NORWEGIAN CRUISE LINE
FREESTYLE CRUISING

ENTERED
SAP JUNE 010

SOURCE REDUCTION EVALUATION

NORWEGIAN PEARL
NORWEGIAN STAR

Public Version

<NCL/ADEC
1/22/09 OK
REMOVED Tech Details
AWTS>

Rev. 0 dated June 20, 2008
Rev. 1 dated January 14th, 2009 (Annual Update) - Appendix 1
Rev. 2 dated April 30th, 2009 (April 2009 Interim Progress Report) – Appendix 2
Rev. 3 dated January 15th, 2010 (Annual Update) – Appendix 3

Due to the nature of the material contained within this Source Reduction Evaluation, the details that follow shall be considered proprietary and shall not be released publicly without NCL and/or Scanship's permission.

7665 Corporate Center Dr. | Miami Florida 33126 | Tel 305 436 4000 | Fax 305 436 4120 | ncl.com

1/16

ENTERED

Introduction:

NCL (Bahamas) Ltd., as the operator of the NORWEGIAN PEARL, NORWEGIAN STAR and NORWEGIAN SUN, has applied for and been granted a permit to operate in Alaskan waters and discharge treated wastewater in accordance with the interim effluent limits of the Large Commercial Passenger Vessel Wastewater Discharge General Permit No. 2007DB0002. Analytical sampling during the previous several seasons indicated that these three vessels were unable to comply with the long-term effluent limits found in Table 1 of the Permit, with respect to ammonia, copper, nickel and zinc. As a condition of approval to operate under the interim effluent limits, a vessel operator must submit a Source Reduction Evaluation (SRE) within 60 days of granting of said permit. This document has been prepared to fulfill the requirements of the General Permit and is applicable to each vessel that NCL may operate in Alaskan waters in 2010.

Summary:

Each of NCL's ships is equipped with the Scanship Advanced Wastewater Treatment System (AWTS). These systems were designed, constructed and installed to meet the requirements of the USCG and Alaska discharge standards pursuant to the 2000 Alaska Cruise Ship Initiative (ACSI), P.L. 106-554 Title XIV--Certain Alaskan Cruise Ship Operations and 33 CFR 159 Subpart E and Alaska Statutes at AS 46.03.460. These standards did not include an ammonia or dissolved metals requirements and, thus, the systems were not designed as such. The Scanship AWTS meets the existing standards easily but will have difficulty, without significant modifications, of meeting the long-term standards of the General Permit.

Sections 1.9.5 through 1.9.7 of the General Permit suggest the following:

- 1.9.5 The Source Reduction Evaluation must identify the likely on-board source(s) of the pollutant(s) of concern, include a plan to reduce concentrations to authorized levels, and include an implementation schedule. The implementation schedule may not extend beyond the beginning of the 2010 cruise ship season.

- 1.9.6 The Source Reduction Evaluation must identify sources and evaluate methods to reduce pollutant loading, including, as appropriate:
    - identification of cleaning products, rodenticides, pesticides, or other industrial products that may be the source of the loading;
    - identification of other sources such as drinking water supplies;
    - adoption of operational practices to reduce pollutant sources such as use of alternative cleaning products;
    - substitution of non-chemical methods for methods that involve chemicals; and
    - other methods identified by the permittee or the Department.

2/16 A

ENTERED

- 1.9.7 The implementation schedule must include a list of specific practices, any equipment changes, and a timeline that the vessel operator will undertake to reduce pollutant loading. Sampling for the pollutant of concern must be increased to a minimum of twice per month.

Source Reduction Evaluation Overview

Efforts under the SRE plan will fall into two categories of activities:

1. Source reduction evaluation of inflows to reduce introduction of constituents to the waste water stream. This would involve primarily the dissolved metals.

2. Technology Evaluation / Implementation to identify and install (as necessary and if possible) technology to reduce effluent concentrations.

It should be noted that technology solutions are not yet available for application on a large cruise ship and in particular for NCL's Scanship systems. Therefore there remains much uncertainty in the evaluation and potential implementation of such solutions.

Influent Source Reduction Evaluation

An influent Source Reduction Evaluation will commence this summer and may include:

1) Identification of cleaning products, rodenticides, pesticides, or other industrial products that may be the source of the loading, particularly dissolved metals.
2) Identification of sources of dissolved metals such as shore-based drinking water supplies. This study should involve identification of existing data pertaining to bunkered water quality as well as additional sampling and analysis to complete the total picture of Alaska water supplies.
3) Identification of on-board sources of dissolved metals due to production and distribution systems.
4) Based on the results of 1), evaluation of alternative on-board use of cleaning or industrial products that may enter the wastewater stream and affect the effluent quality.
5) Based on the results of 2 and 3), steps that may be taken to reduce the introduction of dissolved metals into the wastewater stream.

Technology Evaluation / Implementation

The present Advanced Wastewater Treatment System (AWTS) consists of 5 primary stages: drum type pre-filters, a moving bed bio-reactor (MBBR), flotation units, polishing filter and UV units.

ι. Detailed discussions with the vendor, Scanship, have indicated that there are some modifications of the system that may result in meeting the new General Permit standards. These steps will have to be imposed in a systematic and orderly way to determine their individual effects on the system.

3/16 4

ENTERED

1. Retrofit existing bio-reactors:

2. Install polymer dosage system

4. If (1) and (2) do not achieve the desired results, install ammonia ion exchange filters for ammonia polishing. These types of filters are only capable of removing smaller amounts of ammonia and cannot be relied on if 1) and 2) do not work.

Discussion:

1) Bio-reactor retrofit - The present bioreactors are based on the Kaldnes MBBR process and were not designed for nitrification. Biological processes are normally limited by DO (dissolved oxygen) and this particularly applies to nitrification. Nitrification (or oxidation of ammonia) is essentially an operation that is linearly related to dissolved oxygen and detention time. It takes 4.5 parts of O_2 per one part of NH_3 to be degraded. Adding more oxygen to the bioreactor and increasing the detention time will increase the degradation of organic material and enhance nitrification.

ENTERED

Ship Specific Issues:

The Scanship AWTS was retrofitted (SUN and STAR) or purposefully built (PEARL) into the ships. There is little room for expansion or additional equipment which may make some of the aforementioned projects difficult. Bio-reactors cannot be expanded in size, but the internal

5/16 A

ENTERED

modifications may yield some successes. It is also important to note that each of the three NCL ships operating in Alaska at this time, and for the foreseeable future, have three different generations of the Scanship system, each one being optimized based on the experience gained earlier. This has resulted in smaller more efficient designs and the capability to handle more waste streams.

NORWEGIAN SUN was one of the first ships to have an installed system and has the lowest bio-reactor volume to POB (persons on board) ratio. This may make this the most difficult system to reduce the ammonia levels to the desired level.

The NORWEGIAN STAR system was expanded somewhat, based on the 1st generation, and may have the most flexibility to meet the long-term standards.

NORWEGIAN PEARL has the most optimized system, with a more refined bio-reactor and flow system and will be problematic from the start. The system also includes the ability to process "reject water" from the bio-sludge and food pulp dewatering systems that gave this ship the ability to dry and incinerate these waste streams. This, of course, increases the BOD to the bio-reactor and will have to be discontinued in order to meet the long-term GP standards.

Time-Line:

July – September 2008

Begin water inflow studies, including analysis of bunkered water and the effect of on-board production and distribution of potable water to the wastewater plant.

Review of chemical inputs to the gray water system and identification of possible sources of dissolved metals.

Installation of ammonia monitoring equipment for preliminary analysis of ammonia levels and for further analysis of steps to be taken. These monitors are interchangeable between effluent and influent to the AWTS.

October 2008 – March 2009

Conduct engineering analysis of data obtained from ammonia monitoring and develop bio-reactor modification plans. (1) Select one or more of the three ships for systematically introducing bio-reactor modifications. (Note that the AWTS will have to shut down for up to one month in order to make these modifications. For obvious reasons, this cannot be done until the 2008 Alaska season is complete.)

- o
- o
- o

6/16 A

ENTERED

Begin monitoring and evaluation of ammonia levels during several month stabilization period for the "new" bio-reactors.

<u>April 2009 – June 2009</u>

Based on evaluation of previous steps, determine further need for and procure and install pre-treatment polymer dosing system (2). Continue with further evaluation.

<u>July 2009 – September 2009</u>

Based on evaluation of previous steps, determine need for, procure and install ammonium ion exchange filters. Continue with further evaluation.

<u>October 2009 – March 2009</u>

Continue to evaluate status of and fine-tune equipment and ability to meet the 2010 long-term standards.

Annual Progress Reports:

Annual progress reports will be prepared for 2008 and 2009 to describe actions to develop and implement this Source Reduction Evaluation. It will include:
(a) the results and dates of the sampling analysis required under this section and any equipment or process changes made to achieve compliance with the long-term water quality standards; and
(b) an explanation of why any completion date was not or cannot be met and a description of any corrective measures.

Submitted: 20 June 2008

Randall R. Fiebrandt
Director, Environmental Technical Operations

7/16 A

ENTERED

Appendix 1 – 2008 Annual Progress Report

In 2008, DEC issued a wastewater discharge permit for large cruise ships. Section 1.9 of the permit allows DEC to grant interim effluent limits for ammonia, copper, nickel, and zinc to operators in 2008 and 2009. In exchange, the operator is required to complete a Source Reduction Evaluation that NCL submitted on June 20, 2008 and was accepted by ADEC. In turn, NCL was authorized to discharge treated effluent in Alaska waters using the interim effluent limits noted in the permit. In accordance with Section 1.9.12, an operator who was granted the interim effluent limits must submit an annual progress report within two weeks of the end of the calendar year. This Appendix constitutes NCL's annual progress report that will attempt to document progress on the source reduction efforts, changes to any operational practices, and technology investigations.

Since the SRE was submitted in June of 2008, NCL has continued to evaluate steps needed to reduce ammonia levels in the AWTS effluent as well as identification of sources of dissolved metals in potable water and wastewater systems. As the original Scanship AWTS's were designed and built to the original Title XIV discharge standards, modifications to the ships and it's systems, to meet the 2010 standards, at this time is quite difficult and may prove to be nearly impossible. Nevertheless, NCL, in conjunction with its primary subcontractor, Scanship, has embarked upon a program that, it is believed, may reduce the ammonia levels to the final effluent limits. Only installation, time and testing will confirm that belief.

This annual progress report is divided into several sections, based on the original requirements of the SRE, namely (1) Influent Source Reduction Evaluation to include evaluation of pesticides and rodenticides, evaluation of drinking water supplies, identification of possible chemical influences to dissolved metals, and any mechanical systems to eliminate dissolved metals; and (2) Technology/Evaluation Implementation.

To recap 2008, each of NCL's Alaska-bound ships (NORWEGIAN PEARL, NORWEGIAN STAR and NORWEGIAN SUN) completed the 2008 season with no exceedences of the interim effluent standards. The Scanship AWTS performed exactly as designed and as expected. There were no non-compliances to the existing USCG discharge standards or the ADEC interim discharge standards, with the exception of one anomalous pH result (which met the USCG standard but not the new higher ADEC standard). In total, during the 2008 season, there were 36 effluent analyses taken. Of these, all 36 samples exceeded the final ammonia discharge standard of 2.9 mg/l (the range being 6.6 to 71 with the median being 26.5). Twenty-five (25) exceeded the final copper standard of 3.1 μg/l (the range of exceedences being 3.4 to 19.3 with the median being 5.6). Eleven exceeded the nickel standard of 8.2 μg/l (the range of exceedences being 8.4 to 14 with the median being 11.0). Eleven also exceeded the zinc standard of 81 μg/l (the range of exceedences being 94 to 160 with the median being 110). There are some notable and significant differences in the three ships, though, but the reasons are somewhat unclear.

The obvious conclusion that can be drawn from the above is, for a system that was not designed specifically to remove ammonia and dissolved metals, it performs very well in this regard. Consistently meeting the interim effluent standards is noteworthy. The exceedences of the final

8/16 A

standard, in general, are not that great, but modifying existing equipment to meet these standards is proving to be an exceptional challenge.

(1) Influent Source Reduction Evaluation

(A) A review of the pesticides/rodenticides used on board shows that only one item has any possibility of entering the black or gray water system. Nearly all the insecticides/pesticides used are dry containers, sprays or traps. Only a product called Bio-Gel is occasionally added to certain galley and/or bar floor drains to control insect infestations, when needed. Maximum usage amounts to about 4 liters per month. This product is not actually a pesticide, but a bacterial disgester used to control the organic sources in the drains that attract insects. It does not contain any metal compounds that would contribute to high copper, nickel and zinc content. Based on our review, we conclude that the use pesticides/ rodenticides aboard NCL ships needs no further evaluation in terms of this Source Reduction Evaluation.

(B) During the latter stages of the 2008 season, the Alaska Cruise Association contracted for an extensive sampling program of potable water sources throughout many of the ports that cruise ships visit. It was suspected that some of the dissolved metals in the discharged effluent may have been coming aboard in the potable water bunkered in this ports. The terminals used by NCL include Pier 66 in Seattle (7), Skagway's Broadway (8) and Ore (8) Docks, Juneau's AJ Dock (8), Ketchikan's Berth #3 (9) and #4 (9), and Vancouver's Canada Place East (4). The numbers in parentheses represent the number of samples taken at each location.

a. Copper – Juneau's AJ Dock, Seattle's Pier 66 and Canada Place East nearly always had high copper readings that nearly always exceeded the values discharged in NCL ship effluent. Ketchikan and Skagway water was acceptable. This means that a considerable amount of the dissolved copper is coming from bunkered potable water sources.
b. Nickel – Of the terminals where NCL called, nickel content was not an issue. Skagway Railway dock had very high nickel content, however, NCL used this dock only once in 2008. It is noted that NCL's exceedences of nickel content were insignificant.
c. Zinc – Levels of dissolved zinc in terminals used by NCL were generally acceptable. There were a few instances of high sample results at Ketchikan Berth #4 that could indicate very high receipt of dissolved zinc in potable water although it is doubtful that these random events would have had much effect on the effluent constituents. NORWEGIAN SUN docks there, but this vessel had no zinc exceedences, so this effect is inconclusive.

(C) A review of onboard chemical usage has been done, restricted primarily to those chemicals that may be introduced into the ships black and gray water systems. These include galley and cleaning chemicals, laundry chemicals and wastewater treatment chemicals. The major chemical products that may enter the black or gray water waste streams are provided by Ecolab and to a lesser extent, Wilhelmsen

ENTERED

Unitor (primarily related to small quantities of bio-organic digesters to keep wastewater piping clean). Additionally, a relatively higher volume of chemicals are used in the treatment of the ship's wastewater; these are typically flocculants/ coagulants consisting of an aluminum chloride based organic acid. NCL has identified these chemicals and is attempting to evaluate whether any of these contribute to the dissolved metals content. This evaluation is still underway, but preliminary results do not shown any direct contribution to copper, nickel and zinc levels in the effluent.

(D) At the end of the 2008 Alaska season, NCL undertook a study of dissolved metals content at various places throughout the ship on each of the three Alaska bound ships. This was an attempt to identify possible sources of dissolved metal content at various locations in the water pathways. Samples were taken over a period of one week, including bunkered water, production water, supply and distribution points and influent and effluent from the AWTS. A summary of each ship is discussed in the following:

a. NORWEGIAN STAR – During the week of August 26th, 20 samples were taken and analyzed for dissolved metals. Some of the potable water sources (3 of 4) slightly exceeded the long-term dissolved copper standard, our evaporators and RO plant added little to no dissolved metals, but we had moderately higher levels of dissolved metals in the distribution system, i.e. the ship's piping and storage tanks. The highest Cu level recorded was 1300 in the potable water bunkering line but was less than 280 everywhere else. This high level is a mystery as there is no copper in the bunkering lines. The highest nickel level recorded was 20 in a galley, and the highest zinc level was 160 in the GW/BW mixing tank. However, the effluent from the AWTS was either below or close to the long-term final discharge limit proving that the existing AWTS is removing 99.9% of the copper. The nickel levels are, in general, so low as to be insignificant. Zinc levels were less than twice the final standard.
b. NORWEGIAN PEARL – During the week of September 2nd, 21 samples were taken and analyzed for dissolved metals. Some of the potable water sources exceeded the long-term dissolved metals standards, our evaporators (not the RO units) added a moderate amount of dissolved metals (< 40 µg/l), and we picked up higher levels of dissolved metals in the distribution system, i.e. the ship's piping and storage tanks. The highest Cu level recorded was 1300 in the GW/BW mixing tank (where all water accumulates), the highest nickel level recorded was 1200 at the same point, and the highest zinc level was 3000 in the laundry and GW/BW mixing tanks. We will have to do some further investigation on what is happening in those tanks at the next available opportunity. However, the effluent from the AWTS was either below or close to the long-term final discharge limit proving that the existing AWTS is removing 99.9% of the copper, nickel and zinc levels, in all cases (5.8, 8.0 and 63 µg/l, respectively).

ENTERED

c. NORWEGIAN SUN – During the week of August 20th, 18 samples were taken and analyzed for dissolved metals. The potable water sources had low levels of dissolved metals, our evaporators (not the RO units) added a moderate amount of dissolved metals (< 100 μg/l), and we clearly got higher levels of dissolved metals in the distribution system, i.e. the ship's piping. The highest Cu level recorded was 310 at the AWTS influent, highest nickel level recorded was 51 at the evaporator, and highest zinc level was 1300 on a galley drain line. However, the effluent from the AWTS was either below or close to the long-term final discharge limit proving that the existing AWTS is removing 98.4%, 79%, and 91.5% of the copper, nickel and zinc levels, respectively.

d. The net result of this analysis, as best we can tell, is that there are some influences on board, in terms of distribution piping, evaporator coils or A/C condensate that are contributing primarily to copper content and to drain piping contributing to zinc content (likely galvanized pipes). Many of NCL ship's have been constructed with plastic piping of various sorts; for example, the NORWEGIAN SUN is primarily poly-butylene potable water piping, but still had marginally higher copper levels that a ship with copper piping (NORWEGIAN STAR). In any case, retrofitting of existing piping systems and/or equipment is not an option in the short term, and certainly could not take place by May of 2010, due to both logistical and engineering factors.

(E) At this point in time, we have not identified any mechanical systems to reduce the dissolved metals to levels lower than the existing AWTS already removes them. We understand that ADEC, through its contractors, is investigating various possibilities and NCL will review these results and consider available systems if feasible. However, it is our hope that the increase of biological activity and removal of BOD will aid in the removal of some of the metals. The extra oxygen also can cause metals to oxidize further and make them more easily removed in the chemical steps. We have had discussions with the Cape Systems researcher, and with Scanship specifically, on the nature of ion exchangers, but this technology has never been tried onboard cruise ships and, to our knowledge, is of limited use until ammonia and metals levels are brought down to low levels initially. We are pursuing some additional testing at the behest of Cape Systems to evaluate the effect of water hardness on the possible use of ion exchangers

(2) Technology/Evaluation Implementation

When the original SRE was drafted and submitted, the initial analysis of options to modify and/or retrofit the existing Scanship AWTS was still fresh. Since that time, there have been some additional thoughts by the Scanship R&D team with respect to steps that may be taken. The initial phases of the project essentially remain the same,

ENTERED

NCL has committed over $700,000 to the modifications to two of the three ships prior to the 2009 season. This commitment however, took somewhat longer than expected due to the economic downturn and other factors, such as the unexpected bankruptcy of *Scanship Environmental AS* in November and their, fortunately, rather quick restructuring under new ownership as *Scanship AS*.. To date, purchase orders have been issued for equipment to begin Phase 1 work on the NORWEGIAN PEARL and NORWEGIAN STAR. It is our hope that we will be able to begin the construction phases of the project in the very near future, but time is drawing short to be able to do this work and have the system in operating condition by 30-days prior to the first Alaskan arrival in 2009. The 30 days is necessary in case we need to conduct a new series of sampling events. Any work on the NORWEGIAN SUN is being held off until the fall of 2009 pending the results of the initial testing phases.

SUMMARY:

We are hopeful that ammonia levels could be moderated with the planned modifications to the AWTS. If this construction can be accomplished prior to the start of the 2009 season, we may have some results by mid-season. Our goal throughout this process is to maintain the operation of the system, as much as possible, throughout the work and to have the system fully operational by the vessels first arrival to Alaska. NCL also continues to evaluate possible source reduction techniques, but our analysis confirms that there is very little that can be done to make dramatic and significant reductions in dissolved metals content. Because of the affinity of dissolved metals to organic matter, we expect that we will get some improvement from the bio-reactor modifications.

Revised Time Line:

July – October 2008

Begin water inflow studies, including analysis of bunkered water and the analysis of dissolved metals content in water at various locations aboard the vessels. ✓

Review of chemical inputs to the gray water system and identification of possible sources of dissolved metals. ✓

ENTERED

October 2008 – January 2009

Continue to evaluate options with Scanship AS and develop bio-reactor modification plans. ✓

Gain management approval for Phase I modifications to the AWTSs. ✓

Sign and issue purchase orders for equipment and contracts for on-board work. ✓

February 2009 – April 2009

Modifications made to NORWEGIAN STAR (1st) and NORWEGIAN PEARL (2nd), to include

- SEVERAL MBR UPGRADES –
-
-
-
-

Begin monitoring and evaluation of ammonia levels during several month stabilization period for the "new" AWTS SYSTEM

May 2009 – August 2009

Based on evaluation of Phase I modifications during the 2009 season, determine further need for additional modifications/installations. Continue with further evaluation.

October 2009 – March 2010

If necessary, continue with Phase II work on NORWEGIAN STAR and NORWEGIAN PEARL and begin modifications to NORWEGIAN SUN.

ENTERED

Appendix 2 – April 2009 Interim Progress Report (Issued as a result of Denise Koch letter dated March 13, 2009)

1) The final (or additional) findings of the review of onboard chemical usage and its potential to contribute to ammonia, copper, nickel or zinc.
As mentioned in our comments of February 12th, 2009, NCL has completed a contract with a new hotel chemical vendor, Swisher Hygiene, Inc. (http://www.swisherhygiene.com). The NORWEGIAN PEARL has completed the conversion and the NORWEGIAN STAR and NORWEGIAN SUN will be done in the next few weeks. Therefore, we have focused our review on the Swisher product line.

Ammonia - By converting to the new Swisher program we are eliminating two products in our previous program that contained a small amount of ammonia. One was a glass cleaner and the other a floor stripper. However, it was highly unlikely that either product could end up in the gray water stream and this change should have little to no effect. No other products in our new program contain ammonia. This includes all ware-washing and laundry detergents.

Nickel – There is no nickel in any of the products, and to our knowledge, neither did the Ecolab products.

Copper - There is no copper in any of the products, and to our knowledge, neither did the Ecolab products. We noted that some of the Ecolab dispensers were hooked up using soft copper tubing; these have been removed and replaced with stainless steel tubing. A minor effect, but it may help.

Zinc - There is zinc in our new floor finish product, as there was in the Ecolab floor finish product. Manufacturers include it as a "binder" for their finishes; all "normal" floor finishes have zinc in their formulations. However, it is unlikely that floor finish residues will end up in the gray water.

2) Any revisions to the timeline, especially in regards to modifications to the Scanship wastewater treatment system that is installed on the Norwegian Star and Norwegian Pearl.
We have begun the Phase I work on the NORWEGIAN STAR. We completed the modification to the bio-reactor and replaced 40m3 of bio-media

. We installed two continuous ammonia monitoring instruments in the system. Unfortunately, the unit installed in the influent failed shortly after installation and a replacement is on order. We have implemented a "Chem Redux" program

. It is unclear if this will have any reduction in the constituents of interest; we will monitor this closely.

cing

. This system will be commissioned later this summer and we may see some improvement in the effluent results. The remainder of Phase I, including the installation is pending as the acquisition and installation of a new air compressor has proven to be a challenge. We hope to finalize this process in the next month or so. However, delivery and installation is likely not possible while the ship is in Alaska due to cabin availability, CBP construction crew restrictions, and our concern for disrupting the fine balance of the existing AWTS.

14/16 A

ENTERED

3) Any influent and effluent performance samples taken on the modified Scanship systems. NCL should describe the sample methods used and quality assurance procedures.

There are no significant performance results at this time. Preliminary analysis, using the onboard ammonia monitors, shows that there might be some additional nitrification taking place due to the bio-reactor modifications.

We will monitor the ammonia levels through our on-board monitoring system as well as the periodic sampling program to see if there are changes from last year's results.

4) Specify whether there are any additional plans to evaluate or modify the plumbing systems, and include a description of the effects on the pollutant levels.

We have no plans at this time to replace any piping systems as there is no clear indication of the sources. We feel, due to our relatively low levels of dissolved metals in our effluent, that further AWTS treatment is the only course of action at this time. If this proves insufficient, we may have to consider some sort of after-treatment, however, this technology does not yet exist to meet the levels required.

5) A description of changes, if any, made to the potable water sourcing (percentage of bunkered versus produced drinking water: preferential bunkering in particular towns, etc.) for 2009 in order to reduce metals in the wastewater effluent during the 2009 season.

At this time we have made no changes to our potable water sourcing. We produce as much water on board as possible; however, we are limited by physical, economic and regulatory principles. Water making capacity in Alaska is reduced due to the cold water temperatures that require more energy (ie. cost of fuel and emissions issues) and by our limited time underway (cannot produce water in port due to PHS standards). Thus, we must purchase water in every port we visit. As we have stated earlier, from our limited data, it would appear that the level of metals in our bunkered water is not sufficiently high that our system is unable to remove most of it from the effluent. It is noted, though, that some of the connections, particularly in Juneau and Skagway, supply water that far exceeds ADEC's permitted levels, such that an open faucet draining into the harbor violates the standard. Therefore, we cannot guarantee, at any given point in time, that the water we receive consistently meets some standard. ADEC might consider a program to monitor this bunkered water on a consistent basis and support the ports' program to update their distribution systems.

Appendix 3 – 2009 Annual Progress Report

Pursuant to the original discharge permit requirements and the accepted SRE submitted in June 2008, NCL offers this 2009 annual progress report.

NCL has made a business decision to remove the NORWEGIAN SUN from further Alaska voyages, beginning with the 2010 season. Therefore, NCL plans no further efforts on the NORWEGIAN SUN at this time. This ship's name has been removed from the title page of this SRE.

To recap 2009, each of NCL's Alaska-bound ships (NORWEGIAN PEARL, NORWEGIAN STAR and NORWEGIAN SUN) completed the 2009 season with no exceedences of the interim ammonia and dissolved metals effluent standards. The Scanship AWTS performed exactly as designed and as we have experienced in past years. There were no non-compliances to the existing USCG discharge standards or the parallel ADEC interim water quality standards, with the exception of one anomalous pH result (which met the USCG standard but not the new higher ADEC standard) and one high fecal coliform result, due most likely to a contaminated pipeline. In total, during the 2009 season, there were 34 effluent analyses taken that included ammonia and dissolved metals. Of these, 33 samples exceeded the final ammonia discharge standard of 2.9 mg/l (the range being 2.3 to 66 with the median being 37). Twenty-eight exceeded the final copper standard of 3.1 μg/l (the range of results being 2.2 to 43 with the median being 4.7 (i.e. 50% were below 4.7 !)). Twenty-two exceeded the nickel standard of 8.2 μg/l (the range of results being 5 to 18 with the median being 9.5). Only nine exceeded the zinc standard of 81 μg/l (the range of results being 17 to 110 with the median being 67). These results are comparable with those from 2008 and show consistent high quality effluent, although not quite meeting the final water quality standards of the Permit.

As noted in the April 2009 update, some installation work on the NORWEGIAN STAR was underway, just in time for the 2009 season. T

installation of an ammonia monitoring system, installation of a chemical
reduction system (see figure 2),
The latter two items were primarily done to improve efficiency of the system in the hopes to reduce operating cost, but there may be some benefit to improve effluent quality.

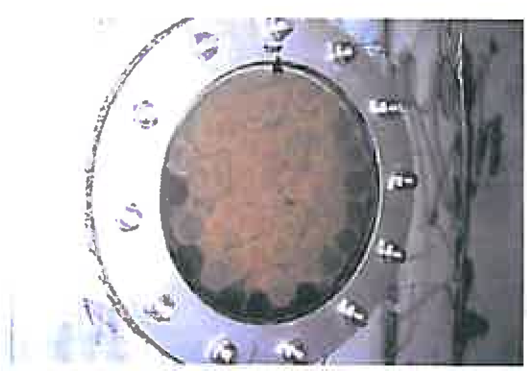

Figure (1): bio-media New bio-media

16/16

ENTERED

Figure (2)

These systems are operational. Results from samplings during the 2009 season indicate the performance of the system is as good as before. However, as noted earlier, a new air compressor is needed to drive the entire nitrification process by providing sufficient compressed air for the oxygen generator. The latter components are installed aboard, awaiting this final component. There have been some unavoidable delays configuring and obtaining the compressor, but it has been ordered and we are expecting delivery in the next couple months. Depending on the final delivery date, we hope to get it aboard and installed prior to the Alaska season. However, we will have to carefully look at the initial, and unknown, effects it might have on system performance and decide whether to activate it in the spring or wait until the fall.

Because of the commitment of resources and the experimentation on the NORWEGIAN STAR, we have postponed further work on the NORWEGIAN PEARL until we can see the results of the initial tests on the NORWEGIAN STAR. This would allow us to best configure any future installations based on the results of the initial experimentation.

As noted earlier, we have completed the conversion to the new hotel chemicals product line, i.e. Swisher. Our earlier review indicated that there would be no contribution to any dissolved metals from this change and the year over year results do not indicate any change that could be attributed to this change.

Submitted: 15 January 2010

Randall R. Fiebrandt
Director, Environmental Operations

24 16A/16A