

Source Reduction Evaluation (Copper and Nickel) Plan, m/v Silver Shadow

ALASKA SOURCE REDUCTION EVALUATION M/V "SILVER SHADOW"

Pursuant to Section 1.9.1 in Alaska Department of Environmental Conservation Large Commercial Passenger Vessel Wastewater Discharge Permit No. 2007DB0002, and following authorisation 0025 Silver Shadow given by ADEC Alaska to discharge **copper and nickel** under interim effluent limits, Silversea Cruises is submitting this Source Reduction Evaluation (SRE) Plan to identify methods to reduce the presence of these constituents in the discharges authorized.

It is expected that by the carrying out the action plan as outlined in the SRE , the Silver Shadow will achieve the long term effluent limits for Copper and Nickel in September 2009

It should be recognised that this plan has been issued in response to General Permit and ADEC authorisation, as mentioned, and it will be updated and amended as further information will be gathered in process of completing this evaluation.

The following reports on the progress of the SRE Plan will be submitted to ADEC:

- interim report by 31st Oct 2008
- annual report by 15th Dec 2008
- interim report by 30th June 2009
- annual report by 15th Dec 2009

Source Reduction Evaluation overview

Efforts under this plan will fall into one of two categories of activities:

1. **Source Reduction** of inflows to reduce introduction of constituents to waste water system.
2. **Technology Evaluation/** Implementation to identify a better technology to eventually reduce effluent concentrations.

It should be noted that technology solutions are not yet commercially available for application on a large cruise ship, and therefore at present there remains much in certainty in the evaluation and potential implementation of such technologies.

Activities under each of these categories are described further below:

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1. **Influent Source Reduction Evaluation** will consider three areas as follows:

i) use of chemicals

- a) To collect technical sheets and identify all cleaning products and maintenance products used on board. Evaluation and estimation of potential contributions from cleaning products to copper, nickel in the effluent.

Time limit:

- Completion of Review due by 01st Jan 2009
- progress to be reported in the interim ADEC report due in October 2008

Persons in charge:

- Environmental Officer; Marine Suptd (Environmental)

- b) Based on the outcome of the above review, adoption of operational practices to reduce pollutants sources such as use of alternative cleaning products to take place

Time limit:

- due by 01st Mar 2009
- outcome to be reported in an interim ADEC report in June 2009

Persons in charge:

- Technical Superintendent; Purchasing Agent

- c) To produce and analyze the technical sheets of the paints used on board for the potable water tanks, water purifier, double bottoms of tanks used for grey water collection

Time limit:

- Completion of Review due by 15th Oct 2008
- outcome to be reported in the interim ADEC report due in October 2008

Persons in charge:

- Environmental Officer; Marine Suptd (Environmental)

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- d) Based on the outcome of the above review, consideration to be given on changing some of the paint coatings with others with lesser amount of copper or nickel if feasible

Time limit:

- due by 01st Mar 2009
- outcome to be reported in an interim ADEC report in June 2009

Persons in charge:

- Technical Superintendent; Staff Captain

ii) water source evaluation

- a) Additional sampling of potable water to be carried in different points of the distribution and production plant in order to locate anomalies, if any.

(First sampling has been carried out on June 6th, Ketchikan);

Time limit:

- due by 10th Sep 2008
- outcome to be reported in the interim ADEC report due in October 2008

Persons in charge:

Environmental Officer, Staff Captain; Marine Manager, Marine Suptd (Environmental)

- b) To plan water sampling analysis of the shore water supply bunkered in Alaska and determine also the volumes bunkered there

Time limit:

- due by 10th Sep 2008
- outcome to be reported in the interim ADEC report due in October 2008

Persons in charge:

Environmental Officer, Staff Captain; Marine Manager, Fleet Manager

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- c) To plan water sampling analysis of the shore water supply bunkered outside Alaska and determine also the volumes bunkered there

Time limit:

- due by 15th Oct 2008
- outcome to be reported in the interim ADEC report due in October 2008

Persons in charge:

Environmental Officer, Staff Captain; Marine Manager, Fleet Manager

- d) based on the outcome of the above sampling analysis to determine if it would be feasible to either bunker more water from shore and from where - in or outside Alaska, or produce own water onboard. This to take also in consideration other impacts from producing more water onboard (energy consumption, public health requirements)

Time limit:

- due by 01st Mar 2009
- progress to be reported in the annual ADEC report due in December 2008 and determination reported in an intermediate ADEC report in June 2009

Persons in charge:

Environmental Officer, Staff Captain; Marine Manager, Fleet Manager

l ii) other potential contributors,

- a) To identify all possible sources of water influents going for treatment and currently formed by: laundry water, water originated by passengers and crew accommodations, water from the toilets

Time limit:

- Completion of Review due by 15th Dec 2008
- progress to be reported in the interim ADEC report due in October 2008

Persons in charge:

- Chief Engineer, Technical Superintendent

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- b) Based on the review, any new sources identified to be further analyzed as influents for contributors to copper and nickel

Time limit:

- Completion of Review due by 01st Mar 2009
- To be reported in an interim ADEC report in June 2009

Persons in charge:

Environmental Officer, Chief Engineer, Technical Superintendent

- c) To identify the different types of materials used in the piping of the fresh water and waste water systems of the discharge

Time limit:

- Completion of Review due by 15th Dec 2008
- To be reported in the annual ADEC report in Dec 2008

Persons in charge:

Environmental Officer, Chief Engineer, Technical Superintendent

- d) Based on the outcome of the above review to consider change of pipes made of different materials, metals and alloys

Time limit:

- due by 01st Mar 2009
- progress to be reported in the annual ADEC report due in December 2008 and determination reported in an intermediate ADEC report in June 2009

Persons in charge:

Chief Engineer, Fleet Manager

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- e) To identify the mixing ratio of sewage and greywater influent before it is treated. To identify if changing this ratio affects effluent quality. This to be done by additional sampling

Time limit:

- due by 15th Dec 2008
- progress to be reported in the interim ADEC report due in October 2008 and determination made and reported in an intermediate ADEC report in June 2009

Persons in charge:

Environmental Officer, Chief Engineer; Marine Manager, Fleet Manager

- f) To consider separating and landing waste water from galley to shore facilities (procedure already in place) and to identify through sampling if this changes the effluent quality for copper and nickel

Time limit:

- due by 15th Dec 2008
- progress to be reported in the interim ADEC report due in October 2008 and determination made and reported in an intermediate ADEC report in June 2009

Persons in charge:

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2) Treatment Technology Evaluation

Identification of potential technologies for addressing the target constituent is both more complex than, and yet will be considerably supported by information by the influent source reduction evaluation described above. Silversea will work with the AWWPS vendors and evaluate additional treatment technologies as appropriate for reduction of these pollutants that are practicable for implementation in a cruise ship environment.

i) Investigation with the Manufacturers of the AWWPS re available technology to reduce copper and nickel with the following scope:

a. Need for different Instructions on the way of operating the current system

Time limit:

- due by 15th Oct 2008
- reported in the intermediate ADEC report in October 2008

Persons in charge:

Environmental Officer, Chief Engineer, Fleet Manager

b. chemical treatment processes changes or introduction of new/different chemicals

Time limit:

- due by 15th Dec 2008
- progress reported in the intermediate ADEC report in October 2008 and final determination in the annual 2008 report in Dec

Persons in charge:

Chief Engineer, Fleet Manager

c. need for modifications or add-ons to the existing plant

Time limit:

- due by 15th Dec 2008
- progress reported in the intermediate ADEC report in October 2008 and final determination in the ADEC intermediate report in June 2009

Persons in charge:

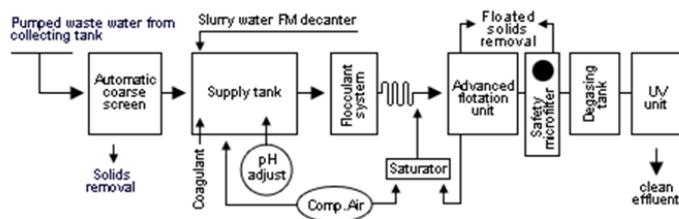
Chief Engineer, Fleet Manager

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Appendix with Additional information (as requested by ADEC):

- Class Information:
 - vessel built year 2000
 - flag Bahamas
 - gross tonnage 28258
 - passenger capacity 435
 - crew capacity 305
 - classed with RINA as Recognized Organization
 - average daily water use per individual: 383 litres
- Type of potable water drinking water system:
 - total capacity 1035 m³
 - water production plants specifications
 - 2 x Evaporators:
 - production rate: nominal 7.2 m³/hr; actual ~4.5 m³/hr
 - sea water temp. 25÷30°C
 - 1x Reverse Osmosis Fresh Water Generator:
 - production rate 5.0 m³/hr
 - sea water temp. 25°C
 - rate decreases 3% every 1°C drop of sea water temperature
- Specifications of the Advanced Wastewater Treatment System:
 - MariSan250 (I.S.I.R.)
 - treating treated sewage by the 2x MSDs type II (Bioepuro250) mixed with grey water
 - capacity 250 m³/day
 - principles and stages of operation
 - pre-treatment: removing large debris, water chemistry pH adjustment and preliminary stream conditioning including advanced coagulation
 - primary treatment: injection of flocculants, removal of primary solids in utilizing the buoyancy and specific gravity of the incoming solids and their inherent nature to float; float (sludge) collected and moved for further processing
 - secondary treatment: automatic microfilter ensures a low level of suspended solids and maintenance of consistent effluent quality; de-gaser unit eliminates residual air and a disinfecting stage consisting of an Ultraviolet Unit

▪ Principle Schematics



▪ System description

physical and electro-chemical treatment system based on the following main components: - Self-cleaning coarse filter - pH adjustment and conditioning stage - ionised gas generator - dissolved air flotation unit with rotating skimming arm, gimbal-mounted to self-adjust according to the ship's motion - disinfecting stage UV-C lamp