Carnival Spirit, Source Reduction Evaluation (SRE) 2008 Alaska Season.

SER Annual Report January 14, 2009
CC submitted on February 6, 2009

General permit of the Carnival Spirit to discharge treated waste water with in the Alaska waters, received in 2008.

General Permit #:2007DB0002	Expires March 25, 2013	**Submit this report to**: Alaska Department of Environmental Conservation Division of Water/ CPVEC 410 Willoughby Ave, Suite 303 PO Box 111800 Juneau, AK 99811-1800 Phone (907) 465-5300, FAX (907) 465-5274 DEC.WQ.Cruise@alaska.gov	
File Number: 920.45.009 **Authorization Number: 2007DB0002-0023**			

Name:	Mr. Gerald Zyderveld	**Responsible party:**	Carnival Cruise Lines
Address:	3655 NW 87 Avenue, Miami FL 33178	**Phone / email:**	305 599 2600 ext 13045 Gzyderveld@Carnival.com
Vessel:	Carnival Spirit	**Onsite Contact:**	Matteo Cavallarin - ship chief engineer (spcheng@carnival.com)

General information .

Year ship joined fleet	April 2001
Gross tonnage	85,920 metric tons
Passenger capacity(#)/voyage	~ 2,125
Crew capacity(#)/voyage	934
MSD system (USCG type)	Triton Format (MSPT 9 Standard) No UV in Use Sewage#1 USCG Certification # 159.015/6109/01 Sewage#2 USCG Certification # 159.015/6109/01 Sewage#3 USCG Certification # 159.015/6109/01 Sewage#4 USCG Certification #

	159.015/6109/01
Number of MSD units	4
Other water treatment units (type & capacity)	ROCHEM UF – Bio-Filt Treatment Plant (BTP B-2098) with UV burner. Capacity : 310 to 395 M3/d Gray Water Treatment System (GWFP LPRO-160-10 B2099) with UV burner. Capacity : 740 m3/d
Blackwater treatment (type & capacity)	Triton Format (MSPT 9 Standard) No UV in use Capacity : Filt 24-60 M3/d ROCHEM UF – Bio-Filt Treatment Plant (BTP B-2098) with UV burner. Capacity : 310 to 395 M3/d
Treated blackwater holding tank capacity & location (holding capacity includes double bottom tanks)	M1 – 163.9 M^3 -Tank Top -Frame # 44-54 M2 – 163.9 M^3 -Tank Top- Frame # 44-54 Holding tank for Treated Black water and BTP & GWFP sludge BW 6 SB = 88 M^3 DB Frame # 166-186 BW 6 PS = 88 M^3 DB Frame 166 to 186
Graywater treatment (type & capacity)	Gray Water Treatment System (GWFP LPRO-160-10 B2099) with UV burner. Capacity : 740 m3/d
Graywater collection tank capacity & location Before the treatment plant	Gray Water from Accommodation : 5212.001 frame # 57 PS – 5212.003 frame # 161 PS – 5212.005 frame # 184 SB – 5212.006 frame # 184 5212.007 frame # 257. All collecting tanks have a capacity of 5 M3. Gray Water from Galleys : 5212.002 frame # 57 PS – 5212.004 frame # 168 PS The two heated grease separator tanks have a total capacity of 5 M3. Gray Water from Laundry : Laundry collecting tank (GW3P) frame # 274 capacity 8 M3.
Graywater holding tanks capacity & location	GW/BW 7P 142.9 M^3 – Double Bottom – Frame 166 to 186 (Laundry Water & Grey Water form Accommodation) GW/BW 7S 142.9 M^3– Double Bottom – Frame 166 to 186 gray water from Accommodation. GW/BW 5 PS (342.9 M^3)-DB Frame 129-163 GW/BW 5 STBD (342.9 M^3)-DB Frame 129-163 Dedicated as GWFP concentrate holding tank

	BW/GW 3 SB 136.8 M^3 Frame 86-110 BW/GW 3 PS 131.2 M^3 Frame 86-110 BW/GW 4 SB 173.8 M^3 Frame 134-166 BW/GW 4 PS 173.8 M^3 Frame 134-166 BW/GW 8 SB 169.4 M^3 Frame 188-206 BW/GW 8 PS 169.4 M^3 Frame 188-206 GW1 SB 122.1 M^3 Frame 34-44 Galley Water GW1 PS 122.1 M^3 Frame 34-44 Galley Water GW2 SB 149.1 M^3 Frame 274-285 Laundry Water GW2 PS 167.4 M^3 Frame 274-285 Laundry Water GW3 SB 12 M^3 Frame 274-278 Laundry Reuse Water
Mixed treated gray water/treated black water holding tank capacity & location	GWFP permeate effluent & MSDs treated back water effluent can be mixed in : BW 6 SB = 88 m3 DB Frame 166-186 BW 6 Port = 88 m3 DB Frame 166-186 M1 – 163.9 M^3 –Tank Top – Frame 44 to 54 SB is the designated holding tank where treated black water from MSDs can be mixed with GWFP concentrate effluent.
Maximum discharge flow rate per discharge port [1] and discharge pump type Please see below	GWFP & BTP permeate discharge specs : 50 M^3/hour/discharge port -discharge line diameter is DN 100 Pump type : KSB Etachrom BC 50-125 / 552.1
Average discharge flow rate per discharge port[1] and discharge pump type	The flow rate settings of feed flow from the system is controlled by the PLC which provides information that the flow controller will send to the frequency converter of the feed pump PK6001x according to the feed flow measured by FORCA-6001x during the filtration process sett. limits 0-15 m^3 /h. line DN 65

[1] The pump(s) rate and discharge line diameter must be given to check the flow rate.

List of overboard discharge ports and location on vessel (Starboard/Port) & discharge line diameter and distance below/above waterline		See attachment "A" Carnival Spirit Gray and Black Water Overboard Valve List.
Blackwater generation per day		~ 90 M^3/day
Graywater generation per day	**Accommodations**	~ 600 M^3/day
	Galley	~ 250 M^3/day
	Laundry	~ 130 M^3/day
Daily water use/individual		~ 280 liters/day
Seawater usage per day		N/A
Peak water use per hour		~ 50 M^3/h
Hours of peak water use		0700 – 0900 & 1700 – 2000 hours

The Carnival Spirit has **only** discharge a limited volume of treated accommodation GW trough an approved Rochem RO plant into Alaska State waters when needed on the North bound cruise.

These are the volumes of treated accommodation waste water discharged in Alaska waters during the 2008 season:

July '08 = 310 m3
September '08 = 434 m3
August '08 = 967 m3

Rochem GWFP:

The Rochem Gray Water Filtration Plant is based on low pressure reverse osmosis.
The GWFP system was originally designed to treat daily:

- 612 M^3/day of accommodation gray water.
- 24 M^3/day of drain water from the pools.(whirlpools) ,swimming pools only in backwash mode ~ 10m^3
- 126 M^3/day from the laundry.

Presently the Rochem GWFP plant treats gray water from accommodations and whirlpool only. The GWFP is located in the aft osmosis room starboard side (Tank Top Deck) between frames 166 and 186.
Once the Gray Water has been processed by the GWFP it is collected in the permeate tank B 9001. From the permeate tank the permeate can be transferred through UV Burner to the effluent tank B 9101 or through the UV Unit and discharged overboard. The overboard (#80) is located at the Starboard side, frame # 182-183, with size DN 100. The GWFP plant overboard system has a dedicated UV Burner unit. This UV unit is also located in the aft osmosis room SB.

The BTP and the GWFP systems has dedicated overboard (permeate) pumps, the permeate tank discharge pumps are : KSB Etachom BC 50-125 552.1

7/30/2008	Wednesday	Spirit	Vancouver (Canada Place)
7/31/2008	Thursday	Spirit	Cruise the Inside Passage
8/1/2008	Friday	Spirit	Ketchikan
8/2/2008	Saturday	Spirit	Juneau
8/3/2008	Sunday	Spirit	Skagway
8/4/2008	Monday	Spirit	Sitka
8/5/2008	Tuesday	Spirit	Cruise Prince William Sound
8/6/2008	Wednesday	Spirit	Whittier (Anchorage) , AK
8/7/2008	Thursday	Spirit	Cruise Prince William Sound
8/8/2008	Friday	Spirit	Sitka
8/9/2008	Saturday	Spirit	Juneau
8/10/2008	Sunday	Spirit	Skagway
8/11/2008	Monday	Spirit	Ketchikan
8/12/2008	Tuesday	Spirit	Cruise the Inside Passage
8/13/2008	Wednesday	Spirit	Vancouver (Canada Place)

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All other generated waste streams such as galley -, pulper -, laundry -, and remaining accommodation water have been discharged out side the 12 NM or the 4 NM if needed due to limited holding capacity or vessels stability.

Plans have been made and implemented to reduce the water consumption on board the vessel.

The source of this portable water comes from shore side bunker water (75 %) from Alaska ports and Vancouver and the remaining (25 %) from the Atlas fresh water generators set on board which can produce 2 X 600 M3/day on board and which can be operated when the vessel is outside the 4 NM zone at speed > 6 NM.

Both water sources are being treated and pre paired for use as per standard approved and inspected by USPH regulations.

Enclosed is a typical monthly water bunker, production and consumption list of the Carnival Spirit with head count on board.

July - Water Log 2008 - Form.xls

The cleaning materials used that can wind up in this particular accommodation waste stream are closely monitored on board by the Engine and House keeping department and we have not seen any fluctuations of the ammonia levels.

No additional chemical/cleaner is introduced to the accommodation piping system.

Sampling 2008/Results:

The 2008 effluent test results for metals (e.g. CU, NI and ZN) and ammonia have shown that the discharged effluent from the treated accommodation GW is with in the requirements at the moment. (General Permit limits).
It is our understanding that the Spirit has been the only ship that has been treated accommodation water trough a Rochem membrane system, so we do not have any thing to compare it with.

We had one noncompliance during the 2008 season which was on July 26, 08 when one of the pH readings was above the limits, we believe that this was a spike. However, this " spike " temporarily higher value was immediately addressed and resolved by the vessel.

In the event that we will notice that the bunker water from the various ports in Alaska, (Juneau, Ketchikan, Skagway and Whittier) and the one Canadian port (Vancouver) that we bunker in have metal contents above the standards we have the following options:
1. Discontinue bunkering FW in Alaska ports with high metal readings.
2. Ask the port to install additional equipment to bring the metal readings down to acceptable levels.
3. Ask the port to install a waste water connection, so that we can discharge waste water shore side for treatment.

4. Change the cruise schedule, so that the ships stays outside the 4 and 12 NM for a longer period of time to discharge waste water and or eliminate certain Alaska ports. Please note that the Carnival Spirit has enough waste water holding capacity to maintain present schedule, discharging waste water outside the 4 and 12 NM.
5. Install bunker water treatment systems on board the ship if Alaska ports bunker water that does not meet the drinking water standards.
6. Install additional waste water treatment equipment on the discharge side of the wastewater treatment system if it is proven that the bunker water quality metal values are below requirements.
High ammonia levels in accommodation GW can be controlled with chemical balancing if needed, this how ever has not been tested so far.

It has to be noted that the Rohem system treating the accommodation GW does not have a bio reactor and has less chance forming ammonia in the system.

Wastewater treatment is one of the earliest large-scale applications of biotechnology. It differs from other industrial microbiological processes in that there is little or no control over the raw material and only moderate control over the operating conditions, yet the process is expected to produce a uniform finished product. The goals of the process normally include the removal of organic pollutants and nutrients (i.e. nitrogen) before discharge.

Removal of "nitrogenous compounds is critical" as excessive amounts of ammonia and nitrite/nitrate levels are detrimental to water quality. Ammonia exerts an oxygen demand in aquatic environments; 4.7 grams of oxygen are required to oxidize one gram of ammonia. Nitrite is toxic to marine life and can induce methemoglobinemia (a reduction in the oxygen-carrying capacity of the blood) in humans. These factors call for effective removal of nitrogen from the wastewater before it is discharged to natural water systems.

The conventional method of removing nitrogen from wastewater starts with oxidation of ammonia to nitrite/nitrate (nitrification) and ends with reduction of nitrite and nitrate to nitrogen gas (denitrification).

This conventional approach to ammonia removal only converts one form of nitrogen (ammonia) to another (nitrite or nitrate).

Nitrogen exists in wastewater in four different forms:

- Organic nitrogen (amino acids, proteins, purines, pyrimidines, and nucleic acids);
- Ammonia nitrogen (NH_3-N);
- Nitrite nitrogen (NO_2-N); and
- Nitrate nitrogen (NO_3-N)

In an untreated wastewater sample, the major fraction is usually ammonia nitrogen and the organic nitrogen. These are oxidized to nitrite and then to nitrate in the environment.

The conventional biological nitrification, a two-step process, begins with ammonia being converted to nitrite by Nitrosomonas bacteria, followed by nitrite being oxidized to nitrate by Nitrobacter bacteria. These bacterial species are typical examples for the nitrification process. They are autotrophic in nature and use carbon dioxide as their cell carbon source.

Material information of equipment and pipes that the fresh water is in contact with on board:


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So far no portable water samples of bunker water of Alaska and Vancouver ports have been send to a lab to check for metals and ammonia levels.
We have received the bunker sample results from our sister company HAL to have an idea what we had to deal with during the 2008 season.

Gerald Zyderveld.
Ships Manager Carnival Spirit.