State of Washington Department of Ecology

Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges

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

Section A: General Information

Vessel Name:	NORWEGIAN SUN	Date:	June 24, 2006
Vessel Operator:	NCL (Bahamas) Ltd.	Entry Time:	9:25 AM
IMO Number:	9218131	Exit Time:	12:35 PM
Vessel Type:	Passenger Ship	Notification (name & date):	Randy Fiebrandt/6-20-2006
Location:	Pier 66, Seattle	On-board contact(s):	Carl Hergeselle, Environmental Officer (env02@ncl.com) Jose Lecciones, Environmental Engineer/Scanship System Operator
Inspector(s):	Amy Jankowiak (Ecology), Kevin Fitzpatrick (Ecology)		
# passengers/crew:	~2000/920±10	Amount of Wastewater:	~750-850 m^3/day average actual
Obtain copy of SMC:	☐		

Description of advanced wastewater treatment system (name, type, major components, etc):
Scanship is a biological reactor and ultrafiltration system The system includes prefiltration, biological treatment via a biofilm process, chemical precipitation, clarification through flotation tanks, polishing filtration and UV disinfection. Approval for continuous discharge from Ecology was granted on May 4, 2006

Section B: Areas Evaluated

☒	Black/Gray wastewater system	☒	Operations Center/ Computer system	☒	Records/Reports	☒	Sampling/Monitoring
☒	Discharge locations	☒	Operations & Maintenance	☒	Sludge Handling/Disposal	☒	Other (oil spill notification drill, debunking)

Section C: For vessels discharging ≥ 1nm from berth and ≥ 6 knots only

☐	Schematics match black/gray wastewater system	NA
☐	Sludge disposal protocol per MOU	NA
☐	Notification procedures (for contacting Ecology of non-compliance) in place	NA

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)

☒	Schematics match black/gray wastewater system	System is as depicted in schematics
☒	Sludge disposal protocol per MOU	Discharges 12 nm out and outside of the Olympic Coast National Marine Sanctuary Area to Be Avoided per stated protocol.
☒	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	Notification numbers were posted and a copy of the current MOU was available on board
☒	Operations as described in submitted documentation	Operations were as described.
☒	Daily 24-hour continuous turbidity or equivalent monitoring	Has continuous TSS monitoring.
☒	Turbidimeter or equivalent monitoring equipment functioning properly	Appears to be functioning properly Details in narrative
	Turbidity or equivalent Last calibration: as needed Frequency of readings: continuous Trigger level for alarm: 30 Trigger level for shutdown: 30 Recorded turbidity/equivalent levels above triggers: Yes, typically a couple of times/season	

☒	Auto shut down or operational controls to insure system shut down if a system upset occurs	If TSS > 30 then automatically diverts to tank 3 for holding
☒	Ultraviolet (UV) light disinfection immediately prior to discharge	3 UV banks available typically use two at a time and run in series. There are 14 bulbs for each unit. There is a holding tank available after UV which is only used in areas not approved for discharge.
☒	UV replacement bulbs available	There is one unit's worth of spares available (14). Lights show which bulbs are out/broken. All bulbs are replaced after every 10,000 hours of use.
☒	UV/bulbs cleaned regularly	Yes, the units are cleaned by dosing Metal Bright about 2-3 times/month or if UV intensity is low (alarmed). Bulbs are also cleaned about once every 6 months (manufacturer recommendation is once/year).

Section E: General		
☒	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	Yes, as of the date of the inspection
☒	Whole Effluent Toxicity Testing 1 per 2 years	WET testing not conducted yet. In first season of approval.
☒	Training up to date for system operators	Scanship conducts training on the ship during start-up of the system
☒	Discharge records maintained	Maintained properly
☒	Alarms functioning properly	Alarms appear to be functioning properly.
	Alarms Shutdowns: Yes High turbidity/TSS warnings: Yes High wastewater levels: Yes UV disinfection (intensity, bulbs, bank out, power failure): Yes	

Section F: Sample Results

Parameter	Effluent Result
Biochemical Oxygen Demand (5-Day)	6.70 mg/l
Total Suspended Solids (TSS)	5.0 mg/l
Fecal Coliform (MF)	1 CFU/100 ml
Residual Chlorine	<0.1 mg/l
Ammonia, Nitrogen	30 mg/l
pH	6.50

Section G: Summary of Findings/Comments

Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program, Municipal Compliance Specialist and Kevin Fitzpatrick, Ecology, Northwest Regional Office, Water Quality Program conducted the inspection on June 24, 2006. The main contacts on board the NORWEGIAN SUN included Carl Hergeselle, Environmental Officer and Jose Lecciones, Environmental Engineer/Scanship System Operator. Prior notification of the visit was given on June 20, 2006 for security protocol. The purpose of the inspection was to evaluate the operating conditions of Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the *Memorandum of Understanding Cruise Operations in Washington State*, as amended. The NORWEGIAN SUN received approval to discharge continuously per the MOU on May 4, 2006.

The NORWEGIAN SUN was built in 2001, is 848 feet long with 13 decks, with about a 26-foot draft. Passenger capacity is 2400 maximum total passenger berths. There are typically about 2000 passengers and 920±10 crew. The ship's wastewater system, Scanship, was installed in 2003.

Inspection

We arrived boarded the ship at about 9:25 am and began with introductions and a plan for the day. Bunkering of fuel was taking place upon arrival (photo #01). We then headed to the control room to discuss the operation of the Scanship system and a review of records. We then headed down for a tour of the Scanship system. Next we looked at some of the areas of potential waste streams. Notification procedures were checked on the Bridge. Samples were pulled prior to finalizing the inspection and disembarking the vessel at about 12:35 pm.

Mr. Carl Hergeselle, Environmental Officer described his training and that of Mr. Jose Lecciones, Environmental Engineer and Scanship System Operator. Mr. Hergeselle has 20 years of experience, six of which have been as an Environmental Officer for Norwegian Cruise Lines, and has been with the Norwegian SUN since its initial voyage. Mr. Hergeselle is at the 2nd Engineer level and has training in all environmental aspects of the vessels. Mr. Lecciones has had training with Scanship on the system and has also been with the Norwegian SUN since 2001

While in the control room where the Scanship system is monitored (photos #02 & #04), we asked Mr. Lecciones and Mr. Hergeselle to go over the Scanship system with us. Both Mr. Lecciones and Mr. Hergeselle seemed very familiar with the system. Mr. Lecciones is basically operating the system or is on call. Other engineers also monitor the system. The Scanship system collects galley water, graywater, and shower water by pipes and blackwater (toilets) is collected by vacuum to a buffer tank. Wastewater then goes through pre-screening by splitting and going through the two drum screens (photo #05). Solids screened out go to the sludge tank (14S) while liquid moves to the two biofilm tanks (photo #06) for biological treatment. Coagulant is dosed and mixes in the two flocculation tanks (photo #08). Polymer (photo #11) is then added prior to settling in the two flotation units (photo #07). Solids float to the top in the flotation units and are sent to the sludge tank (14S) while decant is sent to the two polishing filters (photos #10 & #12) with fine mesh screens. Solid material collected from the polishing filters is sent back to the influent. Effluent from the polishing filters goes through two of three ultraviolet (UV) disinfection units (photo #14) in series prior to being discharged directly through an overboard port (photo #15) where approved to discharge continuously. If not in an area approved for discharge, effluent from the UV goes to a holding tank.

The UV system includes three units with 14 bulbs per unit. Metal Bright cleaner is dosed into the UV for cleaning two to three times/month or if UV intensity is low (alarmed). Bulbs are also cleaned about once every six months (manufacturer recommendation is once/year). There is one unit's worth of spares available (14). Lights show which bulbs are out/broken. All bulbs are replaced after every 10,000 hours of use.

An online continuous TSS monitor is used to measure the turbidity of the effluent. An alarm level is set at 30 TSS, which triggers the automatic shutdown of discharges and recycles the flow back through the system. The system has experienced the automatic shut down for short durations a couple of times a season typically when there is galley washing with chemicals. Mr. Hergeselle has been talking to galley staff about the effects. The TSS meter is calibrated by checking the reading with sample results. If the results were out of calibration, Scanship is notified and only they can calibrate the meter. Scanship is on board the ship periodically for checks and is scheduled to be on board this July. Scanship can also monitor the entire system on-line. At 10:28 am, the TSS meter read 3.9 mg/l.

Mr. Hergeselle stated that if TSS on the graywater is less than 150, they discharge (photo #17) at greater than four nautical miles and if the TSS is greater than 150, they discharge at 12 nautical miles out. This protocol is of serious concern in that in Washington waters, you can be greater than four nautical miles, but still be in State waters and Waters Subject to the MOU. This concern was pointed out to Mr. Hergeselle.

The protocol for sludge discharges is that if a discharge is necessary, the Environmental Officer verifies location as greater than 12 nautical miles from shore and outside the Olympic Coast National Marine Sanctuary with the bridge (twice) then unlocks the chained and lock overboard port (photo #16). Only the Environmental Officer has keys for all overboard ports. The latitude and longitudes are recorded in the *Sewage and Graywater Discharge Record Book* (photo #03) along with all other discharge records. A review of the Record Book appeared to show that discharges in the Seattle area did not begin this season until May 27, 2006, well after approval was granted. Discharge records were well kept and include dates, times, discharge locations, port locations, effluent type, volumes, speed, signatures and remarks.

The overboard ports all had locks on them and were labeled. Pipes and Scanship treatment components were also well labeled.

Mr. Lecciones maintains the system which includes process control. The biofilm and flotation tanks are checked daily by visual sample. The color is checked as well as a visual observation of whether or not the biofilm tank is foaming. Defoamer is added if foaming becomes apparent. Only one of the two biofilm tanks has the ability for visual checks, so if the visible tank needs defoamer, defoamer is also added to the other tank. The biofilm tanks are also monitored for oxygen dosing. The typical dose is 80%. If the oxygen gets below 40%, the biota typically would die off (not reported to have ever occurred). The flocculation tanks are monitored for pH (photo #09) which indicates polymer dosing requirements (pH is typically around six). Effluent from the UV is tested for chlorine residual daily. While chlorine is not used as disinfection, various cleaning products throughout the ship may contribute. The chlorine residual results have never been above the requirements. Chlorine is also used to clean the effluent line from the UV to the overboard discharge periodically. One liter of chlorine solution is used per 100 liters of water. The pools use chlorine, however, they discharge overboard greater than 12 nautical miles as needed.

Mr. Hergeselle, the Environmental Officer was able to correctly identify the appropriate number to call (The MOU requires "NWCA members to immediately self-report non-compliance with any provision of this MOU to the Department of Ecology at

the following 24-hour number: 425-649-7000.") The ship had a copy of the most current version of the amended MOU

Garbage and recycling is separated (photo #19) and sent to shore Aerosol is collected (photo #20) and sent to shore as hazardous waste. Fluorescent lights are crushed in a new Fluorescent Lamp Crushing System (photo #21) for mercury vapor removal. Food waste is collected and extracted The water is recycled and eventually, the decant and the extracted food waste (photo #23) is discharged outside of four nautical miles or 12 nautical miles (typically) Paper/cardboard, flowers, and some plastics are incinerated (photo #24). Glass is crushed, bagged and sent to shore Metals are compacted (photo #22) and sent to shore. Ash from the incinerator is bagged and sent to shore Hazardous wastes are labeled, collected, stored (photo #18), and then sent to shore for proper disposal (to Prince Rupert only). The photo area uses a silver recovery system (to less than five parts per million) and the wastes are collected (photo #26) and sent to shore. Laundry uses detergents and dry cleaning uses PERC (photo #25) which is also collected with the hazardous wastes and sent to shore The medical facility has wastes such as x-ray chemicals, sharps, blood and other wastes; which are collected in special red containers for proper disposal to shore. Pills are collected separately (photo #28) and sent to shore as medical waste

A Norovirus Test Kit was delivered to the ship about a week prior to the inspection. The kit is to be used for sampling the UV effluent, UV influent and influent to final filtration of the Scanship system during an outbreak of Norovirus (3%). The test kit was located in the medical facility (photo #28) and includes all needed supplies and directions for usage Mr. Hergeselle and Mr. Lecciones should review the procedures for the test in order to be able to conduct the testing upon an outbreak

Samples were taken (photo #30) for Biochemical Oxygen Demand (BOD 5-Day), Total Suspended Solids (TSS), pH, chlorine residual, fecal coliform and ammonia from the effluent of the UV disinfection at the discharge port. Mr Lecciones heated the port prior to sampling for a clean sample. The TSS monitor read 3 mg/l at the time of sampling (photo #29). The samples were put on ice immediately and were transported to AmTest laboratory in Redmond, Washington that afternoon Chain of Custody and sampling procedures were followed. All results are in Section F

Conclusions and Recommendations
The Scanship system appears to be functioning well The automatic shutdown during high TSS levels appears to be functioning properly

The staff was generally knowledgeable of the system.

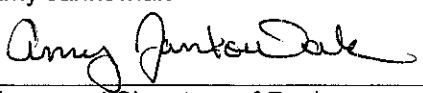
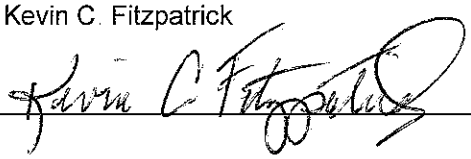
The system has experienced the automatic shut down for short durations a couple of times a season typically when there is galley washing with chemicals. It is recommended that staff continue to work with galley staff on ways to prevent chemical cleaning from disrupting the Scanship system.

Mr. Hergeselle stated that if TSS on the graywater is less than 150, they discharge at greater than four nautical miles and if the TSS is greater than 150, they discharge at 12 nautical miles out This protocol is of serious concern in that in Washington waters, you can be greater than four nautical miles, but still be in State waters. Discharging untreated graywater in Waters Subject to the MOU (which includes areas greater than 4 nautical miles) is not allowed nor is discharging treated graywater that would likely be above 30 TSS allowed This concern was pointed out to Mr. Hergeselle

Mr. Hergeselle and Mr. Lecciones should review the procedures for the Norovirus Test Kit in order to be able to conduct the testing upon an outbreak.

Attachments:
Photographs
Sampling Results Report

Copies to:
Randy Fiebrandt, NCL
Carl Hergeselle, Environmental Officer env02@ncl.com
Amy Jankowiak, Ecology
Frank Meriwether, Health
Kevin Fitzpatrick, Ecology
Central Files: Norwegian Cruise Lines - NORWEGIAN SUN; WQ 6.1

Section H: Signatures		
Name and Signature of Inspector Amy Jankowiak 	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	Date 8/10/06
Name and Signature of Reviewer Kevin C. Fitzpatrick 	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Section Manager/ (425) 649-7033	Date 8/10/06

State of Washington Department of Ecology

Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges

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

Section A: General Information

Vessel Name:	OOSTERDAM	Date:	July 22, 2006
Vessel Operator:	Holland America Line	Entry Time:	9:19 AM
IMO Number:	9221281	Exit Time:	12:05 PM
Vessel Type:	Passenger Ship	Notification (name & date):	John Turvey, 7/19/06
Location:	Pier 30, Seattle		
On-board contact(s):	John Turvey, Senior Manager/Auditing Douglas Weeks, Manager, Special Projects David Bass, Environmental Officer Ryan Torres, Rochem systems operator		
Inspector(s):	Amy Jankowiak, Department of Ecology; Kevin Fitzpatrick, Department of Ecology		
# passengers/crew:	Actual ~1800/~650	Amount of Wastewater:	GW ~ 34m^3/hr BW ~14m^3/hr

Description of advanced wastewater treatment system (name, type, major components, etc):
Rochem Advanced Waste Water Purification System. The Rochem greywater system includes prefiltration, reverse osmosis and UV disinfection. The Rochem blackwater system includes prefiltration, biological treatment via bioreactors, ultrafiltration, and UV disinfection. Approval for discharge at greater than one nautical mile away from port and at greater than six knots from Ecology was granted in July 2004, June 2005 and June 22, 2006.

Section B: Areas Evaluated

☒	Black/Gray wastewater system	☒	Operations Center/ Computer system	☒	Records/Reports	☒	Sampling/Monitoring
☒	Discharge locations	☒	Operations & Maintenance	☒	Sludge Handling/Disposal	☒	Other

Section C: For vessels discharging ≥ 1nm from berth and ≥ 6 knots only

☒	Schematics match black/gray wastewater system	Yes.
☒	Sludge disposal protocol per MOU	Yes. Biomass (sludge) is discharged at > 12 nautical miles and outside of the Olympic Coast National Marine Sanctuary. The overboard port is padlocked until location with bridge is confirmed.
☒	Notification procedures (for contacting Ecology of non-compliance) in place	Yes. Notification numbers and procedures known and available.

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)

☐	Schematics match black/gray wastewater system	Not Applicable
☐	Sludge disposal protocol per MOU	Not Applicable
☐	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	Not Applicable
☐	Operations as described in submitted documentation	Not Applicable
☐	Daily 24-hour continuous turbidity or equivalent monitoring	Not Applicable
☐	Turbidimeter or equivalent monitoring equipment functioning properly	Not Applicable
	Turbidity or equivalent : Not applicable Last calibration Frequency of readings: Trigger level for alarm: Trigger level for shutdown: Recorded turbidity/equivalent levels above triggers:	
☐	Auto shut down or operational controls to insure system shut down if a system upset occurs	Not Applicable
☐	Ultraviolet (UV) light disinfection immediately prior to discharge	Not Applicable

☐	UV replacement bulbs available	Not Applicable
☐	UV/bulbs cleaned regularly	Not Applicable

Section E: General		
☒	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	As of the date of the inspections, sampling has been conducted as required
☒	Whole Effluent Toxicity Testing 1 per 2 years	WET testing was conducted in 2005.
☒	Training up to date for system operators	
☒	Discharge records maintained	Did not discuss during this inspection.
☒	Alarms functioning properly	Alarms appear to be functioning properly.
	Alarms Shutdowns: not applicable High turbidity/TSS warnings: High wastewater levels: UV disinfection (intensity, bulbs, bank out, power failure):	

Section F: Sample Results

Parameter	Effluent Result
Biochemical Oxygen Demand 5-Day (BOD)	<10 mg/l
Total Suspended Solids (TSS)	2.0 mg/l
Fecal Coliform, MF	<1 CFU/100ml
Residual Chlorine)	<.01 mg/l
Ammonia, Nitrogen	28 mg/l
pH	7.25 Standard Units

Section G: Summary of Findings/Comments

Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program, Municipal Compliance Specialist and Kevin Fitzpatrick, Ecology, Northwest Regional Office, Water Quality Program conducted the inspection on July 22, 2006. The main contacts on board the HOLLAND OOSTERDAM included John Turvey, Senior Manager/Auditing, Douglas Weeks, Manager, Special Projects, David Bass, Environmental Officer, and Ryan Torres, Rochem systems operator. Prior notification of the visit was given on July 19, 2006 for security protocol. The purpose of the inspection was to evaluate the operating conditions of Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the *Memorandum of Understanding Cruise Operations in Washington State*, as amended. The HOLLAND OOSTERDAM received approval to discharge at greater than one nautical mile from shore and at greater than six knots in July 2004, June 2005 and June 22, 2006.

The HOLLAND OOSTERDAM (photo #01) was built in 2002, and is 936 feet long with a width of 106 feet and a maximum draft of 26 feet. There are typically about 1800 passengers and about 650 crew. The ship's wastewater systems', Rochem, were installed in 2002.

Inspection

We arrived boarded the ship at about 9:19 am and began with introductions and a plan for the day. We then headed to the control room where the Rochem systems are monitored (photos #02 and #03), to discuss the operation of the systems and to review records. We then headed to the bridge to review discharge protocols (photo #06) and to view the Norovirus test kit which was just sent to the ship. Next we looked at some of the garbage/recycling area. We then headed down to the Rochem systems and took samples of the combined treated blackwater and graywater effluent. The handling of medical wastes was observed in the infirmary prior to disembarking the vessel at about 12:05 pm. During the inspection, the OOSTERDAM was testing their shore power hook-up

Discharge Protocols:

The effluent from the graywater system and the blackwater system is combined prior to discharge. The protocol for discharging treated effluent from the Rochem systems is to verify with the bridge that they are greater than one nautical mile from berth, verify the operating condition of the Rochem systems and then double check the location from the bridge prior to discharge. The discharge location is logged on the bridge as well as in the blackwater and graywater discharge record book in the control room. The Environmental Officer also does weekly checks of the bridge logs for verification. If the vessel needs to hold their discharge, for example while at port, once the vessel is underway and greater than one nautical mile from shore, the effluent in the holding tanks is then all discharged. There are locks on all overboard ports other than the

graywater/blackwater treated effluent port. The Second Engineer and the Control Room Watch Keepers have keys to the overboard locks Pool water (with bromine addition) is discharged overboard via bridge protocol Biomass (sludge) is sent to a holding tank and then discharged at greater than 12 nautical miles. It should be clear that you can be greater than 12 nautical miles from shore, but still inside the "Waters Subject to the MOU". Staff was aware of the requirements not to discharge biomass until outside of the Strait of Juan de Fuca and outside of the Olympic Coast National Marine Sanctuary, Area To Be Avoided, and maps (photo #08) located on the bridge did indicate no discharges in the Olympic Coast National Marine Sanctuary, Area To Be Avoided, however, the discharge protocol sheet on the bridge was not as clear (photo #7). The "OOSTERDAM Overboard Discharge Matrix Incl. Boiler-incinerator Alaska 2006" lists distances off land for discharges of untreated gray water, Bio Mass, and Ground/Liquid Waste as >12 miles. It is recommended that these descriptions be clarified to match the requirements of the MOU.

Graywater System:
Laundry water and passenger shower/sink wastewater goes into the graywater holding tank and is sent to the low pressure reverse osmosis (LP-RO) treatment system. The graywater is dechlorinated prior to entering prefiltration due to cleaning chemicals. After dechlorination, the flow enters prefiltration (photo #12) and then goes to the LP-RO units (photo #11). Screenings from the prefiltration are collected (photo #13) and sent to incineration. The LP-RO system consists of four different units The number of units used can be changed depending on need. The pore size in this LP-RO system is reported to be about 0.001 microns, which is smaller than viruses. Effluent from the LP-RO system goes to a permeate tank and then onto ultraviolet (UV) disinfection. PH is adjusted with sodium acid and caustic soda From the UV, the flow can either go straight overboard (photo #17) after being combined with the blackwater system effluent, or can go to storage tanks

Blackwater System:
Toilet waste, Galley waste, infirmary drains and crew waste goes to a buffer tank and then onto the blackwater treatment system (Rochem UF; ultrafiltration). From the buffer tank, flow goes to prefiltration Solids are vibrated out and sent to incineration. PH is adjusted with caustic soda after prefiltration Liquid from the prefiltration filtrate tank goes to the bioreactors. From the bioreactors, flow goes through the membranes for ultrafiltration (UF). According to information from Rochem, the pore size on its UF system is about 0.025 microns, which is close to the middle of the range of diameter sizes for viruses. Effluent from the membranes is disinfected via a separate UV system (photo #15). From the UV, the flow can either go straight overboard after being combined with the graywater system effluent, or can go to storage tanks. TSS is monitored on the effluent of the blackwater system and is alarmed at 15 mg/l and 25 mg/l (photo #04)

Rochem Maintenance and Process Control:
The graywater and blackwater prefiltration system (SWECO) is manually cleaned about every two weeks with chemicals The reverse osmosis system filters are changed out daily and the membranes are cleaned automatically about every 50-60 hours. They are also acid washed manually about every 500 hours The UV systems are both inspected and cleaned about once a month. To do so, the system is shut down or flow is re-routed back-through the system. The quartz sleeves are acid cleaned and dried with air. Spare bulbs are available (an inventory of about 24). The UV lights are replaced annually. The blackwater system ultra filters are cleaned manually with caustic and acid based on pressure/flow gauges. The trans-membrane pressure and flux (flow through) is also checked on the ultra filters. Sensors on the biodigesters on the blackwater system are checked for verification of the system. Air as well as the water jets are checked weekly The TSS and turbidity monitors (photo #14) are checked manually about once a month. They are taken out to see if the wipers are working okay and measurements are checked for calibration If the readings on turbidity or TSS are high, all units are checked and the system is shut down if necessary. High readings are typically related to dirty wipers on the monitors. There is a chlorine monitor on the graywater system for the purpose of adjusting dechlorination Measurements for pH are taken on the blackwater system before the bioreactors and on the graywater system after treatment. Staff relies on the sensors and how the final effluent looks as well as weekly sampling results from samples taken in Juneau Rochem receives sampling results and is on board the ship about every six months. Rochem is also responsive to questions

Other waste streams:
Garbage, recycling and hazardous waste is separated (photo #09) and sent to shore in Victoria Aerosol is collected (photo #10) and sent to shore as hazardous waste Food waste is collected and burned. Bio-hazardous medical waste (red bagged) is collected (photo #19) and sent to shore. Non-hazardous medical waste (photo #20) is incinerated. Leftover/expired medications are typically collected and off-loaded to shore (rarely are the medications destroyed on board, if so, to medical drains and the blackwater system) Hazardous wastes are labeled, collected, stored, and then sent to shore for proper disposal. The photo area uses a silver recovery system (to less than five parts per million) and the wastes are collected and sent to shore Dry cleaning uses PERC which is also collected with the hazardous wastes and sent to shore

Sampling:
A Norovirus Test Kit (photo #05) was just delivered to the ship. The kit is to be used for sampling the UV effluent, UV influent and influent to final filtration of the Rochem systems during an outbreak of Norovirus (3%). The test kit was located on the bridge and includes all needed supplies and directions for usage. It was recommended that Mr. Bass and Mr. Torres review

the procedures for the test in order to be able to conduct the testing upon an outbreak.

Samples were taken (photo #16) for Biochemical Oxygen Demand (BOD 5-Day), Total Suspended Solids (TSS), pH, chlorine residual, fecal coliform and ammonia from the combined effluent of the UV disinfection systems. The samples were put on ice immediately and were transported to AmTest laboratory in Redmond, Washington that afternoon. Chain of Custody and sampling procedures were followed. All results are in Section F.

Conclusions and Recommendations
Mr. Torres and Mr. Bass seemed very knowledgeable of the system

The Rochem systems appear to be functioning well.

It should be clear that you can be greater than 12 nautical miles from shore, but still inside the "Waters Subject to the MOU". Staff was aware of the requirements not to discharge biomass until outside of the Strait of Juan de Fuca and outside of the Olympic Coast National Marine Sanctuary, Area To Be Avoided, and maps located on the bridge did indicate no discharges in the Olympic Coast National Marine Sanctuary, Area To Be Avoided, however, the discharge protocol sheet on the bridge was not as clear. The "OOSTERDAM Overboard Discharge Matrix Incl. Boiler-incinerator Alaska 2006" lists distances off land for discharges of untreated gray water, Bio Mass, and Ground/Liquid Waste as >12 miles. It is recommended that these descriptions be clarified to match the requirements of the MOU

Attachments:
Photographs
Sampling Results Report

Copies to:
John Turvey, HAL
David Bass, Environmental Officer
Amy Jankowiak, Ecology
Frank Meriwether, Health
Kevin Fitzpatrick, Ecology
Central Files: Holland America Line – HOLLAND OOSTERDAM; WQ 6.1

Section H: Signatures		
Name and Signature of Inspector Amy Jankowiak Amy Jankowiak	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	Date 8/23/06
Name and Signature of Reviewer Kevin C. Fitzpatrick Kevin C. Fitzpatrick	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Section Manager/(425) 649-7033	Date 8/23/06

State of Washington Department of Ecology

Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges

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

Section A: General Information			
Vessel Name:	DAWN PRINCESS	Date:	July 22, 2006
Vessel Operator:	Princess Cruises	Entry Time:	1:03 PM
IMO Number:	9103496	Exit Time:	2:37 PM
Vessel Type:	Passenger Ship	Notification (name & date):	Leslie Geiger, 7/19/06
Location:	Pier 30, Seattle		
On-board contact(s):	Duncan McGregor, Environmental Officer		
Inspector(s):	Amy Jankowiak, Department of Ecology; Kevin Fitzpatrick, Department of Ecology		
# passengers/crew:	~2000/~875 capacity	Amount of Wastewater:	~420m^3/day - combined

Description of advanced wastewater treatment system (name, type, major components, etc.):
Hamworthy is a biological reactor and ultrafiltration system. The system includes screening via a screen press, biological treatment via bio-reactors with inter-stage filters and a membrane system, and ultraviolet light disinfection Approval for continuous discharge from Ecology was granted on May 4, 2006, although the vessel chooses not to discharge in Washington waters at this time.

Section B: Areas Evaluated							
☒	Black/Gray wastewater system	☒	Operations Center/ Computer system	☒	Records/Reports	☒	Sampling/Monitoring
☒	Discharge locations	☒	Operations & Maintenance	☒	Sludge Handling/Disposal	☒	Other

Section C: For vessels discharging ≥ 1nm from berth and ≥ 6 knots only		
☐	Schematics match black/gray wastewater system	Not Applicable
☐	Sludge disposal protocol per MOU	Not Applicable
☐	Notification procedures (for contacting Ecology of non-compliance) in place	Not Applicable

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)		
☒	Schematics match black/gray wastewater system	System appears to be as depicted in schematics.
☒	Sludge disposal protocol per MOU	All screen press material is incinerated and all other sludge from the Hamworthy system are discharged at >12nm.
☒	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	Yes Proper notification procedures known and available.
☒	Operations as described in submitted documentation	Operations appeared to be as described in submitted documentation.
☒	Daily 24-hour continuous turbidity or equivalent monitoring	Continuous turbidity monitoring.
☒	Turbidimeter or equivalent monitoring equipment functioning properly	Appears to be functioning properly.
	Turbidity or equivalent : Yes Last calibration: ~1/year Frequency of readings: continuous Trigger level for alarm: Trigger level for shutdown: Yes, appears to be set at 5 Recorded turbidity/equivalent levels above triggers: Yes, typically wipers need cleaning.	
☒	Auto shut down or operational controls to insure system shut down if a system upset occurs	Yes.
☒	Ultraviolet (UV) light disinfection immediately prior to discharge	Yes.
☒	UV replacement bulbs available	Yes. There are two full sets of 6 bulbs each available on board.
☒	UV/bulbs cleaned regularly	Yes. Wiper cleaned and hand wiped with Lime Away about once a week.

Section E: General		
☒	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	As of the date of the inspections, sampling has been conducted as required.
☒	Whole Effluent Toxicity Testing 1 per 2 years	Not required yet, in first year.
☒	Training up to date for system operators	Yes
☒	Discharge records maintained	Maintained properly.
☒	Alarms functioning properly	Alarms appear to be functioning properly.
	Alarms Shutdowns: Yes High turbidity/TSS warnings: Yes High wastewater levels: Yes UV disinfection (intensity, bulbs, bank out, power failure): Yes	

Section F: Sample Results

Parameter	Effluent Result
Biochemical Oxygen Demand 5-Day (BOD)	78 mg/l
Total Suspended Solids (TSS)	<1 mg/l
Fecal Coliform, MF	<1 CFU/100ml
Residual Chlorine	<0.1 mg/l
Ammonia, Nitrogen	35 mg/l
pH	7.15 Standard Units

Section G: Summary of Findings/Comments

Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program, Municipal Compliance Specialist and Kevin Fitzpatrick, Ecology, Northwest Regional Office, Water Quality Program conducted the inspection on July 22, 2006. The main contact on board the DAWN PRINCESS was Duncan McGregor, Environmental Officer. Prior notification of the visit was given on July 19, 2006 for security protocol. The purpose of the inspection was to evaluate the operating conditions of Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the *Memorandum of Understanding Cruise Operations in Washington State*, as amended. The DAWN PRINCESS received approval to discharge continuously per the MOU on May 4, 2006.

Inspection

We arrived and boarded the ship (photo #01) at about 1:03 pm and began with introductions and a plan for the day. We then headed to the control room to discuss the operation of the Hamworthy system and a review of records. We also took a look at the sampling and testing laboratory. We then headed down for a tour of the Hamworthy system. Next we looked at some of the areas of potential waste streams. Samples were pulled prior to finalizing the inspection and disembarking the vessel at about 2:37 pm.

While in the control room area where the Hamworthy system is monitored (photo #08), we asked Mr. McGregor, Environmental Officer, to go over the Hamworthy system with us. Mr. McGregor seemed very familiar with the system. Mr. McGregor, along with two "plumbers", basically operate the system. Other staff also monitors the system. The Hamworthy system collects blackwater by vacuum and graywater by gravity. Galley gray water and pool/Jacuzzi water are the only liquid streams not included. Galley graywater and pool water are discharged at greater than 12 nautical miles. Gray water is collected into two gray water buffer tanks (photo #17). Blackwater is given preference going to the Hamworthy system, and then as flow allows, graywater is added. All of the graywater to the buffer tanks eventually goes through the Hamworthy system. Anti-foam is added as needed at the vacuum tank (evac tank).

There are three separate Hamworthy systems and they then combine prior to disinfection. Wastewater enters the Hamworthy system at the screen press (photo #11) where solids are screened out to bags. The screened solids are then sent to the incinerator. The liquid moves to the 1st stage of the membrane bioreactor (MBR) (photo #12) where aeration occurs. From the 1st stage, flow moves to the inter-stage filters (photos #14 and #15) ("Russell bag"), then onto the 2nd stage of the MBR for further aeration. From the 2nd stage MBR, flow is sent to the membrane modules for ultrafiltration. Solids from the filters are sent back to the 2nd stage MBR. Effluent is sent to holding tanks which allow continuous flow to the ultraviolet (UV) disinfection system (photo #16). Disinfected effluent either goes directly overboard or to a holding tank if in an area not approved for discharge.

Turbidity is measured continuously before the permeate tank/UV (photo #13). Total Suspended Solids (TSS) measured on

the effluent of the Hamworthy system The turbidity is alarmed at about five (photo #09) and then automatically shuts down the discharge. Samples are taken and ran weekly on board the vessel with the use of a small laboratory Coliform is tested with a Quanti-tray type method (photo #02) TSS is measured with a Hach meter (photo #04). COD is tested using a standard Hach COD Digestion Reagent Vials (photo #03) PH is measured with a meter (photo #05) as is chlorine The results are typically within the ideal ranges and if not, retesting takes place and measures are taken to work out the problem. If TSS is out of range, air pressure and sludge rates can be adjusted. Maintenance on the system includes occasional maintenance on the screen press, checks on the diffusers/air of the MBR's daily, manual cleaning (daily) and changing out of filter bags, cleaning of the UV system. The UV system is wiper cleaned as well as being hand wiped with "Lime Away" about once a week There are about two full sets (12 total) of spare bulbs for the UV system In order to clean the UV, the flow is re-circulated through the Hamworthy system. Calibration of instruments occurs as needed. It is recommended that the manufacturer recommendations be reviewed for all meters and instruments to assure that calibration is being done as needed. Hamworthy representatives are on board at least once a year and as necessary The Hamworthy staff is easy to reach for questions

All overboard ports for the Hamworthy system, including sludge, are padlocked (photo #10). The keys to the padlocks are kept in a locked cabinet (photo #07) in the control room The Chief Technical Officer and Watch Officers are the only staff with a key to the locked cabinet for the overboards. This system is especially noteworthy for its simplicity and fool-proof method in preventing unauthorized overboard discharges. While the DAWN PRINCESS is approved for continuous discharge in Washington waters, the vessel chooses NOT to discharge while in Washington waters. The protocol is to discharge Hamworthy effluent outside of Washington waters. Sludge from the Hamworthy system MBR's is discharged at greater than 12 nautical miles, while screened solids are incinerated. While Mr. McGregor seemed very familiar with the details of the MOU, it should be clear where the "Waters Subject to the MOU" start and stop It is possible to be greater than 12 nautical miles from shore, but still be in "Waters Subject to the MOU" and inside Washington waters. Notification procedures for non-compliance with the MOU were well known and available

Discharge records (photo #06) were reviewed and are well kept. The records include dates, times, discharge locations, port locations, effluent type, volumes, speed, signatures and remarks

Areas of potential waste streams were looked at or discussed. Photo waste is collected and run though a silver recovery system (photo #18). The silver waste is collected and stored (photo #19) and the non hazardous waste is sent to the incinerator. Garbage and recyclable material is sorted and stored (photo #20) to be incinerated or sent to shore. Cardboard, paper, flowers, and other materials safe for incineration are sent to the incinerator which is not run while at port. Food waste is collected and discharged at greater than 12 nautical miles. Glass is collected and crushed (photo #21). Light bulbs are collected and off-loaded to shore whole. Hazardous waste is collected, labeled and stored (photo #22) to be off-loaded about monthly in Seattle via "Clean Harbors" transport. Materials such as PERC from dry cleaning, oils, adhesives, and other chemicals are included as hazardous waste. Medical waste that has been red-bagged is typically incinerated except for sharps which are off-loaded. X-rays from the infirmary are done digitally

A new Norovirus Test Kit had yet to be delivered to the ship. The kit is to be used for sampling the UV effluent, UV influent and influent to final filtration of the Hamworthy system during an outbreak of Norovirus (3%). Once the kit is on board, Mr McGregor should review the procedures for the test in order to be able to conduct the testing upon an outbreak.

Samples were taken for Biochemical Oxygen Demand (BOD 5-Day), Total Suspended Solids (TSS), pH, chlorine residual, fecal coliform and ammonia from the effluent of the UV disinfection prior to going to the holding tank (photo #23). Mr McGregor cleaned the sample port for a clean sample. Mr. McGregor also took samples of his own at the same time (photo #24) The samples were put on ice immediately and were transported to AmTest laboratory in Redmond, Washington that afternoon. Chain of Custody and sampling procedures were followed All results are in Section F.

Conclusions and Recommendations

The Hamworthy system appears to be functioning well

The weekly testing on-board is an excellent way to monitor and make needed adjustments to the system. Having a laboratory on-board for the testing is ideal.

The overboard port locks and the system in place for discharges is a secure method.

Mr. McGregor is very knowledgeable of the Hamworthy system as well as the other environmental impacts of the vessel

It is recommended that calibration manufacturer recommendations be reviewed and implemented as required.

While the DAWN PRINCESS is approved for continuous discharge in Washington waters, the vessel chooses NOT to discharge while in Washington waters. The protocol is to discharge Hamworthy effluent outside of Washington waters.

Sludge from the Hamworthy system MBR's is discharged at greater than 12 nautical miles. While Mr. McGregor seemed very familiar with the details of the MOU, it should be clear where the "Waters Subject to the MOU" start and stop. It is possible to be greater than 12 nautical miles from shore, but still be in "Waters Subject to the MOU" and inside Washington waters.

Attachments:
Photographs
Sampling Results Report
MBR Schematic

Copies to:
Leslie Geiger, Princess Cruises
Duncan McGregor, DAWN PRINCESS
Amy Jankowiak, Ecology
Frank Meriwether, Health
Kevin Fitzpatrick, Ecology
Central Files: Princess Cruises- DAWN PRINCESS; WQ 6 1

Section H: Signatures		
Name and Signature of Inspector Amy Jankowiak Amy Jankowiak	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	Date 8/23/06
Name and Signature of Reviewer Kevin C. Fitzpatrick Kevin C. Fitzpatrick	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Section Manager/(425) 649-7033	Date 8/23/06

State of Washington Department of Ecology

Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges

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

Section A: General Information

Vessel Name:	NORWEGIAN STAR	Date:	July 30, 2006
Vessel Operator:	NCL (Bahamas) Ltd	Entry Time:	9:30 AM
IMO Number:	9195157	Exit Time:	11:25 AM
Vessel Type:	Passenger Ship	Notification (name & date):	Randy Fiebrandt, 7/25/06
Location:	Pier 66, Seattle		
On-board contact(s):	Jan Nilsen, Environmental Officer; Delfin Josen, Scanship System Operator		
Inspector(s):	Amy Jankowiak, Ecology Northwest Regional Office, Water Quality Program; Marietta Sharp, Ecology Northwest Regional Office, Solid Waste Program		
# passengers/crew:	Actual: ~2600/~1100	Amount of Wastewater:	40-50 m^3/hr

Description of advanced wastewater treatment system (name, type, major components, etc):
Scanship is a biological reactor and ultrafiltration system The system includes prefiltration, biological treatment via a biofilm process, chemical precipitation, clarification through flotation tanks, polishing filtration and UV disinfection Approval for continuous discharge from Ecology was granted in 2004, 2005 and May 4, 2006

Section B: Areas Evaluated

☒	Black/Gray wastewater system	☒	Operations Center/ Computer system	☒	Records/Reports	☒	Sampling/Monitoring
☒	Discharge locations	☒	Operations & Maintenance	☒	Sludge Handling/Disposal	☒	Other (oil spill notification drill, debunking)

Section C: For vessels discharging ≥ 1nm from berth and ≥ 6 knots only

☐	Schematics match black/gray wastewater system	NA
☐	Sludge disposal protocol per MOU	NA
☐	Notification procedures (for contacting Ecology of non-compliance) in place	NA

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)

☒	Schematics match black/gray wastewater system	System is as depicted in schematics
☒	Sludge disposal protocol per MOU	Discharges 12 nm out and outside of the Olympic Coast National Marine Sanctuary Area to Be Avoided per stated protocol.
☒	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	Notification numbers were known and a copy of the current MOU was available on board
☒	Operations as described in submitted documentation	Operations were as described
☒	Daily 24-hour continuous turbidity or equivalent monitoring	Has continuous TSS monitoring
☒	Turbidimeter or equivalent monitoring equipment functioning properly	Appears to be functioning properly Details in narrative
	Turbidity or equivalent Last calibration: not sure Frequency of readings: continuous Trigger level for alarm: 25 Trigger level for shutdown: 30 Recorded turbidity/equivalent levels above triggers: Yes	

☒	Auto shut down or operational controls to insure system shut down if a system upset occurs	Automatic shutdown appears to be operating properly
☒	Ultraviolet (UV) light disinfection immediately prior to discharge	3 UV banks run in series for effluent with 14 bulbs each. There is a holding tank available after UV if holding the discharge.
☒	UV replacement bulbs available	There is one unit's worth of spares available (14).
☒	UV/bulbs cleaned regularly	Yes, the units are cleaned by dosing Metal Bright at a set point of about every 2-3 days. Hand wiping of the bulbs is not done.

Section E: General		
☒	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	As of the date of the inspection, sampling has been conducted as required.
☒	Whole Effluent Toxicity Testing 1 per 2 years	Acute WET testing was conducted in 2005 and Chronic WET testing in 2006.
☒	Training up to date for system operators	Scanship conducts training on the ship during start-up of the system
☒	Discharge records maintained	Maintained properly.
☒	Alarms functioning properly	Alarms appear to be functioning properly.
	Alarms Shutdowns: Yes High turbidity/TSS warnings: Yes High wastewater levels: Yes UV disinfection (intensity, bulbs, bank out, power failure): Yes	

Section F: Sample Results

Parameter	Effluent Result
Biochemical Oxygen Demand (BOD 5-Day)	6.30 mg/l
Total Suspended Solids (TSS)	1.0 mg/l
Fecal Coliform (MF)	<1 CFU/100ml
Residual Chlorine	<0.1 mg/l
Ammonia, Nitrogen	28 mg/l
pH	7.40 standard units

Section G: Summary of Findings/Comments

Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program, Municipal Compliance Specialist and Marietta Sharp, Ecology, Northwest Regional Office, Solid Waste and Financial Assistance Program, Biosolids Specialist conducted the inspection on July 30, 2006. The main contacts on board the NORWEGIAN STAR included Jan Nilsen, Environmental Officer and Delfin Josen, Scanship System Operator. Prior notification of the visit was given on July 25, 2006 for security protocol. The purpose of the inspection was to evaluate the operating conditions of Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the *Memorandum of Understanding Cruise Operations in Washington State* (MOU), as amended. The NORWEGIAN STAR received approval to discharge continuously per the MOU in 2004, 2005 and on May 4, 2006.

The NORWEGIAN STAR was built in 2001, is 965 feet long with 15 guest decks, with about a 28-foot draft. Passenger capacity is 4080 total passenger berths. There are typically about 2600 passengers and 1100 crew. It is my understanding that the ship's wastewater system, Scanship, was installed in 2004.

Inspection

We arrived boarded the ship at 9:30 am and began with introductions and a plan for the day. We then headed to the control room to discuss the operation of the Scanship system and a review of records. We looked at some of the areas of potential waste streams. We then headed down for a tour of the Scanship system. Samples were pulled prior to finalizing the inspection and disembarking the vessel at about 11:25 am.

Mr. Nilsen has been with Norwegian Cruise Lines since 1971 and has been the Environmental Officer for four years. Mr Josen has been with NCL for one and a half years and has been working with the Scanship system for about a month. Mr. Josen's training included on the job training for three weeks with the environmental engineer. Mr. Josen has yet to work with

the Scanship representatives

While in the control room where the Scanship system is monitored, we asked Mr. Nilsen and Mr. Josen to go over the Scanship system with us and to describe maintenance for the system. Both Mr. Nilsen and Mr. Josen seemed very familiar with the system. The Scanship operates in basically this sequence: prescreening (2 drum screens), biological treatment (biofilm on rotating plastic pieces – 2 tanks in series), chemical precipitation (flocculants, polymer), clarification via flotation tanks (2 tanks), ultrafiltration via polishing filters (2 rotating mesh drums), and disinfection via ultraviolet light (UV).

Maintenance on the drum screens (photo #01) includes weekly washing with high pressure water, calibrating the pH sensor, regular checks of the screens, and oiling the gears and bearings as needed. The various pumps throughout the system are maintained by greasing and changing over which pumps are used monthly. The bioreactors (photo #02) are checked for the need of anti-foam by looking at the color. If it is pale, more antifoam is added, if it is brown, it is okay. The blowers on the bioreactors are always on at 100%. The Flocculation tanks are checked and the pH sensor is calibrated (with buffers of 4 and 7). The flotation tanks (photo #03) are cleaned with high pressure water once a week. The bearings are greased as needed. Mr. Josen also uses a container to dip into the tank to check the water clarity which should be relatively clear. The polishing filters (photos #04 & #05) are also cleaned with high pressure water weekly, greased as needed and once a month, chlorine is added (0 5 liters mixed with water). The dispersion units (for flotation) are checked for air pressure regularly. The UV system includes 3 units of 14 bulbs each which are cleaned by dosing the "Metal Bright" solution by set point about every 2-3 days. No hand wiping occurs. It is recommended, as it was in last years inspection report, to closely review the manufacturers recommendations for cleaning the UV system as hand wiping is commonly required to prevent scaling. The bulbs are changed as needed and there is one set (14 bulbs) of spares on board.

An online continuous TSS monitor is used to measure the turbidity of the effluent. An alarm level is set at 25 mg/l TSS, and a TSS of 30 mg/l triggers the automatic shutdown of discharges which sends the flow to the clean holding tank for discharge at greater than 12 nautical miles. The system has experienced the automatic shut down for short durations throughout the season typically when cleaning the filters or if there is a lot of ship movement. The TSS sensors are cleaned, the flotation units are checked for clarity and the discharge restarts when the TSS falls below 25 mg/l again. At the time of inspection, TSS read 1.1 mg/l. Since Mr. Josen has been working with the system, a calibration of the TSS meter has not occurred. Mr. Josen mentioned that he has been reading through all of the systems manuals. It was recommended that as calibrations occur, per manufacturer's recommendations, they be recorded in a log book.

Sludge from the drum screens and the flotation tanks is sent to tank 15S. Air is added at a constant 100%. The decanter separates the sludge and the water. The liquid goes to tank 18P which is the tank where gray water and black water are collected prior to the Scanship system. The solids are dewatered and sent to a holding tank. When that tank is at a certain level, the solids are sent to the dryer where steam does the work. The dryer has a humidity sensor that sometimes breaks down. The sludge system is checked regularly and parts are greased as necessary. From the dyer, the solids go to a tank and onto the incinerator. The incinerator is typically started up about an hour after leaving port and takes an hour to get hot. There is not enough volume in the dryer to process all of the sludge, so some of it is discharged at greater than 12 nautical miles and outside the Olympic Coast National Marine Sanctuary. About 30% is incinerated and about 70% is discharged.

The latitude and longitudes are recorded in the *Sewage and Graywater Discharge Record Book* along with all other discharge records. Discharge records were well kept and include dates, times, discharge locations, port locations, effluent type, volumes, speed, signatures and remarks. When discharging sludge, a call is made from the bridge verifying appropriate location. The bridge included maps showing areas of allowed discharges. Proper notification procedures for non-compliance of the MOU were posted on the bridge. Pool and Jacuzzi water which uses chlorine is discharged at greater than 12 nautical miles overboard.

Food waste is sent (photos #06 & #07) to two tanks for pulp. Water from the food waste is sent to a tank and then recycled to the pulpers. Occasional discharge of the recycle water is necessary and that flow goes through the Scanship system (graywater) prior to discharge. The food waste itself is discharged from the tanks (photos #10 &#11) at greater than 12 nautical miles. Garbage and recycling is separated (photo #08) and sent to shore. Grease from the food waste is separated, collected and disposed of on-shore. Fluorescent lights are crushed in a Fluorescent Lamp Crushing System for mercury vapor removal. Ash from the incinerator is bagged (photo #09) and sent to shore. Hazardous wastes are labeled, collected, stored and then sent to shore for proper disposal (Victoria). Aluminum cans are the only waste materials off-loaded in Seattle.

Oily bilge water is sent to a dirty bilge tank and then onto the Marinfloc for separating oil. Waste from the Marinfloc is off-loaded and liquid flow goes to the Clean bilge tank and onto the oily water separator. From the oily water separator, the oil content is again measured in the locked "white box". If the parts per million exceed 15, there the discharge valve closes and sends the waste either to the clean bilge tank where it then again goes through the oily water separator or it can be sent all the way back to the dirty bilge tank. Approximately 5 5 cubic meters of oily sludge along with cooking oil is incinerated per week.

A newer Norovirus Test Kit should have been delivered to the ship or will be delivered shortly. The kit is to be used for sampling the UV effluent, UV influent and influent to final filtration of the Scanship system during an outbreak of Norovirus (3%). Mr. Nilsen and Mr. Josen should review the procedures for the test in order to be able to conduct the testing upon an outbreak.

Samples were taken for Biochemical Oxygen Demand (BOD 5-Day), Total Suspended Solids (TSS), pH, chlorine residual, fecal coliform and ammonia from the effluent of the UV disinfection at the discharge port. The samples were put on ice immediately and were transported to AmTest laboratory in Redmond, Washington that afternoon. Chain of Custody and sampling procedures were followed All results are in Section F.

Conclusions and Recommendations
The Scanship system appears to be functioning well. The automatic shutdown during high TSS levels appears to be functioning properly.

The staff was generally knowledgeable of the system

The UV disinfection system is cleaned by dosing the "Metal Bright" solution by set point about every 2-3 days, however no hand wiping occurs It is recommended, as it was in last year's inspection report, to closely review the manufacturer's recommendations for cleaning the UV system Hand wiping is commonly required to prevent scaling.

It was recommended that as calibrations occur, per manufacturer's recommendations, they be recorded in a log book.

Mr Nilsen and Mr Josen should review the procedures for the Norovirus Test Kit in order to be able to conduct the testing upon an outbreak.

Attachments:
Photographs
Sampling Results Report
Scanship System Process Flow Diagram

Copies to:
Randy Fiebrandt, NCL
Jan Nilsen, STAR
Amy Jankowiak, Ecology
Frank Meriwether, Health
Kevin Fitzpatrick, Ecology
Central Files: Norwegian Cruise Lines - NORWEGIAN STAR; WQ 6 1

Section H: Signatures		
Name and Signature of Inspector Amy Jankowiak Amy Jankowiak	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	Date 8/28/06
Name and Signature of Reviewer Kevin C Fitzpatrick Kevin C Fitzpatrick	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Section Manager/ (425) 649-7033	Date 8/28/06

State of Washington Department of Ecology

Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges

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

Section A: General Information

Vessel Name:	SUN PRINCESS	Date:	July 30, 2006
Vessel Operator:	Princess Cruises	Entry Time:	12:41 PM
IMO Number:	902928	Exit Time:	2:50 PM
Vessel Type:	Passenger Ship	Notification (name & date):	Leslie Geiger, 7/25/06
Location:	Pier 30, Seattle		
On-board contact(s):	James Roumen, Environmental Officer; Francesco Villella, Chief Technical officer; Arturo T Mondalo, Hamworthy System Operator		
Inspector(s):	Amy Jankowiak, Ecology Northwest Regional Office, Water Quality Program; Marietta Sharp, Ecology Northwest Regional Office, Solid Waste Program		
# passengers/crew:	~2100/840	Amount of Wastewater:	~80m^3 blackwater, ~500m^3 graywater, ~200m^3 galley water

Description of advanced wastewater treatment system (name, type, major components, etc.):
Hamworthy is a biological reactor and ultrafiltration system. The system includes screening via a screen press, biological treatment via bio-reactors with inter-stage filters and a membrane system, and ultraviolet light disinfection. The Hamworthy system was installed in approximately 2002 Approval for continuous discharge from Ecology was granted on May 4, 2006, although the vessel chooses not to discharge in Washington waters at this time.

Section B: Areas Evaluated

☒	Black/Gray wastewater system	☒	Operations Center/ Computer system	☒	Records/Reports	☒	Sampling/Monitoring
☒	Discharge locations	☒	Operations & Maintenance	☒	Sludge Handling/Disposal	☒	Other

Section C: For vessels discharging ≥ 1nm from berth and ≥ 6 knots only

☐	Schematics match black/gray wastewater system	Not Applicable
☐	Sludge disposal protocol per MOU	Not Applicable
☐	Notification procedures (for contacting Ecology of non-compliance) in place	Not Applicable

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)

☒	Schematics match black/gray wastewater system	System appears to be as depicted in schematics
☒	Sludge disposal protocol per MOU	All screen press material is incinerated and all other sludge from the Hamworthy system are discharged at >12nm.
☒	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	Yes. Proper notification procedures known and available.
☒	Operations as described in submitted documentation	Operations appeared to be as described in submitted documentation.
☒	Daily 24-hour continuous turbidity or equivalent monitoring	Continuous turbidity monitoring
☒	Turbidimeter or equivalent monitoring equipment functioning properly	Appears to be functioning properly.
	Turbidity or equivalent : Yes Last calibration: done by weekly checks Frequency of readings: continuous Trigger level for alarm: 15 NTU	Trigger level for shutdown: Yes, appears to be set at 15 NTU
☒	Auto shut down or operational controls to insure system shut down if a system upset occurs	Yes
☒	Ultraviolet (UV) light disinfection immediately prior to discharge	Yes
☒	UV replacement bulbs available	There are sufficient spare bulbs on board.
☒	UV/bulbs cleaned regularly	Yes. Wiper cleaned and hand wiped periodically.

Section E: General		
☒	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	As of the date of the inspections, sampling has been conducted as required.
☒	Whole Effluent Toxicity Testing 1 per 2 years	Not required yet, in first year
☒	Training up to date for system operators	Yes
☒	Discharge records maintained	Maintained properly
☒	Alarms functioning properly	Alarms appear to be functioning properly
	Alarms Shutdowns: Yes High turbidity/TSS warnings: Yes High wastewater levels: Yes UV disinfection (intensity, bulbs, bank out, power failure): Yes	

Section F: Sample Results

Parameter	Effluent Result
Biochemical Oxygen Demand 5-Day (BOD)	<2 mg/l
Total Suspended Solids (TSS)	<1 mg/l
Fecal Coliform, MF	<1 CFU/100ml
Residual Chlorine	<0.1 mg/l
Ammonia, Nitrogen	13 mg/l
pH	7.23 standard units

Section G: Summary of Findings/Comments

Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program, Municipal Compliance Specialist and Marietta Sharp, Ecology, Northwest Regional Office, Solid Waste and Financial Assistance Program, Biosolids Specialist conducted the inspection on July 30, 2006. The main contacts on board the SUN PRINCESS were James Roumen, Environmental Officer; Francesco Villella, Chief Technical Officer; and Arturo T. Mondalo, Hamworthy System Operator. Prior notification of the visit was given on July 25, 2006 for security protocol. The purpose of the inspection was to evaluate the operating conditions of Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the *Memorandum of Understanding Cruise Operations in Washington State* (MOU), as amended The SUN PRINCESS received approval to discharge continuously per the MOU on May 4, 2006.

Inspection

We arrived and boarded the ship at about 12:41 pm and began with introductions and a plan for the day. We then headed to the control room to discuss the operation of the Hamworthy system and a review of records. We looked at some of the areas of potential waste streams We then headed down for a tour of the Hamworthy system Samples were pulled prior to finalizing the inspection and disembarking the vessel at about 2:50 pm.

The overboard ports for the Hamworthy system are padlocked and the keys to the padlocks are kept in the control room The officer on watch has control over the locks. While the SUN PRINCESS is approved for continuous discharge in Washington waters, the vessel chooses NOT to discharge while in Washington waters. The protocol is to discharge Hamworthy effluent at least four nautical miles outside of Washington waters and moving at a minimum of six knots. Sludge from the Hamworthy system MBR's is discharged at greater than 12 nautical miles and outside of Washington waters, while screened solids are incinerated. Notification procedures for non-compliance with the MOU were well known and available.

While in the control room area (photo #12) where the Hamworthy system is monitored, we asked Mr. Villella to go through the Hamworthy system with us. Mr Villella seemed very familiar with the system. Mr. Roumen, the Environmental Officer is brand new to the vessel and is still gaining familiarity with the particulars. The Hamworthy system collects blackwater by vacuum and graywater by gravity. Galley gray water, laundry water and pool/Jacuzzi water are the only liquid streams not included as treatment by the Hamworthy system Galley graywater, laundry water and pool water are held and then discharged at greater than 12 nautical miles and outside of Washington waters. Gray water is collected into two gray water buffer tanks (photo #02), approximately 50 tons each with approximately 1-2 days holding time. Blackwater is given preference going to the Hamworthy system, and then as flow allows, graywater is added. All of the graywater to the buffer tanks eventually goes through the Hamworthy system Anit-foam is added as needed at the vacuum tank (evac tank)

There are three separate Hamworthy systems and they then combine prior to disinfection. Wastewater enters the Hamworthy system at the screen press (photo #05) where solids are screened out to bags. The screened solids are then

sent to the incinerator about every 4 hours The liquid moves to the 1st stage of the membrane bioreactor (MBR) where aeration occurs. From the 1st stage, flow moves to the interstage filters (photos #04 & #06) and then onto the 2nd stage of the MBR for further aeration (photo #03) From the 2nd stage MBR, flow goes to the ultrafiltration membranes (photo #03) There are 18 membranes on each system, of which 12 membranes are in service at any one time Membrane effluent is sent to the permeate tanks which allow continuous flow to the ultraviolet (UV) disinfection system Disinfected effluent either goes directly overboard or to a holding tank if in an area not approved for discharge. The bilge water includes an oily/water separator. The vessel includes a second meter on the separator in the "white box" (photo #09)

Turbidity is measured continuously before the permeate tank/UV (photo #07). At the time of the inspection, the turbidity read 9.2, 1.6 and 0.3 on the three systems Total Suspended Solids (TSS) is measured continuously on the effluent of the Hamworthy system The turbidity is alarmed at about 15 NTU and then automatically shuts down the discharge. Samples for COD, chlorine, pH, and TSS are taken and ran weekly on board the vessel with the use of a small laboratory (photo #08). Coliform is sampled and tested daily A review of recent results for all parameters showed excellent and consistent results The results are typically within the ideal ranges and if not, retesting takes place and measures are taken to work out the problem If turbidity alarms, the engineer checks the system, the permeate tank and each MBR.

Maintenance on the system includes occasional maintenance (typically monthly or every couple of months) on the screen press which includes cleaning, replacing filters, checking parts and greasing The MBR's are emptied every 6 weeks to clean the inside and to clean out for air flow The goal is not to have the biomass to young or too old and to control filaments. The membranes are backwashed (photo #01) and changed over about every 20 days. If there is contamination of any of the membranes (coliform), the membranes are check and tested for leaking and changed out as needed They had 4 spare membranes on board at the time of the inspection, in addition to the availability of the unused membranes (six on each system) The interstage filters (photo #11) are replaced every 200 hours of use The UV system is hand wiped periodically To do so, flow is recirculated to the permeate tank Spare lamps are available on board. A light indicates whether or not the bulbs are working Calibration of instruments occurs as needed. The pH meters are calibrated with buffers (4, 7 and 10) The turbidity meter is calibrated by weekly checks. COD is calibrated with a solution check and TSS by comparison. It is recommended that the manufacturer recommendations be reviewed for all meters and instruments to assure that calibration is being done as needed

Discharge records were reviewed and are well kept. The records include dates, times, discharge locations, port locations, effluent type, volumes, speed, signatures and remarks.

Some areas of potential waste streams were looked at or discussed. Food waste is collected, ground and discharged from two tanks about twice a week at greater than 12 nautical miles. The water is recycled, and any excess is sent to the graywater system. Grease is separated and is incinerated or discharged at greater than 12 nautical miles. Photo waste is collected and run though a silver recovery system. The silver waste is collected and stored and the non hazardous waste is sent to the incinerator. Garbage and recyclable material is sorted and stored (photos #13 & #14) to be incinerated or sent to shore in Seattle. Cardboard, paper, flowers, and other materials safe for incineration are sent to the incinerator which is not run while at port. Light bulbs are collected and off-loaded to shore without being crushed. Hazardous waste is collected, labeled and stored (photo #14) to be off-loaded in Seattle via "Clean Harbors" transport. Materials such as PERC from dry cleaning, oils, adhesives, and other chemicals are included as hazardous waste Medical waste that has been red-bagged is typically incinerated except for sharps which are off-loaded

Samples were taken for Biochemical Oxygen Demand (BOD 5-Day), Total Suspended Solids (TSS), pH, chlorine residual, fecal coliform and ammonia from the effluent of the UV disinfection prior to going to the holding tank (photo #10) Roumen cleaned the sample port for a clean sample. Mr. Roumen also took samples of his own at the same time The samples were put on ice immediately and were transported to AmTest laboratory in Redmond, Washington that afternoon Chain of Custody and sampling procedures were followed All results are in Section F

Conclusions and Recommendations

The Hamworthy system appears to be functioning well.

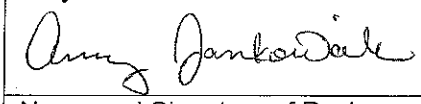
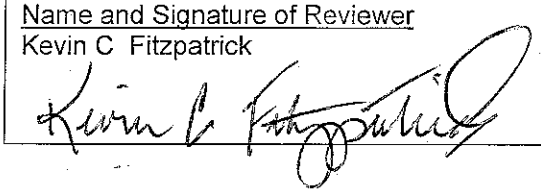
The weekly testing on-board is an excellent way to monitor and make needed adjustments to the system Having a laboratory on-board for the testing is ideal

The overboard port locks and the system in place for discharges is a secure method.

It is recommended that calibration manufacturer recommendations be reviewed.

Attachments:
Photographs
Sampling Results Report

Copies to:
Leslie Geiger, Princess Cruises
James Roumen, DAWN PRINCESS
Francesco Villella, DAWN PRINCESS
Amy Jankowiak, Ecology
Frank Meriwether, Health
Kevin Fitzpatrick, Ecology
Central Files: Princess Cruises- SUN PRINCESS; WQ 6.1

Section H: Signatures		
Name and Signature of Inspector Amy Jankowiak 	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	Date 8/28/06
Name and Signature of Reviewer Kevin C Fitzpatrick 	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Section Manager/(425) 649-7033	Date 8/28/06

State of Washington Department of Ecology

Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges

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

Section A: General Information

Vessel Name:	WESTERDAM	Date:	August 27, 2006
Vessel Operator:	Holland America Line	Entry Time:	9:24 AM
IMO Number:	NA	Exit Time:	11:44 AM
Vessel Type:	Passenger Ship	Notification (name & date):	John Turvey, 8/24/06
Location:	Pier 30, Seattle		
On-board contact(s):	Roy William Powell, Environmental Officer (current during inspection); Robert Vos, Environmental Officer (upcoming); Danny Van Dijk, Advanced Wastewater Treatment System Operator, Tina Stotz, Environmental Compliance Program, HAL		
Inspector(s):	Amy Jankowiak, Department of Ecology		
# passengers/crew:	~2000/~800	Amount of Wastewater:	Not known

Description of advanced wastewater treatment system (name, type, major components, etc):
Rochem Advanced Waste Water Purification System The Rochem graywater system includes prefiltration, reverse osmosis and UV disinfection. The Rochem black water system includes prefiltration, biological treatment via bioreactors, ultrafiltration, and UV disinfection Approval for discharge at greater than one nautical mile away from port and at greater than six knots from Ecology was on June 22 2006.

Section B: Areas Evaluated

☒	Black/Gray wastewater system	☒	Operations Center/ Computer system	☒	Records/Reports	☒	Sampling/Monitoring
☒	Discharge locations	☒	Operations & Maintenance	☒	Sludge Handling/Disposal	☒	Other

Section C: For vessels discharging ≥ 1nm from berth and ≥ 6 knots only

☒	Schematics match black/gray wastewater system	Yes.
☒	Sludge disposal protocol per MOU	Yes. Biomass (sludge) is discharged at > 12 nautical miles, outside of the MOU waters and outside of the Olympic Coast National Marine Sanctuary. Discharges are verified.
☒	Notification procedures (for contacting Ecology of non-compliance) in place	Yes Notification numbers and procedures were known and available.

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)

☐	Schematics match black/gray wastewater system	Not Applicable
☐	Sludge disposal protocol per MOU	Not Applicable
☐	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	Not Applicable
☐	Operations as described in submitted documentation	Not Applicable
☐	Daily 24-hour continuous turbidity or equivalent monitoring	Not Applicable
☐	Turbidimeter or equivalent monitoring equipment functioning properly	Not Applicable
	Turbidity or equivalent : Not applicable Last calibration Frequency of readings: Trigger level for alarm: Trigger level for shutdown: Recorded turbidity/equivalent levels above triggers:	
☐	Auto shut down or operational controls to insure system shut down if a system upset occurs	Not Applicable

☐	Ultraviolet (UV) light disinfection immediately prior to discharge	Not Applicable
☐	UV replacement bulbs available	Not Applicable
☐	UV/bulbs cleaned regularly	Not Applicable

Section E: General		
☒	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	As of the date of the inspections, sampling has been conducted as required
☒	Whole Effluent Toxicity Testing 1 per 2 years	Not required yet. In first season of approval.
☒	Training up to date for system operators	Yes
☒	Discharge records maintained	Yes
☒	Alarms functioning properly	Alarms appear to be functioning properly
	Alarms Shutdowns: not applicable High turbidity/TSS warnings: Yes. High wastewater levels: Yes. UV disinfection (intensity, bulbs, bank out, power failure): lights as indicators.	

Section F: Sample Results

Parameter	Effluent Result
Biochemical Oxygen Demand 5-Day (BOD)	4.50 mg/l
Total Suspended Solids (TSS)	1.0 mg/l
Fecal Coliform, MF	<1 CFU/100 ml
Residual Chlorine	<0.1 mg/l
Ammonia, Nitrogen	96 mg/l
pH	7.30 standard units

Section G: Summary of Findings/Comments

Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program, Municipal Compliance Specialist conducted the inspection on August 27, 2006 The main contacts on board the HOLLAND WESTERDAM included Roy William Powell, Environmental Officer (current EO during inspection); Robert Vos, Environmental Officer (upcoming EO); Danny Van Dijk, Advanced Wastewater Treatment System Operator, and Tina Stotz, Manager, Auditing and ISO 14001 Coordination for Holland America Line Prior notification of the visit was given on August 24, 2006 for security protocol The purpose of the inspection was to evaluate the operating conditions of Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the *Memorandum of Understanding Cruise Operations in Washington State* (MOU), as amended. The HOLLAND WESTERDAM received approval to discharge at greater than one nautical mile from shore and at greater than six knots on June 22, 2006

Inspection

We arrived boarded the ship (photo #01) at about 9:24 am and began with introductions and a plan for the day in the control room area where the Rochem systems are monitored, to discuss the operation of the systems and to review records. Questions were asked regarding other waste streams such as oily bilge water and food waste. We then headed down to the Rochem systems for a tour. We then took a look at the hazardous waste storage and discussed the handling of other solid wastes. Samples of the combined treated blackwater and graywater effluent were taken prior to concluding the inspection and disembarking the vessel at about 11:44 am. During the inspection, the vessel was hooked up to shore power.

Both of the Environmental Officers were recently trained as EO's in a 40-hour class in the Netherlands. The EO's also go through a three-week handover with the previous EO. Mr Powell has been on board as the EO since May 28th and Mr. Vos has been on board for seven days and is currently undergoing the three-week handover. Mr. Van Dijk has had training with the advanced Rochem systems with Rochem personnel for three months, has received his certificate, and also went through a 3 week handover Mr. Van Dijk has been on the WESTERDAM for three months and has been with Holland America Line since 1999.

Discharge Protocols:

While the WESTERDAM is approved to discharge at greater than one nautical mile from shore at greater than six knots, staff have decided not to discharge anywhere in Washington waters or Waters Subject to the MOU at this time in an effort to

prevent any confusion and have clear discharge protocols. For discharges that do occur (outside MOU waters), the discharge locations are first verified by having the watchkeepers contact the engine control room (ECR) to verify locations. The discharge locations are logged in the blackwater and graywater discharge record book in the control room. The discharge record books were reviewed and checked for possible discharges in MOU waters. Of the various dates looked at, discharges did not occur in MOU waters.

Graywater System:
Laundry water and shower/sink wastewater goes into the graywater holding tank and is sent to the low pressure reverse osmosis (LP-RO) treatment system. The flow enters the SWECO (photo #05) prefiltration system (mechanical vibration) and then goes to the filtrate tank. Screenings from the prefiltration are collected and sent to incineration. From the filtrate tank, flow goes to the LP-RO system (photo #06) which consists of four different units. Effluent from the LP-RO system goes to a permeate tank (photo #08) and then onto ultraviolet (UV) disinfection (photo #09). Turbidity is measured prior to UV and with a setting of 30 FNU. From the UV, the flow can either go straight overboard after being combined with the blackwater system effluent, or can go to storage tanks.

Blackwater System:
Toilet waste is filtered and sent to the buffer tanks (photo #10). The waste then combines with passenger and crew galley wastewater, medical station water, eye-wash water, cleaning water, and retentate from the graywater system which helps to dilute the blackwater influent some for better treatment. The waste then goes to the blackwater system (Rochem UF; ultrafiltration) by first going to the SWECO screen for prefiltration (photo #11) and then liquid goes to the filtrate tank. Screenings from the prefiltration goes to the tank 5S which is the sludge tank (photo #17) and then overboard per protocol as above. Liquid from the filtrate tank goes to the bioreactors (photos #12 & #13) where the bacteria work as treatment. From the bioreactors, flow goes through the membranes (photo #15) for ultrafiltration (UF). Effluent from the membranes goes to the permeate tanks and then onto disinfection via a separate UV system (photo #16). From the UV, the flow can either go straight overboard after being combined with the graywater system effluent, or can go to storage tanks. TSS is monitored (photo #14) on the effluent of the blackwater system and is alarmed at 30 mg/l.

Rochem Maintenance and Process Control:
The graywater and blackwater prefiltration system (SWECO) is greased and manually cleaned weekly (with alkaline by spray and soak for blackwater, water cleaned for the graywater system). The graywater system and blackwater system filtrate tanks are cleaned monthly. The bag filters (photo #04) are changed out daily. The reverse osmosis system is cleaned when the pressure is high and about weekly. This is done by emptying, chemicals (photo #07), start-up of pumps and with an eye on temperature. The graywater system permeate tanks are cleaned and inspected weekly. The graywater and blackwater UV systems are cleaned and inspected monthly. They are cleaned by hand wiping with a cloth and acid. The bulbs are all replaced annually and there are about 20 spares on board. Turbidity is monitored before UV on the graywater system. The blackwater system bioreactors are cleaned monthly. The membrane filters are back flushed when flow is lower with a chemical alkaline acid. The TSS and turbidity sensors are checked and calibrated monthly.

Other waste streams:
Oily bilge (photo #03) from the engine room goes to 3 different tanks and separation occurs in stages. Bilge then goes through the 50 part per million (ppm) "Facet" and moves onto the interstage bilge tank if less than 50 ppm. If greater than 50ppm, the oily bilge water is recycled back to the tanks. From the interstage bilge tank, flow goes through the 15 ppm "SEREP". If greater than 15 ppm, the flow is recycled back to the interstage filters. The bilge water that is less than 15 ppm is discharged overboard. The oily water content meter is calibrated every six months with the last calibration being three weeks ago.

Food waste is sent through a shredder and to the food waste tank. From there the waste goes to storage tanks, and when there is sufficient food waste, a dewatering unit is used to dry out the food waste which is then incinerated. Water from the dewatering unit is sent to the galley grease separator (photo #18) and onto the graywater system for treatment.

Garbage, recycling and hazardous waste is separated and sent to shore in Victoria. Materials such as PERC from the dry cleaning, batteries, refrigerant, paints, biohazards, and sharps are included in the hazardous waste (photo #19). Aerosol is collected (by puncture and removal) and is also sent to shore as hazardous waste. Photo waste is collected and sent back to the developer in Victoria. Light bulbs are crushed with a mercury removal system.

Sampling:
A Norovirus Test Kit (photo #02) was delivered to the ship and is stored in the Environmental Officer's office. The kit is to be used for sampling the UV effluent, UV influent and influent to final filtration of the Rochem systems during an outbreak of Norovirus (3%). Staff have reviewed the procedures included with the kit.

Samples were taken for Biochemical Oxygen Demand (BOD 5-Day), Total Suspended Solids (TSS), pH, chlorine residual, fecal coliform and ammonia from the combined effluent of the UV disinfection systems (photo #20). The samples were put

on ice immediately and were transported to AmTest laboratory in Redmond, Washington that afternoon. Chain of Custody and sampling procedures were followed. All results are in Section F.

Conclusions and Recommendations

Mr. Van Dijk seemed very knowledgeable of the Rochem systems and did an excellent job describing the system and operations and maintenance.

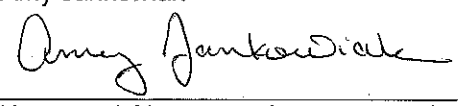
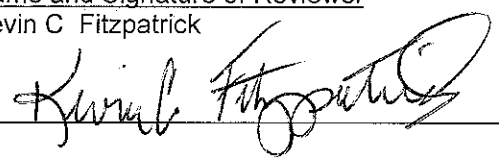
Mr. Powell and Mr. Vos were very knowledgeable of all environmental aspects of the vessel, especially for being so new to the vessel. This awareness is most likely due to quality training and informative three week handovers.

The Rochem systems appear to be functioning well

The staff's knowledge of the MOU and discharge protocols was excellent.

Attachments:
Photographs
Sampling Results Report

Copies to:
John Turvey, HAL
Tina Stotz, HAL
Roy William Powell, Environmental Officer
Amy Jankowiak, Ecology
Frank Meriwether, Health
Kevin Fitzpatrick, Ecology
Central Files: Holland America Line – HOLLAND WESTERDAM; WQ 6 1

Section H: Signatures		
Name and Signature of Inspector Amy Jankowiak 	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	Date 9/29/06
Name and Signature of Reviewer Kevin C Fitzpatrick 	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Section Manager/(425) 649-7033	Date 9/29/06

State of Washington Department of Ecology

Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges

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

Section A: General Information

Vessel Name:	VISION OF THE SEAS	Date:	September 1, 2006
Vessel Operator:	Royal Caribbean Cruises Ltd.	Entry Time:	9:44 AM
IMO Number:	9116876	Exit Time:	11:25 AM
Vessel Type:	Passenger Ship	Notification (name & date):	Rich Pruitt, 8/29/06
Location:	Pier 30, Seattle		
On-board contact(s):	Justine Kane, Environmental Officer, Jerzy Gramczynski, Chief Engineer, Zeljko Radovic, Second Engineer		
Inspector(s):	Amy Jankowiak, Department of Ecology, Robert Duff, Department of Health, Lenford O'Garro, Department of Health		
# passengers/crew:	~2500/~760	Amount of Wastewater:	~40-50 m^3/day

Description of advanced wastewater treatment system (name, type, major components, etc.):
Hydroxyl blackwater treatment system The hydroxyl system is a bioreactor system with oxidation, ozone, and UV disinfection Holding for graywater and discharge at greater than 12nm and outside MOU waters. The vessel is not approved for discharge in Washington MOU waters.

Section B: Areas Evaluated

☒	Black/Gray wastewater system	☒	Operations Center/ Computer system	☒	Records/Reports	☐	Sampling/Monitoring
☒	Discharge locations	☒	Operations & Maintenance	☒	Sludge Handling/Disposal	☒	Other

Section C: For vessels discharging ≥ 1nm from berth and ≥ 6 knots only

☐	Schematics match black/gray wastewater system	Not Applicable
☐	Sludge disposal protocol per MOU	Not Applicable
☐	Notification procedures (for contacting Ecology of non-compliance) in place	Not Applicable

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)

☐	Schematics match black/gray wastewater system	Not Applicable
☐	Sludge disposal protocol per MOU	Not Applicable
☐	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	Not Applicable
☐	Operations as described in submitted documentation	Not Applicable
☐	Daily 24-hour continuous turbidity or equivalent monitoring	Not Applicable
☐	Turbidimeter or equivalent monitoring equipment functioning properly	Not Applicable
	Turbidity or equivalent : Not applicable Last calibration Frequency of readings: Trigger level for alarm: Trigger level for shutdown: Recorded turbidity/equivalent levels above triggers:	
☐	Auto shut down or operational controls to insure system shut down if a system upset occurs	Not Applicable
☐	Ultraviolet (UV) light disinfection immediately prior to discharge	Not Applicable
☐	UV replacement bulbs available	Not Applicable
☐	UV/bulbs cleaned regularly	Not Applicable

Section E: General		
☐	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	Not Applicable
☐	Whole Effluent Toxicity Testing 1 per 2 years	Not Applicable
☐	Training up to date for system operators	Not Applicable
☐	Discharge records maintained	Not Applicable
☐	Alarms functioning properly	Not Applicable
	Alarms Shutdowns: not applicable High turbidity/TSS warnings: High wastewater levels: UV disinfection (intensity, bulbs, bank out, power failure):	

Section F: Sample Results

Parameter	Effluent Result
Biochemical Oxygen Demand 5-Day (BOD)	NA
Total Suspended Solids (TSS)	NA
Fecal Coliform, MF	NA
Residual Chlorine)	NA
Ammonia, Nitrogen	NA
pH	NA

Section G: Summary of Findings/Comments

Introduction
Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program, Municipal Compliance Specialist conducted the site visit/inspection on September 1, 2006 Robert Huff, Department of Health, and Lenford O'Garro, Department of Health also attended the visit to gain better knowledge of the advanced wastewater systems as they are working with the virus study as required by the Washington State legislature The main contacts on board the VISION OF THE SEAS included Justine Kane, Environmental Officer, Jerzy Gramczynski, Chief Engineer, and Zeljko Radovic, Second Engineer (wastewater system operator) Prior notification of the visit was given on August 29, 2006 for security protocol. The purpose of the inspection was to evaluate the operating conditions of Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the *Memorandum of Understanding Cruise Operations in Washington State* (MOU), as amended and to gain familiarity with the Royal Caribbean vessel and environmental practices The VISION OF THE SEAS has not requested and is not approved for discharge in Washington State.

Inspection
We arrived boarded the ship (photo #12) at about 9:44 am and began with introductions and a plan for the day in the control room area where the Hydroxyl wastewater system is monitored, to discuss the operation of the system. We then headed down to the Hydroxyl system to tour the system. Next, we took a look at garbage/recycling and then headed to the control room to review records. Questions were also asked regarding other waste streams such as oily bilge water and food waste. We concluded the visit and disembarked the vessel at about 11:25 am.

Discharge Protocols:
The VISION OF THE SEAS has not requested, and is not approved to discharge in waters subject to the MOU. The vessel collects and holds all graywater, then discharges at greater than 12 nautical miles and outside of the waters subject to the MOU. Blackwater is collected and treated through the Hydroxyl system prior to going to holding tanks and then discharges at greater than 12 nautical miles and outside of the waters subject to the MOU. Oily bilge water is treated (oil water separators) and is disinfected with UV prior to being discharged at less than five parts per million (photos #07 and #08). Food waste is collected and discharged at greater than 12 nautical miles and outside of the waters subject to the MOU. Sludge is either incinerated or landed ashore in Victoria for treatment and land application. For all discharges, the bridge notifies the control room when coming to an area where discharge is approved and when nearing an area where discharge is not approved. The bridge enters the time, location, and speed of discharges. All overboard ports are padlocked. The 2nd engineer and the watchkeepers have access to the keys. Blackwater and Graywater discharges are also logged in the discharge book and kept in the control room.

Blackwater System:
Toilet discharges are sent by vacuum system to the collection tank (photo #01) From the tank, the flow is strained by suction through a ¼ inch screen. Solids screened out are collected and sent to the incinerator daily Liquid flow is feed pumped to BFM Station #1 (photo #02). Flocculant/polymer (photo #03) is added at this stage to help bring the solids up. Sludge from the BFM is sent to the sludge tank for landing ashore. Liquid flow from BFM Station #1 moves to the 1st

Bioreactor (photo #04) for biological treatment, from there it goes to the 2nd Bioreactor for further treatment Flow then moves to BFM Station #2 where more polymer is added Liquid flow then goes to the oxidation tank (photo #05) for ozone treatment Air is added from 2 air pumps on timers Effluent from the oxidation tank is disinfected with an ultraviolet disinfection unit (photo #06) and then sent to ballast tanks The two tanks can hold flow for at least 72 hours before discharging Maintenance on the Hydroxyl system is minimal, and process control changes are also minimal (adjusting air times, polymer injection) The Hydroxyl blackwater system is slated to be completely replaced with a new system that will treat both blackwater and graywater this year

Other waste streams:
Food waste is sent to the pulper (photo #09) and the solid food is incinerated The liquid from the pulper is recycled, and eventually discharged along with the graywater

All solid wastes are land ashored in Victoria or are incinerated (photos #10 and #11) Materials collected and sent to Victoria include photo waste from the silver recovery system, medical sharps, dry cleaning waste (PERC), and other hazardous wastes Medical wastes, cardboard, and some wastewater solids are incinerated, except while at port

Sampling:
A Norovirus Test Kit has not been sent to this vessel A Kit may be sent in the future The kit is to be used for sampling the UV effluent, UV influent and influent to final filtration of the advanced wastewater system during an outbreak of Norovirus (3%) for the purposes of a study being done in Washington State to evaluate the impact of viruses from vessels on shellfish

Samples were not taken, as the vessel does not discharge in MOU waters Discharge records were reviewed and of the dates looked at (2006 season to date), no discharges occurred on the dates the vessel was in Washington waters

Conclusions and Recommendations
Ms Kane, Environmental Officer, Mr Gramczynski, Chief Engineer, and Mr Radovic, Second Engineer (wastewater system operator) were all very knowledgeable of the wastewater system and other environmental systems and protocols

Attachments:
Photographs

Copies to:
Rich Pruitt, RCCL
Justine Kane, VISION OF THE SEAS
Amy Jankowiak, Ecology
Frank Meriwether, Health
Robert Duff, Health
Lenford O'Garro, Health
Kevin Fitzpatrick, Ecology
Central Files: Royal Caribbean Cruise Line – VISION OF THE SEAS; WQ 6.1

Section H: Signatures		
Name and Signature of Inspector Amy Jankowiak Amy Jankowiak	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	Date 9/29/06
Name and Signature of Reviewer Kevin C. Fitzpatrick Kevin C Fitzpatrick	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Section Manager/(425) 649-7033	Date 9/29/06

State of Washington Department of Ecology

Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges

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

Section A: General Information

Vessel Name:	MERCURY	Date:	September 15, 2006
Vessel Operator:	Celebrity Cruises	Entry Time:	9:36 AM
IMO Number:	91006302	Exit Time:	11:44 AM
Vessel Type:	Passenger Ship	Notification (name & date):	Rich Pruitt, 9/12/06
Location:	Pier 66, Seattle		
On-board contact(s):	Ionnis Koutoufaris, Environmental Officer; Zafeirios Triantafyllos, Rochem Operator		
Inspector(s):	Amy Jankowiak, Department of Ecology, Donald A Seeberger, Department of Ecology, Melodie Selby, Department of Ecology		
# passengers/crew:	~1900/~850	Amount of Wastewater:	420m^3/day

Description of advanced wastewater treatment system (name, type, major components, etc):
Rochem Advanced Waste Water Purification System The Rochem combined blackwater and graywater system includes prefiltration, reverse osmosis in two stages and UV disinfection.

Section B: Areas Evaluated

☒	Black/Gray wastewater system	☒	Operations Center/ Computer system	☒	Records/Reports	☐	Sampling/Monitoring
☒	Discharge locations	☒	Operations & Maintenance	☒	Sludge Handling/Disposal	☒	Other

Section C: For vessels discharging ≥ 1nm from berth and ≥ 6 knots only

☐	Schematics match black/gray wastewater system	Not Applicable
☐	Sludge disposal protocol per MOU	Not Applicable
☐	Notification procedures (for contacting Ecology of non-compliance) in place	Not Applicable

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)

☐	Schematics match black/gray wastewater system	Not Applicable
☐	Sludge disposal protocol per MOU	Not Applicable
☐	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	Not Applicable
☐	Operations as described in submitted documentation	Not Applicable
☐	Daily 24-hour continuous turbidity or equivalent monitoring	Not Applicable
☐	Turbidimeter or equivalent monitoring equipment functioning properly	Not Applicable
	Turbidity or equivalent : Not applicable Last calibration Frequency of readings: Trigger level for alarm: Trigger level for shutdown: Recorded turbidity/equivalent levels above triggers:	
☐	Auto shut down or operational controls to insure system shut down if a system upset occurs	Not Applicable
☐	Ultraviolet (UV) light disinfection immediately prior to discharge	Not Applicable
☐	UV replacement bulbs available	Not Applicable
☐	UV/bulbs cleaned regularly	Not Applicable

Section E: General		
☐	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	Not Applicable
☐	Whole Effluent Toxicity Testing 1 per 2 years	Not Applicable
☐	Training up to date for system operators	Not Applicable
☐	Discharge records maintained	Not Applicable
☐	Alarms functioning properly	Not Applicable
	Alarms Shutdowns: not applicable High turbidity/TSS warnings: High wastewater levels: UV disinfection (intensity, bulbs, bank out, power failure):	

Section F: Sample Results

Parameter	Effluent Result
Biochemical Oxygen Demand 5-Day (BOD)	Not Applicable
Total Suspended Solids (TSS)	Not Applicable
Fecal Coliform, MF	Not Applicable
Residual Chlorine)	Not Applicable
Ammonia, Nitrogen	Not Applicable
pH	Not Applicable

Section G: Summary of Findings/Comments

Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program, Municipal Compliance Specialist, Donald A. Seeberger, Ecology, Compliance & Technical Assistance Unit Supervisor, and Melodie Selby, Ecology, Water Quality Program conducted the site visit/inspection on September 15, 2006. The main contacts on board the MERCURY included Ionnis Koutoufaris, Environmental Officer, and Zafeirios Triantafyllos, Rochem Operator. Prior notification of the visit was given on September 12, 2006 for security protocol. The purpose of the inspection was to evaluate the operating conditions of the Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the *Memorandum of Understanding Cruise Operations in Washington State* (MOU), as amended and to gain familiarity with the Celebrity Cruises vessel and environmental practices. The MERCURY has not requested and is not approved for discharge in Washington State.

Note: The information in this report depicts the information given to Ecology at the time of this visit. A follow-up visit on October 6, 2006 and information exchanges with various staff provided some different details than those described here. Please see the separate October 6, 2006 report for details

Inspection

We arrived boarded the ship at about 9:36 am and began with introductions and a plan for the day in the control room area where the Rochem wastewater system is monitored, to discuss the operation of the system and to review discharge records. We then headed down to the Rochem system to tour the system. Questions were asked regarding oily bilge water and food waste. We then looked at some of the other waste streams including garbage/recycling, chemical and hazardous waste storage, and photo waste. We concluded the visit and disembarked the vessel at about 11:44 am. Mr. Koutoufaris, the Environmental Officer, has been with the MERCURY since 2001. Mr. Triantafyllos, the Rochem Operator, has worked with the Rochem system for about three years.

Discharge Protocols:

The MERCURY has not requested, and is not approved to discharge in waters subject to the MOU. The vessel collects and holds galley water, then discharges at greater than 12 nautical miles and outside of the waters subject to the MOU. Blackwater and the rest of the graywater (sink, shower, and laundry) is collected and treated through the Rochem system prior to going to a holding tank in Washington waters. The solids collected from the Rochem system are also sent to the same holding tank. The current protocol is to hold until beyond 12 nautical miles from shore and outside of the MOU waters. During the review of discharge records, it was discovered that, although the vessel is not approved to discharge in Washington waters, the vessel did discharge during part of the 2005 season. Copies of some of those discharge records were requested and provided. A close look at the location of those discharges did show clearly that many of the discharges occurred in Washington State/MOU waters. A full copy of records for the period of 2004 to present was requested. The discharge discrepancies were pointed out to Mr. Koutoufaris. Mr. Koutoufaris mentioned that they understood that they were meeting MARPOL requirements by discharging at greater than four nautical miles. I explained to Mr. Koutoufaris that the MOU, which they are a member line of, does not allow the discharges. A copy of the 1st Amendment of the MOU was on the

vessel and available. A copy of the current MOU, the 2nd Amendment, was handed to Mr. Koutoufaris during the inspection

It is important to note that the discharge of the untreated graywater and/or solids/sludge from the holding tank into Washington State Waters is a violation of state regulations (Revised Code of Washington (RCW) 90.48 080 and Washington Administrative Code (WAC) 173-201A).

E-mails had been exchanged with Mr. Koutoufaris in July of 2005 in which Mr. Koutoufaris requested to know if treated graywater could be discharged in Washington State waters. Mr. Koutoufaris explained that their protocol was to discharge at greater than 12 nautical miles. Ecology responded with a clear no to discharging any treated graywater, and the requirements of the MOU were pointed out including pointing out the map in the MOU which shows where the MOU waters are, as well as describing that the MOU waters are the same as Washington State waters. Discharges in 2005 after the date of the e-mail exchanges showed discharges in MOU/State waters.

Oily bilge water is treated and discharged at less than five parts per million greater than 12 nautical miles and outside of the Olympic Coast National Marine Sanctuary, Area To Be Avoided. Food waste is discharged at greater than 12 nautical miles.

For all discharges, the bridge and the control room communicate and verify locations with charts.

Blackwater/Graywater System:
Toilet discharges and accommodation sink and shower, and laundry water are sent to the collection tank. From the tank, the flow is sent to the SWECO screen (photo #01). Solids are vibrated and collected and are then sent to the Circulation Tank (photo #02) for discharge. The liquid from the SWECO system is sent to the 1st Stage of the Reverse Osmosis (RO) system. Flow is then sent to the 2nd Stage of the RO system for further treatment (photo #08). PH is adjusted and then flow is sent (photo #04) to the ultraviolet (UV) light disinfection system. After UV, the flow is sent through carbon filters (photo #07) and then is either discharged directly overboard if in an area approved for discharge, or the flow is sent to the circulation tank for holding and is then discharged at a later time.

PH is monitored and adjusted after the 2nd stage (photo #06) and prior to UV disinfection. TSS is monitored as needed. Mr. Triantafyllos stated that they do not have an on-line Turbidimeter, but instead use a hand held one for occasional readings. The Reverse Osmosis filters are cleaned regularly and are also chemically cleaned every three months. The UV system is cleaned by hand wiping occasionally with a soft rag. The bulbs have light indicators to show when they are no longer working. Spares are available on board.

Other waste streams:
Food waste is sent to the pulper, is screened and extracted (photo #11) and combined with the graywater.

Oily bilge water is treated through the Marinfloc system (photo #5) and is treated to less than five parts per million.

Garbage and recycling materials are sorted (photo #15). All solid wastes are land ashored in either Vancouver or San Diego with the exception of some cardboard and light plastics which are incinerated. Fluorescent bulbs are sent to the Fluorescent bulb machine (photo #09) where they are crushed and mercury vapors are removed and collected. The crushed bulbs are stored (photo #10) and then landed ashore. Batteries are collected (photo #12) and aerosol cans are collected, punctured (photo #13), and sent ashore. Aluminum cans are crushed (photo #14) and recycled in Seattle. Hazardous wastes are collected and stored in several different locations (photos #17 through #22). Some hazardous wastes include PERC from dry cleaning (photo #16), paints, and photo wastes. Photo waste material is first sent through a silver recovery system (photo #21) and is treated to less than five parts per million (photo #22). Medical waste is collected and sent ashore.

Sampling:
A Norovirus Test Kit has not been sent to this vessel. A Kit may be sent in the future. The kit is to be used for sampling the UV effluent, UV influent and influent to final filtration of the advanced wastewater system during an outbreak of Norovirus (3%) for the purposes of a study being done in Washington State to evaluate the impact of viruses from vessels on shellfish.

Samples were not taken, as the vessel does not discharge in MOU waters.

Conclusions and Recommendations
During the review of discharge records, it was discovered that, although the vessel is not approved to discharge in Washington waters, the vessel did discharge during part of the 2005 season. The discharge of the untreated wastewater from the holding tank into Washington State Waters is a violation of state regulations (Revised Code of Washington (RCW) 90.48.080 and Washington Administrative Code (WAC) 173-201A).

Knowledge of what maintenance occurs for the Rochem system was limited. Manufacturer recommendations for all components of the Rochem system should be reviewed and followed.

Attachments:
Photographs

Copies to:
Mr John Krousouloudis, Vice President of Marine Operations for Celebrity Cruises Inc.
Rich Pruitt, RCCL
Ionnis Koutoufaris, MERCURY
Amy Jankowiak, Ecology
Frank Meriwether, Health
Donald A. Seeberger, Ecology
Melodie Selby, Ecology
Kevin Fitzpatrick, Ecology
Central Files: Celebrity Cruises – MERCURY; WQ 6.1

Section H: Signatures		
Name and Signature of Inspector Amy Jankowiak Amy Jankowiak	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	Date 10/25/06
Name and Signature of Reviewer Kevin C. Fitzpatrick Kevin C. Fitzpatrick	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Section Manager/(425) 649-7033	Date 10/25/06

State of Washington Department of Ecology

Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges

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

Section A: General Information			
Vessel Name:	VEENDAM	Date:	September 25, 2006
Vessel Operator:	Holland America Line	Entry Time:	9:32 AM
IMO Number:	NA	Exit Time:	11:42 AM
Vessel Type:	Passenger Ship	Notification (name & date):	John Turvey, 9/19/06
Location:	Pier 30, Seattle		
On-board contact(s):	Renee Diepenbrock, 3rd Engineer, Wastewater system operator Robert Van Duin, 1st Engineer Gerard Mensink, Chief Engineer Captain Albert Schoonberbeek Dan Grabb, Manager, ECP Audit/Support Tina Stotz, Manager, Auditing and ISO 14001 Coordination for Holland America Line		
Inspector(s):	Amy Jankowiak, Department of Ecology; Lori LeVander, Department of Ecology		
# passengers/crew:	~1300/~500-700		

Description of advanced wastewater treatment system (name, type, major components, etc):
Zenon advanced wastewater treatment system The Zenon black water and gray water system includes prefiltration, biological treatment via bioreactors, ultrafiltration with Zenon membranes, and UV disinfection. Approval for discharge at greater than one nautical mile away from port and at greater than six knots from Ecology was on September 22, 2005 and May 4, 2006.

Section B: Areas Evaluated							
☒	Black/Gray wastewater system	☒	Operations Center/ Computer system	☒	Records/Reports	☒	Sampling/Monitoring
☒	Discharge locations	☒	Operations & Maintenance	☒	Sludge Handling/Disposal	☒	Other

Section C: For vessels discharging ≥ 1nm from berth and ≥ 6 knots only		
☒	Schematics match black/gray wastewater system	Yes
☒	Sludge disposal protocol per MOU	Sludge is discharged at > 12 nautical miles, outside MOU waters, and outside the Olympic Coast National Marine Sanctuary.
☒	Notification procedures (for contacting Ecology of non-compliance) in place	Ecology is notified per the number in the MOU, internal notifications are made as well.

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)		
☐	Schematics match black/gray wastewater system	Not Applicable
☐	Sludge disposal protocol per MOU	Not Applicable
☐	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	Not Applicable
☐	Operations as described in submitted documentation	Not Applicable
☐	Daily 24-hour continuous turbidity or equivalent monitoring	Not Applicable
☐	Turbidimeter or equivalent monitoring equipment functioning properly	Not Applicable
	Turbidity or equivalent : Not applicable Last calibration Frequency of readings: Trigger level for alarm: Trigger level for shutdown: Recorded turbidity/equivalent levels above triggers:	
☐	Auto shut down or operational controls to insure system shut down if a system upset occurs	Not Applicable

☐	Ultraviolet (UV) light disinfection immediately prior to discharge	Not Applicable
☐	UV replacement bulbs available	Not Applicable
☐	UV/bulbs cleaned regularly	Not Applicable

Section E: General		
☐	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	Checking sampling data for compliance
☐	Whole Effluent Toxicity Testing 1 per 2 years	In second season of approval, although approved at the very end of last season.
☐	Training up to date for system operators	Yes However, the current wastewater operator did not have the advantage of a handover from the previous operator. Other staff assisted in training.
☐	Discharge records maintained	Yes
☐	Alarms functioning properly	Alarms appear to be functioning properly
	Alarms Shutdowns: not applicable High turbidity/TSS warnings: turbidity High wastewater levels: yes UV disinfection (intensity, bulbs, bank out, power failure): light indicators	

Section F: Sample Results

Parameter	Effluent Result
Biochemical Oxygen Demand 5-Day (BOD)	<10 mg/l
Total Suspended Solids (TSS)	2.0 mg/l
Fecal Coliform, MF	1 CFU/100 ml
Residual Chlorine	<0.1 mg/l
Ammonia, Nitrogen	0.75 mg/l
pH	7.50 standard units

Section G: Summary of Findings/Comments

Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program, Municipal Compliance Specialist, and Lori LeVander, Ecology, Water Quality Program, conducted the inspection on September 25, 2006. The main contacts on board the HOLLAND VEENNDAM included Renee Diepenbrock, 3rd Engineer AND Wastewater system operator, Robert Van Duin, 1st Engineer, Gerard Mensink, Chief Engineer, and Captain Albert Schoonberbeek Dan Grabb, Manager ECP Audit/Support for Holland America Line and Tina Stotz, Manager, Auditing and ISO 14001 Coordination for Holland America Line were also on board to assist in the inspection Prior notification of the visit was given on September 19, 2006 for security protocol. The purpose of the inspection was to evaluate the operating conditions of Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the *Memorandum of Understanding Cruise Operations in Washington State* (MOU), as amended. The HOLLAND VEENDAM received approval to discharge at greater than one nautical mile from shore and at greater than six knots on September 22, 2005 and May 4, 2006.

Inspection

We arrived boarded the ship at about 9:32 am and began with introductions and a plan for the day in the control room area where the Zenon system is monitored, to discuss the operation of the systems and to review records Questions were asked regarding other waste streams such as oily bilge water. We then took a look at the garbage and recycling, and hazardous waste storage. We then headed down to the Zenon system for a tour Samples of the treated effluent were taken prior to concluding the inspection and disembarking the vessel at about 11:42 am

Ms Diepenbrock, the Advanced Wastewater Treatment System operator has worked with the Zenon system for about four weeks on this vessel. Previous experience including being a watchkeeper. Ms. Diepenbrock received basic as well as advanced training on the system There was no handover period with the previous operator. Other staff assisted in training on board the vessel

Discharge Protocols:

The VEENDAM discharges effluent from the Zenon system at greater than one nautical mile from shore and at greater than six knots. The discharge locations are logged in the blackwater and graywater discharge record book in the control room The discharge record books were reviewed (photos #23 and #24) and checked for discharges in MOU waters and locations One of the discharges on September 26, 2005 in MOU/Washington waters was recorded at a speed of five knots. The MOU

and the approval requires six knots minimum. This discharge is a violation of the MOU. The cruise line submitted a compliance report dated December 1, 2005 detailing compliance with the provisions of Section 1 1 3 for the VEENDAM The discharge was treated effluent from the Zenon advanced Wastewater Treatment system at a volume of $23m^3$.

Sludge from the Zenon system is collected and discharged at greater than 12 nautical miles, outside of MOU waters and outside of the Olympic Coast National Marine Sanctuary. All overboard ports are checked and verified with the bridge and recorded by e-mail as well Captain Albert Schoonberbeek had a great understanding of the MOU and its requirements The Captain was also very aware of notification procedures for non-compliance and where to find the appropriate phone number within the MOU document.

Zenon System:
Gray water which includes all galley water, sink water and shower water, is sent to the gray water tank. Black water, which includes toilet water is sent to the blackwater tanks (photo #10). Both waste streams combine and go (photo #07) through the Masco filter screens (photos #08 and #09) of which there are two in series. From there, liquid flow is sent to the raw water tank (photo #13), while solids are collected (photo #12) and landed ashore in VanCouver about once a month From the raw water tank, flow then moves to the bioreactors (two) where aeration promotes the biological treatment (photos #17 and #18). Solids from the bioreactors are sent to tank six which is later discharged at greater than 12 nautical miles, outside MOU waters, and outside of special areas Effluent from the bioreactor goes through the membrane ultra filters ("Zeeweeds") (photo #17). Some of the flow from the Zeeweeds overflows into the bioreactors. Effluent from the filters goes to the back pulse tanks (photo #19) and onto ultraviolet (UV) disinfection (photo #20) The back pulse tanks are use to clean the membrane filters An on-line turbidity meter (photo #14) continuously reads the turbidity prior to disinfection. At the time of the inspection, the turbidity was 0 280 NTU PH is also monitored in the system continuously (photos #15 and #16) From the UV system flow either goes overboard if in an area approved for discharge, or is sent to holding tanks for future discharge There are actually two trains within the system (two bioreactor/membrane filters, two back pulse tanks, one UV system)

Zenon Maintenance:
The filter screens are washed down daily or as needed and are also automatically cleaned four times per day for 10 minutes each. The bioreactors/ultra filters are chemically cleaned with chlorine about five times per week and cleaned with citric acid about twice a week. The ultra filter membranes are cleaned by back pulsing every cycle. The UV disinfection system includes eight lights with light indicators showing whether the bulbs are working or not The UV system is cleaned about once a month with "enviroclean" soap by rag/gloves Spare lights are on board for replacements The continuous Turbidimeter is calibrated about once every two week and if there are suspicious readings The lenses are cleaned weekly Zenon is available for emergencies Ms Diepenbrock has an extensive "process control" sampling regime. Ms. Diebenbrock does daily visual checks throughout the system and samples for e-coli once a week as well as COD, solids, suspended solids, temperature, and pH. Ms Diepenbrock uses a small laboratory (photo #22) to run the tests. Ms Diepenbrock had a great understanding of the biological systems involved with the proper operation of the advanced wastewater treatment system

Other waste streams:
Oily bilge from the engine room is pumped to the oily bilge tank. The liquid flow moves to the 50 part per million (ppm) oily water separator and onto the interstage tank. If the liquid does not meet 50 ppm, it is sent back to the oily bilge tank. From the interstage tank, liquid moves to the 15 ppm oily water separator and onto to the SEREP sand filter. If the liquid does not meet 15 ppm, it is sent back to the interstage tank. Effluent meeting 15 ppm is discharged overboard when moving at least six knots and outside special areas. The oil content is monitored and measured by two monitors, one being the "white box" which has limited access

Garbage, recycling and hazardous waste is separated (photo #01), labeled, and sent to ashore. Aerosol cans are sent through an aerosol liquid removal system (photo #02) prior to landing ashore. Paper and cardboard is shredded (photo #03) and incinerated. Oily rags are collected (photo #04) and incinerated Glass, aluminum and tin is recycled (photo #05). Fluorescent bulbs are crushed in a mercury removal system and landed ashore. Waste from the photo-lab and x-ray machines goes through a silver recovery system. Hazardous waste is labeled and stored separately within a storage locker (photo #06) The dry cleaning does not produce PERC, and instead uses a banana oil substance ("MIELE")

Sampling:
Samples were taken for Biochemical Oxygen Demand (BOD 5-Day), Total Suspended Solids (TSS), pH, chlorine residual, fecal coliform and ammonia from the effluent of the UV disinfection system. The samples were put on ice immediately and were transported to AmTest laboratory in Redmond, Washington that afternoon. Chain of Custody and sampling procedures were followed All results are in Section F

Conclusions and Recommendations
Ms. Diebenbrock seemed very knowledgeable of the Zenon system and it's biological activity and did an excellent job

describing the system and operations and maintenance

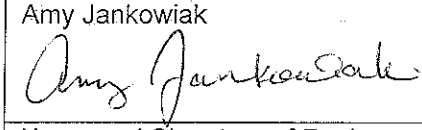
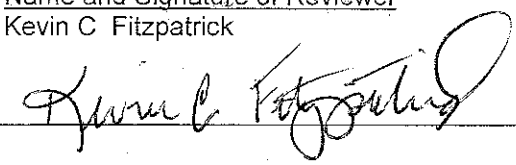
The extensive process control sampling regime is a great way to regularly monitor and adjust the system for optimal performance.

The Zenon system appears to be functioning well.

The discharge record books were reviewed (photos #23 and #24) and checked for discharges in MOU waters and locations. One of the discharges on September 26, 2005 in MOU/Washington waters was recorded at a speed of five knots. The MOU and the approval requires six knots minimum This discharge is a violation of the MOU The discharge was treated effluent from the Zenon advanced Wastewater Treatment system at a volume of $23m^3$.

Attachments:
Photographs
Sampling Results Report
Discharge Record (9/26/05)

Copies to:
John Turvey, HAL
Tina Stotz, HAL
Renee Diebenbrock, 3rd Engineer
Amy Jankowiak, Ecology
Frank Meriwether, Health
Kevin Fitzpatrick, Ecology
Central Files: Holland America Line – HOLLAND VEENDAM; WQ 6 1

Section H: Signatures		
Name and Signature of Inspector Amy Jankowiak 	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	Date 10/25/06
Name and Signature of Reviewer Kevin C Fitzpatrick 	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Section Manager/(425) 649-7033	Date 10/26/06

Holland America Line
A Signature of Excellence

November 30, 2006

Ms. Amy Jankowiak
Department of Ecology
Northwest Regional Office
3190 160th Ave SE
Bellevue, Washington 98009-5452

Re: Veendam/26 September 2005

Dear Ms. Jankowiak:

Further to your conversation with Tina Stotz on October 24, 2006 and your report titled, "Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges" dated October 25, 2006, we have completed our review. For the reasons that follow we have concluded that the vessel did not operate at a speed of 5 knots while discharging permeate in Washington State MOU waters on September 26, 2005. Our review of the ship's Deck Logbook and the automation event/alarm list indicates that the vessel's minimum speed was 11.25 knots during this discharge.

At about 0057 on 26 September 2005, Veendam started a second 8-cylinder diesel generator, which brought the total to one 12-cylinder and two 8-cylinder diesel generators. The additional engine was started to increase the vessel's speed for an on time arrival in Seattle. Pursuant to our standard operating procedures, the Deck Watch Officer took hourly vessel positions which he wrote into the Deck Logbook. For the time between 0100 and 0600, we plotted the vessel positions and calculated the vessel's speed. We found that the vessel's average speed was 13.9 knots and the minimum speed was 11.25 knots. Additionally, the Deck Logbook did not include any comments that the vessel had to slow down for other vessel traffic or other circumstances.

Additionally, we reviewed the vessel's automation event/alarm list for the "Speed Below 6 knots" alarm. This alarm automatically activates and is recorded when the ship's speed falls below 6 knots. A search of the event/alarm records for the time between 0156 and 0400, the times the vessel was discharging permeate, found no records. We know the alarm was functional, as it did activate at 0628, when the vessel was approaching its Seattle berth.

300 Elliott Avenue West • Seattle, WA 98119 • (206) 281-3535
www.hollandamerica.com

On November 21, 2006, we spoke with the Second Engineer that made the 5 knot entry on 26 September 2005, and he stated his entry is not correct, because in his recent review of the automation event/alarm list, he, too, found no alarm indicating the vessel's speed was below 6 knots while the vessel was discharging.

Based on the above I would appreciate any consideration you can give to clarifying this in your report titled, "Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges" and in the upcoming 2006 annual report.

Please feel free to contact me with any questions or comments concerning this letter.

Very truly yours,

William J. Morani, Jr.
Vice President Environmental Compliance
Holland America Line

State of Washington Department of Ecology

Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges

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

Section A: General Information

Vessel Name:	MERCURY	Date:	October 6, 2006
Vessel Operator:	Celebrity Cruises	Entry Time:	9:37 AM
IMO Number:	91006302	Exit Time:	11:48 AM
Vessel Type:	Passenger Ship	Notification (name & date):	Rich Pruitt, 10/03/06
Location:	Pier 66, Seattle		
On-board contact(s):	Ionnis Koutoufaris, Environmental Officer; Georgios Hatzistavros, Chief Engineer; Nikolas Asproudas, oncoming Environmental Officer; and Zafeirios Triantafyllos, Wastewater Operator		
Inspector(s):	Amy Jankowiak, Department of Ecology, Lori LeVander, Department of Ecology, and Norm Davis, Department of Ecology		
# passengers/crew:	~1900/~850		

Description of advanced wastewater treatment system (name, type, major components, etc.):

Biopure is a marine sanitation device including aeration, settling, and chlorination for blackwater only. This system is run at all times.

Rochem Advanced Waste Water Purification System The Rochem combines blackwater from the Biopure system and graywater and includes prefiltration, reverse osmosis in two stages and UV disinfection. The Rochem system is only run at specific times for specific reasons (depending on how much graywater there is and holding capacity – typically only run when discharging in areas of Alaska or when sampling

The vessel has never requested approval for discharge and is not approved for discharge in Washington/MOU waters.

Section B: Areas Evaluated

☒	Black/Gray wastewater system	☐	Operations Center/ Computer system	☒	Records/Reports	☒	Sampling/Monitoring
☒	Discharge locations	☒	Operations & Maintenance	☒	Sludge Handling/Disposal	☒	Other

Section C: For vessels discharging ≥ 1nm from berth and ≥ 6 knots only

☐	Schematics match black/gray wastewater system	Not Applicable
☐	Sludge disposal protocol per MOU	Not Applicable
☐	Notification procedures (for contacting Ecology of non-compliance) in place	Not Applicable

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)

☐	Schematics match black/gray wastewater system	Not Applicable
☐	Sludge disposal protocol per MOU	Not Applicable
☐	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	Not Applicable
☐	Operations as described in submitted documentation	Not Applicable
☐	Daily 24-hour continuous turbidity or equivalent monitoring	Not Applicable
☐	Turbidimeter or equivalent monitoring equipment functioning properly	Not Applicable
	Turbidity or equivalent : Not applicable Last calibration Frequency of readings: Trigger level for alarm: Trigger level for shutdown: Recorded turbidity/equivalent levels above triggers:	
☐	Auto shut down or operational controls to insure	Not Applicable

	system shut down if a system upset occurs	
☐	Ultraviolet (UV) light disinfection immediately prior to discharge	Not Applicable
☐	UV replacement bulbs available	Not Applicable
☐	UV/bulbs cleaned regularly	Not Applicable

Section E: General		
☐	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	Not Applicable
☐	Whole Effluent Toxicity Testing 1 per 2 years	Not Applicable
☐	Training up to date for system operators	Not Applicable
☐	Discharge records maintained	Not Applicable
☐	Alarms functioning properly	Not Applicable
	Alarms Shutdowns: not applicable High turbidity/TSS warnings: High wastewater levels: UV disinfection (intensity, bulbs, bank out, power failure):	

Section F: Sample Results

Parameter	Results (from 17P tank)
Biochemical Oxygen Demand 5-Day (BOD)	240 mg/l
Total Suspended Solids (TSS)	170 mg/l
Fecal Coliform	240,000 MPN/100ml
Residual Chlorine	3.43 mg/l
Ammonia, Nitrogen	47 mg/l
pH	7.2 standard units (pH meter during sampling)

Section G: Summary of Findings/Comments

Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program, Municipal Compliance Specialist, Lori LeVander, Ecology, Water Quality Program, and Norm Davis, Ecology, Puget Sound Field Office conducted the site visit/inspection on October 6, 2006. The main contacts on board the MERCURY included Ionnis Koutoufaris, Environmental Officer, Georgios Hatzistavros, Chief Engineer, Nikolas Asproudas, oncoming Environmental Officer, and Zafeirios Triantafyllos, Wastewater Operator. Prior notification of the visit was given on October 3, 2006 for security protocol. The purpose of the inspection was to follow-up on the previous visit of September 15, 2006 in order to gain a better understanding of the wastewater systems and to take samples from the main wastewater holding tank. The MERCURY is a member line to the NorthWest CruiseShip Association, and therefore party to the *Memorandum of Understanding Cruise Operations in Washington State* (MOU), as amended. The MERCURY has not requested and is not approved for discharge in Washington State

Inspection

We arrived boarded the ship (photo #07) at about 9:37 am and began with introductions and a plan for the day on the bridge of the vessel. A number of questions were asked regarding the types of wastes included in particular discharges, discharge protocols as well as details regarding how each of the wastewater systems work. Samples were then taken from the 17P tank where the effluent is vacuumed to the Rochem system. We then headed to the Biopure system for a quick look. We concluded the visit and disembarked the vessel at about 11:48 am.

Discharges/Protocols:

The MERCURY has not requested, and is not approved to discharge in waters subject to the MOU. Some of the discharge records from the 2005 season which were obtained on September 25, 2006 showed discharge effluent types marked "OTH". When asked what "OTH" meant, Mr. Koutoufaris noted that this is effluent from the Rochem system. Mr. Hatzistavros also confirmed that the discharges were Rochem effluent. There were three occasions in 2005 when these discharges occurred while at the Port of Seattle. When asked why these discharges would occur, they stated that this happened when they were sampling the Rochem effluent. They have since decided to recirculate the Rochem effluent back into the graywater holding tank when sampling, instead of discharging at Port. At the time of the visit, laboratory personnel were on board to sample, and therefore, the Rochem system was operating, without discharging

Mr. Koutoufaris also made a comment that the confusion with last season's discharges in Washington State was because the boundaries – lines for Canada and the US were so confusing. Upon reviewing some locations of recent discharges, we met with the navigation personnel and looked at the navigation maps that are used. The maps did show the international boundary line between Canada and the US. Mr. Koutoufaris also mentioned that the office (referring to the headquarters in Miami) allowed the discharges When asked how the discharges were approved, Mr Koutoufaris said that occurred by e-mail. I asked for a copy of the e-mail coorespondence if it was available. The e-mails were provided to Ecology prior to leaving the vessel Mr. Koutoufaris mentioned again that the office didn't investigate where the boundary lines were

E-mails had been exchanged with Mr. Koutoufaris in July of 2005 in which Mr. Koutoufaris requested to know if treated graywater could be discharged in Washington State waters. Mr. Koutoufaris explained that their protocol was to discharge at greater than 12 nautical miles Ecology responded with a clear no to discharging any treated graywater, and the requirements of the MOU were pointed out including pointing out the map in the MOU which shows where the MOU waters are and that they are the same as Washington State waters. Mr. Koutoufaris responded that if they need to discharge, that would only happen in Canadian waters beyond 4 nautical miles and for treated gray water only. Discharges in 2005 after the date of the e-mail exchanges showed discharges in MOU waters.

When asked why the discharges occurred after this e-mail chain, Mr. Koutoufaris responded that he understood from the e-mails that the discharges would not be allowed, but then received an "exception" from the company and thought that the company had made arrangements with Ecology. No such communications or arrangements were made between the company and Ecology

Mr. Hatzistavros mentioned that the Rochem system was going to be replaced on the vessel within the next year with a system that is more reliable and has more capacity. The Biopure marine sanitation device is currently (at least the last few years) run at all times, while the Rochem advanced wastewater treatment system is typically only run when sampling and discharging for specific reasons, such as being within certain Alaskan waters. When asked why the Rochem system isn't run at all times, they stated that this was due to capacity issues – that the Rochem system can only handle a small amount of the wastewater. Determining whether or not to run the Rochem depends on location, whether or not they are sampling, and how much graywater and holding capacity is available. The Rochem system was not run at all during the 2005 discharges, with the exception of the discharges at the Port of Seattle.

The current protocol (this season) for discharging is to discharge at greater than 12 nautical miles in open waters and a process of communication is used with forms between the Environmental Officer and the engineers prior to valves being opened. The valves are closed about 15-20 minutes prior to being in a position without allowed discharges

Blackwater/Graywater Systems:

There was a great deal of confusion about how both of the treatment systems were run during the September 15, 2006 inspection. During this visit, Mr. Hatzistavros went through each of the systems with us step by step.

The Biopure system (photos #04, #05 and #06) collects only toilet water by vacuum. The vacuumed waste is filtered and solids are separated The wastes then go to the aeration tank of the Biopure system. Solids are cleaned out of the aeration tank about every 3-5 months and are strained and incinerated. The strained liquid goes back into the aeration tank. Polymer is added to help with settling Liquid from the aeration tank moves to the settling tank where the tank is opened and inspected about weekly. The solids are removed from the settling tank as needed and are strained and incinerated. The strained liquid goes back to the aeration tank. From the settling tank, liquid moves through chlorination and then onto the main holding tank (also known as 17P or the circulation tank).

The Rochem system (two parallel units) collects both graywater that is sent to the main holding tank (17P) which includes sink wastewater, shower/bath wastewater, and laundry wastewater and the effluent from the Biopure system which goes to the main holding tank (17P). From the holding tank, wastewater enters the SWECO screen. Solids are vibrated and collected. The solids are removed, strained and incinerated, and the strained liquid is sent to the 17P tank. From the SWECO screening, liquid moves to the 1st Stage of the Reverse Osmosis (RO) system Flow is then sent to the 2nd Stage of the RO system for further treatment PH is adjusted and then flow is sent to the ultraviolet (UV) light disinfection system. After UV, the flow is sent through carbon filters and then is either discharged directly overboard if in an area approved for discharge, or the flow is sent to the main holding tank (17P) for holding and is then discharged at a later time. It is also still unclear whether or not both RO stages are always used. The discharge records indicate that often only one of the units is used most of the time.

Galley water is collected separately from the graywater to protect the treatment systems and is sent through a grease trap/interceptor prior to going to a holding tank and discharge at greater than 12 nautical miles and outside special areas.

Sampling:

Samples were taken (photos #01 and #02) for Biochemical Oxygen Demand (BOD 5-Day), Total Suspended Solids (TSS), pH, chlorine residual, fecal coliform and ammonia from the main holding tank (17P) in order to achieve a rough idea of what the discharges that occurred in 2005 consisted of The sample point was located at the effluent of the 17P tank as the flow was being vacuumed to the Rochem system (photo #03). The Rochem system was operating prior to and during the sampling event, while the Rochem system was not operating during the 2005 discharges away from Port Laboratory protocols were followed and chain of custody was met. The samples were put on ice immediately and were transported to AmTest laboratory in Redmond, Washington that afternoon Chain of Custody and sampling procedures were followed. A summary of the results are included in Section F.

Conclusions and Recommendations

The staff on board the vessel were very cooperative and answered all of our questions.

The discharge of Rochem effluent at the Port of Seattle in Elliott Bay during the 2005 season is a violation of the *Memorandum of Understanding Cruise Operations in Washington State (MOU)*.

Mr. Pruitt, Director Environmental & Public Health Programs, Safety and Environment Department, Royal Caribbean Cruises Ltd., reviewed the discharge records of the 2005 season prior to this inspection and did not indicate any concerns about the "OTH" discharges The lack of understanding of the plants operations, the details of the MOU, and Washington State's regulations shows that an environmental management system is either not in place or not working. The environmental officers and the personnel that run the wastewater and other environmental systems, as well as the staff at Celebrity Cruises/Royal Caribbean International/Royal Caribbean Cruises Ltd. should all have a greater understanding of the environmental systems, the agreements to which they are party to and the local regulations in order to prevent any and all unauthorized discharges.

Attachments:
Photographs
Laboratory Report

Copies to:
Mr. John Krousouloudis, Vice President of Marine Operations for Celebrity Cruises Inc.
Rich Pruitt, RCCL
Ionnis Koutoufaris, MERCURY
Amy Jankowiak, Ecology
Norm Davis, Ecology
Frank Meriwether, Health
Donald A. Seeberger, Ecology
Melodie Selby, Ecology
Kevin Fitzpatrick, Ecology
Central Files: Celebrity Cruises – MERCURY; WQ 6.1

Section H: Signatures		
Name and Signature of Inspector Amy Jankowiak Amy Jankowiak	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	Date 10/25/06
Name and Signature of Reviewer Kevin C. Fitzpatrick Kevin C. Fitzpatrick	Agency/Office/Telephone Department of Ecology/Northwest Regional Office/Water Quality Section Manager/(425) 649-7033	Date 10/26/06