Alaska Cruise Ship Initiative

Report of the Work Groups

Wastewater and Solid Waste Handing
Air Emissions
Oil Spills
Environmental Leadership

May 10, 2000

Important Notes:

(1) The Alaska Cruise Ship Initiative Report of the Work Groups to the Steering Committee (DRAFT) represents the work done through May 10, 2000 by the Work Groups on this Initiative. This draft report is available as of May 10, 2000 on DEC's web site, or through request to Trish Tolles at DEC (email: Ttolles@envircon.state.ak.us). phone: (907)465-5337; FAX: (907)465-5274).

(2) During the period May 10, 2000 and May 17, 2000, the Work Groups will continue to work on details of their actions and recommendations. Any changes to the draft reports will be highlighted during the opening of the May 17, 2000 public meeting of the Steering Committee. During that period, you are encouraged to e-mail comments regarding the report to Trish Tolles at DEC (email: Ttolles@envircon.state.ak.us).

(3) Everyone is invited to attend the May 17, 2000 public meeting of the Steering Committee to participate in a discussion of the draft report. The meeting will be held in the Sheffield Room of Centennial Hall in downtown Juneau, Alaska at 9 a.m. See the DEC web site for additional information on the meeting.

Executive summary

Background

Alaskans are concerned about how the cruise ship industry is impacting air and water, and what the industry is doing to control and mitigate the wastes it creates. They need information. They need sound waste management. They need monitoring and verification. They need answers and action.

During the past decade, the size and number of cruise ships frequenting Alaska's coastal waters have increased dramatically. Ports such as Ketchikan and Juneau may host as many as five large cruise ships and several smaller ones a day. Under certain atmospheric conditions, air emissions from the ships are highly visible, causing reductions in visibility. Concern about ship discharges and their potential impacts on water quality and aquatic resources such as salmon were heightened when one cruise line pleaded guilty to discharging hazardous wastes, such as photo processing wastes, with gray water over a period of years in Alaska waters. Additionally, marine pilots reported ships going to "doughnut holes" (locations in the Inside Passage more than three miles from land) to discharge wastes. Large cruise ships operating in Alaska carry up to 1500 tonnes (405,000 gallons) of heavy, persistent fuel oils. Agencies and citizen's groups have worried about the impacts from potential oil spills since, prior to May 2000, these vessels did not have in-region response capability should a spill occur.

These factors have increased concern over the pollution potential of cruise ships. On the other side, the cruise ship industry reports they have recently implemented a number of progressive, continuously improving management systems and new technologies that should reassure the public. They want opportunities to regain credibility.

The best way to address the concerns of both the industry and the public is by open, full discussion. This type of discussion takes willingness by all the parties involved to listen, thoughtfully analyze and commit to act. In December 1999, Commissioner Michele Brown convened a forum designed to thoroughly review the industry's waste management and disposal practices, and to publicly discuss what is currently being done and what should be done to improve the situation. The Alaska Department of Environmental Conservation asked the U.S. Coast Guard, the U.S. Environmental Protection Agency, and the Southeast Conference (a group representing Southeast Alaska communities) to join cruise ship industry officials in this discussion of ways to improve controls on cruise ship pollution.

Four work groups were chartered by the leaders from the above organizations (the "Steering Committee") to undertake fact finding on air emissions, wastewater discharges, waste disposal management, oil spill prevention and response, and environmental leadership. In a series of open meetings between February and May 2000, these work groups endeavored to:

- Identify the waste streams and spill risks from cruise ships that could impact Alaska's air and water resources;

- Develop pollution prevention and waste management solutions, including better technology and management practices, that will eliminate or reduce impacts;
- Assess what process is needed to verify compliance; and
- Keep Alaskans informed.

Achievements

Although operating under an aggressive schedule, industry members, governmental agencies and citizen's groups have produced a number of recommendations, agreements, protocols, reports, and procedures to address the four objectives listed above. These work products include:

- An agreement for air monitoring in downtown Juneau during the 2000 cruise ship season including analysis of sulfur dioxide, particulate matter and nitrous oxides. (Approved by the Steering Committee on April 24, 2000)
- A survey of waste stream discharges and solid waste handling practices for all cruise ships operating in Alaska.
- Proposals and pilot projects from industry for a number of new technologies; including, ultra-filtration of graywater, cleaner "green" diesels and gas turbines, non-toxic dry-cleaning processes, and more effective oily-water separators.
- Random, third party wastewater analysis of all cruise ships throughout the 2000 season.
- A new voluntary wastewater discharge plan for cruise ships that is designed to minimize wastewater impacts.
- Approval of a maintenance and operations plan for eight new oil spill recovery barges.
- Development of regional priorities, concepts and guidance to ensure continued acquisition of the most cost-effective oil spill response equipment.
- Agreement on the essential elements of environmental leadership and the formation of a sub-committee to pursue a cruise ship environmental leadership program for Alaska.
- Development of a public information document that summarizes the cruise ship industry's environmental management system in layman's terms.
- Cruise Ship Awareness Day(s) in June and/or July 2000, designed to allow the industry, regulatory agencies and citizen's groups to listen, learn, and educate. (Co-sponsored by the industry, ADEC, Coast Guard, EPA, and Center for Marine Conservation.)

Recommendations

The work group requests that the Steering Committee:

1. Endorse the funding arrangements for the downtown air-monitoring plan for immediate implementation. (Appendix A)

2. Approve the wastewater sampling protocol for immediate implementation. (Appendix C) (to be completed).

3. Comment on the cruise industry's voluntary wastewater discharge plan.

4. Disband the Oil Spill Work Group formed under this initiative with the understanding that its activities will be continued under the Southeast Alaska Sub-area Oil Spill Contingency Planning Committee.

5. Approve the recommendation to create a sub-committee that will develop a long-term environmental leadership program.

6. Support Cruise Ship Awareness Day(s) and assist the environmental leadership work group in their efforts to involve community leaders outside of Juneau.

The remainder of this report summarizes the activities of the four work groups. The details of their work, including the minutes of all the meetings, are available on the ADEC web site: http://www.state.ak.us/dec/press/cruise/cruise.htm

Part I: Report of the CRUISESHIP AIR EMISSIONS WORKING GROUP

Goals of the Work Group

This work group is tasked with gaining a better understanding of the type and quantity of air pollutants emitted by the cruise ships, determining whether these emissions are causing adverse public health or environmental impacts and, if so, what actions should be taken to alleviate those impacts. Simply put, the goals are - GET THE FACTS, IDENTIFY PROBLEMS, DEVELOP SOLUTIONS.

Work group progress to date

1. Air monitoring

The work group developed a plan for a cost-effective analysis of ambient air quality in downtown Juneau during Summer 2000. Highlights of this agreement include:

- Operation of a sophisticated ambient air urban trend monitor (on loan for 30 days from EPA, subject to approval from EPA headquarters);
- Installation and operation of three particulate matter monitors and one sulfur dioxide monitor; and
- Operation of a downtown meteorological station.

The complete agreement is included as Appendix A of this report.

2. **Emission Control Strategies**

The industry reports that efforts are continuing to identify and implement technology to reduce air emissions and the impacts of those emissions; including,

Current practice

- Use of medium speed diesels
- Experimenting with changes in operations (ex. Running two of four engines when safe operations permit)
- Use of IFO (Intermediate Fuel Oil) 180 instead of IFO 380 or 780,
- Continuing to search for the best quality, lowest sulfur fuels available.
- Prohibiting the use of incinerators in port.
- Attention to timing and maintenance to achieve optimum combustion.

Promising technology and future plans

- "Green" diesel engines on new vessels and possible retrofit for existing vessels. "Green" diesels utilize fuel injector systems similar to those installed on late model automobiles. In addition, injected steam more effectively atomizes fuel to achieve near 100% combustion.
- Gas turbine engines on new vessels that burn light diesel. Light diesel fuel is more expensive than IFO 180, but because gas turbines use the energy of combustion more efficiently than medium speed diesels, fuel consumption is less.

Safety during maneuvering

Both state marine pilots and cruise ship operators have expressed the concern that ships might feel a pressure to maneuver for emissions minimization rather than safety. Work Group notes that Alaska State statures allow temporary excursions of opacity standards for the purpose of maneuvering. It was never the intent that safe navigation should be compromised to meet opacity standards.

Future plans

- Implement the air quality analysis plan as described above;
- Prepare and widely distribute an end of season report explaining the air quality information gathered;
- Review the end of season report and determine whether additional activity is necessary, including the possibility of similar monitoring efforts in other communities;
- Track the results of several independent opacity monitoring efforts (smoke reading);
- Through the Environmental Leadership Work Group, publicize and promote new technologies and operational procedures that will reduce emissions on ships.

Recommendation to the Steering Committee

Approve the funding arrangements of the *Pilot Saturation Study of Air Impacts in Downtown Juneau during Summer 2000* (Appendix A).

Part II: Report of the CRUISE SHIP WATER DISCHARGES AND SOLID WASTE WORKING GROUP

Goals of the Work Group

The overall objective of the Work Group on Waste Water and Solid Waste is to assess the nature and extent of wastewater and solid waste discharges from cruise ships in Alaska so the public, government, and industry will have the best possible information to make decisions concerning these discharges. Simply put, the goals are - GET THE FACTS, IDENTIFY PROBLEMS, DEVELOP SOLUTIONS.

Progress to date

Fact finding and Analysis

1. A contractor was retained to assemble information on the type and quantity of discharges from cruise ships. The contractor's report, *A Survey of Waste Stream Discharges and Solid Waste Handling Practices of Cruise Ships Operating in Southeast Alaska*, provides a brief description of waste stream handling methods and lists new technology that may minimize the impact of waste discharges. This survey is included as Appendix B. The reviewer may want to examine Tables I & II first. These tables provide an overview of wastewater discharges and compare them to Southeast Alaska municipalities.
2. The contractor's survey is only the first step in an effort to quantify the impact of discharges from cruise ships. Determining the water quality of these discharges is the next step. Wastewater quality will be monitored during the 2000 Alaska cruise ship season through an extensive collaborative sampling effort between the industry, Coast Guard, ADEC, and citizen's groups. The scope of work and sampling plan developed for this effort is attached as Appendix C (to be completed). Highlights of the plan include procedures for:
    - Random, unannounced sampling;
    - Analysis of conventional pollutants;
    - Analysis of priority pollutants; and
    - Oversight by Coast Guard inspectors.

Changes in operational practice or technology to minimize impacts

1. Currently, cruise ships do not discharge graywater or treated blackwater in port. However, discussions have revealed that "in-port" has various definitions among marine operators. The cruise ship industry is developing general consensus definitions of "in-port" and "underway". These definitions will be terms that can be used worldwide, while still incorporating the unique nature of Alaskan operations.
2. The cruise industry has committed to working with federal, state and local agencies to identify especially sensitive areas where wastewater discharges should

be avoided. This will be an on-going dialogue but an initial list of especially sensitive areas will be developed this season.

3. The industry reports that efforts are continuing to identify and implement technology to reduce the amount of waste generated and to reduce the impacts of waste that is discharged; including:
    - Graywater filtration systems capable of treating wastewater to a level achieved by landside secondary treatment facilities. Two ships will be outfitted with these systems in the summer of 2000. Preliminary results indicate that the filtration can remove 90% of the BOD.
    - Effective and efficient digital photo technology or other technologies to reduce hazardous waste stream generation during photo processing.
    - Alternative dry cleaning processes such as CO_2 and "wet" processes.
    - Recycling laundry water to reduce graywater discharge.
    - Use of non-toxic based printing ink, non-chlorinated solvents and other non-hazardous products to eliminate the hazardous wastes in print shops.
    - Oily water separators that produce effluents with less than 5 ppm oil.

Future plans:

1. Implement the random, unannounced wastewater sampling and analysis program for the 2000 season as described in Appendix C (to be completed).
2. Report the results of the sampling and program.
3. Develop a list of especially sensitive areas where discharges should be avoided.

Recommendations to the Steering Committee

1. Approve the wastewater sampling protocol for immediate implementation. (Appendix C)
2. Comment on the cruise industry's voluntary wastewater discharge plan.

Part III: Report of the CRUISE SHIP OIL SPILL WORK GROUP

Goals of the Work Group

The large cruise ships operating in Alaska carry up to 1500 tonnes (405,000 gallons) of heavy, persistent fuel oils. Prior to May 2000, these vessels did not have in-region response capability should a pollution incident occur. In addition, the oil transportation industry's spill response equipment in Southeast Alaska was designed for highly refined products, primarily diesel, and could not effectively recover the higher viscosity oils. However, this situation is changing. The North West Cruise Ship Association (NWCA) is constructing 4 sets of paired oil spill recovery barges for pre-positioning throughout Southeast Alaska. A cruise line is providing nearly $2.5 million in response equipment and planning expertise as the result of a settlement with the State of Alaska.

By sharing relevant information with state and federal agencies, becoming a participating partner in regional spill response, and by forming alliances with local oil spill response contractors, the industry will make a significant, positive impact on improving the pollution response capabilities of the region. To that end, an oil spill work group was formed from members of cruise industry, the United States Coast Guard, Alaska

Department of Environmental Conservation, the Northern Lynn Canal Nearshore Project and the Southeast Alaska Petroleum Resource Organization (SEAPRO. The work group's goals were:

- to assist in standardizing equipment,
- to provide input for pre-planning,
- to work towards agreements on multi-party use,
- to identify equipment shortfalls for future planning.

The work group decided to divide the work into two phases. The first phase involved a series of discussions that focused on:

- regional response needs,
- capability and deployment of the response barges being provided by North West CruiseShip Association (NWCA),
- recommendations and guidance for equipment to be provided by a cruise line under the terms of a settlement agreement with the State of Alaska.

In phase two the work group will transition into the Southeast Alaska Sub-area Contingency Planning Committee, a federally mandated response preparedness committee lead by the Coast Guard and ADEC.

Progress to date

Phase One: Activity and Achievements

Regional response needs: The group discussed a number of issues critical to preparation for a major fuel oil spill including; planning standards, the nature of a maximum most probable discharge, availability and capability of Southeast Alaska inventory of containment boom and shoreline protection boom, geographic response plans, and staging location. Although the work group did not attempt to reach a consensus on any specific criteria, the information will be carried forward into the subsequent work of the Sub-area Oil Spill Contingency Planning Committee.

NWCA response barges: Construction is underway on four-paired response barges (eight barges total) systems for open water recovery systems. The barges will be positioned in four locations in Southeast Alaska. The first pair was delivered to Glacier Bay on May 7, 2000. All barges will be pre-positioned by September 2000. The capabilities of each pair is:

Recovery capacity:	Lori brush inclined plane skimmer rated for 700 barrels/hour (29,400 gals/hour)
Temporary storage:	250 barrels per barge, 500 barrels (21,000 gals) total
Boom:	2000 feet per pair, 1000 feet of 20-inch boom per barge
Work boat:	3700 pound skiff that can be launched and retrieved through an on board davit system.
Tow speeds:	up to 20 knots to the scene, around 8 knots loaded

NWCA barge management plan: SEAPRO developed a management plan for NWCA barges. This plan lays out, in detail, the logistical and operational details of the barges including equipping and using the barges during pollution response activities in Southeast Alaska. The work group was satisfied with the plan as presented by SEAPRO and asked that it be formalized. The work requested that SEAPRO include the barges in its basic ordering agreement (BOA) with the Coast Guard. A BOA is a contractual arrangement that allows the Coast Guard to quickly mobilize and hire SEAPRO for a federally funded clean-up.

Cruise Line/State Settlement: Members of the Work Group had an extended discussion regarding the type of equipment that should be provided as part of the $2,100,000 supplemental environmental project required by a cruise line settlement with the State of Alaska. The Work Group decided not to develop a specific list of equipment needs, believing it was more appropriate to set criteria for response capability. Ten concepts and priorities for equipment selection were developed. These criteria are (in order proposed by members, not by weighting):

1. Manageable out-year operation and maintenance costs.
2. Best coverage for cruise ship operating areas.
3. Independent response capability (self-contained response system).
4. A 6-hour on-scene response time for higher risk areas.
5. Capability for shoreline protection.
6. First response capability for wildlife protection.
7. Ability to perform a number of functions (most capability for the cost)
8. Ability to use in both persistent and non-persistent oil spills.
9. Shallow water response capability.
10. Compatibility with the existing Southeast Alaska response inventory.

Specific equipment and the timeline for delivery will be an outcome of on-going discussions between ADEC and the cruise line.

Future plans and recommendations:
With a response barge management plan approved and a list of criteria to help guide equipment purchases completed, **the Oil Spill Work Group recommends to the Steering Committee that their activities transition into the Southeast Alaska Sub-area Contingency Planning Committee.** This federally mandated planning body is well suited to continue planning activities on a broader scope. The work group suggests that the following issues be addressed by the Sub-area committee:

- Development of Geographic Response Strategies for Southeast Alaska – A contract for this project is a funded provision of a cruise line settlement with the State.
- Regional spill response needs to cover the whole range of oil products carried onboard vessels transiting our waters, persistent and non-persistent alike.
- Standardization of response resources and tactics.
- Identification of additional response equipment shortfalls.
- Review and comment on proposals for equipment procurement.
- Compilation and review of baseline data.

Part IV: Report of the Environmental Leadership Work Group

Goals of the Work Group

Environmental Leadership is the integration of environmental stewardship into the business management practices of an organization. It is a continuing process that achieves environmental excellence through prevention based environmental systems and environmental accounting. Organizations move beyond mere compliance with existing regulations by establishing an environmental management system that incorporates pollution prevention into the core business philosophy and practices. Every business, community, citizen and ultimately the environmental will benefit.

The overall goal of the Environmental Leadership Work Group is a clean Alaskan environment. The establishment of a sustainable system for long term environmental leadership will help achieve that goal. The Work Group recognizes that this is long-term process. There are similar environmental leadership models but none currently exist that can be easily adapted for the complicated systems of the cruise ship industry. The Work Group process will eventually lead to an environmental leadership program that:

- Re-establishes credibility. Credibility is a major concern of the cruise ship industry. Citizen's community groups have expressed concern over the lost of credibility. The Cruise Ship industry believes there are many environmental systems currently in place that demonstrate credibility.
- Reassures the communities that cruise ships are complying with environmental rules, regulations, and laws.
- Establishes an environmental leadership program that goes beyond compliance with existing laws and regulations.
- Identifies standards and criteria that achieve environmental leadership beyond what is currently in place.
- Recognizes existing environmental management systems (EMS).
- Identifies and involves stakeholders and communities with the environmental leadership process.
- Verifies and recognizes environmental leadership as valuable to all stakeholders.

Progress to date

The Environmental Leadership Work Group met four times between February 18 and May 16 and involved extensive discussion of a number of topics including:

- Current models of Environmental Leadership and Environmental Management Systems (EMS) including the State of Florida Agreement, Greenstar, International Standards Organization (ISO) 14001, New Mexico Zia Program, Oregon Green permits, International Safety Management Code (ISM) and the Presidential Directive.
- Methods for describing and promoting existing best management practice within the cruise ship industry.
- Third party oversight and verification. The form of the 3rd party verification is to be determined. The 3rd party verification that was discussed included regulatory agencies, Citizen's Advisory group and recognized environmental leadership programs.
- Process and methodology for promoting "beyond compliance"
- Initiatives that have worldwide impact but recognize the uniqueness of Alaska waters and port communities.
- Establishing credibility within the port communities, citizen's groups and agencies.
- Achieving community engagement.
- Defining and promoting the involvement of stakeholders.

Agreements of the Work Group

1. The Work Group agreed that effective environmental leadership would be comprised of the following essential elements:
    - Pollution Prevention (P2)
    - Environmental Management Systems
    - Beyond Compliance
    - Community Involvement
        - Defines "community"
        - Involves knowledgeable stakeholders
        - Shares information with the community
    - Results Oriented
        - Measurable
        - Standards
        - Score/Rating System
        - Cost/Efficiency accounting

2. The Work Group agreed to produce a public information document that summarizes the cruise ship industry's environmental management system in layman's terms. A draft document, developed by Northwest CruiseShip Association, which explains these existing environmental standards is currently under review.

3. The Work Group chartered a sub-committee to plan cruise ship awareness day(s) in June and July 2000. These gatherings, co-sponsored by ADEC, Coast Guard, EPA, the industry, and the Center for Marine Conservation, will be designed to educate and promote dialogue. Although the format is still under discussion, events will likely include:
    - Shipboard tours that allow inspection of waste management systems.
    - Presentations or forums by or among ADEC, USCG, industry and citizens groups.
    - Opportunities for citizens to ask questions and voice concerns.
    - Displays and presentations from manufacturers of waste treatment equipment and systems.
    - Presentations by third party auditors (Lloyd's, American Bureau of Shipping, Det Norske Veritas, etc.).

Future plans

The Work Group agreed to begin a long-term process for continuous dialogue and activity in environmental leadership. A sub-committee was proposed for the task of developing a format for engagement. Components of this process could include:

- Development of standards. Standards are to be developed in conjunction with industry, community, citizens and other stakeholders.
- Third party verification or evaluation. Evaluators will be trained to understand the concepts and process of environmental leadership and industry specifics.
- Tools for promoting community involvement.
- Regulatory agency input.
- Recognition of superior performance.

Recommendations to the Steering Committee

1. Approve the recommendation to create a sub-committee that will develop a long-term environmental leadership program.

2. Support Cruise Ship Awareness Day(s) and assist the planning committee in gaining the involvement of community leaders outside of Juneau.

Appendices

A. Monitoring - Pilot Saturation Study of Air Impacts in Downtown Juneau during Summer 2000

B. Report to the Wastewater and Solid Waste Work Group

C. Wastewater Sampling Protocol (to be completed)

D. List of Steering Committee and Work Group participants

Appendix A

MONITIORING – PILOT SATURATION STUDY OF AIR IMPACTS IN DOWNTOWN JUNEAU DURING SUMMER 2000

1. The purpose of this saturation study is to obtain a cost-effective analysis of ambient air quality in downtown Juneau during Summer 2000. The parties understand and acknowledge that similar efforts may be necessary in other impacted communities and agree to develop a plan to address these questions as soon as possible if the information obtained in the Juneau Saturation Study indicates such efforts are needed.

2. Subject to approval by the United States Environmental Protection Agency (EPA) Headquarters Office, the DEC and EPA will cooperatively install and operate an ambient air urban trend monitor (Opsis) for approximately 30 days during the summer of 2000. The DEC and EPA will use the monitor to sample ambient air in downtown Juneau and will analyze the data collected to assess ambient air quality. The study will focus on NO2, SO2, and formaldehyde.

3. The DEC will install three particulate matter monitors and one sulfur dioxide monitor to conduct ambient air sampling in downtown locations during the summer of 2000. The Department will also install a meteorological station in downtown Juneau in preparation of future monitoring efforts. A contractor will be hired to assist in this effort subject to DEC oversight.

4. A preseason report will be released to the public, which describes the activities that will be undertaken to quantify air quality in and around the port of Juneau.

USE OF DATA - REVIEW AND ANALYSIS OF RESULTS OF JUNEAU SATURATION STUDY

1. At the end of this period a report will be prepared analyzing the air quality information gathered in a manner that can be clearly understood by the public.

2. Following release of this report, a committee consisting of representatives from the public at large, the City and Borough of Juneau, the Alaska Department of Environmental Conservation, the Environmental Protection Agency, the cruise ship industry and other interested communities or industries will review and evaluate the information and discuss future courses of action. Possible courses of action could include additional monitoring, emissions modeling, cumulative impact/long term trend analysis, development of enforceable control strategies, standards for enforcement and other measures, as appropriate.

FUNDING

1. In addition to the in kind contributions of personnel and equipment (Opsis Urban Trend Monitor; Particulate and SO_2 Monitor Operation; Meteorological Installation and Operation) by DEC and EPA, the projects identified in this agreement require financial contributions of $53,000 dollars.

2. Funding will be provided as follows:

Industry:	$_____
Government (State):	$_____
Government (Fed.):	$_____
Local Government:	$_____
Other:	$_____

3. Summer 2001: Activities are dependent on additional funding. The parties agree in principle to continue to provide funding and in kind support in the same proportions as necessary and appropriate. The agreement to provide funding and other resources beyond the 2000 season will not be binding on any party until memorialized in a separate written agreement signed by that party.

The parties signing below agree to the terms of this agreement:

State

EPA – Region 10

Cruise ship reps

others

Appendix B

Report

to the

Wastewater and Solid Waste Work Group

A Survey of Waste Stream Discharges and Solid Waste Handling Practices of Cruise Ships Operating in Southeast Alaska

A product of the Alaska Cruise Ship Initiative

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B. Graywater
C. Bilgewater
D. Ballast water

VII. Food waste

VIII. Solid Waste Handling Methods

A. Non-hazardous Solid Waste
B. Hazardous and potentially hazardous waste

Appendix A: Details for cruise ships by tonnage class

Appendix B Promising Technology

I. Objectives and scope of this survey

One objective of the Work Group on Waste Water and Solid Waste is to assess the nature and extent of wastewater and solid waste discharges from cruise ships in Alaska so the public, government, and industry will have the best possible information to make decisions concerning these discharges. This report contributes to that objective by assembling information on the type and quantity of discharges from cruise ships. It provides a brief description of waste stream handling methods and lists new technology that may minimize the impact of waste discharges.

This survey reports the amount of wastewater discharged from cruise ships. It is the first step of an effort to quantify the impact of discharges from cruise ships. Determining the water quality of these discharges is the next step. Wastewater quality will be determined during the 2000 Alaska cruise ship season through an extensive collaborative sampling effort between the industry, Coast Guard, ADEC, and citizen's groups.

This report presents information on 20 cruise ships that will sail the Inside Passage of Southeast Alaska in 2000. The information needed to complete this survey came from:

- Interviews with cruise industry marine operations managers,
- The International Council of Cruise Lines' paper, "Cruise Industry Waste Management Practices and Procedures".
- The North West CruiseShip Association's response to the 34 questions posed by ADEC.
- Federal regulations.
- Official Coast Guard records including information on the Commandant of the Coast Guard port state exchange web site..
- ADEC records.
- **Juneau Convention and Visitors Bureau**

II. Overview

Data on discharges for vessels by tonnage class is displayed in Appendix A. This vessel- specific data is summarized in Table I. In an attempt to place numbers in context, Table II shows wastewater data from two Southeast Alaska municipalities alongside data from two cruise ships with comparable populations. Exhibit I, *Twenty-four hours in the Life of Cruise Ship Hypothetica*, attempts to help the reader visualize wastewater handling on cruise ships sailing the Alaska Inside Passage. In reviewing this summary data it is important to note that:

- Cruise ships vary greatly in size and passenger/crewmember carrying capacity (13 to 78 thousand gross tons, 1072 to 3224 occupants).

- The comparisons between ships and municipalities are made only for the purpose of placing numbers in a context that can be more easily understood by readers unfamiliar with large ship operations.
- Vessel data represents maximum load conditions.

Table I
Overview of Waste Water Discharges from Cruise Ships Operating in Southeast Alaska

Waste water	Production/24 hr	Holding tank capacity	Discharge rate	Quality of effluent
Blackwater (toilet water & medical facility water)	20-61 tonnes (5,400-16,100 gals)	150-500 m^3 (40,000-132,000 gals) Note: Treated blackwater typically held in graywater tanks.	60-200 m^3/hr (15,800-52,840 gals/hr) Usually through graywater pumps	Fecal coliform count[1] <200/100 ml TSS[1] <150 mg/l BOD: TBD
Graywater (showers, sinks, food liquid[2])	570-768 tonnes (93,800-272,100 gals)	600-1500 m^3 (158,000-396,000 gals) Total holding capacity: 1 to 3 days	60-200 m^3/hr (15,800-52,840 gals/hr)	Fecal coliform count[3] (TBD) TSS[3] (TBD) BOD (TBD)
laundry water	100-200 tonnes (26,000-53,000 gals)	held in graywater tanks	discharged with graywater	same as graywater
bilge water	5-20 tonnes (1300-5,300 gals)	100-200 m^3 (26,200-52,840 gals)	oily water separator capable of treating 1-10 tonnes (up to 2600 gals) of bilge water per hour	<15 ppm oil

[1] Title 33, Part 159, U.S. Code of Federal Regulations requires cruise ships operating in U.S. territorial waters to treat blackwater to a level that ensures the fecal coliform bacteria count is not greater than 200 per 100 milliliters (0.1 liter or 0.026 gallons) of effluent (see 33 CFR 159.3 & 159.126) and the total suspended solids is not greater than 150 milligrams per liter (0.264 gallons) (see 33 CFR 159.3 & 159.126a)

[2] Food liquids, extracted from pulped, compressed food waste account for 1.5-10 tonnes (400-2,600 gals) of the graywater production. This waste stream undoubtedly has high BOD and TSS. However, it is diluted in graywater by a factor of 60:1.

[3] Graywater is not regulated. However, given that treated blackwater is typically mixed with graywater prior to discharge the effluent quality is assumed to be less than blackwater standards required by 33 CFR 159. See footnote 1.

Table II
A Comparison of Cruise Ship Discharges with that of Similarly Populated Southeast Alaska Municipalities

	Cruise Ship A	Cruise Ship B	Municipality A[4]	Municipality B[1]
Total population[2]	3224	2760	3398	2,589
Wastewater production	211,300 gals/day (max load)	158,500 gals/day (max load)	614,000 gals/day (avg Jan-Mar, May 99)	375,000 gals/day (avg May-Aug 97)
Total Suspended Solids	<150 mg/l required federal std, exact conc to be determined during 2000 monitoring program	<150 mg/l required federal std, exact conc to be determined during 2000 monitoring program	56.5 mg/l (avg Jan-Mar, May 99)	19.7 mg/l (avg May-Aug 97)
BOD	not reported, exact conc to be determined during 2000 monitoring program	50-80 mg/l reported, exact conc to be determined during 2000 monitoring program	115.74 mg/l (avg Jan-Mar, May 99)	46.5 mg/l (avg May-Aug 97)
Holding Tank Capacity	396,300 gals, 1.9 days at max load	311,000 gals, 2 days at max load	NA	NA
Discharge rate as limited by max pump capacity	52,840 gals/hr while underway	15,850 gals/hr while underway	25,580 gals/hr continuous	15,625 gals/hr continuous
Time required to empty full holding tanks at max pump capacity	7.6 hrs	19.6 hrs	NA	NA
Gallons/mile discharged at 12 knots	3,880	880	NA	NA
Discharge to seawater dilution ratio at 35 meters from discharge port	1:248[6]	1:285[3]	1:1006[7]	1:3032[4]

[1] Municipality discharge data provided by ADEC.
[2] Ship population taken from the International Safety Equipment Certificate. Municipality population figures taken from Alaska Department of Labor estimates for July 1998.
[3] Estimated using CORMIX computer model. Seawater temperature assumed to be 50 degrees F. Assumes one overboard discharge port. Some ships have several, thus the discharge rate at each port will be reduced accordingly.

[4] Estimated using PLUMES model, assuming deep multiport diffusers.

Exhibit I: ***Twenty-four hours in the Life of Cruise Ship Hypothetica***

Note: The *Hypothetica* is fictitious ship. The wastewater generation rates and handling methods are approximations.

The *Hypothetica*, a 76,000 gross ton cruise ship with 2700 passengers and crewmembers on board, moored at Ketchikan City Dock at 6:30 a.m., following a 2-day voyage from Vancouver, BC. The last wastewater discharged had been at 4:30 a.m. when the vessel was in Clarence Strait, approximately 12 miles southwest of Ketchikan.

By the time the vessel departed Ketchikan at 2:00 p.m., 5000 meals had been served, 2000 showers and baths had been taken, several tons of laundry had been washed, and 115,000 gallons of graywater and treated blackwater from these activities had accumulated in the 300,000 gallon capacity holding tank. Seven hundred gallons of oily water, primarily from engine maintenance, had accumulated in the bilge. This bilge water was held in a 5000 gallon tank for eventual processing through an oily water separator. The effluent (<15 ppm oil to water) would be discharged in the Gulf of Alaska, two days later.

Leaving Ketchikan, the *Hypothetica* sailed north through Tongass Narrows, then northwest through Clarence Strait enroute Juneau at an average speed of 19 knots (21.5 mph). On board, wastewater continued to drain to the holding tanks on an average of 7,000 gallons per hour until around 10:00 p.m., after which wastewater production tapered off dramatically. At 3:30 p.m., when the vessel was 3 miles north of Guard Island, the vessel began to discharge graywater and treated blackwater from the holding tank at 16,000 gallons per hour. As the effluent was pumped through a 4-inch overboard discharge port 12 feet below the waterline, it was quickly diluted by the speed of the vessel and water turbulence along the hull. Within 100 feet of the discharge port, the effluent was diluted in seawater at a ratio of 1 to 300.

Wastewater discharge continued until 2:30 a.m. By then the *Hypothetica* was in Stephens Passage, 46 miles south of Juneau. Overboard discharge ports were secured as the vessel made preparations for a 6:00 a.m. docking in Juneau.

III. Assumptions and limitations of the survey

- This survey is limited to large cruise ships exceeding 20,000 gross tons. Smaller vessels, often referred to as excursion vessels or "pocket cruisers", were not surveyed.
- Information of the volume or quantity of the discharges was supplied by the cruise industry. It was not independently verified. However, the volumes of the effluents are tied to the size of the holding tanks. The size of holding tanks can be verified from plans, many of which are held by the Coast Guard.
- Raw blackwater production cannot be easily measured or even estimated on most ships. Therefore, the total volume mix of treated blackwater (effluent from a Coast Guard marine sanitation device) and graywater is the most reliable figure for discharge quantity determinations. The industry estimates that each passenger or crewmember will generate 5 gallons of raw blackwater per day. Based on calculations from data available to this consultant, that estimate appears to be accurate and useful for planning purposes.
- There is little information available on the quality of graywater and blackwater. Therefore, this survey states wastewater quality in terms of the maximum pollutant concentrations allowed by federal regulations. Wastewater quality will be determined during the 2000 Alaska cruise ship season through an extensive collaborative sampling effort between the industry, Coast Guard, ADEC, and citizen's groups.
- Information regarding solid waste handling practices was primarily gathered from interviews with marine operations managers and the best practice paper developed by International Council of Cruise Lines. If a vessel follows the practices set forth by ICCL, the only impacts on the Alaskan environment from solid waste generation will be the smoke from the incinerator, which is only used underway.

IV. Rules of thumb useful for extrapolation.

A passengers or crewmember will:

- Consume 40 to 70 pounds of food and drink in a week. Total consumption on a large ship will be 60 to 100 tonnes (132,000-220,000 pounds) of food and drink per week.
- Flush up to 5 gallons of toilet water each day.
- Generate 50 to 65 gallons of graywater per day.
- Produce two pounds of dry trash a day.
- Dispose of two bottles and two cans each day.

IV. Definitions and units:

biochemical oxygen demand: A standardized means of estimating the degree of water contamination. BOD is the amount of dissolved oxygen (expressed as mg of oxygen per liter of water) required to stabilize the decomposable organic matter present in the water.

fecal coliform: Bacteria associated with the intestines of warm blooded animals and are commonly used to indicate the presence of fecal material and the potential presence of organisms capable of causing human disease.

parts per million (ppm): A unit of concentration used to express the number of parts of contaminate per million parts of water or air.

tonnes: Metric ton, 1000 kilograms, 2200 pounds. Standard unit of mass (and by inference, volume) used virtually everywhere but in the U.S. Foreign flag cruise ships typically report liquid production and consumption in tonnes. One tonne of wastewater is approximately 264.2 U.S. gallons. One tonne of shipboard fuel oil is approximately 260 U.S. gallons or 6.2 U.S. barrels. A one cubic meter tank or double bottom will hold one tonne of wastewater.

TSS: Total suspended solids

VI. Wastewater

A. Blackwater

Definition: Waste from toilets and urinals; medical facility water.

Discharge regulated by: 33 CFR 159

Brief description of handling method: Waste from toilets flushed by vacuum sewer in guest cabins, crew quarters and public restrooms plus any waste water the medical facility is treated on-board, in a Coast Guard approved Type II, Marine Sanitation Device (MSD). Systems used on today's cruise ships are typically

one of two types. Biological systems employ aeration and clarification for biological digestion of the sewage. Chemical treatment systems involve mastication, addition of salt water (up to 8 times), and chlorine treatment. Ships using biological MSD's usually four installed, allowing one to two to be placed off-line for maintenance. Two chemical systems are usually found on ships using this treatment method. After treatment the effluent is usually pumped to a wastewater holding tank. Many vessel hold graywater and treated blackwater in the same holding tanks, eventually discharging the effluent while underway.

Discharge: Discharge from a properly operating MSD Type II is allowed within the waters of Southeast Alaska (territorial seas). By policy, no discharge from the holding tanks takes place while the ships are in port or at anchor. After the ship is underway the treated water is discharged at a rate of 60 to 200 metric tonnes per hour, depending on the pump capacity. By operating practice some ships start discharging once they are well out of port. Other vessels will only discharge when three or even 12 miles from the nearest shoreline.

Sludge that cannot be masticated and aerated will eventually be landed ashore at some point in the MSD maintenance cycle.

B. Graywater

Definition: Generally understood to the waste water incidental to the operation of the ship. Graywater is defined in 33 CFR 151.05 (the US regulation that implements Annex I, II and V of MARPOL) as drainage from dishwashers, showers, laundry, bath, galleys, and washbasins and does not include drainage from toilets, urinals, hospitals, and cargo spaces.

Discharge regulated by: The US regulations implementing the FWPCA include a provision that exempts all of the wastewater included in the above definition of graywater and other discharges incidental to the operation of a ship from the Clean Water Act's permitting program (formally known as the National Pollution Discharge Elimination System (NPDES) program). Finally, the US Coast Guard regulations include provisions that essentially combine the two

definitions from the IMO and the Clean Water Act. The conclusion to be drawn from these various regulations is that wastewater discharges incidental to the operation of a ship are generally not subject to permitting or other regulatory programs.

Brief description of handling method: Graywater from showers, vanities, galleys and laundries is not commingled with untreated toilet sewage. Graywater drains to holding tanks to await discharge. Although not prohibited from discharging in port, ICCL/NWCA policy is to discharge graywater only while underway.

Effluent quality specifics: The concentration or presence of fecal coliform, total suspended solids, biochemical oxygen demand and other potential contaminants will be determined during the summer 2000 voluntary monitoring/verification program. According to the industry, all cleansers and detergents that may be part of graywater are biodegradable. Most vessels have separate drains for photo shops in order to ensure silver is not advertently discharged. Medical clinic drains go the blackwater MSD. Food liquids are drained to graywater holding tanks. (See section VII.)

C. Bilgewater

Definition: The area of the ship at the very bottom is known as the bilge. This area is where water that seeps into the ship from various operational sources will collect. The bilge beneath all engine and machinery spaces will also collect oil that leaks from machinery fittings and engine maintenance activities. This oily water is known as bilge water or bilge slops.

Discharge regulated by: 33CFR151.10(b)

Brief description of handling method: In order to maintain ship stability and eliminate potential hazardous conditions from oil vapors in engine and machinery spaces, the oily water from the bilge spaces must be periodically pumped dry. This bilge water is pumped to a tank where it is processed through an approved oily-water separator (OWS). The OWS must be capable of producing effluent that without dilution has oil

content less than 15 ppm. Regulations require that all oil or oil residues, which cannot be discharged in compliance with this standard, be retained onboard or discharged to a designated reception facility. Different ships use different OWS (coalescing, clay compression, plate baffles) and the effluent is continuously monitored for the presence of oil.

Strict record keeping is required by 33 CFR 151.10(b)

D. Ballast water

Definition: Any water taken on board a vessel to control or maintain trim, draught, stability, or stresses of the vessel. Ballast water taken in foreign ports have been found to contain potentially harmful aquatic nuisance species capable of surviving in U.S. coastal waters.

Discharge regulated by: 33CFR151 (enacting the National Invasive Species Act of 1996) In fact, the regulations establish voluntary guidelines only. Basically, the rule asks vessels to conduct a ballast water exchange prior to entry into waters of the U.S. in an area beyond the Exclusive Economic Zone, no less than 200 miles from any shore and where the water depth exceeds 2000 meters.

Brief description of handling method: Ballast water exchange must be occur in a manner that provides protection against the release of non-indigenous species in Alaska waters. Cruise ships coming to Alaska follow a practice of discharging all ballast tank water that may contain tropical or other non-indigenous species during their positioning voyage and before arrival in Vancouver, replacing it with Pacific NW water. The Canadian Coast Guard monitors this practice. In the course of the Alaska cruise season, any ballast water taken on or released is strictly water of the Pacific NW, and not subject to importation of species not native to this region.

VII. Food waste

Food waste is separated and processed separately from other wet garbage. This waste is pulped, compressed, dehydrated and eventually incinerated while underway or discharged over 12 miles offshore. The food liquids (1,300 to 2,600 gallons per day) removed during dehydration are recycled through to pulping/compression process several times and eventually end up in the graywater holding tanks. These liquids have high

BOD but represent only a fraction of the liquids in the holding tanks. The compressed, dehydrated food waste is incinerated while underway.

VIII. Solid Waste Handling Methods

A. Non-hazardous Solid Waste

Definition: Generally, non-hazardous solid waste is passenger and crew generated trash; including glass, paper, cardboard, plastics and other packaging products, aluminum and steel cans. For the purpose of this report, food or victual waste is not included in this definition.

Regulated by: 33 CFR 151 and MARPOL Annex V. Overboard disposal of plastics are prohibited everywhere. Other trash included in the above definition may be discharged overboard 3 miles away from land and outside US navigable waters if ground to a point where the waste can past through a mesh size no larger than 25 mm (1 inch). [For a summary of restrictions, see Appendix A to 33 CFR 151.51 through 151.77]

General description of handling method: A strategy of source reduction, waste minimization and recycling has allowed the cruise industry to significantly reduce shipboard generated waste. Non-hazardous solid waste that cannot be recycled is either incinerated or landed ashore. Typically, 75-85% of the non-hazardous solid waste is incinerated. The cruise industry does not operate their incinerators in port or Glacier Bay. Little solid waste is taken ashore in Southeast Alaska ports and then almost exclusively to Juneau's private incineration company. Some pallet boards are recycled in Ketchikan. The vast majority of solid waste that is not incinerated, and all hazardous waste, is unloaded at the port of Vancouver or other homeports on the West Coast where it is disposed of and tracked by certified waste disposal companies. Although it is legal to do so, there is no indication that cruise ships discharge ground solid waste into the sea. A waste management plan and strict record keeping is required by 33 CFR 151.55 & 151.57.

Quantity of discharge: It is estimated that the average cruise passenger will generate two pounds of dry trash and dispose of two bottles and two cans each day. Glass, aluminum, other metals, paper, wood and cardboard are, in most (many)

cases, recycled. Material that cannot be recycled is landed ashore in Vancouver, incinerated, or discharged overboard.

Quality of discharge: Hazardous waste is not incinerated. Plastics, paper, wood, rags, dehydrated food waste and other similar trash is incinerated. Incinerator ash is landed ashore in accordance with the shipboard waste management plan. Paper, glass, metal, rags and other similar refuse comminuted or ground to less than 25mm (1 inch) when discharged between 3 to 12 miles from the nearest land. Beyond 12 miles grinding or comminuted is not required.

B. Hazardous and Potentially Hazardous Waste

Hazardous wastes and waste streams onboard cruise vessels are identified and segregated for individual handling and management in accordance with appropriate laws and regulations. Hazardous wastes are not discharged overboard nor are they commingled or mixed with other waste streams. According to the cruise industry, no hazardous wastes are landed ashore in Alaska. The following information is adapted from ICCL waste management practice and procedures.

1. Photo Processing, including X-Ray Development Fluid Waste

There are several waste streams associated with photo processing operations that have the potential to be regulated under the Resource Conservation and Recovery Act (RCRA). These waste streams include spent fixer, spent cartridges, expired film and silver flake.

Photographic fixer removes the unexposed silver compounds from the film during the developing process. The spent fixer can have as much as 2000-3000 parts per million (ppm) of silver. Silver bearing waste is regulated by RCRA as a hazardous waste if the level of silver exceeds 5 ppm as determined by the Toxicity Characteristic Leaching Procedure (TCLP) test.

Silver recovery units are used to reclaim the silver from the used fixer waste stream. There are two types of recovery units. These are active (with electricity) and passive (without electricity) units. The active unit uses electricity to plate silver onto an electrode. The passive unit uses a chemical reaction between steel wool and silver to remove most of the silver from solution.

The effluent from the silver recovery process must be tested before it can be discharged. The regulatory limit for silver discharge is 5 ppm.

Cruise ships use one of two handling methods:

Handling Method 1

Treat used photographic and x-ray development fluids to remove silver for recycling.

Verify that the effluent from the recovery unit is less than 5 parts per million (ppm) silver as measured by EPA-approved methodology.

After treatment, the residual waste stream fluid is non-hazardous and may be landed ashore or discharged in accordance with the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78).

Handling Method 2

Assume used photographic and x-ray development fluids to be a hazardous waste and land ashore in accordance with the requirements of the Resource Conservation and Recovery Act (RCRA).

2. Dry-cleaning waste fluids and contaminated materials

Shipboard dry cleaning facilities use a chlorinated solvent called perchlorethylene (also known as PERC or tetrachloroethylene) as a dry cleaning fluid. This is the approved dry cleaning solvent for these units. To handle PERC safely, operators must receive specific training.

The dry cleaning units produce a small volume of waste from the bottoms of the internal recovery stills and filter media. This waste is comprised of dirt, oils, filter material, and spent solvent. Each ship utilizing these dry-cleaning units produces approximately two pounds of waste material weekly. However, the amount may vary greatly by season and passenger load. This material is classified as hazardous waste under RCRA and must be handled accordingly. By industry practice, this waste is landed ashore in Vancouver, not Alaska.

3. Print Shop Waste Fluids

Print shop waste may contain hazardous waste. Printing solvents, inks and cleaners all may contain hydrocarbons, chlorinated hydrocarbons, and heavy metals that can be harmful to human and aquatic species. Recent advances in printing technology and substitution of chemicals that are less hazardous reduces the volume of print shop waste generated and reduces the impact of these waste products.

Whenever possible, the cruise industry utilizes printing methods and chemicals used in the printing process chemicals that produce less total waste and less

hazardous waste products. Alternative printing inks such as soy based, non-chlorinated hydrocarbon based ink products will be used whenever possible. All printshop waste including waste solvents, cleaners, and cleaning cloths will be treated as hazardous waste, if such waste contains chemical components that may be considered as hazardous by regulatory definitions. All other waste will be treated as non-hazardous.

Cruise ships employ two handling methods

Handling Method 1:

When using traditional or non-soy based inks and chlorinated solvents, treat all print shop waste as hazardous and discharge ashore in accordance with RCRA.

Handling Method 2:

Use non-toxic based printing ink such as soy based, non-chlorinated solvents, and other non-hazardous products to eliminate hazardous waste products.

4. Photo Copying and Laser Printer Cartridges

Increased use of laser and photo copying equipment on shore as well as onboard ship results in the generation of increased volumes of waste cartridges, inks, and toner materials. ICCL encourages cruise ships to use only such inks, toners and printing/copying cartridges that contain non-hazardous chemical components and to return cartridges to the manufacturer for credit, recycling, or for refilling. No cartridges or their components are discharged into the marine environment.

5. Unused And Outdated Pharmaceuticals

Ships carry varying amounts of pharmaceuticals. The pharmaceuticals carried range from over-the-counter products such as anti-fungal creams to prescription drugs such as epinephrine. Each ship stocks an inventory based on its itinerary and the demographics of its passenger base.

Pharmaceuticals and medications which are off specification or which have exceeded their shelf-life, and stocks that are unused and out of date are removed from the ship. Each regulatory jurisdiction has a posting of listed pharmaceuticals that must be considered hazardous waste once the date has expired or the item is no longer considered good for patient use.

To ensure that unused and/or outdated pharmaceuticals are effectively and safely disposed the cruise ship industry uses one or more of the following handling methods:

- Reverse distribution system for returning unexpired, unopened non-narcotic pharmaceuticals to the original vendor.
- Appropriate destruction of narcotic pharmaceuticals onboard ship in a manner that is witnessed and recorded.
- Landing of listed pharmaceuticals in accordance with local regulations. Listed pharmaceuticals are a hazardous waste having chemical compositions that prevent them from being incinerated or disposed of through the ships sewer system. Pharmaceuticals are not landed ashore in Alaska.
- Disposal of other non-narcotic and non-listed pharmaceuticals through onboard incineration or landing ashore.

6. Fluorescent And Mercury Vapor Lamp Bulbs

The recycling of fluorescent lights and high intensity discharge (HID) lamps is a proven technology capable of reliably recovering greater that 99 percent of the mercury in the spent lights. This is done by using a crush-and-sieve method. In this process, the spent tubes are first crushed and then sieved to separate the large particles from the mercury containing phosphor powder. The phosphor powder is collected and processed under intense heat and pressure. The mercury is volatized and then diluted to the required purity. The glass particles are segregated and recycled into fiberglass. Aluminum components are also recycled separately.

Storage and handling of used lights pose no compatibility problems; nevertheless, storage and shipment of the glass tubes is best-done keeping the glass tubes intact. These items are classified as "Universal Waste" when they are shipped to a properly permitted recycling facility; as such, testing is not required.

It is the cruise ship industry's practice to collect spent fluorescent and mercury vapor lamps for recycling or land disposal.

7. Batteries

If not properly disposed of, spent batteries may constitute a hazardous waste stream. Most of the large batteries are on tenders and standby generators. Small batteries used in flashlights and other equipment and by passengers, account for the rest. There are four basic types of batteries used.

Lead-acid batteries – These are used in tenders and standby generators. They are wet, rechargeable, and usually six-celled. They contain a sponge lead anode, lead dioxide cathode, and sulfuric acid electrolyte. The electrolyte is corrosive. These batteries are disposed of as hazardous waste, unless recycled or reclaimed.

Lead-acid batteries use sulfuric acid as an electrolyte. Battery acid is extremely corrosive, reactive and dangerous. Damaged batteries must be drained into an

acid-proof container. The leaking battery is then placed in another acid-proof container, and both the electrolyte and the damaged battery placed in secure storage for proper disposal as a hazardous waste.

Nickel-cadmium (NiCad) batteries – These are usually rechargeable, and contain wet or dry potassium hydroxide as electrolyte. The potassium hydroxide is corrosive and the cadmium is a characteristic hazardous waste. Therefore, NiCad batteries are disposed of as hazardous waste, unless recycled or reclaimed.

Lithium batteries – These are used as a power source for flashlights and portable electronic equipment. All lithium batteries must be disposed of as hazardous waste, or sent out for reclamation.

Alkaline batteries – These are common flashlight batteries and are also used in many camera flash attachments, cassette recorders, etc. They are recycled, properly disposed or reclaimed.

Discarded batteries are isolated from the refuse waste stream to prevent potentially toxic materials from inappropriate disposal. The wet-cell battery-recycling program is kept separate from the dry battery collection process. Intact wet-cell batteries are sent back to the supplier. Dry-cell batteries are manifested to a licensed firm for recycling.

Appendix A
Selected Data presented by Vessel Size

	76,000-78,000 Gross tons	50,700-55,400 Gross tons	46,000-48,000 Gross tons	22,000 Gross tons
Max passengers and crew	2700-3200	1850-2380	1505-2156	1100
Blackwater production[8], max (thousands of gallons/day)	14 -16	9.2-11.9	7.5-10.8	5.4
Graywater, Treated blackwater production, max (thousands of gallons/day), incl laundry water	158.5-272.1	150.0-190.4	132.1-161.2	93.8
Holding tank capacity Graywater& treated blackwater (thousands of gallons)	300-400	160-200.0	260.0	159
Max discharge rate (thousands of gallons/hour)	52.8	16.0	15.85	
Discharge specifics	4-inch dia outlet 12-15 ft below W.L.	4-inch dia outlet 12-15 ft below W.L.	4-inch dia outlet 3 ft below W.L.	4-inch dia outlet 12-15 below W.L.
Bilgewater production, max (gal/day)	2640	5000	3000	1000
Bilgewater max Treatment capacity	6400	5000	4000	5000
Max discharge rate (gal/hr)	6400	5000	4000	5000

[1] Blackwater production estimated by assuming each person on board will flush 5 gallons of toilet water per day.

Appendix B
Promising Technology

The cruise ship industry is researching or in some cases installing several new technologies and design features to minimize waste and waste impact; including,

- **Graywater filtration systems** capable of treating wastewater to a level achieved by landside secondary treatment facilities. Two ships will be outfitted with these systems in the summer of 2000. Preliminary results indicate that the filtration can remove 90% of the BOD.

- Effective and efficient digital photo technology or other technologies to reduce hazardous waste stream generation during **photo processing**.

- Alternative **dry cleaning processes** such as CO_2 and "wet" processes.

- **Recycling laundry water** to reduce graywater discharge.

- Use of non-toxic based printing ink and non-chlorinated solvents and other non-hazardous products to eliminate the hazardous wastes in **print shops**.

- ***Oily water separators*** *that produce effluents with less than 5 ppm oil.*

- ***"Green" diesels*** *that reduce air emissions.*

- **Gas turbine main propulsion** systems the reduce air emissions..

Appendix C

Wastewater Sampling Protocol
(to be completed)

Appendix D Participants

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