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IMPROVING THE COST EFFECTIVENESS OF HAZARDOUS MATERIALS MANAGEMENT PROGRAMS ABOARD U.S. NAVY DOCK LANDING SHIPS (LSD'S)

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This thesis analyzes the cost effectiveness of alternatives to the U.S. Navy's current hazardous materials management practices onboard its ships. Numerous recent laws regarding pollution prevention aboard ships as well as significant reductions in Department of Defense spending has led the Navy to seek initiatives to manage hazardous materials in a more efficient and cost effective manner. This thesis deals with reducing wastestream volume and costs and improving the management of the Hazardous Minimization Centers (HMC's). Research was conducted onboard seven U.S. Navy Dock Landing Ships (LSD's): USS ANCHORAGE, USS COMSTOCK, USS FORT FISHER, USS FORT MCHENRY, USS HARPER'S FERRY, USS MOUNT VERNON and USS RUSHMORE. Hazardous material wastestream data was gathered for each ship to determine the significant material contributors to disposal costs. Additionally, information was accumulated concerning the training received by HMC operators to identify potential management weaknesses. Research identified significant cost savings by replacing the currently used baled wiping rags with shop towels provided by a contracted commercial vendor. Also noted was the fact that HMC operators were not receiving the requisite training required to properly manage HMC's. Therefore, training alternatives are addressed to ensure competent management of HMC's.

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ABSTRACT

This thesis analyzes the cost effectiveness of alternatives to the U.S. Navy's current hazardous materials management practices onboard its ships. Numerous recent laws regarding pollution prevention aboard ships as well as significant reductions in Department of Defense spending has led the Navy to seek initiatives to manage hazardous materials in a more efficient and cost effective manner. This thesis deals with reducing wastestream volume and costs and improving the management of the Hazardous Minimization Centers (HMC's). Research was conducted onboard seven U.S Navy Dock Landing Ships (LSD's): USS ANCHORAGE, USS COMSTOCK, USS FORT FISHER, USS FORT MCHENRY, USS HARPER'S FERRY, USS MOUNT VERNON and USS RUSHMORE. Hazardous material wastestream data was gathered for each ship to determine the significant material contributors to disposal costs. Additionally, information was accumulated concerning the training received by HMC operators to identify potential management weaknesses. Research identified significant cost savings by replacing the currently used baled wiping rags with shop towels provided by a contracted commercial vendor. Also noted was the fact that HMC operators were not receiving the requisite training required to properly manage HMC's. Therefore, training alternatives are addressed to ensure competent management of HMC's.

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I. INTRODUCTION

This thesis analyzes the hazardous materials management processes aboard United States Navy Dock Landing Ships (LSDs). Its purpose is to identify potential cost avoidance initiatives for certain items in the hazardous wastestream, and improve the competence of hazardous material managers by changing the Hazardous Minimization Center manning and associated training requirements.

A. BACKGROUND

1. Decentralized Hazardous Materials Management Afloat

Up until 1994, hazardous materials aboard United States Navy ships were managed in a highly decentralized fashion. Each department, and often times divisions, maintained their own inventories of hazardous materials for day-to-day use. These items included: lubrication oils, greases and boiler water treating chemicals used by the engineering department; paints and thinners for ship preservation maintained by the deck department; and insecticides and x-ray developer used by the medical and dental departments. By maintaining these inventories, the departments incurred the responsibility for properly ordering, receiving, stowing and using hazardous materials, and disposing of the resulting hazardous wastes. Because many of the people responsible for properly handling these potentially dangerous materials were not trained and knowledgeable in their special requirements, there were many deficiencies in hazardous materials management.

2. Environmental Concerns

Secondly, the United States Navy was accustom to dumping almost any waste material into the ocean with the very few restrictions. This was the easiest and cheapest disposal method. However, with increasing public interest and resulting Congressional interest in preserving the environment, the Navy came under pressure to improve its disposal practices. In fact, Congress has mandated the elimination of all at sea waste disposal by December 31, 1998. Therefore, the Navy is faced with the challenge of developing technologies that will allow ships to meet the fast approaching deadline, without jeopardizing operational flexibility.

3. Federal Funding

Thirdly, competition for Federal funds is becoming keener everyday. With large spending increases for mandatory programs in recent years, and a national debt of nearly $5 trillion, discretionary programs provide short-term solutions to a tight federal budget. United States defense spending has declined sharply over the past several years and deeper cuts into the discretionary "pot" are are likely in the future. Consequently, the U.S. Navy must creatively search for new opportunities to save money and be able to fully justify the funds they require.

4. Summary

We find ourselves in an era where two of the hottest subjects are environmental issues and federal spending. This places the U.S. Navy hazardous materials management programs under great scrutiny. Areas that require reform must be identified. This thesis will specifically focus on the areas where cost avoidance and process improvements can enhance the effectiveness and efficiency of the overall hazardous materials management program.

B. OBJECTIVES OF THE RESEARCH

The recent adoption of a new hazardous materials management philosophy significantly improved the Navy's usage and disposal practices. The Consolidated Hazardous Reutilization and Inventory Management Program (CHRIMP) established centralized control and intensive inventory management of hazardous materials at all Navy commands. This has largely reduced the inefficiencies experienced under the decentralized environment. However, this is merely an initial step in a continuous effort of process improvement.

The first area of study will focus on potential cost avoidance initiatives. Specifically, the research examines U.S. Navy ship wastestreams to determine major disposal cost producers and materials providing potential cost avoidance alternatives. Secondly, since Hazardous Minimization Centers (HMCs) and managers of those centers are the foundation of CHRIMP, focus will shift to the shipboard HMC operators. Particular attention is paid to manning structure and the competence development of those HMC managers, since the CHRIMP objectives depend heavily on a well-trained core of personnel to properly manage and administer hazardous materials programs.

C. SCOPE OF THE RESEARCH

There are numerous areas in the hazardous materials management process where alternative methods may provide cost avoidance or management improvement initiatives. This study takes a two-pronged approach. First, the end of the life cycle of hazardous materials (wastestream disposal) is analyzed to determine the most significant disposal cost producers. The research found baled wiping rags to compose a significant portion of disposal costs. Therefore, they are a likely candidate for cost avoidance initiatives. Second, a deficiency in the formal training of those responsibile for managing hazardous materials was identified. Therefore, research focused on initiatives for improving the manning structure and training requirements for HMCs.

The wastestream data came from seven U.S. Navy Dock Landing Ships (LSDs) homeported at the San Diego Naval Station in 1995. These ships are: USS ANCHORAGE (LSD-36), USS COMSTOCK (LSD-45), USS FORT FISHER (LSD-40), USS FORT MCHENRY (LSD-43), USS HARPER'S FERRY (LSD-49), USS MOUNT VERNON (LSD-39) and USS RUSHMORE (LSD-47). Taking advantage of the commonalities of all U.S. Navy ship types and their life cycles allows the calculations and resulting models to be readily applied to other ship types.

D. METHODOLOGY OF THE RESEARCH

This study primarily utilized three methodologies to obtain the information and data required to develop the research conclusions. The three forms of methodology are:

observational, archival and opinion.

1. Observational

The initial phases of research relied heavily upon observing the various facets of the hazardous materials process. This included observing shipboard hazardous materials management practices, pier disposal procedures and the general operations of supporting shore activities; such as, Naval Station Environmental and the Fleet Industrial Supply Center (FISC) Hazardous Minimization department. Some of the weaknesses of this method are that people tend to act differently when observed by others outside of their immediate organization, which may distort normal activity. Additionally, observation only provides current data with no specific reference for what transpired in the past. This latter point makes the archival method, the next method discussed, a valuable asset.

2. Archival

The archival method was employed to collect the majority of the data. Obtaining wastestream disposal data from Naval Station Environmental personnel was crucial to identify overall quantities and costs of specific wastestream items. This data formed the basis for several models. Archival data was also vital in determining the number of students trained in hazardous materials management procedures and the associated costs over the past year. This method tends to produce the most unbiased information of the three methods employed, because the information is predominantly numerical. Numerical data tends to eliminate biases that are more apparent in written word or verbal interaction. The exception is when it is advantageous to misstate numerical data for internal or external reporting reasons. This does not seem to be the case for the data obtained in this study.

3. Opinion

Lastly, opinions were obtained throughout the research process through interviews with the people involved in the hazardous materials process. This method contains the most potential for bias. To minimize this potential it is important to employ a standard line of questioning and interview a wide range of people with varying perspectives. This method was particularly helpful in identifying training deficiencies experienced by hazardous materials managers. This consistent finding focused additional attention to this particular area in this thesis.

E. ORGANIZATION OF THE STUDY

1. Chapter I: Introduction

Chapter I presents an overview of events leading up to this research and identifies the particular focus and scope of the study. It also specifies the research methodology and some of the limitations associated with those methods.

2. Chapter II: Environmental Legislation as an Impetus for Improving the Hazardous Materials Management Afloat Process

Chapter II discusses the development of environmental concerns in the United States, particularly in the last few decades. In particular, the U.S. government enacted legislation, such as the National Environmental Policy Act (NEPA) and Act to Prevent Pollution from Ships (APPS), to preserve the environment for future generations. This translated into increasingly more restrictive regulations for the U.S. Navy and the ultimate "zero discharge" mandate set for 1998. The Navy responded by establishing pollution prevention programs and research and development efforts to meet the deadline without disrupting normal ship operations.

3. Chapter III: Financial Reasons for Improving the Hazardous Materials Management Afloat Process

Two particular aspects of the United States federal budget continue to significantly impact funding for the Department of Defense. First, federal spending for mandatory programs has increased steadily over the years. Second, the national debt is currently nearly $5 trillion, and also increasing. Consequently, Congress has targeted discretionary programs as an attractive funding source. In particular, the Department of Defense budget, constituting the largest portion of the discretionary budget, has declined steadily since the mid-1980's. The forecast is for more of the same, especially with the view of some that the United States military should be reduced after the conclusion of the Cold War.

4. Chapter IV: Methodology and Data Presentation

By collecting and assimilating various hazardous material related data for a specific class of U.S. Navy ships (LSDs), a couple of important research areas became obvious. For example, after accumulating wastestream disposal data for LSDs based in San Diego, California, is was obvious that wastestreams containing baled rag material constituted a signficant portion of disposal volume and costs. Therefore, models are developed in this chapter to determine the actual life cycle costs of baled rags. Additionally, deficiencies were observed in the current system for managing Hazardous Minimization Centers (HMCs) aboard ships. The deficiencies eminate from the fact that HMC operators are not being trained to fulfill their jobs. Calculations are performed to estimate the costs of training HMC personnel.

5. Chapter V: Analysis of Data

Chapter V presents an alternative to baled rags, called the shop towel program. This program, obtained through a civilian contractor, provides a superior quality product at vastly reduced cost when compared to baled rags. Actual calculations are performed employing absorbency and volumetric equivalents to achieve a range of potential cost avoidance for both oil saturated and paint/solvent saturated rags.

The second section of Chapter V exposes training deficiencies in HMC operators and the factors leading to those deficiencies. To solve the problem, personnel with the desire and the requisite capabilities to manage HMCs must be identified. Addtionally, these managers must receive the training required to perform their functions competently.

6. Chapter VI: Conclusions and Recommendations

The final chapter discusses potential methods for implementing the shop towel program, restructuring HMC manning and providing training for HMC operators. First, information about the cost savings and other advantages of the shop towel program must be communicated to shipboard personnel. Then, a policy is established to ensure comprehensive implementation. Second, to improve the effectiveness of HMCs, appropriate personnel must be chosen as operators. This specifically requires people with inventory management skills, who can realize career advancement opportunities through HMC employment. Therefore, a program for consolidating the HMC operation with the established storekeeper division on the ship is discussed. Lastly, the personnel chosen for HMC jobs must obtain formal hazardous materials training to provide the expertise required to properly manage the HMC operation and achieve the long-term goals of CHRIMP. Two alternatives are presented as avenues for achieving this training.

II. ENVIRONMENTAL LEGISLATION AS AN IMPETUS FOR IMPROVING THE HAZARDOUS MATERIALS MANAGEMENT AFLOAT PROCESS

A. ENVIRONMENTAL LEGISLATION BACKGROUND

Up until the 1960's, there was virtually no legislation of any significance regarding environmental matters in the United States. The couple of laws that existed at that time, such as the Prevention of Pollution of the Sea by Oil (1954) and the Federal Water Pollution Control Act, did not carry any real clout when it came to enforcement. As populations expanded, industries grew and the oceans became thoroughfares for commercial trade, naval ships and other vessels, there was a realization that environmental issues must be addressed. The usual method of disposing of garbage and hazardous materials at sea, without consideration for the environment, was rising at exponential rates with the increasing number of seagoing vessels. If actions were not taken, the consequences could be disasterous for marine life and ultimately the health and welfare of the world's human population. As will be seen in the following paragraphs, the path leading to the current environmental laws in the United States was an evolutionary process. It started with a basic policy that was eventually backed by enforceable legislation.

B. NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

1. Purpose

In 1969, the groundwork was laid for a comprehensive environmental policy for the

United States under the National Environmental Policy Act (NEPA) of 1969. NEPA was actually signed into law on January 1, 1970 (Public Law 91-190) with the following specific purposes:

> To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality [Ref.1:p852].

The Congress, recognizing the potential impact of population growth, high-density urbanization, industrial expansion, resource exploitation and technological advances, knew it was time to act. Additionally, Congress began posturing itself to acquire financial resources to address environmental issues.

2. Contents of the Law

The actual contents of NEPA were quite broad and basically began making people aware of the consequences of their actions with respect to the environment, and to show that the United States government took the issue seriously. Specifically, the law required all Federal agencies to:

a) utilize available environmental technology in making any decisions that affect the environment;

b) include in every recommendation or report on proposals for legislation or other Federal action a full environmental impact statement;

c) study and develop alternative uses of available resources;

d) recognize the worldwide and long-range character of environmental problems, and where appropriate and consistent with United States foreign policy, support and encourage international cooperation in solving problems;

e) make available to states, counties, municipalities, institutions and individuals advice and information useful in restoring, maintaining and enhancing the quality of the environment [Ref.1:p853].

Additonally, NEPA established the Council on Environmental Quality in the Executive Office of the President. This three member council, selected by the President, was tasked with providing an annual Environmental Quality Report to the President beginning with July 1, 1970. The report was to include a status of the various environmental classes; such as, air, land, the forests and the sea and any particular environmental trends that were identified in these areas. It also reported on programs and activities in Federal agencies that impacted the environment, any deficiencies that were noted and courses of action to remedy the deficiencies. Lastly, the council was responsible for advising the President on all environmentally related issues [Ref.1:p854].

In order to carry out this policy, appropriations of $300,000 for fiscal year 1970, $700,000 for fiscal year 1971 and $1,000,000 each year thereafter were established [Ref.1:p856].

C. ACT TO PREVENT POLLUTION FROM SHIPS

1. Purpose

This act, signed into law on October 21, 1980 (Public Law 96-478), implemented the MARPOL Protocol of 1978 relating to the International Convention for Prevention of Pollution from Ships. This treaty, which contained five annexes, was the first legitimate step in establishing regulations for shipboard discharges of various wastes, and enforcing those regulations.

2. Contents of the Law

The Act to Prevent Pollution from Ships is lengthy and delves heavily into setting regulations to significantly reduce, and in some cases eliminate, waste discharges from seagoing vessels. A couple of the more significant sections of the law deal with certification requirements and potential fines that could be levied on violators.

All MARPOL ships (ships from countries signing the MARPOL Protocol treaty) were required to obtain MARPOL certification from their home country stating that the vessel was properly equipped and able to meet the requirements of the law. If a vessel failed to present certification upon arrival in another MARPOL country's waters, the host country was authorized to detain and inspect the uncertified vessel. Additionally, if a vessel was found to violate the discharge requirements imposed by the law, fines of up to $50,000, or imprisonment of up to 5 years, or both could be levied [Ref.2:p2301].

The interesting aspect of this law is in its handling of United States Navy ships. Naval ships fell under an exemption which stated: "This Act does not apply to a warship, naval auxiliary or other ship owned or operated by the United States when engaged in noncommercial service" [Ref.2:p2298]. In view of this, the Congress added a clause which stated: The heads of federal departments and agencies shall prescribe standards applicable to ships excluded to have those ships comply with the MARPOL Protocol in circumstances where it will not impair operations or operational capabilities [Ref.2:p2298].

With the law being little more than an encouragement for the Navy to improve their discharge practices, ships basically maintained their usual way of doing business; no real enforcement was placed on them. However, this law was a sign that stiffer regulations would surely follow for warfighting ships and that environmental issues had now begun to make their way to the top of Congressional agendas.

3. 1987 Ammendment

On December 29, 1987, an additional step was taken to tighten envrionmental regulations in the United States. The Act to Prevent Pollution from Ships was ammended under Public Law 100-220. Specifically, Annexes I and II as they applied to navigable U.S. waters were expanded to include all ships, regardless of whether they were from a MARPOL complying country. Additionally, it allowed rewards to people providing information identifying violators of the law. These people would be entitled to a reward of up to one half of the fine imposed on the violator. One of the most significant requirements of the ammendment was that U.S. Navy ships were to fully comply with MARPOL Annex V. This annex totally banned plastics discharge in all waters and all solid waste discharges in the "Special Areas" designated in the MARPOL Protocol, within 5 years of the passing of the ammendment. The only exception after that time would be during a war or national emergency. Three years after the effective date of the ammendment, the heads of federal agencies were to make formal reports to Congress concerning their abilities to meet the

January 1, 1993, deadline. If the deadline could not be met, the reports were to include: 1) the technical and operational impediments that hampered compliance and 2) alternative schedules for compliance or 3) reasons why compliance would not be technologically feasible [Ref.3:p1461].

Again additional appropriations were established to fulfill this law for fiscal years 1988, 1989 and 1990 at a level of $3,000,000 each year [Ref.3:p1469].

4. 1994 Ammendment

As the 1993 deadline for Navy compliance approached, it was obvious that naval vessels were still deficient in meeting the objectives of the law. Realizing this fact, Congress once again ammended the Act with the Department of Defense Authorization Act. This ammendment recognized the significant need for added attention to research and technology to provide solutions for the difficult disposal problems faced by Navy ships, without impairing their abilities to fulfill missions that required extended periods of ocean transit. It looked at current discharge practices and determined what areas could immediately be improved without costly upgrades to ships and imposed regulations in these areas. It took into account current technology and potential for advances over the next several years and created a timeline for future compliance requirements. The regulations of this ammendment as they currently relate to U.S. Navy ships are deliniated in **Exhibit 1**.

DISCHARGE REGULATION FOR U.S. NAVY SHIPS (Effective until 31 December, 1998)		
Area	Hazardous Materials	Garbage (Non-Plastics)
U.S. internal waters/seas (0-3 nm)	No discharge	No discharge
U.S. contiguous zone (3-12 nm)	No discharge	Pulped or comminuted garbage only
12-25 nm	No discharge	Pulped or comminuted garbage only
> 25 nm	No discharge	Direct discharge permitted
> 50 nm & high seas	No discharge	Direct discharge permitted
MARPOL "special areas"	No discharge	Discharge food waste > 12 nm. When necessary, discharge all other garbage > 25 nm. Report all non-food discharges to CNO (N45) after operations
Foreign countries	No discharge	Discharge food wast > 12 nm from foreign coasts. Discharge all other garbage >25 nm.
Comments	None	Garbage discharged should be processed to eliminate floating marine debris.

Exhibit 1

DISCHARGE REGULATIONS FOR U.S. NAVY SHIPS (Continued) (Effective until 31 December, 1998)		
Area	Garbage (Plastics) (Non-Food Contaminated)	Garbage (Plastics) (Food-Contaminated)
U.S. internal waters/seas (0-3 nm)	No discharge	No discharge
U.S. contiguous zone (3-25 nm)	No discharge	No discharge
> 25 nm	No discharge	No discharge
> 50 nm & high seas	Retain last 20 days before return to port.	Retain last 3 days before return to port.
MARPOL "special areas"	Retain last 20 days before return to port. Discharge if necessary > 50 nm. Report all discharges to CNO (N45) after operations	Retain last 3 days before return to port. Discharge if necessary > 50 nm. Report all discharges to CNO (N45) after operations
Foreign countries	No discharge	No discharge
Comments	Record-keeping requirements exist for at-sea discharge. When plastics processor installed: No discharge	Record-keeping requirements exist for at-sea discharge. When plastics processor installed: No discharge

[Ref 4:p.1]

Exhibit 1 (continued)

There are four additional categories of wastes that are specifically designated for discharge restrictions in the OPNAVINST 5090.1B. They are: sewage, graywater, oily waste and medical wastes. Each of these categories are similarly controlled. The main point being that the Navy is significantly restricted in what they are able to dispose of at sea, with ultimate "zero-discharge" being the law in the near future.

D. CURRENT NAVY POLICY

The Secretary of the Navy's top three priorities are:

1) Ensuring the readiness of our operating forces

2) Protecting and improving the quality of life of our people, and

3) The modernization of our forces.

Pollution prevention is forever tied to all three [Ref.5:p2].

As stated by Robert B. Pirie, Jr., Assistant Secretary of the Navy (Installations and Environment) before the Senate Appropriations Subcommittee for Defense on July 11, 1995:

> We believe that our environmental program is an integral part of our central deterrence and war fighting mission, that it satisfies our legal obligations, and that it sustains our civic role to protect the Nation's future health and welfare.
>
> We recognize that restraints on our access to the oceans of the world or to shore based training areas due to a breach of environmental standards would have a profound, immediate, and serious impact on our military readiness. That is why we take the steps necessary to ensure that our operations on land, at sea, or in the air comply with all applicable environmental laws and why we promote environmental objectives in tandem with naval operations. We have also found that our environmental investments in compliance and pollution prevention programs can actually increase readiness by improving our maintenance processes. They can also improve quality-of-life in the workplace by reducing the exposure of our civilian and military members to hazardous material [Ref.6:p1].

With the enactment of over 40 environmental laws since 1970 that directly impact private industry and the Department of the Navy, putting off compliance is simply not an option. Failure to comply with environmental statutes and regulations can result in fines, penalties, criminal and civil suits, administrative proceedings, court orders, and cease and desist orders against the Department of the Navy or some of our people [Ref.6:p2]. The laws are tightening to the point beyond just the Navy being held liable for environmental violations. Now its employees share the responsibility for compliance. The OPNAVINST 5090.1B explicitly states:

> Most environmental statutes impose criminal liability for willful or knowing violations. Some statutes impose criminal liability for negligent violations. Service members may also be subject to trial by court-martial or to nonjudicial punishment for violation of environmental laws and regulations. Violations may also be prosecuted in State or Federal courts [Ref.7:p1].

In short, environmental compliance is the law of the land and of the sea, and we must obey [Ref.6:p2].

E. NAVY'S INITIATIVES ENROUTE TO COMPLIANCE

Faced with the need to fully comply with Federal regulations and statutes, the Department of the Navy had to seek innovative methods for using resources and disposing of waste materials. The task was especially challenging for aircraft carriers and other naval ships which must function as self-sustaining communities in the ocean environment. How do you send a fully operational ship and crew of anywhere from a few hundred to a few thousand out to sea for 90 days or more straight, and fully comply with Federal regulations, especially when they generate as much or more waste materials than a small to medium sized industrial plant? The following paragraphs present some of the initiatives the Navy designed, with the aid of numerous commercial vendors, to achieve compliance by process improvement of source selection of materials through final disposal.

1. Plastic Waste

Plastic waste has been a particularly prominent issue because of its popularity in packaging all kinds of materials and its non-biodegradable nature. This presents a particularly long-term environmental hazard to marine life. In response to this, and in order to meet the December, 1998 deadline for zero plastic disposal at sea, two programs in particular demonstrate great promise for solving the problem.

First of all, a plastic waste processor has been developed for use aboard naval ships. It was tested on a six month deployment on the aircraft carrier USS GEORGE WASHINGTON. The processor takes all kinds of plastic materials, including contaminated plastics, shreds and melts the plastic into compact, sanitized bricks that can be stored aboard the ship until port entry, where proper disposal or recycling takes place. In January, 1995, the Navy Acquisition Review Board approved Milestone III, and the plastic waste processor has now entered the production and deployment phase in order to meet the 1998 deadline [Ref.6:p7].

Secondly, the Plastics Reduction in the Marine Environment (PRIME) program was initiated as a result of the Pollution Prevention Act of 1990. This Act stated that:

> Pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner [Ref.8:p1388-321].

The key to this law was to prevent pollution at the source, which is the idea behind PRIME. Since its inception, PRIME has been the driving force for reviewing some 516,000 line items in the Navy stock system to reduce or eliminate plastic packaging and introduce consumable items that are fully biodegradable. The Navy estimates that this screening will eliminate 500,000 pounds of plastic from the supply system annually [Ref.6:p8].

2. Other Pollutants

Significant efforts have also been made to reduce other pollutants besides plastics. Some of the most impressive accomplishments have been achieved through creating alternative products for shipboard usage that are more environmentally "friendly," providing more pollution prevention guidance, requiring pollution prevention programs to be established at all Navy activities, and outfitting ships with more technologically advanced equipment for retaining wastes and reducing legal discharge.

First of all, the Navy has replaced such items as trichloroethane, methylene chloride and other solvents with more environmentally "friendly" substances. Additionally, they have suspended the use of lead and chromium-containing paints and are in the process of converting shipboard refrigeration and air-conditioning plants from using the ozone depleting gas CFC-12 to a much safer HFC-134a. In fact, the Shipboard Conversion Program is to be completed by 2001 when all CFC-12 plants will either be converted or retired. There are still many challenges in the area of ozone depleting substances, particularly in weapon systems; such as, jamming pods, radars, engines and aircraft fuel tanks; but the Environmental Protection Agency in cooperation with private chemical manufacturers are working diligently to find new alternatives.

Secondly, the Navy has developed a Pollution Prevention Planning Guide as a comprehensive reference to aid commands in establishing viable pollution prevention programs. As a result, all commands were required to develop an installation specific pollution prevention plan by December 31, 1995. Also, the Navy's Consolidated Hazardous Material Reutilization and Inventory Management Program (CHRIMP) has put structure into hazardous materials management by centralizing life cycle control and management of all hazardous materials and hazardous wastes under well-trained and knowledgeable individuals.

Lastly, normal ship operations produce several unavoidable pollutants; such as, blackwater (sewage), greywater (wastewater from galley sinks and showers) and bilge water. To combat the problems posed by these pollutants, approximately 88 percent of Navy ships have been outfitted with oil/water separators to treat bilge water to international standards and about 65 percent have oil content monitors to ensure bilge water discharges meet standards. All Navy ships have Collection, Holding and Transfer (CHT) systems which allow them to transit coastal waters legally without discharging sewage, and most have CHT systems that offer holding capabilities inport [Ref.6:p9-11].

F. SUMMARY

There has been a realization in recent years that a concerted effort must be made to preserve the environment in a state that provides for the health and welfare of future generations. Taking the lead, the United States government established policies and many laws over the last few decades, such as NEPA and the Act to Prevent Pollution from Ships, to cope with the ever-increasing problem of pollution. Consequently, the U.S. Navy has seen significantly tighter controls placed on their ability to dispose of wastes at sea, and further restrictions are on the near horizon. To comply with current legislation and enable their ships to meet future laws, the Navy has actively pursued research and development programs to reduce harmful pollutants. The efforts have focused on source reduction, pollution prevention guidance and outfitting ships with more technologically advanced equipment for retaining some wastes and treating others for legal discharge.

III. FINANCIAL REASONS FOR IMPROVING THE HAZARDOUS MATERIALS MANAGEMENT AFLOAT PROCESS

Federal funding is another significant area that must be discussed to determine more clearly just where hazardous materials management programs fit in the larger scheme and what support they might expect to receive in the future. Pollution prevention and hazardous materials management are expensive propositions that have enjoyed recent public and Congressional attention as well as increased funding support. Despite recent successes, continued support in the future is very uncertain due the cyclical nature of the budget climate.

A. FEDERAL FUNDING HISTORY

To determine the financial climate the Department of Defense finds itself in today, it is helpful to examine the history of the Federal budget and some of the more powerful forces influencing DoD appropriations.

1. Federal Spending History

First of all, the size of the United States Federal budget has grown remarkably since its inception. In the early 1800's, the government spent a mere $11 million per year, but by 1900 this figure climbed to $521 million. By 1944, Federal spending amounted to $91 billion and today the figure is $1.6 trillion. Another way to look at this spending growth is in reference to the American economy by comparing it to Gross Domestic Product (GDP).

GDP is the total value of U.S. goods and services computed on an annual basis. In the early 1930's, Federal spending was 5 percent of GDP, but it doubled in the 1930's and continued its upward march to the 20 to 25 percent range that it has maintained over the past couple of decades [Ref.9:p3].

What are the reasons for this Federal spending explosion? The real exponential expansion has its roots back in the 1930's when President Franklin D. Roosevelt took action to "dig" America out of the Great Depression. Up until this point, the Federal Government ran on a relatively meager budget which was used simply to pay Federal employees, maintain a military and fund a few other governmentally sponsored activities. The main thrust of President Roosevelt's "New Deal" was to greatly expand federally sponsored programs. Consequently, the federal budget doubled from $4 billion in 1931 to over $8 billion in 1936 [Ref.9:p3].

Although the "New Deal" was generally accepted as a positive program in American history, it also established a precedence for expanded governmental spending to solve national problems. It began with the creation of the Social Security program to provide a more stable financial future for citizens as they departed the workforce; it progressed to the building of the nation's comprehensive interstate highway system and educational benefits for those returning from World War II; and eventually provided income assistance for poverty stricken Americans and health care for the ederly and poor by initiating the Welfare and Medicare/Medicaid programs, respectively. While these constitute the most significant federally funded programs, governmental infusion of resources to solve national and international problems continues in agricultural subsidies, natural resources and parks, environmental issues, transportation systems, education, civilian safety and international aid [Ref.10:p3].

2. Discretionary vs. Mandatory Spending

At this point, it is necessary to distinguish between the two prevalent spending terms used in the government. First of all, there is "discretionary spending," which is that portion of the budget that is left to Congresses' discretion to apportion in the best interests of the nation. This portion of the budget is composed of domestic, international affairs and defense spending; it currently accounts for approximately 35 percent of total Federal spending. The second term is "mandatory spending," which covers all programs that the government is obligated to fund each year unless the specific laws governing these programs are changed by Congress. Mandatory spending applies to net interest on the national debt, Medicare, Medicaid, Social Security and a broad spectrum of other much smaller programs. These programs account for the other 65 percent of governmental spending.

It is important to make this distinction, because although federal spending as a whole has increased significantly, the discretionary and mandatory "pots" have not maintained their relative proportions over the years. Also, the individual programs that make up each of these portions have seen disproportionate changes. In 1962, which is the first year reliable data became available, discretionary spending constituted 70 percent of the total budget as compared to 35 percent today. The defense portion of this pot has seen similar decreases. In 1962, defense spending accounted for nearly 50 percent of all government spending, but dropped-off sharply after the Vietnam War and continued to decline to the current figure of 18 percent of Federal spending. On the other hand, overall mandatory spending has risen exponentially over the past several decades. The following programs established in the 1930's and 1960's have experienced phenominal growth since inception and will continue to grow without legislative reform: Social Security (currently 22 percent of total Federal spending), Medicare (10 percent), Medicaid (6 percent), Aid to Families with Dependent Children (AFDC) (1 percent) and net interest payments on the national debt which has better than doubled since the mid-1960's (15 percent) [Ref.9:p7].

3. Consequence of Federal Funding Expansion

The expansion of federal funding of numerous entitlement programs, large war expenditures, economic recessions that could not be planned for, and inadequate tax revenue to keep pace with expenditures, have all contributed to the inevitable consequence of a large national debt. Simply put, the government has spent more than it has received in revenues. In fact, only nine times since 1930 has the United States government experienced surpluses in revenues, and deficits have been the norm since 1969 [Ref.11:p2]. The net result has been the accumulation of what is now a $4.8 trillion national debt; this debt demands 15 percent of total government spending in interest payments. If the national debt grows more quickly than GDP, interest payments will account for an increasing share of GDP and may one day be the single largest portion of the Federal budget.

B. RECENT LEGISLATION EFFECTING THE FEDERAL BUDGET

With increasing public pressure over the years to have the government fund more programs and increase the support for currently operating ones, while maintaining the freedom of the country and taking aggressive actions to reduce the national debt, something had to change. Obviously the government does not have enough money to solve all of the country's problems nor could it continue to build an insurmountable debt which required an increasing share of U.S. dollars for interest payments. Thus, Congress enacted several laws over the past two decades to deal with the situation.

1. The Congressional Budget and Impoundment Control Act of 1974

The Congressional Budget and Impoundment Control Act of 1974 (Public Law 93-344) established a framework for the Congressional budget process by requiring a Concurrent Budget Resolution to be passed prior to legislative consideration of spending or revenue bills. This provided a means for consolidating all of the issues that would play a role in the legislative decisions affecting appropriations. Additionally, it established budget committees and created the Congressional Budget Office (CBO). The CBO provides specific data and economic assumptions to assist Congress in making budget decisions [Ref.12:p.3].

2. The Balanced Budget and Emergency Deficit Control Act of 1985

The Balanced Budget and Emergency Deficit Control Act of 1985 (Public Law 99-177), better known as the Gramm-Rudman-Hollings (GRH) Act, was specifically aimed at addressing the growing national debt. This law established procedures for reducing the budget deficit on an annual basis with an ultimate goal of achieving a "zero" deficit by 1991. It primarily targeted budget authority and outlays to realize this goal, and established a sequestration process to reduce outlays if the President's budget did not meet the deficit target for a specific fiscal year. This Act was ammended in 1987 with GRH II (Public Law 100-119) which reestablished the zero deficit goal for 1993 [Ref.13:p.C-2].

3. The Budget Enforcement Act of 1990

The Budget Enforcement Act of 1990 (BEA), (Public Law 101-508) revised GRH I and II. It did not target deficits, but rather limited government spending. Specifically, it set budget authority and outlay ceilings on three categories of discretionary spending: defense, domestic and international, for fiscal years 1991 through 1993, and a total discretionary ceiling for all three, for fiscal years 1994 and 1995. The total discretionary ceilings were later extended by the Budget Reconciliation Act (BRA) of 1993 to include fiscal years 1996 through 1998. **Exhibit 2**.

BEA AND BRA CEILINGS (figures in billions of dollars)								
Fiscal Year	1991	1992	1993	1994	1995	1996	1997	1998
Defense								
Budget Authority	288.9	291.6	291.8					
Outlays	297.7	295.7	292.7					
Domestic								
Budget Authority	182.7	191.3	198.3					
Outlays	198.1	210.1	221.7					
International								
Budget Authority	20.1	20.5	21.4					
Outlays	18.6	19.1	19.6					
Total Discretionary								
Budget Authority				509.2	517.4	519.1	528.1	530.6
Outlays				537.3	539.0	547.3	547.4	547.9

[Ref.13:p.C-3]

Note: Beginning in fiscal year 1994, Congress could tap the defense budget to increase the domestic and international portions of the discretionary budget.

Exhibit 2

The BEA also established a mini-sequestration process to meet spending objectives vice the one-time sequestration utilized by GRH I and II. The specifics of this mini-sequestration process are as follows:

1) Discretionary mini-sequesters if any of the three discretionary categories exceeded their spending ceiling.

2) "Pay-as-you-go" sequesters for mandatory spending categories, which meant an increase in a mandatory program must be offset by reductions in other mandatory programs or a provision for increasing revenue.

3) General sequester if maximum deficit targets were not met. A critical aspect

of this being that if targets were not met, the sequester could make up the difference by taking 50 percent of the difference from the defense budget and the other 50 percent from domestic and international programs [Ref.13:p.C-3].

C. CURRENT FUNDING CLIMATE FOR THE DEPARTMENT OF DEFENSE

1. Forces Effecting the Defense Budget

Several events in recent years have put the "spotlight" on the Department of Defense budget. First of all, the post Cold War period has significantly changed attitudes towards the U.S. military. The military expansion period witnessed in the 1980's under the Reagan and Bush administrations has completely reversed with no identifiable foreign threat, like the Soviet Union, challenging the United States' superiority. This change in attitude has contributed significantly to base closures, decommissioning of U.S. Navy ships, reduction of Department of Defense personnel and a declining defense budget.

Secondly, issues of fraud, waste and abuse have surfaced in recent years to raise public's attention to defense spending issues. This has been particularly evident in defense acquisition programs. For example, the Navy's A-12 Avenger II aircraft, the Army's Sergeant York division air defense (DIVAD) gun, and the Air Force's T-46 next generation trainer (NGT) aircraft were all cancelled due to schedule delays and cost overruns. In addition, the military was billed several hundred dollars for wrenches, toilet seats and ash trays by civilian contractors. The culmination of these events has led the public to spur Congress to increase their oversight of defense spending.

Thirdly, backed by public interest in increased defense oversight and Article I, Section 8 of the Constitution which bestows on the Congress the "power of the purse," the Congress has indeed tightened their hold on the budget process [Ref.14:p.34]. Assistant Secretary of the Navy for Financial Management during the Reagan administration, Robert H. Conn, characterized the current congressional control of the defense budget as follows:

> (The Congress) has total and occasionally unconscionable control over every dollar we spend in the Navy, or for that matter, in any department of the federal government....(The Congress) has attained a near-perfect state of anarchy....There is a complete absence of discipline on the Hill....This contortion of the term "congressional oversight" has gone far enough. Unfortunately, the congressional appetite shows no sign of abating....(Congress tends to) also worry about--or tinker with--the Defense Department's requests to buy forklifts, tractor-trailers, bomb fuses and practice bombs....The problem is so severe and the degree of detail has become so oppressive that no one senator and no one representative can possibly know what is in each of the unwieldy pieces of legislation that he is called upon to approve or disapprove [Ref.14:p.41].

An additional reason Congress has shown increasing attention towards the defense budget is that it represents the largest portion of the discretionary spending pot. This makes it a tremendous target for satisfying constituent interests. By ensuring the passage of appropriations to support certain major defense acquisition programs that benefit a home state, or attempting to acquire funds from the defense budget to fund other interest group programs or mandatory programs, a Congressman can bolster constituent support for re-election.

2. Defense Funding in the Near Future

The various forces affecting the Federal budget, and particularly the defense portion, logically lead one to expect declining budgets for the Department of Defense in the coming years. This is even more evident when a history of discretionary outlays is studied. Most notably, discretionary spending as a percentage of the GDP was 13.4 percent in fiscal year 1963. This percentage peaked in 1968 at 14.4 percent, but has declined steadily through today. In fact, the figure for fiscal year 1995 was 7.7 percent and is expected to be 7.4 percent in 1996. If current discretionary caps remain in place, the percentage will drop to 6.5 by fiscal year 2000 [Ref.15:p.1].

Another way to view the defense budget climate is to view authorization figures for the coming years. Since the military build-up in response to the Soviet Union threat in the 1980's, at which time defense authorizations peaked at $302.5 billion in fiscal year 1986, defense budget authority has been on a steady decline. **Exhibit 3** shows expected budget authority figures through fiscal year 2002.

PREDICTED DEFENSE BUDGET AUTHORITY (figures in billions of constant year dollars)								
Fiscal Year	1995	1996	1997	1998	1999	2000	2001	2002
Defense Budget Authority	270	264	266	265	268	272	271	271

[Ref.16:p4]

Exhibit 3

Although these figures show funding growth heading into fiscal year 2000, this is not real growth when compared to GDP. It still shows a significant real decline.

D. SUMMARY

The United States has seen an almost exponential increase in government spending over the past several decades. In recent years, this spending has been predominantly in the mandatory portion of the budget to finance federally sponsored programs. At the same time, the defense budget has declined since its peak in the mid-1980's when the Soviet Union was the major foe. The problem is compounded by the fact that the United States government has accumulated a sizeable debt which is accruing enormous interest obligations. The forecast for the future is much the same, barring any legislative changes for mandatory programs. Therefore, the Department of Defense is certainly going to be faced with the ever-increasing challenge of "how to do more with less resources."

IV. METHODOLOGY AND DATA PRESENTATION

The preceding chapters presented the facts regarding environmental and funding issues that have developed over the years, and predict the likelihood for further "belt-tightening" in the future. With governmental spending increasing steadily over the years and the national debt on its way to $5 trillion, Congress will be forced to make difficult decisions to "cut corners" on spending. This is clearly evident in the inability of the government to reach an agreement for the 1996 budget, being already four months into the new fiscal year. One area that has provided a partial answer for lawmakers is cutting the defense budget. Robert Pirie states:

> Since 1991, our overall budget has been cut nearly one-fourth; we have decommissioned almost one-third of our ships; we are implementing three rounds of base closure and realignments; and the Secretary of the Defense has just announced recommendations for round four. Our environmental program, however, has more than doubled during this same period [Ref.6:p2].

It is obvious that in today's budget climate this trend of increased environmental spending at the expense of other defense programs cannot continue indefinitely, especially with the defense budget spiraling downward. Therefore, it is imperative that the Navy seek avenues to improve hazardous materials management practices with the current funding and technology base. By identifying better ways to manage hazardous materials and the resulting wastestreams, environmental preservation and significant cost avoidance can be realized today.

The focus of this chapter, and the next, will be to identify areas where immediate cost avoidance may be achieved by utilizing existing technology and improving the overall hazardous materials management afloat process. The first section identifies the largest contributors to hazardous material wastestream disposal costs. From this information, two sources, constituting over one third of the total disposal costs, are identified for further analysis; oil saturated and paint/solvent saturated rags. Actual "cradle-to-grave" costs for baled rags are then calculated for comparison to an alternative program that is discussed in Chapter V.

The second section provides a historical perspective on the evolution of today's HMCs aboard ships. The transition from the Navy's traditional method of decentralized hazardous materials management to the current centralized HMC concept was accomplished using the CHRIMP philosophy. CHRIMP relies on a fully trained core of personnel to properly manage hazardous material inventories and administer the HMC functions. However, deficiencies are noted in HMC management practices that are attributable to a general lack of formal training. Calculations are performed to determine the total number of personnel who received training in 1995 and the estimated costs to provide the training. This information will be used in Chapter V as alternatives are sought to improve HMC management expertise.

A. WASTESTREAM GENERATION

Sometimes it is beneficial to begin research at the end of the life-cycle of the system or process being researched. This seemed a logical choice in the case of hazardous materials since the generated wastes pose a tremendous environmental concern. Consequently, their disposal tends to be extremely costly. The hypothesis is that by identifying the major wastestreams generated by U.S. Navy ships, one can trace back through the hazardous materials process (from disposal to ordering) to determine where costs can be avoided and to possibly reduce the overall wastestream.

1. Background

Before actual wastestream data is presented, it is helpful to understand the past disposal practices of U.S. Navy ships. In the years leading up to the 1990's, ships enjoyed great autonomy in determining how they disposed of generated wastes. As seen in Chapter II, there was no legislation that restricted at sea dumping. Therefore, the incentive was for ships to dispose of hazardous wastes in the easiest and most cost effective manner. Disposal at a shore station required appropriately bagging and labeling hazardous materials, and potentially testing some items to determine their exact chemical composition. The ship incurred the cost for these actions, so the simplest method was to dump at sea. Wastes were accumulated in various spaces on the ship during inport periods and dumped during underway operations. U.S. Navy ships were driven by operational priorities with no real incentive for preserving the environment.

Recently, the Navy's incentives have changed. The disposal restrictions outlined in Chapter II and the promise of further tightening of those laws, have introduced negative consequences for breeches of the statutes. Naval stations have also improved the disposal processes at the pier by providing a daily hazardous waste pick-up service, which is more responsive to ships' dynamic schedules. This incentive shift has provided the initial groundwork for a change in the Navy's philosophy regarding the environment and its responsibility to preserve it. Now, the Navy must utilize existing technology to its fullest extent to meet current regulations and reduce avoidable costs associated with hazardous materials. For the longer-term, the Navy needs to develop technology that equips ships to meet the future standards.

2. Methodology

Several approaches were employed to research wastestream data and to ultimately identify specific items for potential cost avoidance analysis. First of all, hazardous material management personnel aboard Navy ships were interviewed to determine where to obtain wastestream data for U.S. Navy ships homeported at the San Diego Naval Station. It was determined that hazardous waste for all Navy ships is collected on a daily basis by the Naval Station Public Works Center (PWC) Hazardous Materials Collection Unit. Further interviews with Naval Station Environmental personnel indicated that PWC began producing monthly reports of hazardous waste generation and resulting disposal costs, by ship, in late 1994. These reports are now generated on a regular basis and sent to Naval Station Environmental for informational purposes. Since 1995 was the first complete year of reliable data, the cosolidated report for January to December, 1995 was obtained from Naval Station Environmental as an initial point for this research. The information provided by this data will be analyzed to identify the major cost producers in the wastestream and potential areas to target for cost avoidance. This data will later be used in Chapter V to determine actual cost avoidance figures achieveable through an alternative program.

3. Assumptions

There are various assumptions that must be made when utilizing the PWC wastestream data. First of all, PWC personnel who pick up hazardous waste materials rely on shipboard personnel to properly label the materials that are bagged for disposal. PWC disposal personnel are trained and knowledgeable in hazardous material identification and are required to verify the materials at pick-up; however, the opportunity, although quite small, exists for misidentification. Secondly, hazardous materials picked-up are weighed-in each day which improves data reliability. But the people that weigh the materials sometimes use different classification names for the same waste materials. Thus, the monthly reports may contain more classifications than actual types of wastes disposed. However, this problem is resolved by combining like categories; such as, "debris paint" and "paint" to form one wastestream for calculation purposes.

Finally, the scope of the study is confined to U.S. Navy Dock Landing Ships (LSDs). Specifically, all data collected will be for the seven LSDs that were based in San Diego, California during 1995. In using wastestream data for a specific ship type, in a specific geographical region, two further assumptions will be made: 1) U.S. Navy ships have similar cyclical lives and, 2) Models created for one type of Navy ship can be used to make similar calculations for other types of ships in other geographical locations. Both assumptions rely on the fact that each U.S. Navy ship follows the same general life cycle pattern, which generally consists of an overhaul/maintenance period, followed by "workups" and inspections, and culminates in a fully operational cycle. Additionally, ages of ships vary from newly commissioned to some with nearly thirty years of service. Since the data collected for this research is from seven LSDs, of different ages, in different stages of their life-cycles, applicability of the models and figures obtained to other U.S. Navy ships should be quite reliable and produce similar results.

4. Data

The data presented here represents consolidated annual figures for the major disposal cost producers of Amphibious Dock Landing Ships (LSDs) that were homeported in San Diego during 1995, as calculated from the PWC annual wastestream report. **Exhibit 4**.

ANNUAL WASTESTREAMS FOR SAN DIEGO BASED LSD'S AND ASSOCIATED DISPOSAL COSTS INCURRED BY PWC (Calendar year 1995)					
	Oil Rags	Paint/Solvent Rags	Debris Oil	Debris Paint	OBA's
Anchorage (LSD-36)	3,303 lbs $5,594	85 lbs $221	10,305 lbs $8,583	1,121 lbs $2,883	1,618 lbs $4,207
Comstock (LSD-45)	10,394 lbs $27,024	674 lbs $1,752	2,430 lbs $6,203	6,577 lbs $16,974	214 lbs $556
Fort Fisher (LSD-40)	2,577 lbs $4,688	1,074 lbs $2,352	7,231 lbs $8,068	2,656 lbs $6,906	89 lbs $229
Fort McHenry (LSD-43)	4,575 lbs $11,841	444 lbs $1,154	1,797 lbs $2,920	5,811 lbs $14,825	477 lbs $1,202
Harper's Ferry (LSD-49)	7,209 lbs $16,870	1,197 lbs $2,218	1,290 lbs $2,751	271 lbs $705	590 lbs $1,409
Mt. Vernon (LSD-39)	4,116 lbs $10,395	347 lbs $902	3,427 lbs $7,877	3,506 lbs $9,116	165 lbs $429
Rushmore (LSD-47)	11,552 lbs $19,825	1,491 lbs $3,062	740 lbs $1,277	6,093 lbs $13,294	403 lbs $1,048
Totals	43,726 lbs $96,237	5,312 lbs $11,661	27,220 lbs $37,679	26,035 lbs $64,703	3,556 lbs $9,080
Average per ship	6,247 lbs $13,748	759 lbs $1,666	3,889 lbs $5,383	3,719 lbs $9,243	508 lbs $1,297
Percentage of total '95 LSD wastestream Totals: 153,778 lbs $304,935	.284 .316	.034 .038	.177 .124	.169 .212	.023 .030
Average disposal cost per pound	$2.200	$2.195	$1.384	$2.485	$2.553

Exhibit 4

One may note that wastestreams of individual ships vary, in some cases significantly. This is due to the fact that ships are in different stages of their life-cycles, as mentioned earlier, and are therefore likely to generate wastes in differing volumes. This strengthens the data by allowing the computation of good cross-sectional annual averages which smooth ship specific fluctuations.

The above data readily shows the major disposal cost producers are oil saturated rags, paint and solvent saturated rags, debris oil and paint, and oxygen breathing apparatus (OBA) cannisters. These five catagories alone account for nearly seventy percent of the total annual wastestream for LSDs and seventy-two percent of the disposal costs. However, the oil saturated and paint/solvent saturated rag categories are specifically chosen for purposes of this study for the following reasons:

1) Oil saturated and paint/solvent saturated rags constitute one third of the total wastestream costs.

2) This study focuses on areas where cost avoidance can be achieved immediately without further technological advancements. There is no current cost effective technology available to recycle raw debris oil and paint wastes for reuse. Therefore, disposal is the only viable option. On the other hand, technology is being developed to eliminate the OBA wastestream. The new breathing apparatus in development will utilize rechargeable oxygen bottles instead of the chemical cannisters. This new technology is due in the fleet in the next couple of years.

With oil and paint/solvent saturated rags targeted for further study, the following subsections provide data for those components.

a. *Oil Saturated Rags*

Wiping rags are invaluable aboard ships and used by nearly every person onboard at one time or another. Engineers use them in the engine room and in the various machinery spaces throughout the ship in performing daily maintenance and to clean-up any spills that may occur. Deck department personnel use rags during their normal everyday tasks of maintaining and preserving mainly the exterior portions of the ship through painting and various preservation projects. Other personnel aboard ships use wiping rags in performing preventative maintenance (PMS) on equipment applicable to their individual operations and other daily tasks requiring the material for primarily clean-up purposes.

With this in mind, it is not difficult to see why oil saturated rags are the largest single contributor to the U.S. Navy ship wastestream and total disposal costs. Comprising twenty-eight percent of the total wastestream and thirty-one percent of the disposal costs, this category lends itself to further research.

(1) Methodology. To accumulate data about the rags used by Navy ships, interviews were conducted with shipboard storekeepers. These interviews revealed that the wiping rags were acquired by individual divisions, on an as needed basis, by taking a requisition document to the Naval Station SERVMART. The SERVMART is a facility operated by the Fleet Industrial Supply Center (FISC) that maintains an inventory of high-demand items for immediate issue to ships and other military installations in the area. FISC records show that the unit of issue for wiping rags is a 50 pound bale at a 1995 cost of

$20.43 per bale (Navy Stock Number: 7920-00-205-1711). These rags are currently acquired for the Navy through a General Services Administration (GSA) contract. Using this information and the wastestream data presented in **Exhibit 4**, a cost model can be created.

(2) Assumptions. Before data is combined, some assumptions must be laid as groundwork for the cost model. First of all, the average weight for an oil saturated bale of rags must be determined to appropriately compare the saturated rag disposal figures presented in **Exhibit 4**. Tests were performed by saturating a half bale of rags to determine the weight increase per bale. The weight increases due to saturation varied between fifty and seventy-five percent, depending primarily on two factors: 1) how fully each rag was saturated; 2) the various material make-ups of the wiping rags. The latter factor is particularly significant because the baled rags sold through the Navy Stock System contain a wide variety of materials (from silk to denim) of various shapes and sizes. To compensate for the discrepencies, the standard issue size of a fifty pound bale was used as the base measurement, and a range of percent weight gains per bale (50 percent, 62.5 percent and 75 percent) were calculated to provide a potential cost window for analysis.

(3) Data. **Exhibit 5** summarizes the absorbency assumptions for saturated baled rags and applies them to the **Exhibit 4** wastestream data for oil saturated rags. A dry or unsaturated bale cost is then obtained and combined with the purchase price of stock system baled rags to achieve a total life cycle cost for baled rags.

BALED RAG STATISTICS (OIL)	
Type (A). Weight of bale saturated to 75% (1.75 x 50 lbs / bale)	87.5 lbs
Type (B). Weight of bale saturated to 62.5% (1.625 x 50 lbs / bale)	81.25 lbs
Type (C). Weight of bale saturated to 50% (1.50 x 50 lbs / bale)	75 lbs
Number of unsaturated bales used to produce total LSD wastestream using type (A) bales: (43,726 lbs oil saturated rags / 87.5 lbs)	500 bales
Number of unsaturated bales used to produce total LSD wastestream using type (B) bales: (43,726 lbs oil saturated rags / 81.25 lbs)	538 bales
Number of unsaturated bales used to produce total LSD wastestream using type (C)bales: (43,726 lbs oil saturated rags / 75 lbs)	583 bales
Disposal cost per unsaturated bale using type (A): ($96,237 / 500 bales)	$192.47
Disposal cost per unsaturated bale using type (B): ($96,237 / 538 bales)	$178.88
Disposal cost per unsaturated bale using type (C): ($96,237 / 583 bales)	$165.07
Purchase cost per bale	$20.43
Total purchase and disposal cost per bale using type (A): ($192.47 + $20.43)	$212.90
Total purchase and disposal cost per bale using type (B): ($178.88 + $20.43)	$199.31
Total purchase and disposal cost per bale using type (C): ($165.07 + $20.43)	$185.50

Exhibit 5

b. Paint/Solvent Saturated Rags

The other wastestream category with the rag material component is paint/solvent saturated rags. This category accounts for 3.4 percent of the total disposal pounds and 3.8 percent of the costs. Data analagous to that for oil saturated rags is presented in **Exhibit 6,** utilizing the same methodology and assuming the same absorbency statistics.

BALED RAG STATISTICS (PAINT/SOLVENT)	
Type (A). Weight of bale saturated to 75% (1.75 x 50 lbs / bale)	87.5 lbs
Type (B). Weight of bale saturated to 62.5% (1.625 x 50 lbs / bale)	81.25 lbs
Type (C). Weight of bale saturated to 50% (1.50 x 50 lbs / bale)	75 lbs
Number of unsaturated bales used to produce total LSD wastestream using type (A) bales: (5,312 lbs paint/solvent saturated rags / 87.5 lbs)	61 bales
Number of unsaturated bales used to produce total LSD wastestream using type (B) bales: (5,312 lbs paint/solvent saturated rags / 81.25 lbs)	65 bales
Number of unsaturated bales used to produce total LSD wastestream using type (C)bales: (5,312 lbs paint/solvent saturated rags / 75 lbs)	71 bales
Disposal cost per unsaturated bale using type (A): ($11,661 / 61 bales)	$191.16
Disposal cost per unsaturated bale using type (B): ($11,661 / 65 bales)	$179.40
Disposal cost per unsaturated bale using type (C): ($11,661 / 71 bales)	$164.24
Purchase cost per bale	$20.43
Total purchase and disposal cost per bale using type (A): ($191.16 + $20.43)	$211.59
Total purchase and disposal cost per bale using type (B): ($179.40 + $20.43)	$199.83
Total purchase and disposal cost per bale using type (C): ($164.24 + $20.43)	$184.67

Exhibit 6

B. HAZARDOUS MATERIALS MANAGEMENT

The second area of study focuses on the people and processes for managing hazardous materials aboard U.S. Navy ships.

1. Decentralized Hazardous Materials Management

Until 1994, hazardous materials aboard U.S. Navy ships were managed in a highly decentralized fashion. Each department, and often times each division, maintained their own day-to-day inventories of hazardous materials. These items included anything from insecticides held by the medical department, to lubrication oil and greases for engineering machinery, to paints and thinners held by the deck department for ship preservation. With each department responsible for ordering and storing their own hazardous materials, and for disposing of resulting hazardous wastes, many deficiencies in this method of management began to appear.

First of all, proper hazardous materials stowage, handling and usage are critical to maintaining a safe environment aboard ships. With the decentralized system this was not always maintained. In many instances, unqualified personnel were responsible for handling hazardous materials. Often times junior personnel maintained hazardous material storerooms without any knowledge of compatibilities between items and the potential dangers posed. This fact could be validated by briefly looking at most hazardous material storeooms on ships or INSURV/IG inspection reports, which frequently cited significant deficiencies in hazardous materials stowage and handling.

Secondly, although required by Navy regulations, hazardous material inventories were rarely maintained. If inventories were kept, they were little more than a slip of paper taped to a flammable liquids locker with line-outs for issues and plus-ups for newly received material. All in all, the system lacked any form of quality inventory control which is particularly crucial for potentially dangerous items.

Another factor, and certainly an outgrowth of insufficient inventory control, was that hazardous items were ordered in a largely random fashion. Generally, the person in charge of a hazardous materials storeroom asked the departmental supply petty officer to place an order after noticing that the inventory of a certain item was nearly or completely depleted. In other instances, hazardous material inventories were refilled using funds remaining at the end of the quarter.

In any case, improper hazardous materials inventory control introduced inefficiencies into the system. In an environment where safety is paramount to crew health and welfare, poor hazardous materials management places sailors at a significant risk. With budgets being "squeezed" at every level in the military, it is critical to manage resources in the most efficient and cost effective manner. The costs associated with decentralized hazardous materials management were significant.

With improper management, bad stowage practices were prevalent. Incompatible materials had a greater possibility of being stowed together. Mixing organic and inorganic acids or calcium hypocloride with oils or greases could produce catastrophic reactions including explosions, fires and noxious gases. In the confines of a ship, with its dense population of people, the potential impacts were significant. Another problem associated with bad stowage practices was that personnel could not quickly and easily find the material desired. There were many ships where people had to literally climb over stacks of cans and other materials to find the item desired in a paint locker or hazardous material storeroom. This wasted valuable time and unnecessarily exposed sailors to many potentially hazardous items. Lastly, improper stowage increased wear and tear on hazardous material containers, making labels unreadable and sometimes puncturing containers. This ultimately led to leakage and unidentifiable materials, which created an unsafe environment and introduced hefty clean-up and disposal costs.--Disposal costs for unidentifiable material run as much as four times normal disposal costs due to the requirement to perform tests to identify the material before proper disposal.

Secondly, poor materials handling by the issuers and users created additional safety hazards and increased associated costs. Often times people used hazardous materials without knowing their specific dangers and would therefore not take the precautions to wear appropriate protective clothing or properly ventilate a space where the material was used. Other times, when the user's the first choice was not easily located, they opted for what they considered substitutes to perform critical preventative maintenance on shipboard equipment and systems. In some cases, this led to premature equipment failure, or in the application of paints, premature flaking and peeling without any real benefit. The costs were readily evident: degraded equipment with costly repairs and lost man-hours in performing preventative maintenance or painting. A final cost resulting from poor handling was incorrect disposal. With numerous untrained individuals using hazardous materials, improper disposal was inevitable. Especially at the end of a workday, it was not uncommon to see hazardous material containers in pier dumpsters; at sea those containers were dumped over the side of the ship. These practices introduced the potential for severe violation charges, and, more importantly, negatively impacted the environment.

Thirdly, the lack of inventory control introduced two other costs:

1) Wasted man-hours and degraded equipment performance resulting from expired shelf-life materials being utilized for critical preventative maintenance jobs.

2) Excess purchase and disposal costs for full containers of material that expired before they were ever opened (Total cost = Purchase cost + Disposal cost, without any associated benefit).

With inadequate inventory records, the shelf-lives of materials could not be monitored and appropriately updated. Some materials could have had their lives legitimately extended according to shelf-life guidelines, but they were disposed of prematurely.

Lastly, and closely related to poor inventory control, was insufficient control over ordering. This led to the inefficient use of scarce operating target (OPTAR) dollars. By not having a legitimate inventory from which to order, and no demand or usage data, the ordering function was sporadic and extraordinarily inefficient. Not ordering the proper item, in the proper quantity, at the appropriate time, increased costs unnecessarily. Materials were stockpiled because some items, like common shipboard paints and engineering lubricants, were ordered almost every time a reorder was sent. This led to excess carrying costs for materials that sat on the shelves for years, in some instances the life of the ship.

2. Consolidation of Hazardous Materials Management

Clearly, the decentralized processes for managing hazardous materials introduced numerous inefficiencies and unsafe practices. There were incidents of improper disposal violations cited by the Environmental Protection Agency and exorbitant base clean-up costs during the Base Realignment and Closure Act (BRAC) process. There were recurring hazardous materials stowage and handling violations noted on INSURV and NAVOSH inspections and personnel injuries and shipboard fires related to hazardous materials. These all provided evidence that it was time for change.

Since the original aim was to clean-up and properly organize hazardous material inventories and thereby create a safer environment for afloat units, a new system would be required to focus on inventory control and the management responsibilities. The philosopy that evolved would remove responsibility for ordering, storing, issuing and disposing of hazardous wastes from the ultimate shipboard users. The responsibility would be placed with a small, thoroughly trained core of people. This would free users from the burden of managing hazardous materials and allow them to perform their shipboard duties. At the same time, it would improve hazardous materials management through centralized control.

The program that evolved was instituted on U.S. Navy ships beginning in late 1994. It is known as the Consolidated Hazardous Material Reutilization and Inventory Program (CHRIMP). The basis for the CHRIMP was established by Commander Ed Payne, the

Commanding Officer of the Naval Air Weapons Station (NAWS), Point Mugu. To comply with the Navy Hazardous Material Control and Management (HMC&M) program, and meet California's stringent environmental regulations, Commander Payne decided to consolidate all the hazardous materials on the base under a single organization called the Hazardous Minimization Center (HAZMINCEN). This center provided more intensive inventory tracking and control to properly manage these materials. The Navy, sold by the program, refined it, developed inventory control software, called Hazardous Inventory Control System (HICS), and directed all U.S. Navy ships to implement CHRIMP [Ref.17:p.1].

a. Methodology

To determine if CHRIMP is improving the effectiveness of HMC operations aboard LSDs, several interviews were conducted and three different ships were visited. This opinion and observational data helps determine how well the CHRIMP concept is being implemented and what areas may lend themselves to further improvement. The interviews indicated several commonalities among all of the LSDs.

1) Shipboard HMCs are supervised by a petty officer storekeeper.

2) Nearly all of the HMCs are operated by three people, including the supervisor. The only exception was the USS COMSTOCK, which recently returned from deployment. This ship had only one second class storekeeper running the operation during their post-deployment leave period. This number was to increase to two or three after the leave period when the ship became active again.

3) All of the ships man the HMCs on a rotational basis. Different departments on the ship send representatives for approximately six months.

4) Few of the personnel operating the HMCs had received any formal hazardous materials training, and none had been to both of the courses currently offered and designed for HMC personnel.

The latter two trends contradict the CHRIMP philosophy of managing hazardous materials using a well-trained core of personnel and intensified inventory control. Despite limited training, the observed HMCs performed well. They were certainly an improvement over the previous decentralized concept. However, most of the personnel operating the centers lacked specialized knowledge about hazardous item compatabilities, shelf-life programs, proper ordering and the various functions of the HICS program. All of these functions are crucial to safe, efficient and cost effective hazardous materials management and critical to CHRIMP's success. Therefore, research was performed to specifically focus on the management make-up and training.

b. HMC Training Costs

Two basic courses are currently offered through the Navy to prepare HMC personnel for their jobs on ships or at shore facilities. One is the Hazardous Materials Management course that covers all aspects of hazardous material handling, from ordering through disposal. It grants the graduating student a 9595 secondary Navy Enlisted Code (NEC). The other is the HICS/CHRIMP course, which provides thorough training on the HICS computer program and its interface with hazardous materials. Actual costs for these courses had not previously been computed, but an estimate can be established using the following conservative basic assumptions:

1) Course costs per person are based on instructor salarys and student salarys for lost worktime away from their command. No course material costs are included because they are nominal, and no travel or perdiem costs are included since they vary greatly depending on the locale of the student's parent command relative to the training location. The latter of these costs are significant, and will be mentioned later.

2) Two instructors currently teach the 9595 course (one lieutenant and one chief petty officer (E7) storekeeper). Since a person's time in paygrade effects their base pay, salaries are computed based on low to mid time in paygrade (6 years for the lieutenant and 12 years for the chief petty officer). The analysis assumes the instructor is single for determining the basic allowance for quarters (BAQ). This provides a significantly lower figure than the with dependent rates. The variable housing allowance (VHA) rate is for San Diego, where the training is conducted.

3) A student's salary is also based on the most conservative figures. The only prerequisite for the course is that the student be a second class petty officer (E5) or above. Therefore, calculations are performed for a low to mid time in service (5 years) E5 living aboard a ship. Using the low end of the student paygrade spectrum, will give low estimates for course costs.

c. Data

Since a well-trained core of personnel are the heart of the CHRIMP program it is helpful to establish estimates for the costs incurred in training personnel to fulfill their HMC duties. Annual figures are based on the average historical enrollment of thirty students per class for the 9595 course and twenty-four per class for HICS/CHRIMP. The costs for the 9595 Hazardous Materials Management course assume fourteen five day classes are given in San Diego. The HICS/CHRIMP course costs include twelve three day classes. These estimates are also based on historical data obtained from the course instructors. Finally, all salaries are based on 1995 figures. **Exhibit** 7.

INSTRUCTOR AND STUDENT SALARIES			
Instructors	Salary	Student	Salary
1 - Lieutenant	Base pay: $2,994.90	1 - E5	Base pay: $1,348.50
	BAQ: 492.00		BAQ/BAS: 0.00
	BAS: 146.16		VHA: 0.00
	VHA: 288.64		CSP: 315.00
	Monthly: $3,921.70		Monthly: $1,663.50
	$3,921.70/30 days= Daily: $ **130.72**		$1,663.50/30 days= Daily: $ **55.45**
1 - E7 Storekeeper	Base pay: $1,973.40		
	BAQ: 356.40		
	BAS: 236.10		
	VHA: 288.64		
	Monthly: $2,854.54		
	$2,854.54/30 days= Daily: $ **95.15**		

Exhibit 7

With the information in **Exhibit 7**, the cost to train one second class petty officer in the 9595 NEC and total annual training costs is calculated.

COST TO TRAIN ONE E5 FOR FIVE DAYS (9595 NEC):

[5days($130.72 + $95.15) / 30 students] + [5 days($55.45)] = $314.90

TOTAL ANNUAL TRAINING COST:

14 classes x 30 students x $314.90 = $132,258.00

Similar calculations are made for the HICS/CHRIMP course assuming that the course is instructed by a civilian contractor from the John J. McMullen Associates Company. The instructor is paid $15,000 for 120 days, divided between ship assist visits and course instruction. The daily rate is $125.00 ($15,000/120 days). The cost to train one second class petty officer in HICS/CHRIMP, and the total annual training costs are estimated below:

COST TO TRAIN ONE E5 FOR THREE DAYS (HICS/CHRIMP):

[3days($125.00) / 24 students] + [3 days($55.45)] = $181.98

TOTAL ANNUAL TRAINING COST:

12 classes x 24 students x $181.98 = $52,410.24

V. ANALYSIS OF DATA

The previous chapter identified the major categories contributing to the wastestream costs for U.S. Navy ships. Two related categories, oil saturated rags and paint/solvent saturated rags accounted for roughly one third of these wastestream costs. The wiping rags were thus identified as a significant driver in disposal costs and an area that could be researched for cost avoidance. Additonally, Chapter IV provided information on the development of shipboard HMCs and the costs associated with training personnel to operate them.

The first section of this chapter will discuss a current commercial industry program that shows great promise as an alternative to Navy Stock System rags and the second section will address HMC management structure and training issues.

A. THE "SHOP TOWEL" PROGRAM

Since wiping rags are required for numerous daily functions aboard U.S. Navy ships, especially for maintenance and general clean-up in engineering spaces, they cannot simply be eliminated. However, saturated rags are a large contributor to ship wastestreams. The ultimate "cradle to grave" price tag per bale of rags ranges from \$185.50 to \$212.90. Thus, alternatives were sought that may avoid some of the costs associated with rags. Since disposal costs are the largest component of the life cycle cost of rags, potential alternatives were sought in commercial industry to reduce the disposal portion of baled rag costs. One interesting program is the "shop towel" program.

1. Shop Towel Concept

The shop towel program began several years ago to assist various commercial businesses in meeting the progressively more stringent U.S. environmental protection laws. Two years ago, the San Diego FISC recognized this program and established a shop towel contract for oil saturated rags with a local vendor: Prudential Overall Supply. This contract provided an alternative to San Diego area ships and shore facilities and is the only contract of its kind currently available in the Navy.

The following is a brief description of the shop towel program:

1) A ship must obtain an annual contract with a commercial vendor offering the shop towel program.

2) The contract specifies the annual price per shop towel used, and pick-up and delivery information.

3) Once the contract is initiated, the vendor delivers a specified number of towels on a weekly basis to the ship.

4) Each week, as new towels are delivered to the ship, the used towels from the past week are picked-up by the vendor who washes the towels at their plant site.

This simplistic process continues throughout the contract year and eliminates the requirement for purchasing and disposing of Navy Stock System baled rags.

2. Shop Towel Costs

How does the cost for shop towels compare with current Navy practices of using baled rags? To answer this question, the following cost data (**Exhibit 8**) is compared with the cost data in **Exhibit 5** presented in Chapter IV:

SHOP TOWEL STATISTICS	
Absorbency comparison estimate: (100 shop towels = 1 bale of rags)	100 towels / bale
Cost per shop towel (FY 95 contract price)	$.035
Disposal cost for shop towel customer	$.000
Total cost for 100 shop towels: (100 towels x $.035)	$3.50

Exhibit 8

The absorbency comparison estimate is based on FISC Hazardous Materials Management surveys of U.S. Navy ships. The shop towels are a standard 18 inches x 18 inches and made of 100 percent cotton, which guarantees consistent absorbency in each towel. Because of their outstanding absorbency properties relative to baled rags, far fewer shop towels are required to perform the same tasks. Shipboard personnel verify that many of the rags in a standard bale, including silk and polyester rags, possess very low absorbency properties.

3. Potential Cost Avoidance

Compiling the purchase and disposal costs of baled rags and shop towels yields striking results. Depending on the absorbency measure used in total bale cost calculation, the shop towel program is between 53 and 61 times cheaper than rags. **Exhibit 9** displays the potential cost avoidance figures.

COST AVOIDANCE ESTIMATES FOR (OIL SATURATED) SHOP TOWELS VS. BALED RAGS				
	Baled Rag	Shop Towel	Cost Avoidance	Percent Avoidance
Shop Towel vs. Baled Rag Type (A)	$212.90	$3.50	$209.40	98.36%
Shop Towel vs. Baled Rag Type (B)	$199.31	$3.50	$195.81	98.24%
Shop Towel vs. Baled Rag Type (C)	$185.50	$3.50	$182.00	98.11%

Exhibit 9

Referring back to **Exhibit 5**, total cost avoidance figures are calculated for the oil saturated rag wastestream for 1995, assuming shop towels were used, **Exhibit 10**.

COST AVOIDANCE FOR 1995 USING SHOP TOWELS	
Baled Rag Type (A) Costs - Shop Towel Costs (500 bales x $212.90 per bale) - (500 bales x $3.50 shop towel equivalency)	$104,700
Baled Rag Type (B) Costs - Shop Towel Costs (538 bales x $199.31 per bale) - (538 bales x $3.50 shop towel equivalency)	$105,346
Baled Rag Type (C)Costs - Shop Towel Costs (583 bales x $185.50 per bale) - (583 bales x $3.50 shop towel equivalency)	$106,106

Exhibit 10

4. The Shop Towel Program for Paint/Solvent Saturated Rags

The previous analysis considered oil saturated rags. At this time, the Navy does not have a shop towel contract with commercial industry to cover paint and solvent saturated towels. There are two basic reasons for this:

1) The shop towel program for oil saturated towels is being utilized by very few ships, thereby reducing the incentive to establish the program for paints and solvents.

2) The cost of the shop towels for paints and solvents are significantly higher. The towels are more difficult to wash and the wastestream resulting from the washing cannot be treated at the washing facility's plant. It must be transported for disposal. It is the second reason that receives attention in this section; the first will be discussed further in Chapter VI.

The cost per shop towel currently in negotiations for paint and solvents is $.06 plus a 4.9 percent environmental fee. The $.06 covers towel costs, pick-up and delivery charges, and washing; the 4.9 percent is an allowance for disposal to meet environmental regulations. All totalled, the final cost per shop towel is $.063. Although this is 1.8 times greater than the $.035 per towel charge for oil saturated towels, savings displayed for the oil saturated towel contract are large enough to accomodate these higher costs and still yield substantial cost avoidance. Referring back to **Exhibit 6**, comparisons between baled rag and shop towel costs are made for 1995 to determine potential cost avoidance figures, **Exhibits 11** and **12**.

COST AVOIDANCE ESTIMATES FOR (PAINT/SOLVENT SATURATED) SHOP TOWELS VS. BALED RAGS				
	Baled Rag	Shop Towel	Cost Avoidance	Percent Avoidance
Shop Towel vs. Baled Rag Type (A)	$211.59	$6.30	$205.29	97.02%
Shop Towel vs. Baled Rag Type (B)	$199.83	$6.30	$193.53	96.85%
Shop Towel vs. Baled Rag Type (C)	$184.67	$6.30	$178.37	96.59%

Exhibit 11

COST AVOIDANCE FOR 1995 USING SHOP TOWELS	
Baled Rag Type (A) Costs - Shop Towel Costs (61 bales x $211.59 per bale) - (61 bales x $6.30 shop towel equivalency)	$12,523
Baled Rag Type (B) Costs - Shop Towel Costs (65 bales x $199.83 per bale) - (65 bales x $6.30 shop towel equivalency)	$12,579
Baled Rag Type (C)Costs - Shop Towel Costs (71 bales x $184.67 per bale) - (71 bales x $6.30 shop towel equivalency)	$12,664

Exhibit 12

The data verifies that the total costs for baled rag purchase and disposal far exceed those incurred through the shop towel program for paint/solvent saturated shop towels.

5. Volumetric Analysis

To extend the analysis one step further, costs are compaired assuming that baled rags and shop towels have equal absorbencies. With equal absorbencies, the required volume of shop towels equals the current volume of a bale of rags. A bale of rags is approximately 24 inches x 24 inches x 24 inches, which is 13,824 cubic inches in volume. 100 shop towels, on the other hand, are 18 inches x 18 inches x 4 inches, or 1,296 cubic inches. It takes 10.67 bundles of 100 shop towels to obtain the volume of one bale of rags. This calculation allows us to compare costs for equal volumes of material. Utilizing the middle measures in **Exhibits 9** through **12** and applying this concept (multiplying 10.67 times the shop towel program cost figures), yields the results in **Exhibits 13** and **14**.

COST AVOIDANCE ESTIMATES FOR SHOP TOWELS VS. BALED RAGS				
	Baled Rag	Shop Towel	Cost Avoidance	Percent Avoidance
Oil Saturated Estimate	$199.31	$37.34	$161.97	81.27%
Paint/Solvent Estimate	$199.83	$67.22	$132.61	66.36%

Exhibit 13

COST AVOIDANCE FOR 1995 USING SHOP TOWELS	
Baled Rag Costs - Shop Towel Costs (Oil Saturated) (538 bales x $199.31 per bale) - (538 bales x $37.34 shop towel equivalency)	$87,140
Baled Rag Costs - Shop Towel Costs (Paint/Solvent Saturated) (65 bales x $199.83 per bale) - (65 bales x $67.22 shop towel equivalency)	$8,620

Exhibit 14

Although research indicates that this is not the most accurate comparison, it does use a conservative absorbency assumption and still demonstrates sizeable cost avoidance under the shop towel program.

B. HAZARDOUS MATERIALS MANAGEMENT TRAINING

Chapter IV described the evolution of today's Hazardous Minimization Centers aboard ships from the highly decentralized environment that once prevailed. CHRIMP and HMCs transfered the responsibilities for proper hazardous materials and waste management from many untrained personnel to a few fully-trained individuals. Additionally, the costs associated with preparing personnel for employment in HMCs, both ashore and afloat, were presented. For the west coast alone, a conservative annual figure of $184,668 was spent to train 420 people for the 9595 NEC and 288 people in HICS/CHRIMP. At first glance, this is encouraging in that many people are receiving the training. However, interviews with the five LSDs that were inport at the time of the research found that none of the 13 people currently operating shipboard HMCs had received either of the courses. Why are the personnel currently operating HMCs aboard LSDs not receiving appropriate training?

1. Reasons for Lack of Trained Personnel Aboard LSD's

There are primarily two reasons why HMC billets are not being manned by fully trained personnel:

1) Many of the course quotas are taken by shore commands.

2) Training was obtained by one or more of the original operators of the HMCs, but their term in the HMC has ended (usually 6 months).

The first argument is valid from two standpoints. First, there are more major shore facilities west of the Mississippi River (approximately 130 that may require some form of HMC), than ships homeported on the west coast (91). Therefore, purely from a numbers perspective, they require more course quotas to meet the demand for trained hazardous material managers. Secondly, from an operational standpoint, shore commands are in a better position to send people to training away from the workplace. Their watchbills are not as stringent and operational tempo not as intense.

The latter argument reflects difficulties caused by the rotational pool from which

HMCs draw their manpower. Departments using significant quantities of hazardous materials are required to provide personnel, on a six month basis, to operate the HMC. Although this concept shares the burden of operating the HMC, it leads to significant problems. First of all, it strains already tight manpower resources in the providing departments. Secondly, the person assigned to the HMC loses valuable experience in their rating, which can adversely effect their promotion. The net effect is that the department does not want to provide a person for the HMC and the person that is ultimately assigned may not be motivated to properly perform the function. Thirdly, to minimize the amount of time away from the parent department, personnel are often not sent to the shooling required to make them an effective HMC member. Furthermore, the few people that receive one or both of the hazardous materials courses and fill HMC billets return to their divisions of origin after six months. Consequently, the direct benefits of HMC training are short-lived. How can the Navy obtain well-trained personnel to operate shipboard HMCs?

2. Establishing a Well-Trained Core

Unfortunately, HMCs aboard ships have evolved as "burden-sharing" operations. They are manned by the divisions on a rotational basis. Divisions must stretch their manpower by contributing personnel to the rotational pool that operates the HMC. With people coming and going every six months, training is hard to schedule, corporate knowledge is lost after the short-term, and continuity in the organization is limited. All of these notions are contradictory to CHRIMP's objective: to properly control hazardous materials through comprehensive inventory management conducted by a well-trained core of personnel. To create an efficient HMC, the core of personnel to operate it must be identified and fully trained.

a. *Identifying the Core*

It is crucial to identify personnel who are capable of properly managing HMCs. This task involves many factors. First of all, assignment to an HMC should not adversely effect a person's promotablity. Secondly, a person should be assigned for a period of not less than two years to develop corporate knowledge and expertise which provides program stability and better continuity. Thirdly, it should not negatively impact the daily functioning of the various departments aboard the ship. Lastly, identifying personnel with experience in hazardous materials or inventory management would help build a strong program.

b. *Training the Core*

Another significant factor is ensuring HMC personnel are trained to perform their duties. Chapter IV estimated that the total cost to train one person in both the 9595 NEC and HICS/CHRIMP was $496.88 ($314.90 for the 9595 NEC and $181.98 for HICS/CHRIMP). Based on this information, the total average annual cost to fully train a ship's HMC personnel under the current manning structure is:

ONE PETTY OFFICER SK SUPERVISOR (1YEAR AVG. ASSIGNMENT):

Annual training cost: $314.90 + $181.98 = $496.88

TWO ROTATIONAL PERSONNEL (6 MONTH AVG. ASSIGNMENT):

Annual training cost: 4 x ($314.90 + $181.98) = $1,987.52

TOTAL ANNUAL TRAINING COST FOR ONE LSD: $2,484.40

These figures are even more significant when viewed from a "return on investment" perspective. Viewed in this manner, one storekeeper produces one year's worth of work in the HMC for a $496.88 investment; one rotational person produces one half a year's work for the same investment. This cycle is perpetuated through the rotational pool concept. Therefore, increasing the length of service in the HMC will pay dividends in the form of return on the training investment.

3. Conclusion

It is apparent from data collected, that further change is required for hazardous materials management aboard ships. The rotational pool concept for staffing HMCs was an acceptable interim plan during CHRIMP initiation and while establishing HMCs. But, it has shown weaknesses as a viable long-term program. The disincentives to the rotational pool personnel and their parent departments are great, which tends to offset the improvements achieved by forming HMCs. Additionally, training, which is crucial for the proper management of hazardous materials, is often neglected, and when it is received does not produce long-term benefits. All of this points to the need for a structural change in HMCs that will achieve CHRIMP's goals to provide a well-trained core of personnel to manage hazardous materials, thereby freeing the ultimate users of the burden. Chapter VI will offer alternatives to the current HMC manning and training policies that may lead to more efficient and cost effective operations for the long-run.

VI. CONCLUSIONS AND RECOMMENDATIONS

This study focused on the evolutionary processes that helped form the hazardous materials management environment on today's U.S. Navy ships. The United States government noticed the environmental impact of many of the country's practices and determined that society would face health and welfare consequences in the future unless policies were immediately enacted to prevent pollution. Therefore, legislation, including the National Environmental Policy Act and the Act to Prevent Pollution from Ships, was passed to display the government's concern for the environment and invoke the public's attention.

Federal spending is a second area that continues to influence the Department of Defense and, consequently, the U.S. Navy. The nearly exponential growth of federal spending, predominantly for nondiscretionary programs, has been partially offset by a continual decline in defense spending since the mid-1980's. This, coupled with the reality of an increasing national debt, points to increasingly more difficult budget decisions in the future and fewer available dollars for the military.

The above mentioned government trends have significantly impacted the hazardous materials management procedures aboard U.S. Navy ships. First, recent legislation has changed the ships' alternatives for hazardous materials disposal. In the past, the simplest and cheapest method for disposing hazardous materials was to dump them at sea during normal operations. With legislative restrictions for at-sea disposal, associated fines and punishment, and better naval station disposal support, the Navy has an incentive to be a "partner" in environmental protection practices. Additionally, the Navy found its hazardous materials management process to be inadequate. The current practice involved decentralized hazardous materials management by numerous untrained personnel. These personnel were responsible for ordering, stowing, issuing and disposing of all hazardous materials. This led to several inefficiencies and unsafe practices. Consequently, the Navy adopted the Consolidated Hazardous Material Reutilization and Inventory Program (CHRIMP). This program consolidated all of a ship's hazardous materials into one Hazardous Minimization Center (HMC). This HMC is operated by a core of well-trained individuals responsible for the central control of all hazardous materials for the organization.

Significant improvements have been made in hazardous materials management in recent years, but there many challenges still ahead. Tighter at-sea dumping restrictions are eminent as the twenty-first century approaches. This has received the focus of many research and development efforts. On the other hand, there are areas of hazardous materials management where immediate cost avoidance and improvements can be achieved without additonal funding or scientific research. That is the focus of this research.

Specifically, two areas at the extremes of the hazardous materials management process spectrum were identified for improvements; baled wiping rags (disposal portion of the process), and the management structure of HMCs (where hazardous materials management decisions are initiated). Baled rags account for nearly one third of the hazardous material wastestream from U.S. Navy ships. They were found to be sixty-five times more expensive than an alternative shop towel program provided through commercial sources. Research also noted that training for HMC operators, which is crucial to administrating CHRIMP, was not received by a majority of managers aboard ships. This allowed inefficiencies to slip into the operations and caused a general lack of continuity. This chapter will specifically address these two areas and how programs may be successfully implemented to improve the overall efficiency and cost effectiveness of the hazardous materials management process.

A. IMPLEMENTATION OF THE SHOP TOWEL PROGRAM

1. Reasons for Ships not Implementing the Shop Towel Program

Currently, there are only four ships at the San Diego Naval Station that utilize the shop towel program. The basic reasons for the lack of interest are listed below:

1) Many ships are simply not aware of the program, as determined through interviews conducted on the various LSDs.

2) To those who are aware of the program, the shop towel is considered as just another contract that must be established and monitored; therefore it is not worth the additional effort.

3) Shipboard users have historically used baled wiping rags provided through the Navy stock system and are reluctant to change their method of doing business.

4) Personnel are not aware of the cost avoidance achievable through the shop towel program.

5) Ships do not pay their hazardous material disposal costs and nobody monitors or questions unusually large disposal costs.

6) The shop towel program is not currently available overseas, so ships are concerned about the transition from shop towels, when homeported in the United States, to baled rags, when deployed. It is easier to maintain one program.

All of these reasons represent the incentives for ships not to participate in the shop towel program. Therefore, it is critical to educate shipboard personnel on the savings available through shop towels, and change the incentive structure so that it is in the ships' best interests to enter the program.

2. Method for Implementation

To successfully implement the shop towel program, it must address the six items identified above. First of all, shipboard personnel must know about the program. The crew must understand the program's significance to provide incentive for the change; and the people capable of implementing the program, the commanding officer and supply officer, must buy into the program. Although the FISC Hazardous Waste Management department has produced newletters delineating the advantages of the program, few people read the articles. Consequently, something more comprehensive is required, that reaches the intended audience.

Chief of Naval Operations (CNO) directives are often interpreted negatively. They frequently restrict the flexibility of personnel and operating units, and may require additional reporting and other administrative burdens. However, in the case of the shop towel program, the savings are significant. Additionally, the administrative burdens are relatively insignificant and actually place control of disposal costs with the appropriate source. Therefore, a CNO directive should be sent, in message format, to all afloat commands addressing the following topics:

a. Explanation of Shop Towel Program and General Advantages

First of all, shipboard personnel must be informed about the shop towel program and how it operates. Secondly, users need to understand that it includes a "user friendly" pick-up and delivery cycle. This relieves shipboard personnel of bagging and labeling baled rags for disposal, and eliminates the time required for personnel to purchase baled rags at SERVMART. Finally, users should know that a contract is already established for oil-saturated shop towels with a local vendor. The only document required from a ship is an naval supply document 1149 (purchase request). This document, including an estimate of shop towels required for the year and the resulting dollar cost based on the current shop towel contract price, can be delivered to the FISC purchasing agent in charge of the contract. This agent will consummate the contract.

To address apprehensions of changing from baled rags, the following advantages of shop towels over baled rags should be advertised:

1) Shop towels are a standard 18 inch x 18 inch size and made of 100 percent cotton, which ensures consistent absorbency properties. Baled rags contain various fabric make-ups and sizes.

2) The customer does not have to worry about stock outages, as can

occur with baled rags at the FISC SERVMART.

3) Lastly, shop towels require far less space for storage. A bale of rags requires 13,824 cubic inches of space; shop towels with equivalent absorbency properties only require 1,296 cubic inches (10.67 times less space).

Communicating these points would address the first three reasons described earlier for not implementing the shop towel program. Cost issues should also be discussed to inform people about current disposal costs and potential savings achievable through the shop towel program.

b. Disposal Costs and Potential Program Savings

Probably the most significant reasons why more ships are not utilizing the shop towel program is that they are not aware of the quantity of baled rags they purchase, the resulting disposal costs they incur, and the savings that can be realized through the shop towel program.

First of all, as stated earlier, each department on the ship is responsible for acquiring their own baled rags through SERVMART. This purchase is not recorded on the normal stock records in the SNAP II computer inventory system maintained by the ship's storekeepers. Consequently, no historical data is readily available to determine actual demands for baled rags. Therefore, the money spent for baled rag purchases is invisible. More importantly, ships are not responsible for paying their own hazardous material disposal costs. Costs are incurred by the PWC disposal unit and paid by the type commander (Commander, Naval Surface Force). Nobody questions unusually large disposal costs for specific ships. Until PWC's monthly reports were recently initiated, individual ship wastestreams were not tracked. With someone else paying the bill, hazardous waste disposal costs are transparent to ships, which relieves them of any incentive for reducing these costs. To make shipboard personnel aware of disposal costs, a brief summary of current disposal costs and potential savings through the shop towel program could be provided.

Utilizing the medium cost avoidance figures for oil saturated and paint/solvent saturated shop towels in **Exhibits 9** and **11** respectively, and the percentages calculated for volumetric comparisons in **Exhibit 13**, a range of total cost savings can be estimated for U.S. Navy ships homeported in the continental United States. First, take the wastestream disposal cost per ship for oil saturated rags and paint/solvent saturated rags determined in **Exhibits 4** and **6**, respectively. To these figures add the initial purchase price of the bales of rags used. Cost avoidance percentage figures are then applied and the result multiplied by 210, which represents the number of U.S. Navy ships homeported in the continental United States. The final figures are the expected annual savings for the shop towel program using absorbency and volumetric comparisons **Exhibit 15**.

ESTIMATED TOTAL ANNUAL COST AVOIDANCE ACHIEVABLE THROUGH THE SHOP TOWEL PROGRAM				
Per ship disposal cost **Exhibit 4**	Initial purchase of baled rags	Cost avoidance percentage **Exhibits 9,11,14**	Cost avoidance per ship	Total annual cost avoidance
[$13,748 +	(77 x $20.43)] x	.9824 =	$15,051	
[$1,666 +	(9 x $20.43)] x	.9685 =	$1,792	
		Total =	$16,843 x 210=	$3,537,030
[$13,748 +	(77 x $20.43)] x	.8127 =	$12,451	
[$1,666 +	(9 x $20.43)] x	..6636 =	$1,228	
		Total =	$13,679 x 210=	$2,872,590

Exhibit 15

The 210 U.S. Navy ships vary in size, which ultimately influences their hazardous material wastestream quantities per ship. However, LSDs are median sized ships, with frigates and aircraft carriers being the small and large ship extremes. Therefore, the cost avoidance figures based on LSD data should provide a reasonable estimate. Additionally, taking the average of the total values in **Exhibit 15**, ($3.2 million), provides a conservative estimate since the volumetric figures tend to understate the avoidance figures.

c. CNO Shop Towel Policy

With the audience aware of the shop towel program and the significant potential savings, the actual policy can be delineated.

POLICY:

In view of the sizeable savings of the shop towel program over baled rags, all U.S. Navy ships homeported in the continental United States will be required to adopt the shop towel contract within one year. The only exception will be for ships due to deploy within the one year window where, because of the short term nature of the contract, establishing the shop towel program would be infeasible. Commanding officers of each ship will be responsible for authorizing the exemption, but should make the final determination using sound fiscal judgement.

After the initial one year deadline, all ships will be required to obtain the shop towel contract for a period of not later than 30 days after returning from deployment to 30 days prior to departing for deployment. The initial one year window will allow ships to use accumulated stocks of baled rags, determine usage data for shop towel contract initiation and establish the contract. The 30 day window before and after deployment will allow time to reestablish of contracts upon arrival stateside, and terminate contracts and make final vendor payments prior to departure.

Additionally, the responsibility for hazardous material disposal costs will be placed in the hands of those individual commands that generate the wastes. Therefore, beginning next fiscal year, individual ships will be alloted their portion of the type commander budget for hazardous material disposal costs. Ships will receive a monthly billing from PWC delineating the various wastestreams and disposal costs incurred. By performing business in this manner, costs are made visible to the people who are able to control them.

d. *Future Plans for Shop Towel Expansion and Improvement*

The one area that still must be addressed is the idea of using shop towels overseas. Currently, the shop towel program is not available to U.S. Naval ships deployed in foreign countries. However, Prudential Overall Supply, the company that currently holds the San Diego shop towel contract, has a plant in Singapore. As the shop towel program gains popularity throughout the U.S Navy, additional overseas expansion is probable.

Until expansion occurs, there is an alternative that could reduce costs in the interim. The alternative would require ships to purchase a sufficient number of shop towels to last an entire deployment prior to departing the United States; the towels could be disposed in foreign ports as they become contaminated. This is similar to the current practice utilizing baled rags, with two significant differences: 1) The purchase price of baled rags ($20.43) is 5.8 times more than an absorbency equivalent 100 shop towels ($3.50), and 2) a bale of rags occupies 10.67 times more space than 100 shop towels.

The first difference allows a significant purchase price savings by using shop towels. However, the cost would not be 5.8 times less because current shop towel contract prices are based on reusing shop towels after washing. To achieve purchase price savings, the Navy must negotiate a per towel cost of less than $.20 for overseas disposal purposes.

The second difference shows great potential volumetric advantages. First, the average 77 oil saturated bales plus 9 paint/solvent saturated bales used by a ship per year (determined in Chapter IV) is divided by two. This represents anticipated usage for a standard six month deployment (43 bales). This total is then multiplied by the volumetric measure of 13,824 cubic inches to determine storage requirements for six months (594,432 cubic inches or 344 cubic feet). This is compared to 4,300 shop towels, which require 1,296 cubic inches per one hundred, for a total of 55,728 cubic inches or 32.2 cubic feet. It is evident from this comparison, that stocking baled rags for a full six month deployment is not feasible because of space requirements; whereas, a six month stocking of shop towels is. This concept is even more significant when viewed from a supply source perspective. If all U.S. Navy ships utilize shop towels on a full-time basis, baled rags could be eliminated from the stock system. This would considerably increase available space in SERVMARTs, FISCs, and supply support ships (AFSs) allowing for the stocking of other high priority materials. This ultimately will increase overall fleet readiness.

B. RESTRUCTURING HAZARDOUS MATERIALS MANAGEMENT

1. Initial Phases of CHRIMP Implementation

When CHRIMP was implemented aboard U.S. Navy ships, the aim was to establish the program as quickly as possible, while minimizing the impact on daily operations of the ships' various departments. Since hazardous materials are used by all departments on a ship, the rotational pool concept was chosen, where each department takes turns providing personnel to operate the HMC. This concept allowed the HMC's additional administrative burden to be spread among all departments, rather than requiring one department to shoulder the entire responsibility. It also better informed shipboard personnel about properly managing hazardous materials and of the environmental impact of improper practices. Finally, it improved the efficiency and effectiveness of the initial hazardous materials consolidation effort. The consolidation required all hazardous materials onboard the ship to be integrated in HMC spaces. The HMC operators then determined which materials to keep. Those that were in good condition but in excess of the ship's needs were turned-in to the shore facility for re-use; materials with an expired shelf-life or that were unusable for other reasons were disposed. By having everybody represented in the HMC process, departments were more willing to turn-in hazardous materials from their spaces.

All of the positive aspects of the rotational pool concept were important in initially implementing CHRIMP. But as the program matured, numerous problems surfaced which challenge its long-term viability. The reality is that a more permanent, continuous program is needed to fully achieve CHRIMP's goals for the years to come.

2. Structural Change

As noted in Chapter V, a major shortcoming of today's shipboard HMCs is that the personnel who operate them do not receive the comprehensive training they require. The most significant reason for this is the rotational pool. Since the average term of rotational personnel is six months, people transfer in and out of HMCs on a regular basis. This inhibits developing strong technical expertise and program continuity. Additionally, department heads and division officers, in keeping with their interest in maintaining the manpower base in their specific departments, aggressively attempt to minimize their persnonnels' tenures in the HMC. This ultimately sacrifices formal hazardous materials schools, and places heavier reliance upon "on-the-job" training (OJT).

Sacrificing formal training in favor of OJT reduces the HMC's effectiveness in three ways:

1) Time and the resulting productivity must be sacrificed from normal HMC operations to conduct OJT.

2) Because of the requirement to maintain normal daily HMC operations, OJT is often hurried, reducing its effectiveness, or neglected altogether.

3) As OJT substitutes for formal training, a negative compounding effect occurs. Details and requirements of the proper HMC procedures are lost over time and in translation during the OJT process. For example, the latest updates to HICS and CHRIMP are not acquired through OJT as they would be through formal training courses. In formal courses, instructors are current on the latest issues and practices.

All of the above mentioned tendencies lead to inefficiencies in HMCs. Expertise in identifying hazardous material compatabilities; proper ordering procedures; use of laser-scanning equipment for inventories, receipts and issues; and operating the HICS program efficiently; tend to degrade over time without a periodic infusion of formal training. Therefore, the task is to identify a stable core of personnel to manage and operate HMCs for the long-term and provide them formal training to obtain a consistent, quality product.

3. Establishing the HMC Management Core

Chapter V identified four criteria that must be satisfied to establish an HMC management core for the long-term:

1) Assignment to HMCs must not adversely effect promotion opportunities.

2) Personnel should be assigned for at least two year terms to develop corporate knowledge and expertise, allow for continuity, and realize a profitable return on investment in training.

3) HMC manning should not be at the expense of the ship's other departments.

4) Personnel who have previous inventory management experience or skills applicable to daily HMC operations should head the list of possible candidates.

With these criteria in mind, a search through the list of Navy enlisted personnel ratings readily identifies one rating as being the best choice. That is the storekeeper (SK) rating. The storekeepers' function aboard a ship, and throughout their career, deals primarily in financial recording and reporting and inventory control. In fact, SKs manage the inventory for all shipboard spare parts and all associated storerooms. A logical conclusion is to consolidate the hazardous materials control function with the SK operation. At its inception, the shipboard CHRIMP gave supply officers the responsibility for establishing and operating HMCs. This is significant because all SKs are assigned to the supply department under the purview of the supply officer. Consequently, most supply officers, identifying the requirement for better inventory control in the HMC environment, chose SKs as HMC supervisors. This is evident in today's HMC organizational structures.

This recommendation directly addresses two of the disadvantages of the rotational pool. First, assigning SKs to HMCs does not deprive them of in rate job experience. Rather, it opens a new avenue for career development and promotion. Second, they have already established inventory experience and expertise in shelf-life programs and various ordering, issuing and stowing functions. This gives them a solid foundation on which hazardous material nuances may be developed.

The remaining two disadvantages of the traditional rotational pool concept may be addressed through changes in the billeting structure and Navy Enlisted Code (NEC) designation. The challenge is to ensure SK petty officers, who currently hold HMC supervisory positions aboard ships, receive formal training, and that the rotational pool personnel are replaced with additional SK billeting support. The former is achieved by establishing a 9595 HMC supervisor billet requirement for all ships, and requiring all personnel filling these billets to receive formal NEC training. The latter is achieved by changing the navy manpower planning document for shipboard SKs to add sufficient SK billets to man HMCs, depending on the size of the ship. In the case of LSDs, one supervising SK petty officer, and one assistant junior seaman (E3) or below, each fully trained in 9595 and HICS/CHRIMP, are sufficient to efficiently operate an HMC.

The concept of adding billets contradicts today's "downsizing" philosophy. However, in the LSD example, actual HMC manning would be reduced from three, under the rotational pool system, to two, under the SK consolidation. This economy arises by reducing inefficiencies experienced under the rotational pool concept. Interruptions caused by frequent personnel turnovers are eliminated and, more importantly, a strong learning curve is realized through stable manning. This more than compensates for the 33% reduction in manpower. Similar manpower reductions are possible in other ship types, by replacing a short-term untrained workforce with a longer-term expert core.

Another argument supporting this concept recognizes that departments are undermanned when they provide personnel for HMC operations. They will now realize their full allotment of manpower, thereby improving overall ship effectiveness. Lastly, by reducing the number of personnel operating HMCs, and specifically identifying personnel to fill HMC billets, the core that requires training will be smaller and easily identifiable. This reduces training costs. The last section will present two options to fulfill the training requirements for personnel billeted to HMCs.

4. Training HMC Personnel

HMC training can be improved by combining the 9595 NEC and HICS/CHRIMP curricula to form one comprehensive course that fully prepares HMC operators. Since training is strictly for SKs, course material associated with inventory management can be eliminated, such as, receipt, issue, ordering and stowage procedures and shelf-life programs. This will shorten the combined course from eight to possibly seven days. Additionally, this will likely eliminate the requirement for the contracted civilian instructors that are currently employed for HICS/CHRIMP training. This is particularly evident when comparing the 1995 quotas of 420 students for the 9595 course and 288 for the HICS/CHRIMP course, with the projected schooling requirements under the SK consolidation concept **Exhibit 16**.

ANNUAL TRAINING QUOTA REQUIREMENTS FOR THE SK CONSOLIDATION CONCEPT				
Ship type	Number of ships of this type	Number of SK's required for HMC	Total number of SK's requiring training	Total number of SK's requiring training (assuming 2 yr tours)
CV/CVN	13	6	78	
LHA/LHD	8	4	32	
Others	189	2	378	
		Total	488 / 2	= 244

Exhibit 16

This number will be higher initially, to train existing HMC personnel. However, once established, this figure will actually decrease as more SKs complete training and therefore do not require training for subsequent HMC tours. Following this line of reasoning, the first training approach will now be discussed.

a. Training Performed Enroute to HMC Billet

Under this method, SKs are assigned HMC billets aboard ships either as a supervisor, for petty officers transferring from other commands, or as an assistant for E3s or below. Assistants probably come directly from SK "A" school to the ships. Since these assignments are made to fill NEC designated billets, BUPERS should control the training course quotas. As the controlling authority for personnel orders, they are able to manage the flow of personnel to courses and ensure afloat HMC billets are filled by qualified people. When personnel receive orders to an HMC billet, they can be first screened to see if they have already obtained the 9595 NEC and, if not, they are scheduled for the course enroute to their new assignment.

The advantages of this method are:

1) Full visibility and control of HMC billeting and course quotas at BUPERS.

2) More efficient routing of personnel to school; then to their ultimate commands.

3) Reduced training costs by matching HMC billets to course quotas, thereby ensuring only personnel assigned to valid HMC jobs obtain training.

The disadvantages of the method are:

1) An additional administrative burden for BUPERS.

2) Travel, lodging and per diem costs will still be incurred to train personnel enroute to HMC billets.

3) There is still a requirement for the separately established training installations to conduct the HMC training.

An alternative to this method of training is to conduct all HMC training at the SK "A" schoolhouse.

b. Training Performed at SK "A" School

Alternatively, the consolidated 9595 NEC and HICS/CHRIMP course could be integrated into the SK "A" specialty school. This school is attended after bootcamp by personnel entering the storekeeper pipeline. This school provides basic storekeeper training to those designated for careers in the storekeeper rating. In the initial stages of this scenario, there will be a continued requirement for the current HMC training sites, like that in San Diego, predominantly for petty officer SKs that are HMC supervisors. However, this requirement will disipate when enough of those receiving HMC training in SK "A" school begin to reach petty officer to fill the available HMC billets. It will likely take five years before the satellite HMC sites can be closed.

The advantages of this method are:

1) Nearly all SKs will obtain the HMC training, and therefore be able to operate HMCs ashore or afloat. Eventually, there will be no shortage of qualified people.

2) Training costs per person are likely to decrease once the satellite HMC training sites are closed. Existing SK "A" schoolhouse instructors can easily obtain the HMC expertise through training, and integrate an additional HMC module into the current curriculum. Consequently, the satellite instructors and the civilian contractors can be eliminated.

3) Travel, lodging and perdiem costs to send personnel to HMC training will be eliminated once the program is in full operation and HMC training satellite sites are no longer required.

4) The administrative burden for BUPERS is reduced because they do not have to control school quotas. In the long-term, BUPERS will not even be required to monitor HMC billets to ensure they are filled by qualified personnel; eventually nearly all SKs will be qualified.

The disadvantages of this method are:

1) This method trains all SKs even though some may never work in HMCs.

2) Initially, it will be more costly since training is provided both at SK "A" school and the satellite HMC training sites.

C. SUMMARY AND SUGGESTION FOR FURTHER STUDY

First, the various programs and initiatives presented in this study focused primarily on the shipboard hazardous materials environment. However, all concepts are equally applicable to shore commands. In fact, the difficulties imposed by afloat units, such as, deployments and space limitations, are not relevant at shore facilities. This makes transition significantly easier.

Second, the numerous advantages and significant cost savings of the shop towel program need to be advertised to the users, and a strong program must be implemented to achieve these benefits immediately. Additionally, further research and negotiations should be conducted with shop towel companies to both provide an interim plan for towel usage overseas, and determine the feasibility of expanding the recycle program to provide full support in foreign countries.

Third, a long-term strategy must be adopted to realize CHRIMP's full benefits. A structure that provides continuity in the HMC and career advantages to the operators is the first step. Additionally, providing those individuals requisite training will ensure expertise is maintained and renewed periodically. This adds to operational efficiency.

Finally, one subject surfaced as a particularly interesting topic for further study: The feasibility of integrating the HICS inventory system with SNAP, the current shipboard stock inventory system. Specifically, one may research the costs to maintain and upgrade the current systems, and the costs and integration difficulties associated with combining the two.

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