bilge treatment system, and portable pump storage. We then toured the Exhaust Gas Cleaning System (EGCS) and some deck/pool areas. We finished with a records review in the EO's office. The inspection was then finalized with a brief debriefing and I disembarked the vessel at 12:26 pm.

Discharge Types and Protocols in MOU waters, Washington State waters or the Olympic Coast National Marine Sanctuary (OCNMS) (MOU related waters):

The discharge protocols start with voyage plans for each itinerary prior to that route and overview meetings as new staff comes on. A matrix is developed for each route upon a detailed review of locations for allowed discharges, holding ability of the various wastestreams, and other requirements. The matrix for the Seattle/Alaska route details no discharges in Washington State waters, the international waters of the Strait of Juan de Fuca and the Olympic Coast National Marine Sanctuary (OCNMS) for

- bilge water;
- blackwater;
- graywater;
- food waste;
- exhaust gas cleaning system use;
- air emissions;
- ballast and biofouling water;
- fuel type/quality; and
- additional restrictions.

The Bridge and the ECR staff communicate prior to any discharge and the bridge provides a 3-hour notice prior to being in an area to stop/start discharges as the vessel is coming into MOU related waters (stops in Victoria on the way to Seattle and then up through Canada). All discharges are stopped before entering the OCNMS including the EGCS system. Fuel switching is conducted prior to EGCS shut-down to assure Emission Control Area (ECA)-compliant fuel is being used. The EGCS is re-started after exiting the OCNMS inbound to Victoria. Treated sewage and graywater discharges are then allowed in Canadian waters and then off again prior to MOU related waters (the Strait of Juan de Fuca at the Canadian border). The NAPA system is used to electronically log all discharges and there is an electronic recording of discharge ports opening and closing. For black water and gray water, the latitude and longitude coordinates are recorded in the NAPA Permeate as their *Sewage and Graywater Discharge Record Book*, which is electronic and was reviewed for recent discharges. The date, time and location of both the start and the stop of the discharges are recorded, along with the discharge valve ID, volume, discharge type, flow rate, speed and distance from land (at start). Discharge ports are padlocked with the keys held in an electronic security system (photo #07) that allows only those authorized for certain keys to be allowed to access them. When a key is pulled out, it is recorded. Electronic recordkeeping requires logins and passwords and date and time stamps each entry with a specific name. Changes the data is tracked and once the Captain signs off, changes are only allowed with the Captain's permission.

## Discharge Types

### Zenon Black water and Gray water System:

All blackwater (sewage and medical drains) and graywater (sink, shower, laundry, galley...) is combined, with the exception of a portion of graywater at times being held untreated and discharged outside of MOU related waters due to capacity of the Zenon system. The system is approved for continuous A discharge in Alaskan waters. Wastewater is collected and divided to two separate, but identical Zenon trains and is then screened (photo #09) to remove solids. The two screens require manual cleaning and hosing down. From the screens, liquid is sent to the raw water tank before being sent to the bioreactors (photo #11). Residual solids (photo #10) from the screenings and the bioreactors (that are not returned to the system) are drummed and landed ashore in Victoria. Aeration promotes the biological treatment in the two-stage bioreactor.

Effluent from the bioreactor goes through the membrane ultrafilters. The filters are cleaned by back-pulsing (photo #13) every ten minutes (can be adjusted more frequently if membranes are clogging), and a daily chemical cleaning. Every six months, a service cleaning is done. Effluent from the filters goes to the ultraviolet (UV) light disinfection unit (photo #14). Some of the flow from the membranes goes back to the bioreactor and caustic soda is added for pH control. An on-line turbidity meter continuously reads the turbidity prior to UV (read 0.092 ntu during the inspection). The UV system consists of one unit with eight lamps. From the UV system, flow either goes straight overboard if in an area approved for discharge, or is sent to holding tanks for later discharge.

There are two ZENON trains for treatment (2 screens, 2 bioreactors, 2 membrane filters, 2 permeate tanks, 1 UV unit) which are typically both running. One train can be taken down for maintenance while the other is still in use. The ZENON system can be viewed in the ECR (photo #08) and accessed in various locations in the engine area. ZENON monitors the treatment system and test results with information daily and visits the vessel about once every 6 months. Maintenance is done per the AMOS system. Sampling is done per Alaska requirements and on-board as continuous monitoring or by sampling and analysis in the "Zenon Lounge" (photo #12) for pH, temperature, turbidity, phosphates, ammonia, total suspended solids (TSS), chlorine residual and carbonaceous oxygen demand (COD). The system has been operating well all season.

Dirty bilge water collected and is sent to the oily bilge tank. Liquid moves to the Centrifugal oily water separator (COWS) (photo #16) where it is treated to less than 15 parts per million (ppm) oil content. From there liquid moves to the intermediate tank and on to the Static oily water separator (SOWS) (photo #16) for further separation to less than 15 ppm (photo #17). Maintenance on the COWS and SOWS is triggered with the AMOS maintenance system and includes regular cleanings, overhauls, and filter changes. Prior to discharge, the liquid is sent through a white box (photo #18). The COWS, SOWS and white box were installed new in April 2018. The oily sludge is collected to a sludge box, drummed and offloaded at about 30-40 cubic meters every two weeks. This amount includes sludge generated by the fuel purifying process as well as from bilge water treatment. Discharges of clean bilge and offloads of oily sludge are recorded in the Oil record Book. The overboard discharge port is padlocked and seals are on key pieces of equipment. All bilge equipment is labeled to prevent tampering and the area is monitored and video recorded. The EO, Captain, and Chief Engineer only have access to the videos. All seals, padlocks, fittings and portable pumps (seven) are inventoried and checked regularly as part of a critical vulnerability assessment. The portable pumps are kept in a locker (photo #15) which is locked and if it opens, is recorded electronically. The Chief Engineer and EO are in charge of pump usage. The EO confirmed that he is not aware of any rerouting of oily bilge. The OWS were off and recirculating during the inspection and not discharging. Signage (photos #19 and #20) in the ECR as well as in the bilge area is posted for bilge water handling and reporting non-compliance.

Ballast water is not treated on board currently and exchanges are managed in open sea (>200 nm from outside EEZ, >50 nm if not EEZ). Stability is managed with the various tanks on the vessel.

There are two pools (photo #31) and 3 spas, which all use freshwater. Discharges are to occur outside of MOU related waters with disinfection levels checked.

Food waste is sent to a pulper in the galleys with some materials being sorted and collected for compost. Comminuted food waste (photo #04) is discharged via the food chute (photo #05) by the EO after location is confirmed with the Bridge and to occur outside MOU related waters. Pulper water is sent to the graywater, but is discharged outside of MOU related waters as boiler drain down water is sent to the same tank. Food waste for compost (along with flowers) is collected and binned in the cold room and offloaded in Victoria on this route. Used cooking oil is collected and recycled. Grease traps in the engine room collect grease which is drummed and offloaded. Food waste discharges are logged in the NAPA system.

Deck runoff goes to scuppers on the deck. Discharges with cleaning (non-toxic, phosphate free, biodegradable cleaners) chemicals is logged in the Garbage Record book. Outside vessel maintenance such as paint chipping and painting follows a SOP with the Port of Seattle and Best Management Practices are used when conducting work. Only fresh water cleaning of the vessel was occurring during the inspection.

Dry cleaning is done on board with a non-PERC system. Laundry water is sent to graywater and discharged outside of MOU related waters.

Photo waste goes through a silver recovery unit (photo #06) with offloads as non-hazardous in Victoria when silver is less than 5 ppm. Tests are logged and kept. X-rays are done digitally without any waste. Fluorescent bulbs are crushed on board with a mercury vapor removal system (bulb eater). Filters are offloaded as hazardous waste. Hazardous waste materials are stored separately and include items such as paints, thinners, some medical waste, sharps, oily rags, incinerator ash, and chemicals. Hazardous waste is not offloaded in Seattle, only in Victoria on this route.

Unused or outdated pharmaceuticals and narcotics are either incinerated or offloaded as hazardous waste, with no medications going to blackwater. Drains from the medical facility go to the blackwater tanks. Sharps are off-loaded as bio-hazardous waste. Materials including cardboard, medical red bag waste, and paper are incinerated with the one incinerator. The incinerator is off while in MOU related waters. Ash is tested regularly and offloaded in Victoria.

Solid waste (garbage, recyclables, etc) is collected, sorted (photo #02), and either reused, recycled, incinerated or off-loaded to shore as appropriate. The garbage record book was reviewed and showed consistency with requirements.

Glass, some plastics, most cardboard, aluminum, tin and steel cans, some batteries, used cooking oil, electronics (photo #03), carpet (where feasible), oily sludge and other items are recycled. Waste minimization opportunities are maximized by regular tracking, and researching and finding opportunities to recycle and reuse. The vessel recently added oily sludge recycling and single use plastic straw reductions.

ECA fuel-sulfur compliance is achieved either through the use of 0.1% sulfur content fuel, or with higher sulfur heavy fuel oil (HFO) treated by the EGCS to achieve equivalent emissions. The vessel uses an Ecospray Technologies wet scrubbers (photos #29 and #30) on board which is a wet open-loop system to minimize the sulfur oxide emissions (SO<sub>x</sub>). There are three separate scrubbers. Seawater is pumped from a sea chest (photo #23) into the vessel and filtered (photos #26 and #27). It is sent to the top of the exhaust towers where 100-140 nozzles spray the air emissions. A drain line sends the soot water to a soot filter (photos #21 and #22) that is mixed (photo #28) with a saltwater dilution and then discharged (photo #24). Continuous meters monitor polycyclic aromatic hydrocarbons (PAH), and turbidity in the inlet and out of the filter. pH is measured continuously at the inlet and the overboard (photo #25). The scrubbers were installed about 4-5 years ago on the ZAANDAM. PAH meters are calibrated ashore by HACH; turbidity meters are verified by onboard engineers and may be calibrated onboard by HACH technicians. Engineers calibrate pH meters on board. The scrubbers are not used in the OCNMS. The vessel was bunkering (photo #32) fuel during the inspection.

### Conclusions and Recommendations

The protocols for discharges are clear. Records were orderly and appeared consistent with the MOU. The treatment systems appear to be operating well.

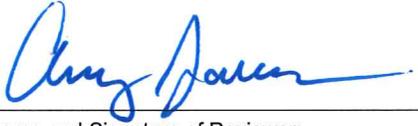
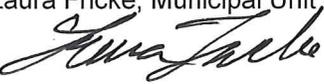
#### Attachments:

Photographs  
Discharge matrix  
EGCS diagrams

#### Copies to:

Jim Peschel, Holland America Group  
Jonathan Turvey, Holland America Group  
David Cooper, Environmental Officer, ZAANDAM  
Mark Toy, Health  
Greg Wirtz, CLIA-NWC  
Donna Spalding, CLIA-NWC  
Joseph Gellings, Port of Seattle  
Laura Fricke, Ecology  
Amy Jankowiak, Ecology  
Central Files: Holland America Line – ZAANDAM; WQ 6.1

**Section H: Signatures**

<p><u>Name and Signature of Inspector:</u> Amy Jankowiak, Compliance Specialist</p> 	<p><u>Agency/Office/Telephone:</u> Department of Ecology Northwest Regional Office Water Quality Program Municipal Compliance Specialist 425-649-7195</p>	<p><u>Date</u>  9/20/18</p>
<p><u>Name and Signature of Reviewer:</u> Laura Fricke, Municipal Unit Supervisor</p> 	<p><u>Agency/Office/Telephone:</u> Department of Ecology Northwest Regional Office Municipal Unit Supervisor 425-649-7103</p>	<p><u>Date</u>  9/21/18</p>



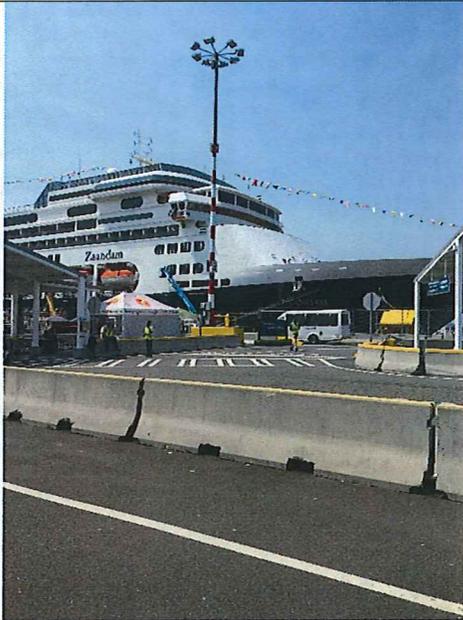


PHOTO #:01 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0136  
DESCRIPTION: VESSEL



PHOTO #:02 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0082  
DESCRIPTION: GARBAGE ROOM – MATERIAL SORTING



PHOTO #:03 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0083  
DESCRIPTION: GARBAGE ROOM – ELECTRONICS RECYCLING

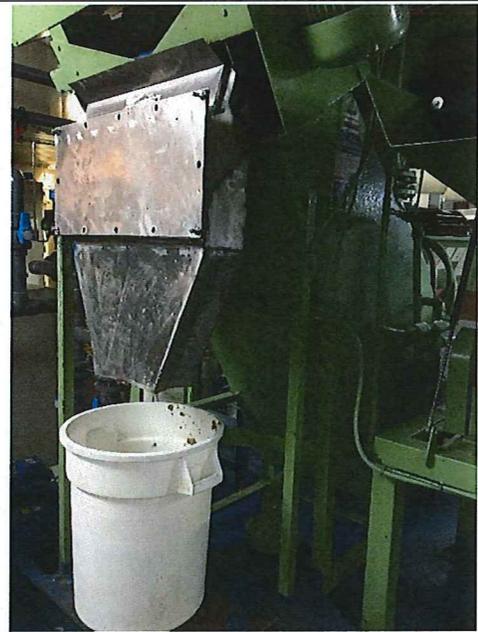


PHOTO #:04 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0086  
DESCRIPTION: GARBAGE ROOM – PULPED FOOD WASTE

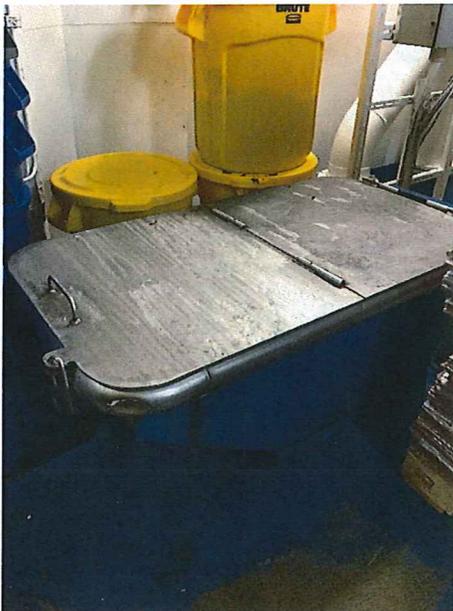


PHOTO #:05 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0088  
DESCRIPTION: GARBAGE ROOM – FOOD CHUTE

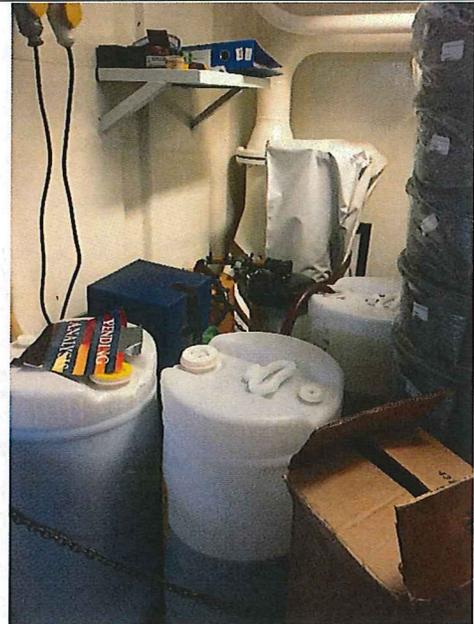


PHOTO #:06 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0089  
DESCRIPTION: GARBAGE ROOM – PHOTO WASTE SILVER  
RECOVERY UNIT



PHOTO #:07 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0090  
DESCRIPTION: ELECTRONIC KEY STORAGE –OUTSIDE ECR



PHOTO #:08 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0091  
DESCRIPTION: ZENON SCREEN SHOT IN ECR



PHOTO #:09 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0092  
DESCRIPTION: ZENON INITIAL SCREENING

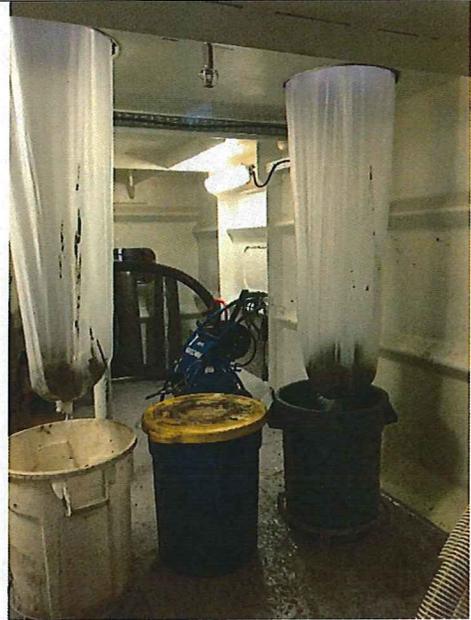


PHOTO #:10 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0093  
DESCRIPTION: ZENON CREENINGS



PHOTO #:11 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0096  
DESCRIPTION: ZENON MEMBRANES (WHITE TANK WALL)

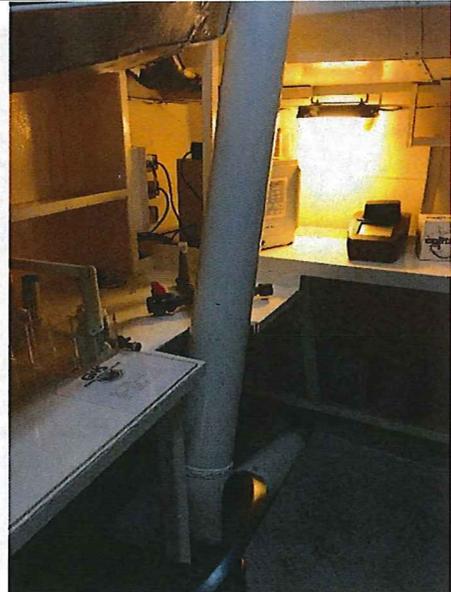


PHOTO #:12 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0098  
DESCRIPTION: ZENON LOUNGE – SAMPLING/ANALYSIS AREA



PHOTO #:13 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0099  
DESCRIPTION: ZENON BACKPULSE TANK



PHOTO #:14 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0101  
DESCRIPTION: ZENON – ULTRAVIOLET LIGHT DISINFECTION



PHOTO #:15 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0102  
DESCRIPTION: PORTABLE PUMP LOCKER (7 OF 7 STORED)



PHOTO #:16 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0103  
DESCRIPTION: CENTRIFUGAL OILY WATER SEPARATOR (COWS (BLUE); STATIC (SOWS) (GREEN)



PHOTO #:17 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0104  
DESCRIPTION: COWS OIL CONTENT METER



PHOTO #:18 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0109  
DESCRIPTION: BILGE WHITE BOX

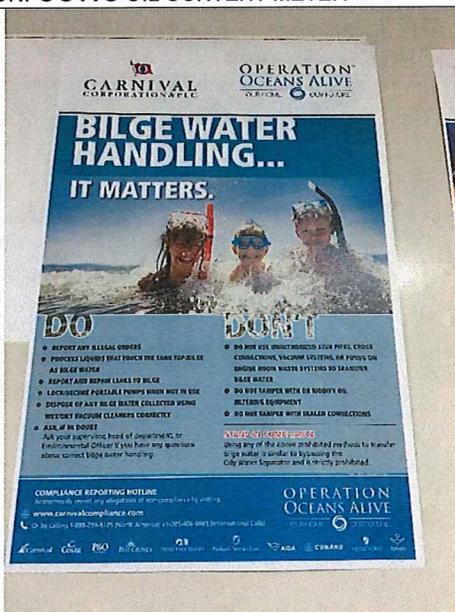


PHOTO #:19 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0112  
DESCRIPTION: BILGE WATER HANDLING SIGNAGE AT ECR



PHOTO #:20 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0113  
DESCRIPTION: REPORTING SIGNAGE AT ECR

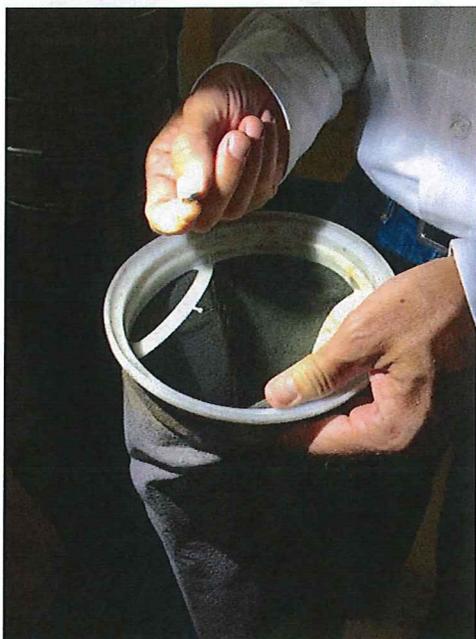


PHOTO #:21 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0114  
DESCRIPTION: EGCS – SOOT FILTER

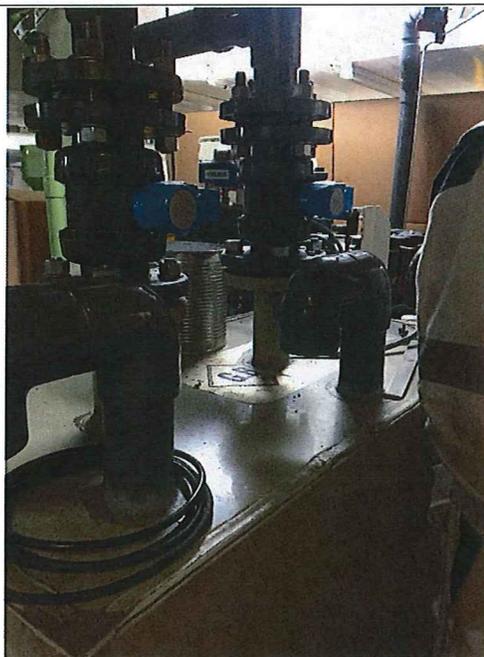


PHOTO #:22 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0117  
DESCRIPTION: EGCS – FILTERS



PHOTO #:23 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0118  
DESCRIPTION: EGCS – SEA CHEST WITH CATHODIC PROTECTION  
(WHITE ANODES)



PHOTO #:24 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0120  
DESCRIPTION: EGCS – WATER FEED PUMPS (BLUE)  
MIXING/DILUTION WATER PUMPS (BLACK)



PHOTO #:25 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0123  
DESCRIPTION: EGCS – RACK FOR MONITORING OVERBOARD



PHOTO #:26 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0124  
DESCRIPTION: EGCS –INTAKE FILTER



PHOTO #:27 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0125  
DESCRIPTION: EGCS – INTAKE FILTER (FOR PHOTO #26)



PHOTO #:28 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0126  
DESCRIPTION: EGCS – MIX TANK FOR SOOT/WATER

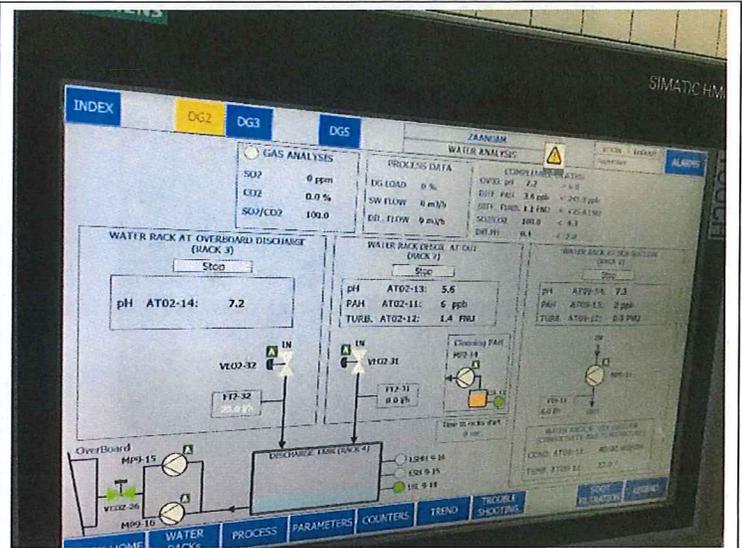
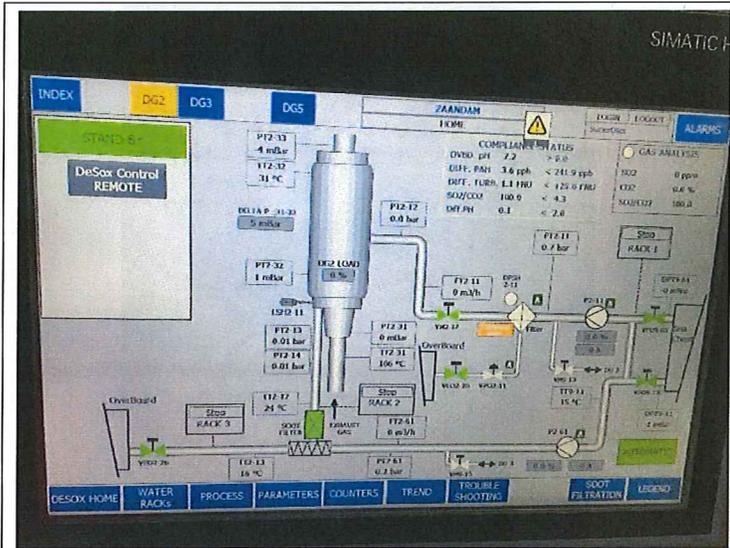


PHOTO #:29 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0127  
DESCRIPTION: EGCS – SCREEN SHOT

PHOTO #:30 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0128  
DESCRIPTION: EGCS – SCREEN SHOT



PHOTO #:31 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0130  
DESCRIPTION: POOL

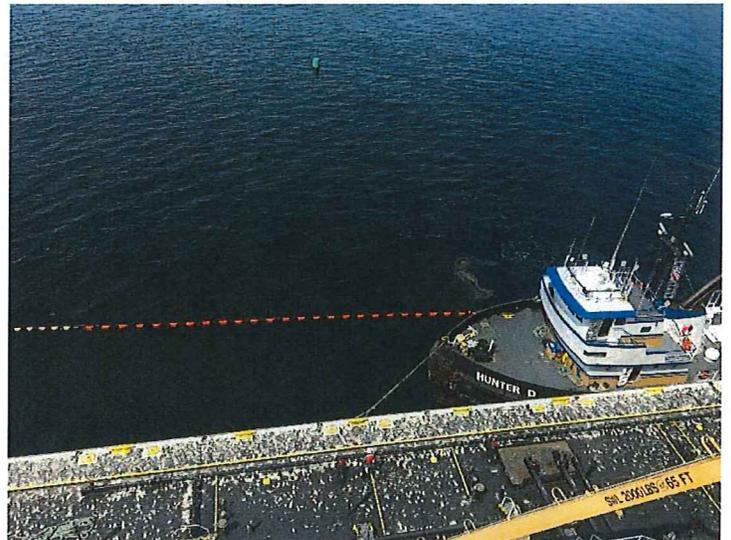


PHOTO #:32 DATE: JULY 30, 2018  
TAKEN BY: AMY JANKOWIAK FILE No.: IMG\_0135  
DESCRIPTION: BUNKERING FUEL







WASTE DISCHARGE REQUIREMENTS - REGION: NORTH AMERICA - VERSION JULY 30, 2018 - LAST UPDATED JULY 30, 2018

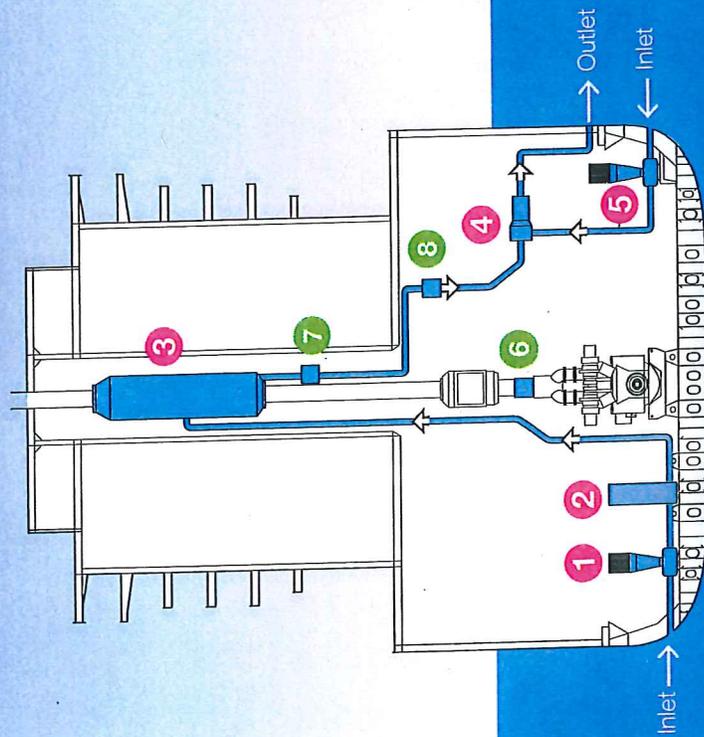
COUNTRY	APPLICABLE	PORT	ADDITIONAL REQUIREMENTS/RESTRICTIONS	BILGE WATER	SEWAGE (MSD AND )	GREY WATER	FOOD WASTE	BALLAST WATER/BALLOUING REQUIREMENTS	FUEL TYPE/QUALITY	EGCS	AIR EMISSIONS/INFORMATION USE
			<p>BASE DISCHARGE REQUIREMENTS Also applicable to St. Pierre &amp; Miquelon (French overseas collectivity)</p> <p>* See ENVI/001742 for baseline details</p>	<p>BILGE WATER</p> <p>&lt;15 ppm oil; &gt;12NM from shore &amp; &gt;6Kts</p>	<p>SEWAGE (MSD AND )</p> <p>MSD: &gt;12NM from the baseline &amp; &gt;6Kts &gt;6Kts and effluent shall not produce visible floating solids or discoloration in the surrounding water Sewage sludge and biomass from sewage treatment plants: &gt;12NM from the baseline &amp; &gt;6Kts</p>	<p>GREY WATER</p> <p>&gt;4NM from shore &amp; &gt;6Kts</p>	<p>FOOD WASTE</p> <p>Non-Commuted Ground: Discharge permitted while en route &gt;6Kts &gt;12NM from the baseline Commuted Ground (625mm): Discharge permitted while en route &gt;6Kts &gt;12NM from the baseline</p>	<p>BALLAST WATER/BALLOUING REQUIREMENTS</p> <p>Use BWTS or if dewatering planned in local waters, conduct ballast water exchange whenever possible &gt;200NM from the baseline &amp; &gt;25NM from the baseline &amp; &gt;200m depth possible Discharge Ballast Water Exchange (DBWE) &amp; Ballouing Record Book (see ENVI/1802)</p>	<p>FUEL TYPE/QUALITY</p> <p>Max 0.7% Sulphur (Worldwide) Max 0.1% Sulphur (in the EPA) Note: HFD can be used with an EGCS</p>	<p>EGCS</p> <p>Use of EGCS is required subject to restrictions listed below</p>	<p>AIR EMISSIONS/INFORMATION USE</p> <p>Stop using incinerator (place in inhibit mode) at least 1 hour prior to incineration. Place incinerator in inhibit mode for at least 1 hour after leaving port or anchorage</p>
			UC2	<p>Part of Long Beach Green Flag Incentive Program. Program offers reduced berthing fees and environmental awards for vessels that help improve air quality by voluntarily reducing speed within the designated air quality compliance zone.</p> <p>The Green Flag air quality compliance zone extends 20 and 40 nautical miles seaward from Point Fermin. The speed of every vessel within the zones is measured and recorded in-bound and out-bound by the marine exchange of Southern California. On approach, ships that slow down to 12 Kts at the 40-mile mark for 90% of their call, during a 12 month period will be eligible for a 25% reduction in berthing fees in the following year. Ships that slow down to 12Kts at the 20-mile mark for 80% of their calls during a 12 month period will be eligible for a 15% reduction in berthing fees in the following year. Ships should voluntarily reduce speed until passing these mile markers when leaving the port for the.</p>							
			UW2	<p>EGCSs cannot be operated in the US Marine Sanctuaries: (1) Gray's Reef National Marine Sanctuary, (2) the Flower Garden Banks National Marine Sanctuary, (3) the Stellwagen Bank National Marine Sanctuary, (4) the St. Lawrence Bank National Marine Sanctuary, (5) Olympic Coast National Marine Sanctuary, (6) Olympic Coast NMS enters into the Traffic Separation Scheme of Strait of Juan de Fuca, (6) Channel Islands National Marine Sanctuary, (7) the National Marine Sanctuaries of Central California included the Gulf of the Farallones National Marine Sanctuary &amp; Cordell Bank National Sanctuary now from 2015, (8) Monterey Bay National Marine Sanctuary, (9) Hawaiian Islands Humpback Whale National Marine Sanctuary.</p> <p>For additional information see the maps provided in Appendix L.</p>							

### 3 System Overview

The Ecospray EGCSs fitted to our ships are wet open-loop systems that utilise seawater to reduce the SOx in exhaust gases from the DGs. The systems pump seawater from a sea chest to a DeSOx Tower where the SOx are removed by mixing the seawater with the exhaust gases. The removal of the SOx also lowers the pH of the seawater and the water must then be diluted with additional seawater to buffer (increase) the pH before it is discharged back into the sea.

The major components of the EGCS are as follows:

- 1 **SW Pump** – pumps the wash-water from the sea chest to the DeSOx Tower
  - 2 **SW Filter** – removes particulate matter from the wash-water to prevent clogging of the spray nozzles in the DeSOx Tower, the filter also has an automatic back-flush function which returns filtered material to the sea
  - 3 **DeSOx Tower** – sprays the wash-water into the exhaust stream to remove the SOx and then separates the wash-water from the exhaust gases. The gases exit the Tower via a Demister and continue to the funnel and the wash-water is drained from the base
  - 4 **Static Mixer** – mixes the wash-water and dilution water to buffer (increase) the pH
  - 5 **Dilution Pump** – pumps the dilution water to the Static Mixer
- On some ships the following equipment is fitted:
- 6 **Dry Oxidation Catalyst** – utilizes an oxidation process to reduce the particulate matter and hydrocarbons in the exhaust gases
  - 7 **Gas Trap/De-gas Unit** – reduces gases entrained in the wash-water
  - 8 **Wash-water Filtration System** – removes particles and oils from the wash-water discharged from the DeSOx Tower



● Main components ● Additional equipment

Components of Exhaust Gas Cleaning System



## 6 Continuous Monitoring

Whenever an EGCS is being used inside an ECA, the Regulations require that the Compliance Parameters are continuously monitored and recorded as follows:

- IMO MEPC – minimum 18 mths
- US EPA VGP – minimum 2 yrs
- Carnival recommends storing ALL historical Compliance Data, Periodic Sampling Records and System Records for a minimum of 3 years.

'Continuously monitored' means that the value of each parameter must be measured and recorded once at least every 4.7 mins (Carnival systems use 3.0 mins). To achieve this, compliance monitoring equipment is installed as part of the EGCS along with a Compliance Computer (either a hardware computer or a virtual computer using the ship's server) which records and stores the data that has been collected by the Ecospray PLC.

**Note:** Certification under IMO Resolution MEPC.259(68) Scheme A (rather than Scheme B) stipulates daily spot checks for exhaust gas emissions monitoring in place of continuous monitoring.



The Compliance Parameters are listed in Section 2 and the compliance equipment installed is as follows:

**Gas Analyzer** – measures the SO<sub>2</sub> and CO<sub>2</sub> content of the exhaust gases which allows the SO<sub>2</sub>/CO<sub>2</sub> ratio to be calculated.

**Sea Suction Rack (Rack 1)** – measures the PAH and Turbidity of the inlet wash-water at the sea suction. Although not required for compliance, on some systems pH is also measured.

**DeSOx Outlet Rack (Rack 2)** – measures the PAH and Turbidity of the wash-water at the outlet of the DeSOx Tower.

**Overboard Discharge Rack (Rack 3)** – measures the pH of the wash-water at the overboard discharge.

**Discharge Tank (Rack 4)** – not compliance equipment and does not perform analysis. It collects water from Racks 2 and 3 and pumps to the Overboard.

Exhaust Gas Cleaning System | Officers' Pocket Guide

Wash-water Racks and Gas Analyzer

