

August 1994

**POLLUTION
PREVENTION**

**Chronology of Navy
Ship Waste Processing
Equipment
Development**





United States
General Accounting Office
Washington, D.C. 20548

**National Security and
International Affairs Division**

B-257874

August 18, 1994

The Honorable Joseph I. Lieberman
United States Senate

The Honorable Gary A. Franks
House of Representatives

In 1973, the United States and other maritime nations signed the International Convention for the Prevention of Pollution from Ships. The treaty was amended in 1978 to resolve some technical problems. It includes five annexes. Annex V regulates the discharge of garbage and other solid wastes--plastics, food, paper, cardboard, metal, and glass--from ships. It prohibits the discharge of plastics anywhere at sea and of food, paper, cardboard, metal, and glass near land and in special areas.¹

The treaty and its annexes were not applicable to naval or other government vessels. To implement the treaty, Congress passed the Act for the Prevention of Pollution from Ships in 1980. The act exempted U.S. naval vessels from its coverage. Congress later amended the act's provisions in the Marine Plastic Pollution Research and Control Act of 1987. This act, which took effect on December 31, 1988, required naval vessels to comply with the pollution requirements of Annex V by December 31, 1993, or report to Congress by December 31, 1991, that it was unable to comply. Just before the deadline, at the request of the Navy, Congress amended the act again to extend the Navy's compliance to 1998 and beyond.

This fact sheet is an interim response to your request that we review the Navy's Shipboard Solid and Plastics Waste Management Program--the Navy's response to the treaty and its accompanying legislation. As agreed with your office, we are providing information on (1) the two plans that the Navy has proposed so far, (2) the solid waste processing equipment the Navy has developed in accordance with these

¹Special areas now in place are the North Sea, the Baltic Sea, and the Antarctic Region. Additional areas such as the Caribbean have been identified, which may later take effect.

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plans, and (3) the cost of this equipment. Appendix I lists the Navy's efforts to develop equipment and appendix II shows Navy expenditures from start of equipment development through fiscal year 1993. We are continuing our work on the remainder of your request.

RESULTS IN BRIEF

The Navy has proposed two plans since the passage of the Marine Plastic Pollution Research and Control Act of 1987. In the Navy's 1987 Shipboard Solid and Plastics Waste Management Program Plan, the Navy anticipated that it would take 11 years (until 1998) to develop, produce, and install the processing equipment necessary to meet shipboard solid waste discharge requirements. The equipment stipulated in the plan were a vertical trash compactor, a solid waste pulper, and a plastics waste processor. In 1993, the Navy revised its plan. The revised plan eliminated the trash compactor, added a metal/glass shredder, and retained the pulper and plastics processor.

Since the 1970s, the Navy has conducted research to develop shipboard solid waste processing equipment. The Navy's first contract to design a trash compactor was awarded in 1979. The Navy began developing a pulper in 1985, a plastics processor in 1987, and a shredder in 1993. Development and production of the trash compactor were terminated in 1993. Acquisition and installation of the pulper and shredder were suspended in 1994. The Navy has several research projects underway for destroying or treating shipboard wastes. These include plasma arc, pulsed plasma arc, molten salt destruction, and ram-jet incineration projects.

According to the Navy, from fiscal years 1979-93, it spent \$26 million to research, develop, and produce processing equipment for its Shipboard Solid and Plastics Waste Management Program. On September 30, 1993, the Navy estimated that its program would cost \$901 million for fiscal years 1992-99. This estimate will change because the Navy made the estimate before the Congress extended the Navy's compliance deadline from 1993 to 1998 and beyond. According to Navy officials, the Navy is currently reconsidering the Shipboard Solid and Plastics Waste Management Program and its cost.

NAVY'S PLANS FOR RESPONDING TO REQUIREMENTS

In November 1987, the Navy developed its first plan to comply with the shipboard solid waste discharge

requirements. In this plan, it is clear that the Navy did not anticipate being able to comply with the act until 1998 (11 years). The Navy's 1987 plan set two objectives. Within 5 years, the Navy was to reduce overboard discharges of plastics waste by decreasing the amount of plastics brought onboard Navy ships and by segregating and storing plastics waste onboard. In the longer term (11 years after the first funding was approved for a plastics processor), shipboard solid waste processing equipment--trash compactor, pulper, and plastics processor--would be developed and installed on Navy ships. Meeting these equipment requirements was estimated to cost \$404 million.

In December 1991, the Navy prepared a draft report to Congress, explaining why it could not meet the December 31, 1993 deadline. In the summer of 1992, the draft was circulated among concerned federal agencies. According to Navy officials, this coordination was not completed until the summer of 1993. Before forwarding the report to Congress, the Navy in April 1993 published a revised plan for its Shipboard Solid and Plastics Waste Management Program, which supported its report to Congress. The revised plan proposed new equipment and installation strategies, requiring more than 2 years of research and development with a projected investment of \$896 million. The equipment strategy eliminated the trash compactor, added a shredder, and retained the pulper and plastics processor. In August 1993, the Navy forwarded its report to the Congress. Attached to the report were proposed amendments to the act, including requests for an extension to the compliance deadline and for changes to the act's requirements for ships in special areas and for submarines.

In Congress' 1993 amendments, the Navy's general compliance was extended to December 31, 1998. However, rather than granting the changes to requirements, Congress mandated compliance deadlines of December 31, 2000, for special areas and December 31, 2008, for submarines.

NAVY'S DEVELOPMENT OF SHIPBOARD
SOLID WASTE PROCESSING EQUIPMENT

In March 1993, the Navy canceled its trash compactor research after deciding that it was no longer needed. The trash compactor that was being developed was designed to process non-industrial and non-hazardous wastes into trash slugs that were supposed to sink to the bottom of the ocean.

According to Navy officials, the pulper was recently dropped from the Navy's program because its use would have required

a change in requirements that Congress opted not to grant. The pulper was designed to tear and grind food, paper, and cardboard wastes into a slurry of small particles that could be pumped overboard and dispersed in the sea. If sorting errors occurred, the pulper could separate and collect other solid wastes--metal, glass, and plastics. Metal and glass would be diverted to and collected in an area of the machine that could be emptied manually. Plastics would be partially shredded and retained in the pulping chamber for manual removal. The Navy had planned to install a production version of the pulper in surface ships by the end of 1998.

Although the metal/glass shredder replaced the compactor as a tool for complying with discharge requirements, its use in the Navy's program was recently modified. According to the Navy, the shredder was initially designed to crush and cut metal and glass into pieces that will sink in burlap bags to the bottom of the sea. The production version of the metal/glass shredder had been planned to be installed in surface ships by the end of 1998. The shredder is now planned to shred only plastic wastes for the plastics processor.

The plastics processor under development generally consists of a shredder and three compress-melt units that shred, compress, and heat plastics waste into solid plastic disks. The plastic disks can be stored onboard ships for later landfill disposal or possibly for future recycling. The Navy plans to install the production version of the plastics processor in surface ships by the end of 1998.

According to Navy officials, several research projects are underway for destroying or treating shipboard wastes, including plasma arc, pulsed plasma arc, molten salt, and ram-jet incineration. All of these projects are still in their early phases and are not included in the Navy's Shipboard Solid and Plastics Waste Management Program Plan. Of these projects, the plasma arc research has been underway the longest. It is a technology to convert most materials to gases or fused slag. It uses an electric arc as a heat source. The pulsed plasma arc is a different technique to sustain an arc. The molten salt destruction uses melted sodium in a closed container. Ram-jet incineration uses high-speed gas technology similar to rocket and jet engines.

COST TO RESEARCH, DEVELOP, AND PRODUCE
SHIPBOARD SOLID WASTE PROCESSING EQUIPMENT

For fiscal years 1979-93, the Navy spent \$26 million to research, develop, and produce shipboard solid waste

processing equipment under its Shipboard Solid and Plastics Waste Management Program for surface ships. The Navy thus far has spent \$4,175,000 for the trash compactor effort,² \$7,598,000 for the large and small pulpers, \$1,190,000 for the shredder, and \$12,998,000 for the plastics processor. In addition to program expenditures, the Navy has spent \$3,600,000 to date on research of alternative technologies-- plasma arc, pulsed plasma arc, molten salt, and ram-jet incineration--to destroy or treat shipboard wastes.

On September 30, 1993, the Navy projected that research, development, and procurement costs for solid waste processing equipment would reach \$901 million for fiscal years 1992-99. This estimate comprises \$30 million for research development test and evaluation, \$580 million for other procurement, \$110 million for operations and maintenance, and \$181 million for ship construction. Similar cost projections were not available for the alternative technologies. The Navy is reconsidering its Shipboard Solid and Plastics Waste Management Program cost estimates in light of the 1993 amendments.

For submarines, Navy officials have projected that an additional \$24 million is needed for research development test and evaluation of plastics processors during fiscal years 1997-99. To date, no funds have been budgeted for the research and no estimate has been made for subsequent equipment acquisition and installation.

SCOPE AND METHODOLOGY

We performed our work at the Office of the Chief of Naval Operations and the Naval Sea Systems Command in Washington, D.C., and at the Naval Surface Warfare Center in Annapolis, Maryland. We reviewed documents and interviewed officials to compile a chronology of the Navy's development of shipboard solid waste processing equipment. We used Navy cost data to calculate the costs associated with this equipment. We did not verify the cost data for this interim report.

We did not obtain written comments on this fact sheet. However, we discussed a draft of it with Navy officials and incorporated their comments where appropriate.

²The Navy and the contractor have not agreed on the trash compactor contract termination cost. The current net proposed settlement is \$2,102,820.

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Unless you publicly announce this fact sheet's contents earlier, we plan no further distribution until 30 days from the fact sheet's issue date. At that time, we will send copies to appropriate congressional committees, the Secretary of the Navy, and the Office of Management and Budget. We will also make copies available to others on request.

Please call me at (202) 512-8412 if you or your staff have any questions concerning this fact sheet. Major contributors to it are listed in appendix III.



Donna M. Heivilin, Director
Defense Management and NASA Issues

CHRONOLOGY OF THE NAVY'S DEVELOPMENT OF
EQUIPMENT TO COMPLY WITH DISCHARGE REQUIREMENTS

The following chronology shows that the Navy developed shipboard solid waste processing equipment (vertical trash compactor, solid waste pulper, metal/glass shredder, and plastics waste processor) in response to a treaty (the 1973/1978 International Convention for the Prevention of Pollution from Ships) and accompanying legislation (the Marine Plastic Pollution Research and Control Act of 1987). The treaty sets forth agreements for controlling worldwide marine pollution, and the subsequent legislation makes portions of this treaty law.

Date	Event
1970s	The Navy begins research on the disposal of solid waste (plastics, food, paper, cardboard, metal, and glass) from Navy ships.
1973	The International Convention for the Prevention of Pollution from Ships is drafted to control marine pollution worldwide.
1978	The International Convention for the Prevention of Pollution from Ships is amended by a protocol to resolve some technical problems.
73/78	Annex V of the treaty and protocol bans discharge of plastics waste anywhere at sea; prohibits discharge of food, paper, cardboard, metal, and glass wastes near land; and prohibits solid waste discharges, except food waste, in special areas. A special area is a sea area where more stringent limitations on discharge of solid waste are considered necessary; special areas now in place are the North Sea, the Baltic Sea, and the Antarctic Region.
1979	The Navy awards a contract for a trash compactor design study.
1980	The Navy awards a contract to develop and test one prototype trash compactor and two preproduction compactors. The compactors are to convert solid waste into sinkable trash slugs.
1980	To implement the International Convention for the Prevention of Pollution from Ships and its annexes, Congress passes the Act for the Prevention of Pollution from Ships. The act exempts U.S. naval vessels from its coverage.
1985	The Navy begins developing a pulper to process solid waste.
1987	The Navy begins developing a plastics waste processor that will shred, compress, and heat plastics waste into solid plastic disks that can be stored onboard ships for later landfill disposal or possibly for future recycling. The Navy plans to install the plastics processor in surface ships by the end of 1998.

Date	Event
1987	At a congressional hearing, the Assistant Secretary of the Navy for Shipbuilding and Logistics indicates that the Navy will make every effort to comply with the United States' commitment to Annex V.
Nov. 1987	The Navy presents its Shipboard Solid and Plastics Waste Management Program Plan and estimates that the program will cost \$404 million. The plan calls for reducing plastics waste discharges from Navy ships within 5 years. The long-term objective (11 years) is to comply fully with Annex V by completing the development of a trash compactor, a pulper, and a plastics processor for Navy ships.
Nov. 1987	The Navy encourages surface ships with incinerators to use them at sea for destroying non-plastic solid wastes, such as paper and cardboard.
Aug. 1988	The Navy issues a survey report on how the plasma arc destruction process could destroy or treat wastes. The plasma arc process is a technology that converts most wastes into gases or fused slag. Subsequently, research on other alternative technologies--pulsed plasma arc, molten salt, and ram-jet incineration--is initiated.
Dec. 1988	The Marine Plastic Pollution Research and Control Act which amended the provisions of the 1980 Act for the Prevention of Pollution from Ships takes effect, implementing Annex V pollution control requirements for naval vessels during peacetime operations. The act gives the Navy until December 31, 1993, to comply and requires it to report to the Congress by December 31, 1991, if it cannot meet the deadline.
Dec. 1991	The Navy's draft report on its inability to comply with requirements is forwarded to the Assistant Secretary of the Navy for Installations and Environment.
Mar. 1992	Navy awards a \$4,598,051 contract for a prototype trash compactor and 25 production trash compactors.
Sept. 1992	As part of the March 1992 contract, the Navy orders 23 more trash compactors at \$3,345,585.
Jan. 1993	As part of the March 1992 contract, the Navy orders 45 more trash compactors at \$6,691,206.
Mar. 1993	The Navy cancels the March 1992 trash compactor contract after deciding that the requirement for a trash compactor no longer exists. To date, the Navy and the contractor have not agreed on the contract termination cost. The current net proposed settlement is \$2,102,820.
Apr. 1993	The Navy begins developing a metal/glass shredder to replace the trash compactor. Subsequently, Navy officials decide that this same shredder will be used with the plastics processor to shred plastic wastes.

Date	Event
Apr. 1993	The Navy issues its revised Shipboard Solid and Plastics Waste Management Program Plan and estimates that the program will cost \$896 million (updated to \$901 million in September 1993). The Navy states that it will comply with discharge requirements after December 31, 1998, and eliminates the compacting requirement, adds the shredder requirement, and retains the requirements for the pulper and plastics processor.
Jun. 1993	The Navy publishes its compliance report for the Congress. The report lists actions taken in response to the Marine Plastic Pollution Research and Control Act, impediments to full compliance by December 31, 1993, and ships that cannot achieve full compliance. The Navy recommends changes to some requirements.
Aug. 1993	The Chief of Naval Operations directs fleet commanders to terminate the incineration of plastics at sea because it is believed that incineration presents safety and health hazards.
Aug. 1993	The Secretary of the Navy reports to the Congress on Annex V compliance. According to the proposed DOD Authorization Bill S. 1298, section 328 amendments to the Marine Plastic Pollution Research and Control Act would extend the compliance date regarding the discharge of plastics from December 31, 1993, to December 31, 1998; adopt a special area standard of "no floating waste, no plastic waste;" and extends submarines' compliance with discharge requirements.
Nov. 1993	In the 1993 amendments to the Act to Prevent Pollution from Ships, the solid waste compliance date for surface ships is extended to December 31, 1998; the special area compliance date for surface ships is extended to December 31, 2000; and the solid waste compliance date and special area discharge requirements for submarines is extended to December 31, 2008. The 1993 amendments require that the Navy issue a request for proposals for the plastics processors by October 1, 1994; that the Navy install the first production unit of the plastics processor in a Navy ship by July 1, 1996, 25 percent by March 1, 1997, 50 percent by July 1, 1997, 75 percent by July 1, 1998, and all ships by December 31, 1998; and that the Navy develop a compliance plan by November 30, 1996.
1994	Navy is reconsidering its Shipboard Solid and Plastics Waste Management Program. For example, it has completed development of the pulper but has terminated its use because the Navy could not use it in special areas as planned.

PROGRAM EXPENDITURES FOR SURFACE SHIPS

Table II.1: Reported Expenditures by Equipment

Dollars in thousands

Fiscal year	Trash compactor ^a	Large pulper ^b	Small pulper ^b	Plastics processor	Shredder ^c	Total ^d
1979	\$85	\$0	\$0	\$0	\$0	\$85
1980	185	0	0	0	0	185
1981	110	0	0	0	0	110
1982	380	0	0	0	0	380
1983	580	0	0	0	0	580
1984	687	0	0	0	0	687
1985	682	0	0	0	0	682
1986	280	0	0	0	0	280
1987	275	0	0	0	0	275
1988	265	430	0	50	0	745
1989	200	700	0	210	0	1,110
1990	380	1,014	0	1,494	0	2,888
1991	20	639	0	2,976	0	3,635
1992	0	825	0	3,427	0	4,252
1993	46	2,660	1,330	4,841	1,190	10,067
Total	\$4,175	\$6,268	\$1,330	\$12,998	\$1,190	\$25,961

^aThe Navy has canceled the March 1992 trash compactor contract. To date, the Navy and the contractor have not agreed on the contract termination cost. The current net proposed settlement is \$2,102,820.

^bAccording to Navy officials, the Navy has completed development of the pulper but has terminated its use.

^cThe metal/glass shredder has been dropped from the Navy's program.

^dTo date, the Navy has spent an additional \$3,600,000 on several research projects underway that are not in its Shipboard Solid and Plastics Waste Management Program, including plasma arc destruction, pulsed plasma arc, molten salt destruction, and ram-jet incineration.

Source: Naval Sea Systems Command.

Table II.2: Reported Expenditures by Appropriation

Dollars in thousands

Fiscal year	Research and development ^a	Other procurement ^b	Operation & maintenance	Ship construction
1979	\$85	\$0	\$0	\$0
1980	185	0	0	0
1981	110	0	0	0
1982	380	0	0	0
1983	580	0	0	0
1984	687	0	0	0
1985	682	0	0	0
1986	280	0	0	0
1987	275	0	0	0
1988	745	0	0	0
1989	1,110	0	0	0
1990	2,888	0	0	0
1991	3,635	0	0	0
1992	4,252	0	0	0
1993	9,766	301	0	0
Total	\$25,660	\$301	\$0	\$0

^aTo date, the Navy has spent an additional \$3,600,000 on several research projects underway that are not in its Shipboard Solid and Plastics Waste Management Program, including plasma arc destruction, pulsed plasma arc, molten salt destruction, and ram-jet incineration.

^bThe Navy has canceled the March 1992 trash compactor contract. To date, the Navy and the contractor have not agreed on the contract termination cost. The current net proposed settlement is \$2,102,820.

Source: Naval Sea Systems Command.

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