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Cruise Ship Discharge Assessment Report

Section 5: Solid Waste

December 29, 2008

Section 5: Solid Waste

Solid waste, as defined in section 1004(27) of the Resource Conservation and Recovery Act (RCRA), is the garbage, refuse, sludge, rubbish, trash, and other discarded materials resulting from industrial, commercial, and other operations, as well as that disposed of every day by individuals, businesses, and communities. Solid waste can be either non-hazardous or hazardous waste. On most cruise ships, solid waste is managed by utilizing a multifaceted strategy that includes source reduction, source segregation for waste streams, waste minimization, and recycling. According to the Alaska Department of Environmental Conservation (ADEC) (2001), 75 to 85% of trash is generally incinerated onboard, and the ash is typically discharged at sea; some solid waste is landed ashore for disposal or recycling (CRS, 2007).

This section discusses the current state of information about solid waste, the laws regulating solid waste from vessels, how solid waste is managed on cruise ships, the potential environmental impacts of cruise ship solid waste, and federal actions taken to address solid waste from cruise ships. The conclusion of this section lists a wide range of options and alternatives that could be considered when addressing solid waste from cruise ships.

5.1 What is solid waste and how much is generated on cruise ships?

Solid waste is the garbage, refuse, sludge, rubbish, trash, and other discarded materials resulting from industrial, commercial, and other operations, as well as that disposed of every day by individuals, businesses, and communities. Solid waste can be either non-hazardous or hazardous waste. Non-hazardous waste, for example, may be in the form of trash and the waste associated with product packaging, cans, bottles, food waste, newspapers, product and machinery parts, disposable products, and recyclable products. This section discusses non-hazardous solid waste generated on cruise ships. Hazardous waste, however, is a type of solid waste, which, because of its quantity, concentration or physical or chemical characteristics, may pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed or otherwise managed. Hazardous waste generally contains hazardous substances which can be liquids, solids, or contained gases and must be handled, tracked, treated, and disposed of separately from other types of solid waste. Hazardous waste generated on cruise ships is discussed separately in Section 6.

Solid waste generated onboard a cruise ship typically comprises the materials used for packaging products for transportation or storage, waste generated by passenger and crew activity, and food waste. More specifically, the types of solid waste generated on a ship can include food waste, glass, paper, wood, cardboard, incinerator ash, metal cans, and plastics. Table 5-1 identifies some types of common solid waste items, including specific examples, generated aboard cruise ships.

Table 5-1. Some Types and Specific Examples/Descriptions of Solid Waste Generated on Cruise Ships

Type of Solid Waste	Examples and Descriptions
Cardboard	Dunnage (lining and packaging materials that float) and cardboard from all manner of packaging materials
Paper	Paper and packaging
Plastic	Synthetic ropes, plastic containers, plastic bags, biodegradable plastics, poly-ethylene terephthalate plastics, and high density polyethylene plastics
Wood	Wood pallets and waste wood
Glass	Chipped or broken glasses, food and beverage jars, bottles
Metal cans	Aluminum soft drink cans, tin cans from the galley, steel cans from ship maintenance operations
Food waste	Wastes derived in whole or in part from fruits, vegetables, meats, or other plant or animal material (includes food scraps, table refuse, galley refuse, food wrappers or packaging materials contaminated with food residue)
Incinerator ash	Ash generated from the incineration of packaging materials, paper and cardboard wastes, etc.
Food wrappers and packaging	Paper and plastic wrapping/packaging materials with food residue

According to a 1999 Royal Caribbean Cruises Environmental Report, packaging materials from consumables and spare parts for a ship can generate up to 15 tons of waste in a single day. Table 5-2 presents the estimates of certain types of solid waste generated per week on an individual vessel in the Holland America Lines and Royal Caribbean Cruises fleets.

Table 5-2. Estimates of Solid Waste Generated Per Vessel per Week

	Holland America Lines	Royal Caribbean Cruises
Dunnage	30 cubic meters	60 cubic meters
Glass and Cans	6,000 lbs of glass 450 lbs of cans	5 cubic meters of glass 2.5 cubic meters of cans
Food Wastes	12 cubic meters	12 cubic meters

Sources: ADEC, 2002 and Royal Caribbean Cruises Ltd., 1999

The amount of solid waste generated by cruise ships varies from ship to ship, based on the size of the vessel, number of passengers and crew, and consumption of material. Compared to other types of vessels, cruise ships generate large volumes of solid waste. Environmental Resources Limited (1991) estimated that a cruise ship generates 70 times more solid waste per day than a typical cargo ship. However, the National Research Council (1995) acknowledges that when examining vessel garbage, the estimate of the quantity of garbage generated is not necessarily a measure of the amount handled by onboard treatment technologies or port reception facilities. When determining the amount of garbage generated on a vessel, the National Research Council (1995) suggests that the "amount of garbage is proportional to the community's standard of living; the higher the standard, the more seafarers are likely to use packaged prepared foods,

supplies, and single use items rather than provisions requiring added preparation and cleanup.” It has been further estimated that 24% of the solid waste generated by vessels worldwide (by weight) comes from cruise ships (National Research Council, 1995).

With large cruise ships carrying several thousand passengers, the amount of waste generated in a given day can be considerable. One large cruise ship of 2,500 passengers and 800 crew (total 3,300 persons onboard) can generate 1 ton of garbage from normal operations in a day (National Research Council, 1995). On average, each cruise ship passenger generates at least two pounds of non-hazardous solid waste per day (CELB, 2003). In addition to that, each cruise ship passenger disposes of two bottles and two cans (both of which are recyclable materials) per day (CELB, 2003). Table 5-3 presents various estimates of the amount of solid waste a passenger generates in a given day during a cruise.

Table 5-3. Estimates of Solid Waste Generated per Person per Day on a Cruise Ship

Source of Data	Trash Generated (lbs/person/day)
Environmental Resources Limited	7.7
Florida Caribbean Cruise Association	0.7
Holland America Line	1.8
Organization of Eastern Caribbean States Waste Management Study	6.5
Seebacher	5.7

Source: Simmons & Associates, 1994

The newest addition in Royal Caribbean’s Freedom family of ships, the *Liberty of the Seas*, is currently the largest cruise ship at 1,112 ft long and carries up to 3,634 passengers and 1,360 crew. Building even larger cruise ships is on the horizon with Royal Caribbean building Genesis class ships that will be almost 1,200 feet long (Bell, 2007). Over the past two decades, the average ship size has been increasing at the rate of roughly 90 ft every 5 years (Bell, 2007). As the size and number of passengers these cruise ships can carry increases, the volume of wastes generated – and discharged – will presumably increase as well.

5.2 What federal laws apply to solid waste from cruise ships?

5.2.1 *International Convention for the Prevention of Pollution from Ships and Act to Prevent Pollution from Ships*

The International Convention for the Prevention of Pollution from Ships (MARPOL)

MARPOL Annex V regulates the disposal of garbage into the sea, by setting forth prohibitions on disposal (e.g., of plastics), to establishing how and where garbage generated during the normal operation of a ship is to be disposed (e.g., food wastes). Under Annex V, the term garbage includes “all kinds of victual, domestic and operational waste, excluding fresh fish and parts thereof, generated during the normal operation of the ship and liable to be disposed of continuously or periodically except those substances which are defined or listed in other

Annexes.” The Annex also requires governments to ensure the provision of facilities at ports and terminals for the reception of garbage. Annex V sets more stringent discharge standards for specifically identified “special areas.” The special areas are “sea areas where for recognized technical reasons in relation to its oceanographic and ecological conditions and to the particular character of its traffic, the adoption of mandatory methods for the prevention of sea pollution by garbage is required.” The special areas identified by Annex V are the Mediterranean Sea, Baltic Sea, Black Sea, Red Sea, Gulfs area, North Sea, Antarctic, and Wider Caribbean Region. In addition, the Annex requires some ships (i.e., depending on size and passenger load) to maintain Garbage Record Books, develop Garbage Management Plans, and display placards that outline the disposal requirements.

Act to Prevent Pollution from Ships

The Act to Prevent Pollution from Ships (APPS) and its implementing regulations (33 CFR 151.51-77) prohibit the discharge of all garbage within three miles of shore; certain types of garbage from 3-25 miles offshore; and plastic anywhere. Vessels are also required to record each discharge or incineration of garbage in a Garbage Record Book. Under APPS, the definition of “ship” includes fixed or floating platforms. There are separate garbage discharge provisions applicable to these units. For these platforms, and for any ship within 500 meters of these platforms, disposal of certain types of garbage is prohibited. Additionally, all manned, oceangoing U.S. flagged vessels of 12.2 meters or more in length that are engaged in commerce, and all manned, fixed, or floating platforms subject to the jurisdiction of the United States, are required to keep records of garbage discharges and disposals. The Coast Guard regularly inspects vessel discharge records and logbooks required by MARPOL, and investigates all allegations of illegal discharges on the high seas or within United States waters. Receipts and record-keeping for Annex V waste streams from ships are addressed in MARPOL Annex V, Regulation 9.

Applicable Coast Guard Regulations

The Coast Guard generally has the primary responsibility to prescribe and enforce the regulations necessary to implement APPS in the United States. The following Coast Guard regulations pertain to the management of solid waste on ships:

- Every manned oceangoing ship of 400 gross tons and above and every ship certified to carry 15 passengers or more shall ensure that a written record is maintained on the ship for the following discharge or disposal operations:
 - discharge overboard,
 - discharge to another ship,
 - discharge to a reception facility, and
 - incineration on the ship (33 CFR 151.55).
- Each manned, oceangoing ship of 40 feet or more in length must have a garbage management plan in place and each person handling the garbage must follow the plan (33 CFR 151.57).
- Each ship of 26 feet or more must ensure that appropriate placards outlining disposal requirements are placed in prominent locations and in sufficient numbers for both passengers and crew (33 CFR 151.59).

- No person onboard any ship may discharge garbage into navigable waters of the United States. Navigable waters means the waters of the United States, including the territorial seas (i.e., the belt of seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters, and extending seaward a distance of three miles). No person onboard any ship may discharge into the sea, or into the navigable waters of the United States, plastic or garbage mixed with plastic, including but not limited to synthetic ropes, synthetic fishing nets, and plastic garbage bags. All garbage containing plastics must be discharged ashore or incinerated (33 CFR 151.66 and 151.67).
- For vessels operating outside a special area, no person may discharge, into the sea, garbage that is separated from plastic, if the distance from nearest land is less than: (1) 25 nautical miles (nm) for dunnage, lining and packing materials that float; or (2) 12 nm for victual wastes (any spoiled or unspoiled food wastes) and all other garbage including paper products, rags, glass, metal, bottles, crockery and similar refuse, except that, such garbage may be discharged outside of 3 nm from nearest land after it has been passed through a grinder or comminuter (i.e., pulverizer) and is capable of passing through a screen with openings no greater than 25 mm (33 CFR 151.69).
- When the garbage is mixed with other discharges having different disposal or discharge requirements, the more stringent requirements shall apply.

Table 5-4 provides a summary of garbage discharge restrictions per 33 CFR Part 151 for vessels operating both in special areas and outside of special areas.

Table 5-4. Summary of Garbage Discharge Restrictions for Vessels

Garbage Type	All Vessels Except Fixed or Floating Platforms and Associated Vessels	
	Outside special areas (33 CFR 151.69)	In special areas ² (33 CFR 151.71)
Plastics, including synthetic ropes and fishing nets and plastic bags	Disposal prohibited (33 CFR 151.67)	Disposal prohibited (33 CFR 151.67)
Dunnage, lining, and packaging materials that float	Disposal prohibited less than 25 miles from nearest land and in the navigable waters of the U.S.	Disposal prohibited (33 CFR 151.71)
Paper, rags, glass, metal bottles, crockery and similar refuse	Disposal prohibited less than 12 miles from nearest land and in the navigable waters of the U.S.	Disposal prohibited (33 CFR 151.71)
Paper, rags, glass, etc. -- comminuted or ground ¹	Disposal prohibited less than 3 miles from nearest land and in the navigable waters of the U.S.	Disposal prohibited (33 CFR 151.71)
Victual waste ⁴ not comminuted or ground	Disposal prohibited less than 12 miles from nearest land and in the navigable waters of the U.S.	Disposal prohibited less than 12 miles from nearest land
Victual waste comminuted or ground ¹	Disposal prohibited less than 3 miles from nearest land and in the navigable waters of the U.S.	Disposal prohibited less than 12 miles from nearest land

Mixed garbage types ³	See Note 3	See Note 3
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Source: 33 CFR 151.51- 151.77 Appendix A

¹ Comminuted or ground garbage must be able to pass through a screen with a mesh size no larger than 25 mm (1 inch) (33 CFR 151.75).

² Special areas under Annex V are the Mediterranean, Baltic, Black, Red, and North Seas areas, the Gulfs area, the Antarctic area, and the Wider Caribbean region, including the Gulf of Mexico and the Caribbean Sea (33 CFR 151.53).

³ When garbage is mixed with other substances having different disposal or discharge requirements, the more stringent disposal restrictions shall apply.

⁴ Virtual waste is any spoiled or unspoiled food waste.

- The regulations applicable to port reception facilities for garbage are published at 33 CFR Part 158. Under those regulations, the Coast Guard administers the reception facility “Certificate of Adequacy” (COA) program for certification, including periodic inspection of the port reception facilities to which those regulations apply. All port facilities and terminals under the jurisdiction of the United States, including commercial fishing facilities, mineral and oil shore bases, and recreational boating facilities, must have a garbage reception facility which meets the regulatory requirements for adequacy (33 CFR 158.133(c)). These regulations apply to U.S. ports and terminals that receive garbage from cruise ships. Though only a subset of those ports require a COA, (see 33 CFR 158.135(c) for COA criteria with respect to Annex V wastes), Coast Guard field units regularly inspect all port reception facilities for adequacy, regardless of the requirement for a COA, and investigate all allegations of inadequate reception facilities.

5.2.2 Clean Water Act

As a general matter, the Clean Water Act (CWA; 33 U.S.C. § 1251 et seq.) prohibits any person from discharging any pollutant from any point source into waters of the United States, which includes the territorial seas (i.e., the belt of seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters, and extending seaward a distance of three miles), except in compliance with a National Pollutant Discharge Elimination System (NPDES) permit or as otherwise authorized under the Act. The term “point source” is defined to include a “vessel or other floating craft.” The term “pollutant” does not include sewage from vessels (within the meaning of CWA section 312). Outside the territorial seas, i.e., in the contiguous zone or the ocean, the addition of any pollutant from a “vessel or other floating craft” is not a “discharge of pollutants,” and therefore does not require an NPDES permit (CWA section 502(12)(b)). The addition of any pollutant to the waters of the contiguous zone or ocean from any point source *other* than a “vessel or other floating craft” is a “discharge of pollutants,” and therefore does require an NPDES permit. However, EPA has interpreted this permitting requirement to apply to certain discharges from a vessel that operates in a capacity other than as a means of transportation such as when used as an energy or mining facility, a storage facility or a seafood processing facility, or when secured to the bed of the ocean, contiguous zone, or waters of the United States for the purpose of mineral or oil exploration or development (40 CFR 122.3(a)).

In addition, EPA regulations (40 CFR 122.3(a)) have historically excluded discharges incidental to the normal operation of a vessel (for example, effluent from properly functioning marine engines, laundry, shower, and galley sink wastes) from the requirement of an NPDES permit.

This regulatory exclusion has not applied and does not apply to discharges of rubbish, trash, garbage, or other such materials discharged overboard a vessel, which would be solid waste subject to RCRA. Whether a discharge is authorized under an NPDES permit affects applicability of RCRA; dissolved and solid materials in industrial discharges which are point sources subject to NPDES permits are not “solid waste” under the RCRA statute. This only applies to materials once they have been discharged. For further information regarding operation of the RCRA statute as it applies to solid waste and hazardous waste, see sections 5.2.4 and 6.2.2, respectively.

5.2.3 National Marine Sanctuaries Act

The National Marine Sanctuaries Act (NMSA; 16 U.S.C. § 1431 et seq.), as amended, established a national program to designate certain areas of marine environments as areas of special national significance that warrant heightened care. The primary purpose of the law is to protect marine resources and ecosystems, such as coral reefs, sunken historical vessels, or unique habitats, from degradation while facilitating public or private uses compatible with resource protection. NMSA authorizes the National Oceanic and Atmospheric Administration (NOAA) to designate as National Marine Sanctuaries areas of the marine environment that have special aesthetic, ecological, historical, or recreational qualities, and to provide comprehensive and coordinated conservation management for such areas. The National Marine Sanctuary Program manages 13 sanctuaries and the Papahānaumokuākea Marine National Monument (together referred to as “sites”). Designated sites are managed according to site-specific management plans developed by NOAA that typically prohibit by regulation the discharge or deposit of most material. Under NOAA's implementing regulations for NMSA, it is illegal to discharge solid waste into most national marine sanctuaries.

5.2.4 Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA; 42 U.S.C. § 6901 et seq.) is the federal law that, among other things, defines and provides for regulation of solid waste and hazardous waste. RCRA is designed to minimize the hazards of waste disposal, conserve resources through waste recycling, recovery, and reduction, and ensure waste management practices that are protective of human health and the environment. In order to achieve these goals, RCRA established a Solid Waste Program (RCRA Subtitle D) and a Hazardous Waste Program (RCRA Subtitle C).¹ RCRA Subtitle D encourages environmentally-sound solid waste management practices that maximize source reduction, reuse, and recycling efforts, and establishes regulations that specify how solid waste disposal facilities (i.e., municipal solid waste landfills) should be designed and operated. RCRA provides that solid waste is predominantly regulated by state and local governments (U.S. Environmental Protection Agency, 2006).

¹ In states with hazardous waste programs authorized by EPA, the authorized state hazardous waste program operates in lieu of the federal hazardous waste program. Some states have authorized hazardous waste programs that are more stringent than the federal hazardous waste program.

5.2.5 Marine Protection, Research, and Sanctuaries Act

The Marine Protection, Research, and Sanctuaries Act (MPRSA, 33 U.S.C. § 1401 et seq.) (also called the Ocean Dumping Act) prohibits (1) the transportation of any material from the United States for the purpose of disposal in ocean waters without a permit; (2) the transportation of any material by U.S. agencies or by U.S. flagged vessels or aircraft for the purpose of disposal in ocean waters without a permit; and (3) any person from dumping, without a permit, any material transported from a location outside the United States into the U.S. territorial seas or into the contiguous zone, to the extent it may affect the territorial seas or the territory of the United States. This Assessment Report does not address the transportation of materials that would require an ocean dumping permit under MPRSA.

5.3 What practices are available to manage solid wastes generated on cruise ships?

The management of shipboard-generated waste is a challenge not only for cruise ships at sea, but also for other commercial vessels, military ships, fishing vessels, and recreational boats. Most cruise ship trash is treated onboard (incinerated, pulped, or ground for discharge overboard) (CRS, 2007). According to ADEC (2001), 75 to 85% of trash is generally incinerated onboard, and the ash is typically discharged at sea; some solid waste is landed ashore for disposal or recycling (CRS, 2007). The Center for Environmental Leadership in Business (CELB) (2003) states that Royal Caribbean's Vision-class ships sort, crush, and off-load about 450 pounds (204kgs) of aluminum cans for recycling per week-long trip.

Food wastes and hazardous wastes generated on cruise ships are often separated from other solid wastes and processed separately. Food waste is often pulped or compressed, and then incinerated. According to ADEC (2000), the food liquids (1,300 to 2,600 gallons per day) removed during dehydration are recycled through a pulping/compression process several times, and eventually end up in the graywater holding tanks; the remaining compressed, dehydrated food waste is incinerated. Hazardous wastes are separated from other solid wastes because onboard incinerators do not operate at the temperatures necessary to properly destroy hazardous substances. Therefore, proper waste identification and segregation of hazardous waste prior to burning is critical. As a result, waste segregation, as well as crew and passenger training, and compliance with appropriate waste handling procedures is a fundamental aspect of vessel waste management and safe discharges. Upon arriving in port, the solid waste generator (the cruise ship) off-loads any remaining solid waste (including incinerator ash) in accordance with applicable state solid waste management requirements.² Examples of Royal Caribbean Cruise's waste management practices are presented in Table 5-5.

² RCRA Subtitle D established regulations addressing how solid waste disposal facilities should be designed and operated.

Table 5-5. Waste Management Practices as Reported by Royal Caribbean Cruises

Type of Waste	Management Practice
Cardboard	Packaging materials are collected onboard and incinerated or off-loaded for recycling or disposal. Incinerator ash is landed ashore for disposal.
Paper	Paper wastes are collected onboard and incinerated or off-loaded for recycling or disposal. Incinerator ash is landed ashore for disposal.
Plastic	Plastic wastes are collected onboard and incinerated or off-loaded for recycling or disposal. Incinerator ash is landed ashore for disposal.
Glass	Glass is collected, crushed onboard, stored, and off-loaded for recycling.
Metal Cans	Cans are collected and sorted onboard to separate out the aluminum cans that have a high market recycling value. Cans are crushed on board, stored, and off-loaded for recycling.
Food Waste	Wet food waste is processed through giant grinders (called pulpers) that reduce the size of food particles, which allows for more efficient removal of water by extractors. Removing excess water allows food waste to be burned and managed more easily. The water removed in the process is ultimately discharged as gray water. Incinerator ash is landed ashore for disposal.

Source: RCCL, 1999

The Cruise Lines International Association (CLIA) environmental standards noted earlier are intended to provide for improved solid waste management through:

- source reduction,
- minimization,
- recycling,
- collection,
- processing, and
- discharge ashore.

The CLIA environmental standards are intended to provide for the elimination of, to the maximum extent possible, the disposal of MARPOL Annex V wastes into the marine environment through purchasing practices, reuse and recycling programs, landing ashore, and onboard incineration in approved shipboard incinerators. Some cruise ships report that they employ various types of equipment such as glass crushers, metal can compactors, and shredders in addition to incinerators, to prepare waste to be recycled in port (U.S. General Accounting Office, 2000).

Adopting a multifaceted strategy that includes waste minimization, source reduction, and recycling, along with waste stream management and periodic ash testing, should be sufficient to ensure that incinerator ash does not meet the definition of hazardous waste (e.g., if it exhibits a characteristic of hazardous waste as defined in 40 CFR Part 261 Subpart C. For more information, see Section 6 for the hazardous waste discussion). Proper hazardous waste management procedures are to be instituted onboard each ship to ensure that waste products which will result in a hazardous ash are not introduced into the incinerator. The CLIA environmental standards further provide that when such items are separated out from the waste stream, the waste will be identified and segregated for individual handling and management in accordance with appropriate laws and regulations. (CLIA, 2006).

As mentioned above, the CLIA environmental standards call for the testing of incinerator ash at least once quarterly for the first year of operation to establish a baseline, and annual testing

thereafter. Any incinerator ash that exhibits a characteristic of hazardous waste as defined in 40 CFR Part 261 Subpart C must be disposed onshore in accordance with RCRA, which may include additionally applicable state law requirements specific to the jurisdiction where the ash is landed. MARPOL Annex V specifies requirements for the disposal at sea of non-hazardous incinerator ash, which alternatively can be landed ashore.

Some additional reported approaches available to large cruise ship lines to reduce solid waste discharges that specifically target the proper handling of plastics include the following (U.S. General Accounting Office, 2000; RCCL, 1998):

- replacing disposable plastic and Styrofoam cups with reusable cups;
- reducing paper and plastic wrapping;
- replacing plastic condiment packages with bulk dispensers;
- eliminating plastic garbage bag liners;
- replacing disposable plastic plates and cutlery with china and washable plastic dishes;
- eliminating plastic bottles of shampoo and body lotion and replacing them with dispensers in the cabins; and
- using recycled paper in laundry bags instead of plastic.

5.4 What are the potential environmental impacts associated with solid waste from cruise ships?

Waste products in the past were made from natural materials and were mostly biodegradable. Now, much of the non-hazardous waste generated is either not easily biodegradable or does not biodegrade at all (CELB, 2003). According to Campbell (1999), the average solid waste generated daily per cruise ship passenger is 3.5 kilograms, which consists of food wastes, glass, plastics, paper, cans, cardboard, and wood. If cruise ships fail to properly store solid waste that is destined for off-loading to port reception facilities or fail to properly incinerate their solid waste before disposing of it into the ocean, or if passengers throw litter overboard or items are inadvertently blown overboard (e.g., towels, clothes, soda cans, plastic bottles, etc.), there is the potential for the introduction of plastics and other solid wastes from cruise ships into the marine environment. In such instances, the solid waste introduced into the marine environment becomes marine debris. According to NOAA, any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes is marine debris (NOAA, 2008). Marine debris has also been defined as “any man-made object that enters the marine environment due to numerous processes, including careless handling or disposal, intentional or unintentional release of materials or as a result of natural disasters and storms (Sheavly, 2007). Marine debris can also be considered simply as objects that are found in the marine environment but do not naturally occur there (U.S. Environmental Protection Agency, 1992).

Even though under the MARPOL agreement and U.S. federal law it is illegal for any vessel to discharge plastics or garbage containing plastics into any waters, there have been cases when unlawful discharges of solid waste and plastics have taken place. From 1993 through 1998, federal data indicate that foreign-flagged cruise ships were involved in 6 cases of confirmed illegal discharges of garbage or plastic (U.S. General Accounting Office, 2000). Solid waste that

enters the ocean directly or indirectly can pose a threat to marine organisms, humans, coastal communities, and commercial industries. This marine debris may accumulate on beaches, on the surface of waters, and in the benthos.

The fate of garbage after it is discharged overboard depends on a number of factors, including the physical characteristics (especially the density) of the solid and whether the garbage is loose or bagged. According to the National Research Council (1995), large, dense particles, such as ground glass and shredded metal, quickly sink. In areas where there is a strong pycnocline, small particles tend to disperse in the surface layer, while emulsified particles may remain in the water column for long periods of time. Organic material may or may not sink.

Plastics are quite buoyant and may accumulate on the surface of water and on beaches. According to Cohen (2008), 60% of trash on beaches is plastic, and 90% of debris floating in the ocean is plastic. Newly discarded plastic items float and may be transported far from the site of discharge. Plastics also may sink over time as they break apart, weather, or accumulate organic coatings, tar, shells, or sand. Floating debris, such as plastics, is being implicated in the contamination of some habitats by nonindigenous invasive species (Cruise Ship Environmental Task Force, 2003). Consequently, implementing proper garbage handling practices for plastics is especially critical given that plastics are “highly functional materials and will continue to be available” (National Research Council, 1995).

Regardless of how materials are predicted to flow in the ocean, wash ups of some types of marine debris on beaches seem to defy logical explanation (National Research Council, 1995). Not only can beach users be injured by pieces of glass, cans, or other litter washed ashore, such marine debris on beaches may cause significant adverse economic impact in coastal communities. For example, in 1988, it was estimated that New Jersey lost between \$379 million and \$3.6 billion in tourism and other revenue as a result of debris washing ashore (National Research Council, 2008).

The potential environmental and physical effects of marine debris include (National Research Council, 1995):

- aesthetic degradation of surface waters and beach areas;
- physical injuries to humans and life-threatening interference with their activities;
- ecological damage caused by the interference of plastics with gas exchange between overlying waters and those in the benthos;
- alterations in the composition of ecosystems caused by debris that provide habitat for opportunistic organisms;
- entanglements of birds, fish, turtles, and cetaceans in lost or discarded nets, fishing gear, and packaging materials; and
- ingestion of plastic particles by marine animals.

Food is often the largest single component of the garbage stream in ships (Polglaze, 2003). If discharged in sufficient quantities, food waste can contribute to increases in biological oxygen demand, chemical oxygen demand, and total organic carbon, diminish water and sediment quality, adversely effect marine biota, increase turbidity, and elevate nutrient levels. Polglaze (2003) further states that food waste components may be detrimental to fish digestion and health,

and have unsuitable nutrient content. Continued disposal of food wastes in restricted environments can cause nutrient pollution, if the water is not freely exchanged (Cruise Ship Environmental Task Force, 2003). Also, regular and sufficiently large inoculations of food waste to an area may cause ecological changes such as perturbations to species behavioral patterns and alternation to community species composition and diversity (Polglaze, 2003). An additional potential environmental impact of discharged food waste may be the inadvertent introduction of food associated plastics. To avoid an unintentional introduction of plastics with food wastes to the marine environment, it is critical to remove all food associated plastics before food wastes are comminuted prior to being discharged at sea or incinerated to then be discharged at sea.

Ash generated from the incinerator consists of trash (e.g., cardboard, paper, plastic), food solids from the food pulper systems, and sewage/graywater residuals (e.g., graywater screening solids, sewage/graywater screening solids, and sewage/graywater waste biosludge). The International Maritime Organization (IMO) guidelines for Annex V implementation recognize the potential for air pollution associated with incinerator use and therefore discourage the use of incinerators in ports in or near urban areas (Annex V, Appendix B, Section 5.4). The guidelines further recognize that some disadvantages of incinerators may include the hazardous nature of the ash or vapor, and that when in use, incinerators may not meet air pollution regulations imposed in certain harbors (Annex V, Appendix B, Section 5.4.5). Further, the incineration of plastics requires special precautions due to the potential environmental and health effects from the combustion of by-products. In these cases, the guidelines suggest that the incineration of plastic wastes complying with Annex V is to take place in a safe manner with an incinerator suitable for the incineration of plastics, otherwise the following problems can result:

- Depending on the type of plastic and conditions of combustion, some toxic gases can be generated in the exhaust stream, including vaporized hydrochloric and hydrocyanic acids. These and other intermediary products of plastic combustion can be extremely dangerous (Annex V, Appendix B, Section 5.4.6.1).
- The ash from the combustion of some plastic products may contain heavy metal or other residues which can be toxic and should therefore not be discharged into the sea (Annex V, Appendix B, Section 5.4.6.2).

Further, the Parliamentary Commission for the Environment (2003) states that a cruise ship solid waste incinerator may produce small amounts of polychlorinated biphenyls and polycyclic aromatic hydrocarbons.

5.5 What action is the federal government taking to address solid waste from cruise ships?

The Interagency Marine Debris Coordinating Committee, a federal group co-chaired by EPA and NOAA, is looking into ways to reduce the impact and sources of marine debris (any abandoned or uncontrolled solid material that is introduced into the ocean and coastal environment), including debris from vessels such as cruise ships. The group provided recommendations for research priorities, educational programs, monitoring techniques, and federal agency action in a Report to Congress in 2008. This report is required by section 5(c) of the Marine Debris Research, Prevention, and Reduction Act (Pub. L. 109-449).

According to the IMO (2007), the United Nations General Assembly invited IMO to review MARPOL Annex V, in consultation with relevant organizations and bodies, to assess the Annex's effectiveness in addressing sea-based sources of marine debris. Comprehensive review of MARPOL Annex V began in February 2006 with the formation of a correspondence group. The U.S. Government has been an active participant in this group. A working group to consider whether amendments to the Annex are necessary will be formed in July 2009 at MEPC 59.

The Coast Guard implements ongoing inspection and compliance programs to insure the adequacy of port reception facilities. In 2006 alone, the Coast Guard conducted over 14,000 facility inspections (up from approximately 3,500 in calendar year 2000), including inspections of MARPOL Annex V port reception facilities for compliance and adequacy. During the period from 2002 to 2006, vessel arrivals at U.S. ports nearly doubled, which in turn increased pressure on the capacities of U.S. ports. In meeting this increased compliance and inspection challenge, the Coast Guard issued or responded to and investigated 7,424 facility deficiencies in calendar year 2006, including reception facility deficiencies (up from 2,587 in calendar year 2000). From the time period between 2002 and 2006, the Coast Guard has documented a 26% reduction in the number of pollution incidents reported at facilities, which demonstrates the Coast Guard's continuing commitment to vigorous implementation of the pollution prevention and environmental stewardship missions which have been entrusted to the Coast Guard by Congress. This includes the administration of the COA program and insuring the adequacy of all U.S. port reception facilities for Annex V wastes from vessels.

The United States (as a party to MARPOL), with active Coast Guard engagement, participates in international work groups in efforts to standardize both Advance Notice Forms generated by vessels with respect to their reception facility needs for all wastes and a standard receipt form for such wastes. Addressing this standardization issue has been an ongoing effort by the MEPC of the IMO (since at least October 2004) to improve the performance of port reception facilities for solid waste management. The Coast Guard itself has focused on ways to address standardized reporting, including updates to implementing regulations, as well as the Coast Guard instructions that provide guidance to its field units. Implementation of standardized receipts, as proposed by the IMO with Coast Guard concurrence, will enhance the capacity of Coast Guard inspectors to confirm both allegations of illegal discharges and reports of inadequate reception facilities (approximately 80 reports of inadequacies have been received and investigated in 2007). Coast Guard inspectors will be able to compare Advance Notice records with reception facility receipts (which are required to be kept with the vessel garbage log book for a period of two years under Section 4.2 of the Appendix to MARPOL Annex V, 2006 Consolidated Edition). Presently, reports of inadequate reception facilities are available through the IMO's Global Integrated Shipping Information System public website at <http://gis.imo.org/Public/>.

The National Park Service (NPS) manages cruise ship waste streams indirectly in Glacier Bay National Park through competitively awarded concession contracts. The NPS has jurisdiction over the submerged lands and marine waters of Glacier Bay National Park up to 3 miles from the mean high tide line and including all of Glacier Bay proper. Glacier Bay is a well known, very popular attraction for the cruise ship industry in Alaska. Recent environmental reviews and decisions allow up to two cruise ship entries per day into Glacier Bay proper during the primary

visitor season. Cruise ship operations in the park are authorized under concession contracts, which are awarded under a competitive solicitation and prospectus process. Impact on park resources is a general standard selection criterion for park concessions. The NPS uses waste stream management as one of a number of selection criteria in this regard. In the past, cruise ship operators have usually proposed to minimize the impact of waste streams by committing to a no-discharge policy while in the park (even if legal under applicable law) for sewage, graywater, ballast water, bilge water, cooling water, hazardous waste, and solid waste. If awarded a contract, companies must comply with their proposal. Typically cruise ships operate in the park for 8-10 hours and then depart. Cruise ships do not dock or transfer any wastes to shore while in the park.

5.6 Possible Options and Alternatives to Address Solid Waste from Cruise Ships

Based on the public comments received on the draft of this report as well as other information gathered, listed below are a wide range of options and alternatives that address solid waste from cruise ships. Identification of any particular option does not imply any EPA recommendation or preference for future action, or that EPA has determined that any of these options are necessary or feasible, or that EPA believes a change to the status quo is warranted, or that EPA or any other entity has the legal authority to implement that option.

Prevention & Reduction

- Increase use and range of on-board garbage handling and treatment technologies (e.g., compactors, pulpers, shredders, and incinerators).
- Resolve issues that may be impeding safe waste storage and expanded use of compactors and incinerators.
- Improve infrastructure to assist in recycling of all glass, paper, wood, cardboard, and aluminum and other metals.
- Introduce and encourage cruise line participation in EPA's *WasteWise* and *Recycle on the Go* solid waste reduction programs which provide technical assistance to organizations to develop and implement solid waste reduction practices (further information is available at <http://www.epa.gov/wastewise/about/overview.htm> and <http://www.epa.gov/osw/conservation/rrr/rogo/index.htm>).
- Employ waste reduction for waste materials and plastics by reducing the amount of plastics and other packaging materials brought onboard.
- Increase efforts to buy in bulk and choose products with less packaging.

Control: Discharge Standards

- Expand training for employees regarding waste segregation requirements by including the legal and environmental basis for those requirements.
- Post waste segregation requirements (along with the associated the legal and environmental concerns) onboard (via placards and written information) for employees and passengers.
- Initiate rulemaking to provide for stronger waste management plans than the current cruise industry practices in order to control solid waste discharges from cruise ships into all U.S. waters.

- Include adequate port reception facilities as a component of a comprehensive vessel garbage management system, and establish a fee system to encourage the use of the facilities.
- Require that U.S. ports initiating port expansions also build additional reception facilities to receive Annex V wastes from cruise ships.
- Sort all wastes onboard and off-load recyclables only at ports with recycling facilities.
- Establish accountability for both vessel operators and port operators with regard to proper solid waste management.
- Determine who should pay for vessel garbage services.
- Ensure all biohazard wastes and infirm/sickbay wastes are properly processed for disposal in compliance with state solid waste disposal regulations for hospital wastes.
- Require an analysis and accounting of the contaminants typically found in cruise ship incinerator ash to determine whether each batch of ash generated should be categorized as a solid waste or hazardous waste to then be managed accordingly.
- Require standardized incinerator ash testing before each overboard discharge.
- Establish performance standards for onboard incinerators to ensure Annex V compliance.
- Develop standards for compacted solid waste discharges to the marine environment.

Control: Geographic Restrictions on Discharge

- Prohibit the discharge of any waste, food, or otherwise macerated waste into any marine sanctuary or any other sensitive area.
- Prohibit the discharging of incinerator ash from cruise ships into U.S. waters.
- Discontinue discharges of dunnage and floating waste in all waters.
- Bring all solid waste to shore for disposal or recycling.
- Encourage the cruise industry to work with private vendors and ports to ensure that ample recycling opportunities exist in foreign ports.
- Expand all port reception facilities to accept solid waste.
- Require that wherever cruise ships call, receiving ports provide reception facilities for solid waste off-loading and have established waste reception plans.
- Prohibit the use of incinerators while in port.
- Require that cruise ships off-load garbage during U.S. port calls.
- Encourage EPA and Coast Guard to:
 - conduct a feasibility study to determine the costs to provide adequate port reception facilities for cruise ships; and
 - develop a “polluter pays” funding mechanism to pay for some or all of the capital costs, operations, and maintenance of such port reception facilities.

Enforcement & Compliance Assurance: Monitoring

- Establish a mandatory, standardized incinerator ash testing program to determine appropriate management of the ash.
- Ensure no discharge of solid waste into the marine environment by establishing a system of monitoring compliance, adequate sanctions for noncompliance, and forwarding non-compliance data to the vessel’s next port of call.

Enforcement & Compliance Assurance: Reporting

- Require that ports provide receipts for garbage off-loaded to their reception facilities; compare the receipts to vessel garbage logs for inconsistencies.
- Assess the need for increased recording/logging of garbage generation onboard cruise ships.
- Require that cruise ships maintain certified log books documenting incinerator ash test results, dates, volumes, ultimate disposition of ash, and locations of legal ash discharges.
- Publicize the APPS whistleblower provisions under 33 U.S.C. 1908(a) to passengers and crew members to encourage detection of illegal pollution.

Enforcement & Compliance Assurance: Inspections & Enforcement

- Streamline enforcement by issuing “tickets” in civil cases.
- Encourage vessel owners to report inadequate reception facilities.
- Conduct public awareness campaigns urging citizens to report illegal garbage disposal (e.g., passengers on cruise ships who observe any illegal dumping and/or the disposal of plastic at sea should report this to the National Response Center or the nearest Coast Guard Marine Safety Office).
- Provide incentives for third party reporting of environmental violations.
- Impose uniform requirements (consistent with international law) on all ships as a condition of port entry and within U.S. waters, regardless of flag state.
- Prohibit or otherwise restrict noncompliant vessels (and sister ships, depending on the degree of involvement by parent companies) from operating in sensitive areas of the marine environment under U.S. jurisdiction.

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