Report 4672

PROCEEDINGS OF THE TECHNOLOGY TRANSFER SEMINAR/WORKSHOP ON THE APPLICATION OF POLLUTION ABATEMENT TECHNOLOGY TO LOCAL GOVERNMENTS

NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

Bethesda, Md. 20084

PROCEEDINGS OF THE TECHNOLOGY TRANSFER SEMINAR/ WORKSHOP ON THE APPLICATION OF POLLUTION ABATEMENT TECHNOLOGY TO LOCAL GOVERNMENTS

Edited by
James W. Stinson

MATERIALS DEPARTMENT

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Naval Ship Research and Development Center
Bethesda, Md. 20034

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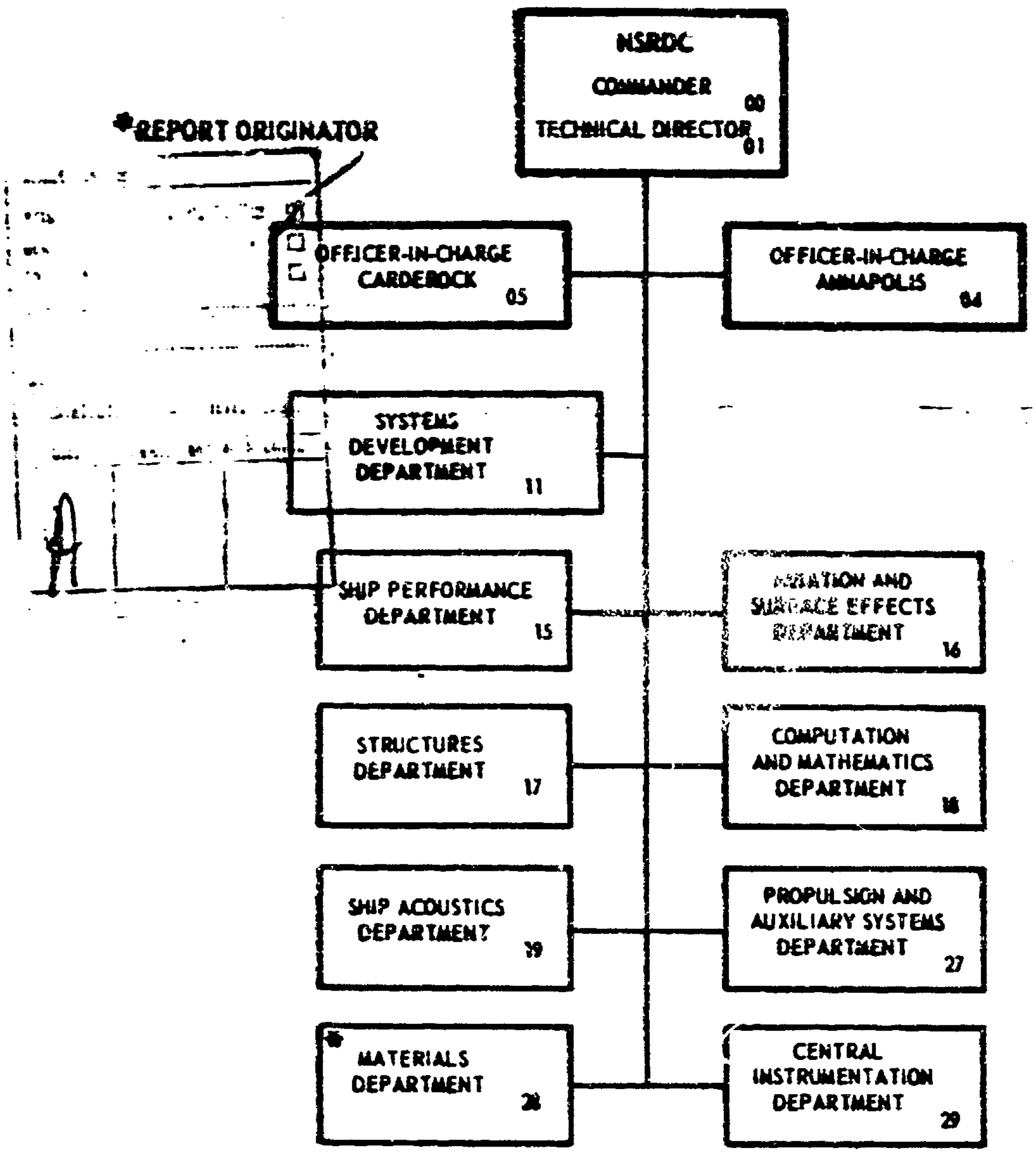

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The Naval Ship Research and Development Center sponsored a one day seminar/workshop to explore the application of pollution abatement technology to local governments. The meeting was held at the U. S. Naval Academy, Annapolis Maryland on 16 October 1974. Congresswoman Marjorie S. Holt (R-Md.), who originally requested the workshop, presented the keynote address.

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PROCEEDINGS OF THE TECHNOLOGY TRANSFER SEMINAR/ WORKSHOP ON THE APPLICATION OF POLLUTION ABATEMENT TECHNOLOGY TO LOCAL GOVERNMENTS

held at the
U. S. Naval Academy
Annapolis, Maryland

16 October 1974

Sponsored by:

The Naval Ship Research and Development Center

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OVERVIEW

The Naval Ship Research and Development Center sponsored a one day seminar/workshop to explore the application of pollution abatement technology to local governments. The meeting was held at the U. S. Naval Academy, Annapolis, Maryland on 16 October 1974. Congresswoman Marjorie S. Holt (R-Md.), who originally requested the workshop, presented the keynote address.

Participating in the program were the Environmental Protection Agency, the National Science Foundation, the U. S. Coast Guard, the Maritime Administration, the U. S. Navy, and representatives from State and local governments, each of whom gave an overview of their pollution abatement programs. Afternoon workshops were devoted to topics on harbor oil spill recovery, test and evaluation procedures for selecting newly developed pollution abatement equipment, pump-out waste treatment methods, solid waste disposal, development of environmentally safe antifouling bottom paints for boats, and environmental toxicity measurements.

The seminar/workshop emphasized the transfer of technology developed by Federal agencies to the local governments. Representatives of the various State, County and City agencies concerned with environmental affairs discussed current applications of and future demands for pollution abatement technology. The forum provided by this workshop initiated a productive dialogue between developers of pollution abatement technology and potential users, in both the government and private sectors, to encourage timely solutions to our Nation's pollution abatement problems.

CHAIRMAN

LCDR C. Farrell, Jr., USN
Office of the Chief of Naval Material

As Program Administrator for the Navy's Environmental Protection Development Program, it is my pleasure to serve as Chairman of today's Workshop on the applications of pollution abatement and technology for the local governments. The Navy is pleased to sponsor such a Workshop and we feel that it is in keeping with Executive Order 11752 which requires the Federal Agencies to take a lead in the national environmental program. The Navy has a major environmental protection research program that is closely coordinated with other Federal programs but responsive to military unique problems. Thus to ensure your day is profitable as possible, we have on today's agenda, representatives from other Federal Agencies. In keeping with the goals of technology transfer, and to welcome you to the Annapolis Area, I am pleased to introduce the President of the Annapolis Chamber of Commerce, Mr. C. Scott Lewis.

WELCOME

Mr. C. Scott Lewis
Annapolis, Chamber of Commerce

Thank you very much. And I'll say good morning, again, and welcome to a seminar on the application of pollution abatement technology to local governments. I am C. Scott Lewis, Eastern Marketing Manager with Honeywell, and a Member of the Annapolis Chamber of Commerce. In behalf of all Members and companies associated with our local Chamber I would like to welcome you to the Seminar Workshop and to the Annapolis Township Area.

It seems to me that it is most fitting that such a meeting should be held right here. We who live in this area often hear and use the phrase "the land of pleasant living." But, surely we could do a better job of ensuring that our land, waterways and environments remain pleasant and livable for the future. A most cordial welcome to you all.

Now, it is my pleasure to introduce to you CAPT P. W. Nelson, USN, and Commander of the Naval Ship Research and Development Center, our sponsoring Agency for the program. Ladies and Gentlemen, CAPT Nelson.

INTRODUCTION

CAPT P. W. Nelson, USN
Commander, Naval Ship Research and Development Center

Thank you Scott. Mrs. Holt, Ladies and Gentlemen, indeed it is a pleasure to be here. I have always considered Annapolis my home, and I and my family have spent many pleasant years here.

We have important things to talk about today. You represent a vital segment of our population which is concerned with an area of great importance–pollution abatement. Pollution abatement is a very nice term for a very distasteful task. We must diminish the mess that we have made of our most precious resources. By choosing the very term abatement, instead of prevention, we are admitting the enormity of the problem. Unless it were possible to recycle all of our wastes, we could never prevent pollution. It took thousands of years to create the chaos that we have today–the fouling of our rivers, polluting of our harbors, the smog, the ugliness of neglected cities, and the mountains of indestructible junk. Today we recognize that we are poisoning the world we live in and we must put all of our talents to use in reversing this trend. The lion's share of this responsibility lies with government agencies and private industry. It is a relatively thankless job–because we still may get the blame for the blight that we cannot remove, even though we have done a great deal to lessen it.

Pollution abatement is like buying a hot water heater for your house–it's something you don't show to your guests. This is one reason why we must share what we have learned in our research and why this workshop is so important to the Nation. None of us can afford to go it alone. We can save the taxpayers millions of dollars if we are willing to cooperate in the search for solutions to this major problem. The Navy has been concentrating on pollution abatement for more than five years now. At our Annapolis Laboratory we have a division of over 30 people working full-time on this problem. Their sole task is to prevent further pollution from our Navy's ships. This research is of primary importance to the entire country. A ship is like a small city with all of the problems a city manager would recognize–sewage, trash, smoke. How can we put a sewage system on board a ship which is already crowded with piping, wiring, boilers, machinery. And where can you, as city managers or county managers, put new dumps when people would like to have the land for their own use for new homes. Ships, like any city, use oil. But some of ours goes into the ocean, and when we blow tubes in a harbor, we are pinpointed again as polluters. Although oil is recognized as a necessity, oil spills and pollution are the inevitable results of using this fuel. I think it is safe to say that both government and private industry are particularly concerned with preventing damage from this most critical product. Those of you here that represent industry are working even harder than we in the Navy in this area. All of us, from the largest agency to the smallest village, can benefit from the cooperative spirit that results from this workshop. If we share our technology we should get better solutions and products at cheaper costs.

And now a driving force behind this technology transfer is our keynote speaker. Mrs. Holt has sailed the waters of the Chesapeake Bay and shares with us a deep concern for the environment. I'm sure her views will serve as an inspiration for your work here today. It gives me great pleasure to introduce the Representative of the 4th District of Maryland, Mrs. Marjorie Holt.

KEYNOTE

Congresswoman Majorie S. Holt
Republican, Maryland

Thank you. Thank you very much and it's certainly a pleasure to be here. I take a lot of pride in the Naval Academy and Annapolis and this great 4th District of Maryland and this certainly is the most beautiful spot of the whole 4th District. I am very pleased to be participating in the program this morning and it's great to see so many of my good friends out there that have been working for a long time for the betterment of Annapolis and Anne Arundel County. I think that the Navy should certainly be commended for its understanding of the contribution defense research can make to the larger community. I was so pleased with the response that I got when I made the request for this Seminar.

Too often people in institutions become so absorbed in their special fields of interest that they fail to recognize the importance of their work to others. I think we see this frequently in the Government–they get carried away with the job at hand and begin to believe that they exist only for their own edification and not for the benefit of the people of this country. Fortunately, the Defense Department recognized long ago that technological achievements associated with military preparedness can be useful to the rest of the world and that we can solve some of our problems by relating back to the technology that we are developing.

Today, we are privileged to see the transfer of military science to one of our foremost problems. Certainly the State of Maryland is deeply involved in trying to conserve our beautiful waterways. CADCOM is developing civilian applications of the technology equipment developed by the Navy for pollution controls. I wish that I could stay here today and participate in this but I hope that I get some good feedback from it–package waste treatment for small craft, the different things that they have been able to develop for pollution abatement equipment. I am sure that we in the Legislative Branch should know more about it, so I hope that you will take full advantage of it. This is one of the biggest problems that we are faced with in the 4th District, and it's very gratifying to see people working and to see you here interested in learning about how we are spending our tax dollars.

In my job on the Armed Services Committee I am very proud of our defense efforts and I think it is important that we stay strong, that we do keep our defenses up in this world that we live in today. But it is also interesting to see that these men and women of our military are dedicated to keeping the peace and that they are doing the research here that is going to improve the quality of the American life. The Navy certainly has a special interest in Maryland, in the Chesapeake Bay, and in the Severn River. For many, many years, the Naval Academy has been turning out young officers and gentlemen and may be turning out young ladies if our Committee has anything to do with it, to command our fleets and this institution and this City certainly has become a hallowed Navy tradition. The young officers train here and the old officers come back and retire here. You heard the glowing description of Annapolis we are very proud of it. So, it's certainly understandable why the Navy is concerned about keeping our beautiful waterways beautiful.

I had learned about this technology transfer idea from the Workshop that was held in Connecticut and another that is to be held in California. I wrote to Admiral Kidd inquiring if we could hold one here, and he responded immediately and this meeting today is the result. So, I hope that from this you will learn ways that we can apply it to our own problems here.

My sailing is limited by a busy schedule. I hope that maybe when we are in recess and between the election and the 13th of November, if they are going to let us off that long, we will have some pretty weather. We didn't provide it today but you can't have everything. I hope that I will be able to get back out there and sail some. In the meantime, we do have more than just our leisure enjoyment of the Bay. This is a real industry in Maryland, our seafood industry. Those watermen who harvest that seafood are dependent upon it for their livelihood. It's a great part of our tradition and as food supplies become short, as nations are competing for these short supplies, our waterways become more important than ever and we've certainly got to do everything we can to preserve them.

I think that one of the great dangers that we have run into in trying to suddenly stop all of the pollution that we have been doing for 200 years is to work a hardship on those who are benefiting from industry, from pleasure boating. We must learn how to accomplish it gradually so that it doesn't affect our use of the waterways. We certainly should be able to and I know that we can. Let's all put our shoulders to the wheel, and you learn a lot today, and we'll clean it up. And I hope that you do enjoy the session here and thank you very much for letting me be a part of it this morning. It's good to be with you.

CAPT NELSON

Thank you Mrs. Holt and I think that you are very fortunate to represent the most beautiful area of the whole country.

And, now it is my honor and pleasure to introduce a fellow Naval Academy Graduate, a Naval Aviator, an Aeronautical Engineer, and former Deputy Commandant here at the Naval Academy. No stranger here to this area, he is presently assigned as Assistant to the Deputy Chief of Naval Material for Development, CAPT C. B. Brown, Brian Brown.

TECHNOLOGY TRANSFER IN THE NAVY

CAPT Brian Brown, USN
Assistant to the Deputy Chief of Naval Material for Development

Thank you Mrs. Holt, CAPT Nelson, Mr. Lewis, and Members of the Seminar Workshop for Technology Transfer. It is indeed a pleasure to be here with this wonderful group this morning and to speak to you today on technology transfer in the Navy and briefly describe to you some of the steps the Department of the Navy has taken recently to bring our technology to bear more directly on today's priorities. But, first let me mention that there is no more tangible evidence of the Navy's active interest in technology transfer than the fact that we are holding this workshop today at the Naval Academy and organized by the Naval Ship Research and Development Center.

Certainly, the transfer of military technology to the civil sector is not new as past spin-offs of military and space technology to the civil sector are familiar to all of us. For example, Navy shipboard requirements in food and temperature control near the turn of the century contributed to the beginning of the present refrigeration and space heating and cooling industries. And we should not overlook the stream of technically skilled military personnel who, after leaving the Navy, make their contribution to the civil sector. I do not intend to dwell on past successes of the military-civilian technology transfer, but do wish to explore with you additional ways in which we can mount a more concerted and systematic effort to realize greater benefits from our technology.

The principal role of the Federal Government in technology transfer is to create the conditions favorable for increased utilization of our Nation's technology resources to improve national wellbeing. The Federal Government has for many years supported a major share of the Nation's fellow research and development efforts. For example, about 50 percent of the $32 billion to be spent on research and development in the United States this year will come from the Federal Government. When one begins to add to these figures Federal research and development expenditures in previous years, stretching back to World War II, it becomes clear that the Nation has an immense investment in technology. The challenge before us, then, is to develop the measures by which our Nation's considerable technological resources built up over the years can more effectively flow (1) into the State and Local Governments to provide more efficient services to the public, and (2) into private industry to improve productivity and strengthen the process by which new and improved goods and services are introduced into the commercial market place.

Now, let me turn to some of the steps that the Navy has taken in recent years to develop a more active technological transfer effort. We are sponsoring Seminar Workshops in different parts of the country, such as the one here in Annapolis today, and we're developing meaningful dialogue between field activities and potential technological users in State and Local Governments, as well as in industry, within the region. We condu ted similar Seminars and Workshops last May in Connecticut and Rhode Island and we have another such Seminar Workshop that will start tomorrow in San Diego, California. In these meetings we hope to learn from the participants their views on how the technology flow could be expedited, what some of the current technological problems and needs are, and to convey our interest and commitment to the common effort. In the same vein, the Navy, in conjunction with American University, the National Technical Information Center, and the National Science Foundation, cosponsored a technology transfer colloquium last year where 130 participants from both the public and private sectors gathered to exchange views on technology transfer and methods to expedite the process. The proceedings of this meeting have recently been published and are currently available.

We have additionally implemented changes in the Navy technical information system pertaining to on-going Navy research and development projects. These changes are designed to improve identification and data retrieval of Navy research and development activities and capabilities which have civilian application. As a result, a description of Navy projects having civilian application as well as identification of the principal Navy inve tors involved, can readily be obtained from the current Navy technical information syst

We recognize that Navy facilities across the country can play an i rtant role in working with State and Local Governments and private industry in their regions. For this reason, the Navy has designated technology transfer focal points in a hundred field activities and installations across the country. Their responsibilities are to facilitate liaison with the civil sector and to assist in the technology transfer process. They effectively constitute the geographically decentralized network of technology agents available to help potential users gain access to Navy technology.

The principal Navy research, development, test and evaluation centers have also engaged in programs designed to apply e ting in-house technologies toward outstanding civil problem areas in environmental protection, transportation, health, communications, and fire safety. These projects in the main are sponsored by Federal civil agencies through interagency agreements.

One of the Navy field activities, the Naval Ammunition Depot at Crane, Indiana, has developed rather unique ties to the State of Indiana through the appointment of its Commanding Officer to serve also as Chairman of the Governor's Science Advisory Committee. This dual role is expected to strengthen measurably the ability to relate State needs to technological resources available at the Naval Ammunition Depot and elsewhere.

Another approach to technology transfer is being undertaken at the Naval Surface Weapons Center at White Oak, Silver Spring, Maryland. The U. S. Environmental

Protection Agency, the National Environmental Research Center, and the Naval Surface Weapons Center are working closely to seek military technology not only in the Navy but also in Army and Air Force laboratories which are applicable to our Nation's air pollution problems. In this activity, the Naval Surface Weapons Center activity links the technology needs and requirements of the Environmental Protection Agency with applicable technology found in defense establishments across the country.

Navy transfer efforts are closely coordinated with other Department of Defense laboratories and centers through a Department of Defense technology transfer consortium. A consortium membership is composed of some 30 Army, Navy, and Air Force field centers and laboratories. All the principal Navy research and development field centers are included in the membership. The purpose of this group is to provide a forum for the interchange of information on technology transfer activities and to provide a mechanism for coordinating technology transfer activities among the Department of Defense laboratories.

I have mentioned some of the ways the Navy has attempted to transfer technology. These by no means exhaust the list. For instance, we have placed Navy personnel on temporary assignments at other civilian agencies such as the National Institutes of Health, the Environmental Protection Agency and the National Science Foundation to improve the cross fertilization of ideas and to improve interagency dialogue and cooperation. We are also working with the Environmental Protection Agency and the United States Coast Guard in the areas of oil spill recovery and water pollution abatement, areas in which the Naval Ship Research and Development Center is actively involved.

So, you see that we have been active in trying to develop greater civilian utilization of our existing technology base. We need the help of groups like this, we like to hear your ideas on how to improve the technology transfer process so that outstanding problem areas and needs can be more effectively addressed. We solicit your active search for Navy technology. With all of us working together we can be optimistic at this afternoon's Workshop sessions, to provide a beneficial exchange of information and strengthen the National technology transfer effort.

Again, I thank you for the opportunity to speak to this wonderful group and to bring you a little bit on the subject of technology transfer as the Navy sees it. Thank you.

CHAIRMAN

LCDR C. Farrell, Jr., USN

As Program Chairman, I would like to thank CAPT Nelson, CAPT Brown, Mr. Lewis, and especially you, Mrs. Holt for their time, their interest, and their remarks this morning. I'm sure that by their presence they have greatly assisted us in charting our course and ensuring that we achieve our goals.

Before introducing this morning's first speaker, I feel it appropriate to make a few remarks regarding the total scope of the Navy's environmental program. "What is our objective?" might be a very good question to ask first. Very simply stated, the objective of our environmental research program is to develop those procedures and systems necessary for the Navy to meet a whole host of environmental regulations. We are bound to meet the most stringent regulations, whether they be State, County, or Federal. So you can see the task at hand is immense when you consider the scope and the extent of the Navy.

In terms of specific goals of our program, we have these in mind. First of all, technology to meet those specific, unique Navy problems. Secondly, we want to reduce the cost of compliance. The total cost of compliance in the Navy is estimated at well over $1.5 billion. So you can see that research and development has an opportunity to tremendously reduce that figure. The third goal is to reduce the impact on our personnel. As you may know, manpower is a very expensive commodity–it's very expensive on-board ship because with every man goes all the support activity. So, we have to reduce our impact on manpower wherever possible. And, the fourth thing that we are trying to do in our program is to prevent unpleasant surprises. We want to know what we are doing to the environment. We would prefer to know that ourselves, in-house, prior to getting a call from Mr. EPA or Mr. Anne Arundel County that asks "Hey, do you know what you're discharging? Do you know what's going over your fence?" We feel it important that we know those things.

What are the areas where we have developmental programs? Our program includes ship environmental protection, which you will hear a good deal about this morning; an oil pollution program; ordnance disposal and reclamation; aircraft environmental protection; and, environmental protection ashore. For those people who have a need for more knowledge regarding not only the Navy program but the Department of Defense developmental program and environmental protection, I call your attention to Area Coordinating Paper No. 42, entitled Environmental Quality, which was published by the Director of Defense Research and Engineering. This particular document will be in the DDC Center within the next month.

I should like to point out that although this is the first formal technology transfer session that we have had in the environmental program, technology transfer is not new to us in environmental protection. One of the things that was done which has assisted the local

Annapolis Area, occurred when NSRDC hosted a session with the Alderman and the town fathers from the Eastport Area regarding a reduction of wastes in streams. We have for a long time cooperated with MARAD and other agencies and it was that cooperation that led to the design of the oil water test facility at the National Maritime Research Center in Galveston.

The environmental data base development program that we have in Pearl Harbor has continuously released the information to those people who needed it. The information has been very informative to the town fathers in the Pearl Harbor Area. They are beginning to recognize what the true scope of their pollution problem is; they have been able to put the Navy's contribution in perspective, and now realize that the sugar cane fields have a great impact.

I cannot help but mention the tremendous cooperation that exists at the present time and has existed in the past between the Navy and the Coast Guard.

I would now like to introduce our first speaker from the Environmental Protection Agency, Mr. William Librizzi. Mr. Librizzi received his Bachelor of Civil Engineering in 1958 from Newark College, and a Master of Science in Sanitary Engineering from New York University in 1972. He has been a member of the Environmental Protection Agency and its predecessor agencies for 8 years. He is presently Chief of the Emergency Response Branch. The subject of Mr. Librizzi's presentation this morning will be the Environmental Protection Agency special research program. Mr. Librizzi.

EPA PROGRAM FOR ABATEMENT OF POLLUTION FROM BOATS

Mr. W. J. Librizzi
Chief, Emergency Response Branch
U. S. Environmental Protection Agency, Region II

Thank you. It certainly is a pleasure to be with you to participate in the technology transfer of techniques for handling wastes generated by ships and ship activity. I might note that in that introduction I should add prior to becoming a Member of the Emergency Response Branch, for Region 2 of the Environmental Protection Agency, I was Chief of the Watercraft and Recreational Research Program operating out of Edison, N. J. and part of National Environmental Research Center in Cincinnati. Hence, my background, in regard to treatment technology for vessels.

Editor's Note: At Mr. Librizzi's request, the following previously prepared paper is provided to serve as a summary of his remarks at the seminar/workshop. The paper is an ASME publication and is included herein with the permission of the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, N. Y. 10017. The paper is coauthored by P. B. Lederman and W. J. Librizzi.

REVIEW OF ENVIRONMENTAL PROTECTION AGENCY RESEARCH IN WASTE TREATMENT FOR WATERCRAFT

P. B. Lederman, Director
W. J. Librizzi, Chief, Watercraft Waste Branch
Edison Water Quality Research Laboratory,
National Environmental Research Center,
Environmental Protection Agency,
Edison, N. J.

Standards required by Section 13 of the Water Quality Improvement Act of 1970 for the control of waste from watercraft have been promulgated by the U. S. Environmental Protection Agency (EPA). The standard restricting the discharge of any treated or untreated human waste necessitates the use of retentive devices, recirculating systems, or both. Such approaches dictate a critical analysis for each vessel under consideration. Physical and operational considerations for large craft such as commercial and naval vessels often restrict the use

NOTES:

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of retentive devices. The few proven recirculating systems on the market suggest that research in this area is urgently needed. In June 1971, the National Environmental Research Center, Cincinnati, began a research program at its Watercraft Waste Branch of the Edison Water Quality Research Laboratory in New Jersey. The program is designed to develop and demonstrate new and unique treatment systems for use on commercial freighters, ferries, and recreational watercraft. This presentation describes the recirculating waste treatment systems that have been successfully evaluated onboard an operating vessel. The discussion includes a presentation of the treatment capabilities; reliability; operation and maintenance requirements; limitations; and economics of each system. The suitability of the treated effluent as a flush water and the potential problems associated with continual water reuse are also considered. Finally, the research needed to advance treatment technology in the total area of marina wastewater management is assessed.

INTRODUCTION

Waste from vessels has and is, in most cases, dumped overboard without treatment. Such wastes include sanitary, oil, bilge and ballast, tank washings, and garbage from both commercial and recreational craft. Although these wastes account for only a fraction of the total waste flowing into the marine environment, they are of major concern. Often the vessel is discharged into the cleanest waters—those used for recreation or commercial fishing.

The national concern for control and treatment of wastes from watercraft was formalized in the Water Quality Improvement Act of 1970. Section 13 required the Administrator of EPA to promulgate standards for marine sanitation devices. It further required EPA to carry out Research, Development and Demonstration (RD&D) efforts to develop suitable devices. In June 1972, as a result of extensive hearings, a "no-discharge" standard was established (1).[1] New vessels are to comply with the standards within 2 years and existing vessels, within 5 years. The standards also provide incentives to achieve a "cleaner" discharge now. Enforcement is delegated to the U. S. Coast Guard, and the 1972 Water Quality Inprovement Act charges the U. S. C. G. to carry out further research on sanitation systems for installation on vessels. At the same time, EPA is to carry out RD&D for land-based pump-out and treatment systems. Detailed discussions of the implications of these acts have been previously presented (2–5).

In the past 2 years, the Watercraft Branch of the Edison Water Quality Research Laboratory, a division of the National Environmental Research Center in Cincinnati, has been developing several systems to handle marine sanitary waste (Table 1).

[1]Numbers in parentheses designate References at end of paper.

Table 1 EWQRL Program in Marine Sanitation

Contractor (Subcontractor)	System Type	Capacity crew/gpd	Installation	Status
Ocean Science & Engineering	Recirculation chemical	60 –	Alcoa Seaprobe Research Vessel	Project demonstration completed. Final report is in publication.
Cleveland Cliffs Iron Co. (Thiokol Chemical)	Flow-thru Physical-chemical	30 3000	Cliffs Victory Ore Carrier	Shipboard demonstrating nearing completion. Final report anticipated in September 1973.
Delaware River & Bay Authority (Maryland Environmental, Inc.)	Flow-thru; recirculation Physical-chemical	– 5000	Cape May-Lewes Ferry	Project demonstration completed. Final report is in publication.
Fairbanks-Morse	Recirculation Physical-chemical	[illegible] –	Corps of Engineers Dredge "Mac Kensie"	Shipboard demonstration nearing completion. Final report anticipated in June 1973.
General American Transportation Corp.	Flow-thru; Physical-chemical	20 700	Corps of Engineers Dredge "Ros"	Laboratory testing completed. Final report is in publication.
Thiokol Chemical Corp.	Flow-thru; recirculation Physical-chemical	4–10 –	Houseboat	Shipboard demonstration underway. Final report anticipated in July 1973.
Westinghouse	Recirculating toilet	4– 6	Westinghouse research craft	Shipboard demonstration nearing completion. Final report anticipated in August 1973.

Originally, the concept was to reduce the coliform levels in the discharge to a low, acceptable level of 240/100 ml, the Biochemical Oxygen Demand (BOD) to 100 mg/l, and suspended solids (SS) to 150 mg/l. An overall goal of 50 mg/l BOD and SS in the discharge was considered for each system. This was based on the assumptions that some discharge would be: (a) economically necessary and (b) ecologically and legally acceptable. These assumptions were based on preliminary evaluation and the initial draft regulation (6).

In June 1972, the final standard was issued. It provides for "no discharge" in all vessels; for many existing ships, a reduced discharge is expected as a result of the incentive provisions (1). As a result of the no discharge requirement, the emphasis of the program was shifted to systems that would recycle the water and have no overboard discharge. Three of the seven flow-through systems then under study were re-engineered to meet this new goal. The remaining four systems were terminated after completion of development and laboratory evaluation.

An analysis of the various systems described here indicates that although most had mechanical problems, several can meet the "no-discharge" requirement.

OCEAN SCIENCE AND ENGINEERING

The Alcoa Seaprobe, a 600-ft research vessel, was equipped under an EPA grant with the Elsan Yarrow recirculating treatment system shown in Fig. 1 (7). The major equipment is listed in Table 2. Waste from a crew of 50 is received in the chemical dosing tank where calcium hypochlorite and sodium hydroxide are added. From the dosing tank, the waste passes into the chemical mixing-settling tank. Here the chemicals are brought into intimate contact with the waste. Recirculation between the chemical mixing compartment and chemical dosing tank assures adequate contact time. Solids and organics are hydrolyzed by the caustic, while the chlorine provides oxidation, improved color, and destroys bacteria. The partially treated waste overflows a weir into the settling compartment where residual solids are allowed to settle. The effluent then passes through a fine screen before it is recirculated

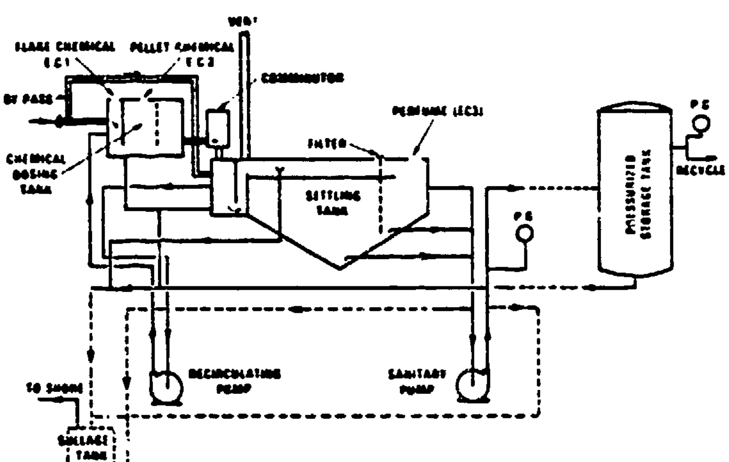

Fig. 1 Elsan-Yarrow sewage treatment plant ocean science and engineering

Table 2 Ocean Science and Engineering, Inc. Elsan Yarrow Waste Treatment System Components

Equipment	Size
Chemical dosing tank	50 gallon
Chemical mixing/settling tank	350 gallon
Sullage tank	500 gallon
Hydraulic accumulator	27 gallon, spherical; 24 3/4 in.; 50 psig operating pressure

A 50-psi bladder diaphragm accumulator maintains an available supply of flush water at the desired pressure. A sullage (sludge) tank is provided to retain any settled solids until onshore disposal is possible.

A two-month demonstration aboard the Alcoa Seaprobe illustrated that the system can provide a generally acceptable quality effluent that can be used as flush liquid. No discharge is, therefore, necessary. There were, however, difficulties that resulted in greater-than-expected maintenance of the plant and the ship's toilet. Equipment malfunction often encountered necessitated system shutdown and repair. The high caustic level of the treated waste water resulted in corrosion to various points in the system. Pumps required extensive weekly maintenance. The impeller was replaced once during the demonstration. The caustic also affected the ship's plumbing fixtures and piping. The toilet bowls required daily maintenance to prevent the buildup of a caustic crust.

Operating data collected during the demonstration indicate that the cost, primarily for chemicals, is about $27 per day or $815 per month. This is based on calcium hypochlorite and sodium hydroxide requirements of 10 to 11 lb per day.

Normal maintenance of the system requires from 1 to 4 hr per day. This maintenance includes toilet bowl cleaning, the replacement of pump impeller when needed, and frequent system flushing and recharging. A major time consumer was the hand cleaning of the chemical dosing screen that had a hard calcium cake buildup.

The most serious difficulty encountered during the demonstration was the buildup of color and odor in the flush liquid. The rapid change in color from clear to yellow was objectionable to the crew. The flush liquid deteriorated so rapidly, the system had to be flushed every 10 days. This color change resulted from organic components in the wastewater that were not totally oxidized by chemical treatment. The increase of the chemical feed above that recommended by the system manufacturer did not improve the situation and, in fact, accelerated the corrosive aspects of the liquid.

A modification to the system was recommended by Elsan Yarrow to improve treatment effectiveness and significantly reduce color. This modification consists of a bar screen in the chemical mixing tank to improve separation of liquid-solids. It was installed on the Alcoa Seaprobe after the EPA demonstration and onboard a Corps of Engineer vessel utilizing a similar treatment process. Reports from the Corps and Alcoa Seaprobe operators indicate that the modification has improved the quality of the flush media and decreased the maintenance requirements. Length of operating time between system flushing and recharge has been increased to 5 weeks. Odor has been significantly reduced. Color, however, was not completely eliminated by this modification. Sampling of the solids in the sullage tank indicates that shoreside solids disposal should be given particular consideration. Waste from the sullage tank is extremely high in chemicals, suspended solids, and organic constituents and has a pH greater than 12. Such waste may require preliminary treatment before disposal at conventional treatment systems.

CLEVELAND CLIFFS IRON CO.

The Cleveland Cliffs Iron Co., Cleveland, Ohio, and Thiokol Chemical Corp., Brigham City, Utah, are conducting, under an EPA grant, a performance evaluation of a physical-chemical treatment system onboard the Great Lakes Ore Carrier, "Cliffs Victory." The system, shown in Fig. 2, will treat the sanitary, galley, laundry, shower, and washwater wastes of the 30-man crew. The major components are listed in Table 3.

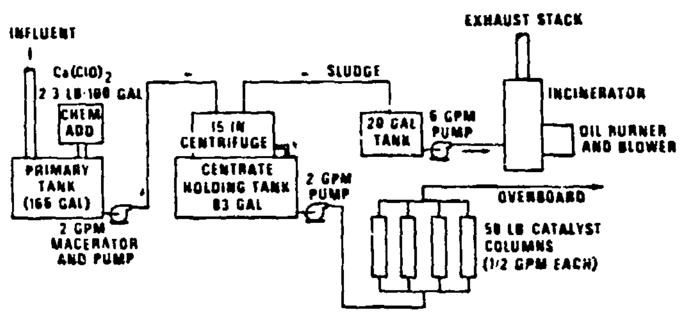

Fig. 2 Sewage treatment system (aft) – "Cliffs Victory"

Table 3 Cleveland Cliffs Iron Co. Thiokol Waste Treatment System Components

Equipment	Size
Hydrasieve	C. E. Bauer, 50 gpm
Primary tank	166 gallons
Centrifuge	DeLaval basket type, 2 gpm
Centrate tank	83 gallons
Catalyst columns	50 lb. alumina-metal oxide
Sludge tank	20 gallons
Incinerator	4 gal per 8 hr @ 8% solids

Wastewater enters the treatment system through the Hydrasieve where solids are removed by the self-cleaning, non-clogging, stainless-steel screen. The partially cleaned waste collects in the primary tank; calcium hypochlorite is added at a rate of about 500 gm/50 gal influent. Level sensors activate a 2-gpm pump which delivers the screened wastewater to the centrifuge. The centrifuge effectively removes the majority of SS, grease, and oils from the waste stream. The centrate collects in an 83-gal tank for controlled feed to the 50-lb catalyst columns. Here, final treatment by chemical oxidation reduces the BOD and coliform to design levels, i.e., 50 mg/l and 240/100 ml, respectively. The columns are steam heated to optimize the oxidizing reaction of the chlorine. Solids from the Hydrasieve and centrifuge are retained in a 20-gal tank and periodically destroyed in the on-deck incinerator.

Shipboard testing on the Cliffs Victory was initiated in late June 1972 and temporarily ended when the vessel was deactivated in December 1972. The system, during this period, operated in automatic mode with only minor equipment malfunction. Equipment servicing required a minimal one hour per day. Operating costs were $3 per day.

Galley waste, however, presented several problems that affected system effectiveness, reliability, and maintenance. Specifically noted during the demonstrations were the large quantities of oils, fats, and grease accumulated in collection tanks that required manual removal. Accumulated grease on the Hydrasieve also reduced its effectiveness. A grease trap in the galley waste line will reduce or eliminate this situation. Broken glassware, washing pads, egg shells, etc., entering the system caused excessive wear of system's components, particularly the macerator and incinerator feed pump. These materials should be segregated from the waste system and disposed of in the existing trash incinerator. Larger than anticipated flows from the galley caused hydraulic overload of the Hydrasieve, thus reducing its effectiveness; a larger capacity unit is necessary if flow cannot be reduced by conservation practices. Larger than anticipated food wastage resulted in sludge tank overload. Again, redesign will be necessary to increase tank size. Finally, the high BOD from detergents, greases, and other organics significantly increased the strength of the incoming waste above design levels and resulted in higher than desired effluent BOD and SS. BOD and SS before galley input ranged from 48 to 890 mg/l and 124 to 850 mg/l, respectively. The range increased after galley input to 420 to 5700 for BOD and 193 to 8500 for SS. Effluent BOD and SS also increased after connection of galley ranging from 55 to 314 mg/l (average 144 mg/l) and 32 to 175 mg/l (average 78 mg/l), respectively, as compared with 27 to 254 mg/l (average 109 mg/l) and 4 to 52 mg/l (average 25 mg/l).

An analysis of the data also showed a gradual buildup in effluent BOD and SS with time. Critical examination of the equipment during the winter design period showed that the catalyst columns were plugged with calcium carbonate deposits, which reduced the contact time. Deactivation of the catalyst was also evident. In addition, indication of corrosion within the catalyst was observed.

Redesign to eliminate the problems associated with the catalyst and galley inflow and improve system operation was accomplished during winter 1972-1973. Testing during 1973 shipping season will fully assess the effectiveness of these modifications.

The Cliffs Victory project also included a subsystem to handle the sanitary waste for the crew stationed on the ship's forward section and a subsystem to handle the forward and aft section shower water and wash water.

The forward system consists of Hydrasieve, filter-incinerator, catalyst reactor, and disinfection. The filter-incinerator is the key to this treatment system. It is made of a glass-cloth filter that removes the majority of solids from the Hydrasieve effluent. The accumulated solids are periodically destroyed by an oil-fired burner that heats the filter-cloth bed to a temperature in excess of 1000 F. The solids from the Hydrasieve are also destroyed in the filter. Laboratory testing proved that the filter-incinerator can effectively remove and destroy suspended solids. Several aspects of the unit (instrumentation, design filtration rate, burner feed, etc.) required extensive research. Shipboard installation and testing were deferred because of this additional research effort and the EPA no-discharge standard.

The shower wash water consists of a primary holding tank and electrolytic cell, "PepCon," manufactured by Pacific Engineering and Production Co. The PepCon, designed for 5-gpm flow, requires a current of 100 amps to produce about 10-lb chlorine disinfectant per day. The treated wastewater is collected in a baffled contact tank for 30-min. detention time to allow bacterial destruction. Evaluation of the shower treatment system will be completed during the 1973 sailing season.

DELAWARE RIVER AND BAY AUTHORITY

A project sponsored by EPA and the Delaware River & Bay Authority in cooperation with Marland Environmental Systems, Inc., developed and evaluated a 5000 gal/day flow-through physical-chemical treatment system onboard the Cape May-Lewes Ferry (8). The system, shown schematically in Fig. 3, consists of commercially available components, listed in Table 4. The system provides a high level of treatment yielding an effluent with less than 50 mg/l of BOD and SS and total coliform less than 240 organisms per 100 ml. The system was also evaluated as a recirculating system to determine its potential for meeting the EPA no-discharge standards.

Fig. 3 Delaware River and Bay Authority

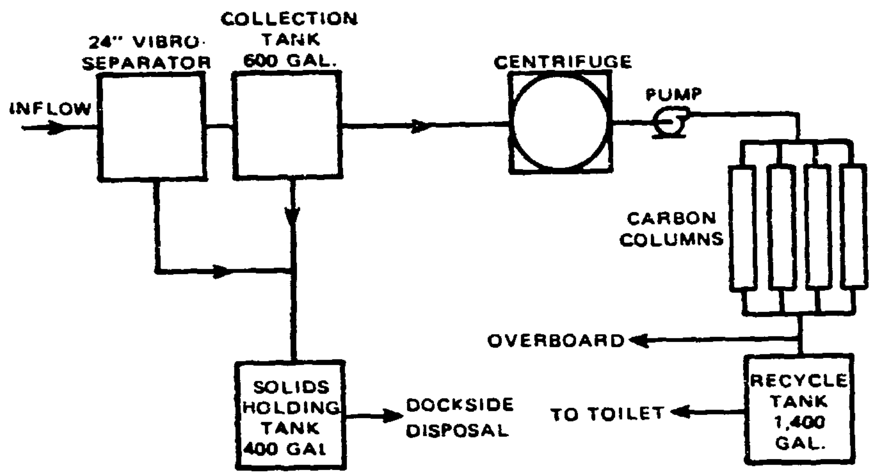

Table 4 Delaware River and Bay Authority Maryland Environmental System, Inc. Waste Treatment System Components

Equipment	Size
Gross solids separator	SWECO Vibro-separator, 24 in. with 64 mesh screen
Fine solids separator	Westfalia SA 7-06 Desludger Centrifuge
Carbon Adsorption	4 columns packed bed; downflow; 14 in diameter by 6 ft high; 4 cu ft of Calgon Filtrasorb 300 (8 x 30 mesh)
Tanks	
collection	600 gallons
solids holding	400 gallons
recycle storage	1400 gallons
Electrical production	Hol-Gar Model 33D6-WRD, 120/240 VAC, 3 Ø

Waste from the toilets and concession operation flows through the vibrating screen for gross solids removal. Screened effluent collects in the 600-gal tank, sized to meet anticipated surge flows, for controlled processing through the centrifuge for final solids' separation. The centrate is finally processed through the four columns of activated carbon for dissolved organics removal. The columns operate in series to provide a detention time of 25 min. for the system flow of 5 gpm. The discharge from the carbon columns is treated with 5.25 percent sodium hypochlorite (household laundry bleach) before overboard discharge or recirculation as flush media.

Daily backwashing of the carbon columns is generally accomplished during the vessel maintenance shift. Backwash water is returned to the collection tank for reprocessing through the system. During recirculation, backwash water is discharged overboard.

Solids removed from the liquid flow are stored in the sludge holding tank for ultimate disposal at an acceptable shoreside support facility. During the demonstration, the accumulated solids were disposed of at an approved landfill

Extensive laboratory testing by Marland showed that the flow-through prototype treatment system met the treatment objectives: effluent BOD and SS below 50 mg/l. The treated waste was free of coliform and, aesthetically, appeared clear and odorless. Percent reduction for BOD and SS were: 32 and 31 percent through the vibrating screen, 85 and 57 percent through the centrifuge, and 95 and 82 percent through the carbon columns. Discharge density of the solids collected from the vibrating screen and centrifuge was between 4.5 to 11.6 percent, averaging around 8 percent.

Shipboard demonstration was conducted during the July-September 1972 peak summer season. Tests were conducted on the flow-through and recycle modes of operation. Performance data for overboard discharge followed the laboratory experience. Suspended solids were less than 50 mg/l. Effluent BOD, however, was somewhat higher, ranging from 98 to 150 mg/l. This increased BOD resulted from carbon column exhaustion and inadequate backwashing. A preliminary assessment indicates that improved carbon design and backwash can reduce the BOD to below the design objective of 50 mg/l.

Testing during treated water recycle showed less satisfactory results. The rapid buildup of BOD and ammonia nitrogen caused serious deterioration of the flush media. Color changed from clear to grey, and an ammonia odor developed after 2 to 3 days loading. Suspended solids, however, remained satisfactorily low, around 50 mg/l. Total and fecal coliform were held below 10 MPN/100 ml.

The experience gained during the recycle tests suggest that the successful reuse of treated wastewater will require specific research effort. The feasibility of increased oxidation by chemical addition, ozonation, etc., to control the rate and level of BOD in the flush liquid should be investigated. Methods for removal of nitrogenous compounds should be considered. Initial treatment processes include ammonia stripping and breakpoint chlorination. The handling of backwash water requires re-evaluation. The return of backwash without special attention accelerates the buildup of BOD, particularly the more persistent types.

Throughout the demonstration, the Marland system was operated in automatic mode. Operational attendance was minimal and required no additional crew members. There were no serious malfunctions of any system components even though the ambient temperatures in the engine room, where the system was installed, were between 100 to 106 F.

Initial system costs, based upon the demonstration, include $40,000 for system hardware and $26,000 for installation, including ship modifications. Operating costs were $200 per month for the peak July-September season and $85 per month for remaining months.

FAIRBANKS MORSE

The Fairbanks Morse (Colt Industries) shipboard sewage treatment system developed and demonstrated under EPA contract is a physical-chemical low-volume flush recirculation system for a crew of 20 to 25 men (9). The system, consisting of gross solids separation, flocculation and paper filtration, carbon adsorption, disinfection, and incineration of solids, is shown schematically in Fig. 4. The major components are listed in Table 5. The system is designed to handle large fluctuations of flow aboard the ship. High-pressure (100-psi), low-volume flushing included as part of the system reduces the water volume used for each flush, hence reducing treatment plant size. Toilet flush was set at 1 1/2 to 2 gal, and urinal flushes were set at approximately 1/2 gal. Recirculation based upon demand eliminates the possibility of flooding individual components, which is a problem in uncontrolled flush water systems.

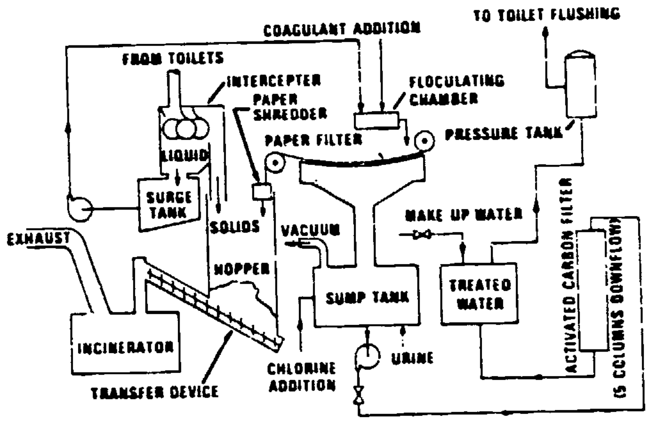

Fig. 4 Fairbanks Morse toilet waste treatment system

Table 5 Fairbanks Morse Waste Treatment System Components

Equipment	Size
Interceptor	Rotary disk, 1 gpm
Surge tank	100 gallons
Paper filter feed pump	1/4 gpm
Paper filter	Rochester Paper Co. 1121-15 1 months supply per roll
Vacuum filtrate tank	40 gallons
Carbon feed pump	Moyno, 1/4 gpm
Active carbon columns	5–6 in. diameter columns, 44 in. deep Westvaco WVL
Treated water tank	80 gallons
Incinerator	330 stainless steel; operating temperature 1200°F; oil fired; 3 gal/day

Wastewater from the ship's toilet are first passed through a rotary-disk interceptor, which separates and accumulates the gross solids in the transfer device hopper. The partially treated liquid is collected in the 100-gal surge tank and pumped at a constant rate (1/4 gpm) through the flocculation chamber to the paper filter. Calgon 2640 is used as the flocculant. The V-shped paper filter, consisting of a continuous strip of paper (Rochester Paper Co. 1121-15) traveling at a controlled rate, removes the remaining solids. The paper with the separated solids is shredded and delivered to the transfer device hopper. The filtered liquid is then processed through the five activated carbon columns to remove color and dissolved BOD. The highly treated liquid is finally disinfected with calcium hypochlorite before recirculation through the pressure tank as flush water. A small amount of the flush water is removed each day to prevent the gradual buildup of residual impurities. Fresh water is added to replace the withdrawn treated water.

The separated solids are periodically fed to the incinerator for ultimate destruction. The incinerator, which operates at temperatures around 1200 F, consists of a cylindrical tub chamber with an interior agitator to keep the solids exposed to the high-temperature gases. The tub, fabricated of a 330 stainless-steel inner shell and a carbon steel outer shell, is insulated to maintain satisfactory outside temperatures. Spent paper and exhausted activated carbon (one column per week) are also destroyed in the incinerator.

System controls are designed to give automatic operation. Level control sequences, relays, and safety controls protect the system from malfunction.

The complete unit cost is estimated between $27,000 to $39,000. Major redesign can reduce the cost, depending on production volume, to between $19,500 to $28,000. Cost to install the system onboard the test vessel, Corps of Engineer Dredge "A. MacKenzie" was $26,000, including piping modifications. Operating costs, which include power, fuel oil, filter paper replacement, carbon, chemicals, etc., are estimated at about $3 per day.

Extensive laboratory monitoring over 6 months operation showed that the system reduced SS and BOD by 99 and 95 percent, respectively. These tests also indicated that urine in the waste gradually decreases the system's BOD removal efficiency; this suggests a buildup of certain organic constituents that are not readily removed by the treatment process. The quality of the flush water did not, however, deteriorate but remained generally clear and odorless. A slight ammonia odor and bluish color was occasionally detected. Initial operation of the system onboard the MacKenzie confirmed laboratory results. Recircualted flush water during the initial three months' loading remained in excellent condition.

Operational problems requiring system shutdown for redesign and hardware development were, however, experienced. The most significant problem was the repeated jamming of the transfer device during heavy use periods. Additional work in the Fairbanks Morse laboratory developed modifications which appear to have solved the problem. Shredder speed was increased to cut the filter paper and separated waste into smaller chips. Modifying the inlet portion of the conveyor screw should relieve the potential for paper jamming. In addition, the incinerator burn cycle was increased to reduce the accumulation of material in the transfer device. Although the transfer device deficiency appears corrected, the device will be closely monitored during the course of shipboard evaluation.

Laboratory and shipboard operation indicates that maintenance procedures are needed to ensure unnecessary system breakdown. Lubrication of gear motors, drive chain, etc. should be conducted on a routine basis. Replacement of high-temperature components in the incinerator will be necessary. In addition, a schedule for replacing paper, carbon, and chemicals must be established to meet the particular shipboard waste situation. Maintenance manhours are estimated at 37 per month or about 1 man-hour per day.

The Fairbanks Morse system evaluation also includes investigating the effectiveness of automatic effluent monitoring. A Biospherics suspended solids meter model No. 54, including a chart recorder, was installed to automatically analyze and record the effluent SS concentrations. Results of laboratory analysis will be compared with the instrument data to determine if readouts are reliable under shipboard conditions. With proven reliability, an assessment will be made to determine if automatic monitoring, improves operational control and provides a means for immediate system check-out. Limited data thus far collected indicate that the instrumentation can provide accurate SS measurement while operating in the shipboard environment.

GENERAL AMERICAN TRANSPORTATION CORP.

A two-stage system for treating wastewater was developed and laboratory tested by General American Transportation Corp (10). Fig. 5 shows the system, while Table 6 describes each major component. The primary stage utilizes a unique hydrophilic filter for suspended solids removal. It is designed to separate solids larger than 30 microns (μ). The secondary system employs carbon adsorption and disinfection.

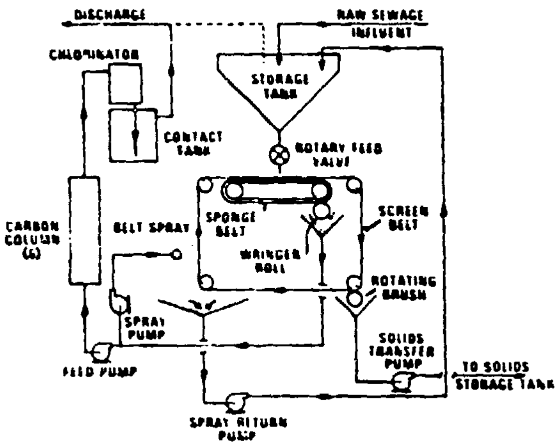

Fig. 5 Watercraft moving screen waste treatment system

Table 6 General American Transportation Corporation Waste Treatment System Components

Equipment	Size
Incoming storage tank	200 gallons, 30 in. H x 29 in. W x 72 in. L
Rotary feed valve	1.5 gpm; 1/40 HP drive motor
Moving screen filter (MSF)	30 in. H x 30 in. W x 36 in. L, process rate–1.5 gpm, belt speed–8 ft/min
Carbon column	6 each upflow; 6 in. dia.; filter sorp.–400, 120 lb.; feed rate–5 gal/ft^2/min @ 1 gal/min
Disinfection unit	Modified commercially available tablet feed unit

Waste is collected in the 200-gal influent storage tank. The rotary feeder, which passes solids greater than 2 in. in diameter, controls the feed to the Moving Screen Filter (MSF). The MSF screen belt, fabricated of polypropylene fabric and driven by timing belts and a chain drive motor, filters out the solids greater than 30 μ. The filtered liquid is pulled through the screen by the hydrophilic action of the sponge assembly underlying the screen. This assembly is fabricated of a cellulose sponge attached to a single-ply, dacron cord endless belt. The separated solids are scraped from the belt by a rotating brush and transferred to the solids storage tank. Liquid collected on the sponge is removed by a wringer roll and subsequently treated by the six carbon columns arranged in series. Finally, the effluent is passed over the specially designed chlorine tablet feeder for disinfection and overboard discharge.

The system was extensively evaluated at the General American Research Division facilities. Human waste from the men's washroom was diverted to the treatment system for processing. After each treatment stage, the percent reduction and final concentration of SS and BOD were determined.

Initial testing showed that the system, without chemical addition, produced a final effluent with BOD and SS ranging from 121 to 440 mg/l and 73 to 211 mg/l, respectively. Percent reductions were considerably less than the 90 percent design objective. Inflow into the system during this period contained BOD on the order of 640 mg/l and SS, 900 mg/l.

In an effort to improve system efficiency, a variety of chemicals were investigated. Calcium hydroxide ($Ca(OH)_2$) addition to increase pH to 11.0 to 11.5 was the most effective of the chemicals investigated. Test feedings of about 3 lb/100 gal $Ca(OH_2)$ showed excellent BOD and SS reduction. Effluent BOD and SS were 10 and 80 mg/l, respectively, which represented 96 and 98 percent reductions. Other chemicals tested, such as sodium hydroxide, American Cyanamid-Manifloc 251-C, and Rohn and Haas Premafloc C-7, could not produce similar results and often resulted in carbon column plugging.

The system was also evaluated using a multimedia hydramation filter (HMF) between the MSF and carbon column to reduce the SS content entering the carbon column. Results showed that the system performance with the HMF was significantly improved. Effluent BOD and SS averaged 130 and 92 mg/l, respectively. The HMF, however, needed frequent backwashing, often two to three times per day.

Experienced gained during laboratory testing indicates that the service life of the screen and sponge is about 2 months; carbon replacement averages 60 lb/month; lime usage varies from 1 to 3 lb/100 gal of sewage processed; power will be about 14 kwhr per day; and monthly operating costs are about $100 per month.

After the laboratory assessment and the EPA no-discharge ruling, Phase II (shipboard installation and evaluation) was abandoned and the project is complete. The laboratory evaluation showed that high level treatment can be achieved by the unique hydrophilic concept and carbon adsorption. Several areas of continued research to refine system design and operation were suggested: (a) preliminary treatment with the compact hydrophilic unit may be improved by changing the screen mesh size to 20 μ; (b) two units in series enhance both treatment and operation; and (c) effective treatment unit between the MSF and carbon columns should be provided to limit the SS inflow into the carbon columns.

THIOKOL CHEMICAL CORPORATION

Thiokol Chemical Corp. has developed a wastewater treatment system for use onboard recreational watercraft (11). The system can also be used on commercial craft, such as tug-boats and workboats. The laboratory tested flow-through and zero discharge concepts are illustrated in Figs. 6 and 7. The zero discharge system will be fully evaluated during the 1973 boating season. Major components are detailed in Table 7.

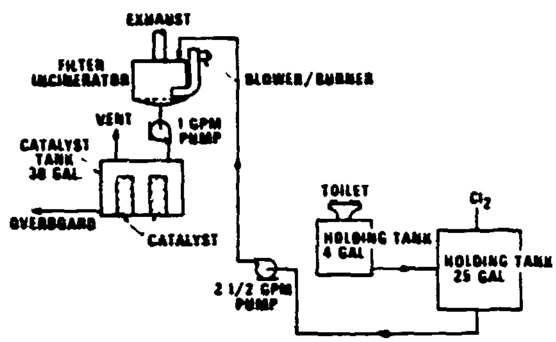

Fig. 6 Flow-through – flowsheet
Thiokol – houseboat

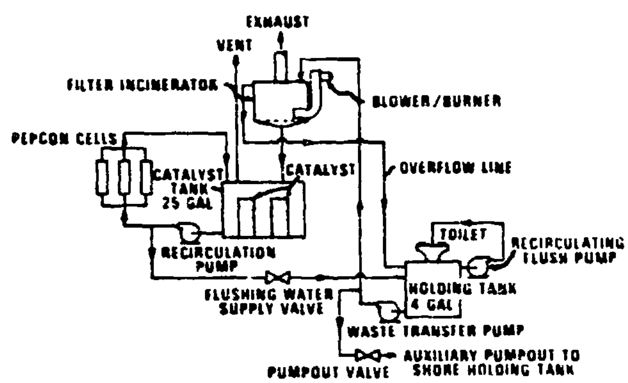

Fig. 7 Zero discharge flowsheet
Thiokol – houseboat

Table 7 Thiokol Chemical Corporation Waste Treatment System Components

Equipment	Size
Flow-through Concept	
Filter-incinerator	Flat filter, tubular refrasil 5 gpm/SF
Holding tank	25 gallons
Feed pump	2 1/2 gpm
Catalyst pump	1 gpm
Catalyst tank	30 gallons
Zero Discharge Concept	
Holding tank	4 gallon
Blower/Burner	1/2 gallon per hr gasoline
Filter-incinerator	5 gal per sf
Catalyst tank	30 gallons
Recirculating pump	1/20 HP 5 gpm

The Thiokol system consists of an advanced filter-incinerator design that provides solids separation and chemical oxidation and disinfection. Liquid sodium hypochlorite or dry calcium hypochlorite is used in the flow-through system. In the zero-discharge mode, hypochlorite is generated by a "PepCon" electrolytic cell, manufactured by Pacific Engineering and Production Co. A chemical catalyst is provided to accelerate the reaction between the chlorine and the dissolved and colloidal organic material. The catalyst also insures that the chlorine residual is sufficient to maintain the aesthetic and bacterial quality of the flush liquid.

About once per day, the solids removed by filtration are incinerated on the filter bed. This process requires about 1 hr.

Laboratory testing initially evaluated the flow-through system performance. Prior pilot research provided the data needed to select the filter material and optimum filtration rates, determine the type and effectiveness of catalyst, and establish the design for the burner assembly. Forty-five batches of highly concentrated sewage (SS ranged from 1000 to 7880 mg/l and BOD ranged from 2000 to 3000 mg/l) were processed. Each batch consisted of 15 gal of waste, which represents the anticipated loading for a small watercraft. Typical results illustrate that significant reduction in BOD and SS, generally greater than 90 percent, can be achieved by the system. Suspended solids were reduced in most batch tests to 50 mg/l or less. BOD was reduced, after catalytic treatment, to between 66 to 327 mg/l.

The incineration process proved effective. Each incineration cycle took 45 min. and used 0.5 gal of gasoline. During all incineration cycles, odor was not detected in the vicinity of the equipment or from the stack. Visible discharge of smoke or particulates was minimal. The tests also showed that an exit temperature of greater than 800 F is necessary to assure complete combustion.

The zero discharge system was evaluated for about 90 days without replacement of the flush liquid. The analytical data indicated a gradual buildup of BOD with an apparent stabilization at concentrations of about 1000 to 1500 mg/l. Suspended solids were generally maintained at around 100 to 200 mg/l. Visually the treated flush water contained no color, appeared slightly cloudy, and had a non-objectionable chlorine odor. Several transmittance tests demonstrated the color removal capabilities of the system. Incoming concentrated waste showed a transmittance of 5 percent. After filtration and 3 hr of chlorine contact the transmittance increased to 22 percent; after 5 hr, 50 percent; after 8 hr, 60 percent; and finally 91 percent after 35 hr.

The incinerator, as in the flow-through tests, functioned without problems. Incineration time for combustion temperatures of 1050 F was 15 min. The residual ash was easily removed with a small, hand-held vacuum cleaner.

Laboratory testing, although showing that both operational modes are satisfactory, indicated several areas that require additional laboratory and specific shipboard investigation. The substances responsible for BOD buildup in the system liquid will be determined and the process redesigned to control this buildup. Flush water monitoring will be expanded to include virus identification as well as coliform analysis. Shipboard testing will include both gravity and vacuum filtration. The replacement of the PepCon cells with manual or automatic dispensing of calcium hypochlorite has been tested in the laboratory and will be further evaluated onboard the vessel. Chemical usage based upon actual loading conditions will be determined.

WESTINGHOUSE

The Westinghouse recirculating treatment device, Fig. 8, developed under EPA contract, provides effective waste disposal for recreational and similarly sized watercraft as well as for shoreside areas, such as recreational sites, piers, and lighthouses remote from support facilities. Equipment details may be found in Table 8 (12).

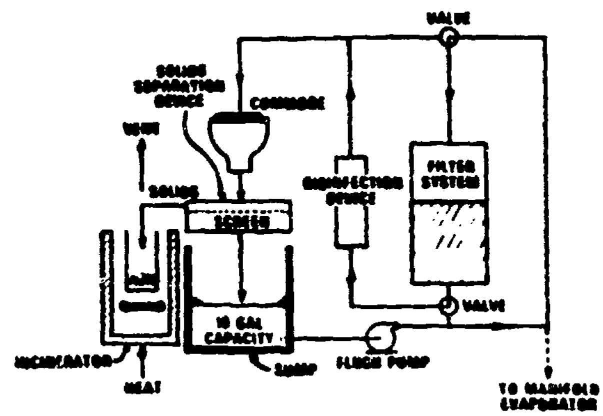

Fig. 8 Westinghouse on-board treatment device

Table 8 Westinghouse Corporation Waste Treatment System Components

Equipment	Size
Traveling-spring screen	16 1/4 in. steel springs
Liquid sump	8 gallon maximum capacity
Flush pump	Teel Model 1P809 1/10 HP
Carbon filter	0.5 cubic feet
Electric incinerator	6 in. x 7.5 in. x 14.5 in. stainless steel with 1/2 in. Kaowool

The Westinghouse device, similar in size to a conventional commode, provides liquid-solid separation, incineration of separated solids, and purification of liquid for recirculation as flush water.

From a user standpoint, the device is operated similarly to the household commode. Waste is removed from the bowl by a stream of flush water. The flushed waste immediately falls onto the traveling spring screen where solids greater than 20-mesh size are separated and conveyed to the incinerator. The liquid flowing through the screen accumulates in the sump until the next flushing sequence. With the next flush, the flush pump draws liquid from the sump, and after treatment with activated carbon and calcium hypochlorite, it is used as flush water. The activated carbon removes colloidal particles not separated by the springs and adsorbs dissolved organics in the water. The addition of calcium hypochlorite insures that the flush water is free of bacteria and improves the color of the liquid. Once each day, the solids accumulated in the incinerator are electrically burned to an inert ash. The burn cycle con' .. d by a timer is complete in about 1 hr. A total of 0.9 to 0.95 kwhr per day is needed to destroy the solids generated by four people.

There is a provision to backwash the carbon column. A simple adjustment of two three-way valves reverses the flow upward through the system to the bowl.

Extensive laboratory and shipboard testing has demonstrated that the Westinghouse waste treatment device can effectively treat human waste and provide an aesthetically acceptable recirculating flush media. The device was capable of handling over 46 man-days of usage without discharge to shoreside support facilities. The spring screen was effective in removing the greater portion of the solids. Subsequent treatment with the carbon columns reduced the SS level to around 60 to 100 mg/l. As would be expected, continued data showed a buildup of BOD generally leveled at about 1000 mg/l. This trend generally occurred after about 200 urine and 60 fecal flushes.

The small incinerator functioned well and successfully destroyed the separated solids. Volatiles in the ash samples varied between 4 to 34 percent. Ash particles were generally less than 1/8 in. dia. Testing also showed that optimum operating temperature should be controlled at about 1000 F. Odor control was achieved with a minimum afterburner temperature of 1400 F. An air blower to provide suction on the vent stack was required for odor and smoke control.

Throughout the evaluation, the greatest problem was color development in the flush liquid. The source of color was not fully resolved, although a preliminary investigation suggested that compounds in the urine, such as urobilin or nitrogen trichloride, were the primary cause. Laboratory work demonstrated that the color can be properly controlled by the chlorine and carbon treatment. Adequate chlorine should be available to react with the color producing constituents. In addition, adequate carbon filtration and adsorption was needed. A 25-μ Cuno felt filter was also added upstream of the carbon to filter out larger solids.

Operation and maintenance of the device throughout testing was minimal. For example, during the 30-day prototype testing, the system was out of operation for only 4 hr to permit maintenance.

From a cost standpoint, first cost has been estimated between $500 to $600 with an operating cost of $1.50 per day.

Ozone in place of chlorine was investigated during the laboratory phase. A Purification Sciences Incorporated Model LOA-2 ozone generator, which produces 2 percent ozone in dry air, was connected to the laboratory model of the treatment device. Promising test results showed that 5 gm of ozone introduced into the flush liquid effectively eliminated the yellow color and destroyed bacteria. In addition, BOD buildup was significantly lower than than that found with Calcium Hypochlorite and carbon treatment. Additional work on the feasibility of using ozone on a small scale is planned for the 1973 sailing season.

Several systems with promise of meeting the sanitary discharge standards for small and medium vessels are under development and have, in part, been demonstrated. Most of the projects, begun as flow-through systems, had sufficient flexibility so that they could be and were adopted to meet a no-discharge standard.

The picture is, however, not a total success. As with most developments of an advanced type, problems remain. The most critical is the color and odor of recirculating water. It appears that with sufficient and properly designed chemical and adsorptive capacity, this problem can be solved; actual demonstration is required. Complexity and high maintenance requirements plague the systems and will require: (a) modifications to meet the latter, and (b) second generation designs to answer the former.

EPA expects to continue work on shore-based pump-out facilities. Work in this area is already underway. The onboard treatment systems will continue to receive the attention of the U. S. Coast Guard.

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SEWAGE TREATMENT DEVICES ON GREAT LAKES CARRIERS

Mr. R. C. Dedrickson
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Maritime Administration

I was delighted to receive the kind invitation to come here to speak at the Naval Academy after an absence of nearly 20 years, since my graduation in 1955. I thought perhaps I could talk about the Gross National Product or domestic problems, or perhaps the U. S.-flag merchant marine or even the Great Lakes shipping industry, with which I am directly involved as an employee in the Division of Great Lakes Shipping in the Maritime Administration.

When Mr. Singerman advised me that he wanted me to talk about marine outhouses, I was overwhelmed by the opportunity to discuss all of these subjects at one time. To be sure, pollution is our most gross national product. Pollution causes some of our biggest domestic problems. It has significant impact on the U. S. Merchant Marine and an even greater impact on the Great Lakes shipping industry, which operates on the world's greatest supply of fresh water.

My primary concern today is to describe some of our problems associated with pollution caused by marine sewage and some of the methods we have tried to solve these problems in our efforts to reduce pollution in the Great Lakes.

In 1972, the Environmental Protection Agency published standards relating to the acceptable quality of effluents produced by marine sanitation devices. In essence, this standard called for no discharge systems with some provisions for use of flow-through devices in certain instances if approved by the Coast Guard at some later date. This may sound confusing, but that is because it is a very confusing problem as I am sure you are all aware. For many months we did not know what quality of effluent was acceptable from flow-through devices because that quality index had not been established, and we are still not sure what it is.

In April of last year, with the cooperation and assistance of the Coast Guard, Environmental Protection Agency, Lake Carriers' Association, Cleveland Cliffs Iron Company and the Navy Department, a project was instituted to develop means of improving the performance of the sewage treatment plants installed on most of the 200 odd U. S.-flag bulk ships. The magnitude of this problem does not appear to be very significant; for example, there are about 10,000 merchant seamen employed on the U. S. and Canadian Great Lakes fleets. This represents a population equivalent to a small community, but distributed over an area covering approximately 95,000 square miles. Simple arithmetic easily reduces this to a population density of about one person per 9 1/2 square miles. These regulations did not treat the shoreside community sewage treatment systems, with effluents flowing into the Great Lakes, with the same severity as it did the marine industry. Nor did these regulations consider that the major commodities carried by these ships comprise most of the raw material used by the steel industry. Since the steel industry is so important to this nation, this aspect magnified our problem immensely.

The average age of the ships that operate on the Great Lakes is currently about 43 1/2 years. There are several new ships which have been built in the last two years; however, many of these ships are sexagenarians. The financial impact of developing and installing completely new systems on these older ships is prohibitive. The installation of holding tanks for sewage which could be pumped out ashore is not practical because shoreside pump out facilities adequate for ships of this size are nonexistent.

Accordingly, the attitude developed that any significant improvements to the existing systems would reduce the current level of pollution and would represent real progress.

Two basic systems were selected for study: (1) the Macerator-chlorinator type design which collects, mixes, and disinfects sewage and (2) an aerobic digestive system which depends primarily on aeriation and aerobic digest of waste solids for disinfection.

Early this spring a team of technicians from the Naval Ship Research and Development Center, Annapolis, visited the Great Lakes with a mobile laboratory to monitor the operational practice of these systems and to collect, test, and evaluate the relative quality of the effluents produced by these systems. The team spent approximately one week on the steamers, GREENE and STIRLING evaluating these systems. The data collected was returned to the lab for analysis and further study of operational practices and operating procedures. The analysis and review of this data provided several areas for improvements to operating procedures and modifications of the equipment which would hopefully provide for more efficient treatment of the sewage and provide an effluent acceptable to anticipated quality standards. The recommended modifications including piping changes, operational procedures, and addition of an incinerator unit on the GREENE and reduction in hydraulic load coupled with post treatment chlorination on the aerobic digestion unit, were accomplished by Cleveland Cliffs Iron Company last month.

Last week a team of technicians completed testing and operation of the modified system installed on the GREENE. I haven't yet received a complete report, but I have received information by telephone that the results obtained from these modifications appeared to be quite favorable. The team has now transferred to the STIRLING, and is monitoring the operation of the modified aerobic digestive system and should be completed with this task by the end of next week. Hopefully, these efforts have provided modifications to these systems, which are adequate to meet the effluent quality standards that we anticipate, and that these modified systems and operating procedures will receive Coast Guard approval for continued operation.

During the course of these investigations it became apparent that disinfection of pathegons was not the only problem. Removal of suspended solids and the reduction of biological and chemical oxygen demand are also required. The removal of solids has been facilitated by the use of a settling tank with subsequent disposal by incineration in the boiler on the GREENE. Chemical and biological oxygen demand is really only affected by dilution. In April of this year representatives of the Coast Guard, Lake Carriers' Association, Cleveland Cliffs Iron Company, the Navy Department, and MARAD determined that a new technology using ozone for disinfection of sewage might be highly desirable. Further investigation determined that the use of ozone as a disinfectant might provide an increased bacterial kill with excellent reduction in biological and chemical oxygen demand and would add no hazardous chloride compounds to the fresh water in the Great Lakes.

A project to develop a system for effluent disinfection is currently underway as an extension of the previous work on the GREENE and STIRLING. This system is being designed and manufactured here in Annapolis and will be tested shoreside this winter to develop operational procedures prior to installation on the GREENE next spring. After this unit has been operated on the GREENE, we plan to install it on the STIRLING to replace the chlorinator that was added to the aerobic digestion unit.

I would like to point out before I close that no real new scientific break-throughs have been achieved but that the results we have achieved thus far have been facilitated through mutual cooperation of government and industry. Instead of the atmosphere of competition that sometimes prevails, I am sure that same spirit of mutual cooperation and the sharing of knowledge and the open discussion of mutual problems shared by all of us here today will benefit us all.

THE COAST GUARD SHIPBOARD RESEARCH AND DEVELOPMENT PROGRAM

Mr. W. McKay

Assistant Chief, U. S. Coast Guard Pollution Branch

Ladies and Gentlemen. The Coast Guard R&D Program consists of five elements, and we have been talking pretty much about only one of those elements. The five elements are: prevention, response, enforcement, abatement, and hazardous materials. Prevention is the most important of these and includes vessel traffic systems to prevent accidents in harbors. The prototype system in San Francisco has proved the concept and systems are now planned for other congested ports. The air deliverable anti-pollution transfer system has proved its ability to off-load a distressed tanker and thus prevent pollution from the spilled cargo. Improved navigational aids, ships structures, personnel training, oil handling standards and vessel discharge standards all contribute to cleaner water. When a spill does occur the Coast Guard with the EPA has the responsibility to see that the spill is properly cleaned up. Normally the spiller, through industrial cooperatives, accomplishes this to the approval of the Coast Guard and the EPA. However, when the spiller is unknown or no local clean-up capability exists, then the Coast Guard response team moves into action with their own equipment. Containment systems have been developed for their use on the high-seas in 20 MPH winds and 5 foot seas and recovery devices capable of picking up 1,000 gal/min are available.

These systems are capable of air delivery and rapid deployment. Disposal of the recovered oil is a local problem usually handled by the local Coast Guard Pollution Officer. Work is underway to develop a response capability for the Arctic. Two series of tests have been conducted demonstrating the present equipment is largely unsatisfactory for that environment and suitable equipment will require development. The Coast Guard is the United States Police Force on the water, charged with the responsibility of enforcing the anti-pollution laws. To effectively accomplish this within the limitations of manpower and funds, remote and insitu monitoring devices are being developed to detect oil spills, and methods of positively identifying spilled oil now assure the responsible party paying for the clean-up.

Discharge standards for oil have been published, controlling discharges to less than a visible sheen. Regulations control discharge piping and also piping hoses and personnel responsible for oil loading and discharging. The International Marine Consulting Organization, IMCO, has established discharge standards for tankers and cargo vessels which will be implemented as soon as suitable test procedures and acceptance standards can be established and proven out in accordance with the law.

Hearings have been held on standards for sanitary devices; flow-through criteria will soon be established and regulations published. Flow-through systems will be acceptable but a zero discharge standard is still the ultimate goal. The Coast Guard as a Ship operator must also meet the oil and water discharge standards and also set an example of compliance. To do this we have conducted research in oil control devices and monitors and in both flow-through and no discharge sanitary devices. The work on oily water separators conducted jointly with the Navy and the Maritime Administration has developed separators suitable for our use. These are cartridge coalescer separators and turbidity type monitors. By controlling the use of detergents and recirculating unsatisfactory discharges we have been able to consistently discharge less than ten parts per million of oil, well below the accepted level for a visible sheen. Monitors and coalescers are now being installed on all Coast Guard ships.

Sanitary devices have been tested for over five years and much has been learned. We now believe that reasonable discharge standards can be met and that no discharge can be accomplished using limited flush systems or by recirculating and reusing the treated water for flush water. Separation and water treatment systems work well and the only remaining problem is a good incinerator.

We have looked at the problems of solid wastes and air pollution. For the Coast Guard, solid waste is not a serious problem, as most voyages are of short duration and solid waste can be returned to port. For some vessels, compaction will be required to conserve space and to assure sanitary storage. Stack discharges have been measured and the causes of air pollution identified.

Work is underway at the Department of Transportation R&D center to develop suitable controls. The Coast Guard is also concerned with other spills besides oil. Hazardous chemical spills present a greater problem as they may disperse through the water or air column. The EPA is listing these materials and we are studying ways to control or neutralize them. A chemical hazardous response information system has been established at headquarters so that field organizations can get the best information available on what to and what not to do. Work is underway to develop protective clothing and to devise ways to effectively counteract any spills hazardous to the environment.

I have with me today Mr. Scarano, LT Ard, and ENS O'Neil and in the Workshops this afternoon we will attempt to be more specific than I have been here and answer any questions that you may have regarding the systems which we have developed and have installed, which we believe can meet the requirements. I also brought along for those that may be interested, a list of reports published by the Coast Guard which I will be glad to give you. Thank you.

THE NAVAL SEA SYSTEMS COMMAND ENVIRONMENTAL PROTECTION PROGRAM

CDR R. R. Miller, USN

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Editor's Note: Slides used during CDR Miller's talk are presented here as figures.

As you can see in Figure 1, the Navy is very much involved from bow to stern. The Navy's problems are concerned mainly with those of a large ship as opposed to those of a marine or yacht-size craft. This morning I would like to discuss three specific pollution problems: sewage, oil, and refuse. Sewage has a requirement for zero discharge tacked to it now while within navigable waters, oil less than 15 PPM or that general range; I think visible sheen is what the law says while within 12 miles and less than 100 PPM discharged while outside of the 12 mile limit. Refuse will not be dumped over the side while within 50 miles of the continental U.S. and outside of the 50 mile limit negative buoyancy is required. Two other areas in which the Navy is just getting started are thermal pollution and noise pollution.

Figure 2 is a generalization of the various water pollution laws. I don't know how clear they are to you out there but should any questions come up later on I will be happy to discuss them with you. (Figure 3) Sewage, oil, and ship wastes are what we will discuss this morning. Figure 4 indicates some of the representative quantities with which we must deal; bilge waste generation rates ranging from 3,000 gallons per day for destroyer-size ships and up to 210,000 gallons per day for carrier-size ships. Sewage—roughly 10–20 gallons per man day, garbage—we find that shipboard trash and garbage generation is about three pounds per man per day. It's quite a problem. That's in general what we have to contend with. The problem was considerably larger than what we determined it to be and considerably more difficult.

The area of sewage, the first problem I will discuss this morning, was even bigger than we thought. The Navy has now chosen to go to what is known as a collection, holding and transfer (CHT) system for the first line of defense.

Figure 5 is a schematic of a (CHT) system and shows, coming in from the upper left, soil drains and waste drains. With the proper position of various divertor valves you can, while at sea, discharge soil and waste drains over the side, or as you pass through the 12 mile area coming into the area known as navigable waters, (I think that is what is defined as within the 3 mile limit) we'll shift and collect the soil and waste drains. It's not necessary according to the law, at this time, to start collection of the liquid waste drains, only the soil waste drains. As we get into port we will hook up to sewer lines on the pier and both soil and liquid wastes will be collected and pumped through the sewer line on the pier and hence to a municipal system. The price tag for this type of operation is pretty much fantastic, roughly in the neighborhood of $3.6 million for a carrier, $1.2 million for a destroyer or submarine tender and roughly $7–800,000 for installation aboard a destroyer. The Navy has attempted to get 12 hours holding in an attempt to not discharge in navigable waters as we pass through them; however, in order to do this sometimes more space for the holding tank is required than is absolutely available. The guidance we have now from CNO is such that we do not affect the military characteristics of the ship and, consequently, are shooting for the 12-hour holding period. Occasionally, and mostly in the destroyers, it will be something less than a 12-hour period. However we will be hooking up to the sewer line on the pier when alongside.

Figure 6 is a schedule of the major port complexes and when you can expect completion. This schedule has probably slipped from 6 months to a year. The Navy has roughly 5 years to comply with the law of zero discharge while alongside of the pier and in navigable waters. Figure 7 shows the estimated completion dates for various minor port complexes but these dates may also have slipped somewhat.

Some ships cannot–just plain do not have the room for the collection, holding and transfer system, and as a result, a small treatment package is being considered for some of these. Six such systems are shown in Figure 8. Two of them, the GATX and the JERED system are presently undergoing technical evaluation and then an operational evaluation aboard Navy ships. Now, the JERED system is in its technical evaluation and it's having one or two problems that we are working on. The GATX system has completed its technical evaluation with no problem whatever and is well into its operational evaluation. I would expect that the GATX system will soon be certified acceptable for fleet usage. These systems are the smaller systems and what one would expect in some version or another to be used on a destroyer size or smaller.

The GATX system shown in Figures 9 and 10, is a very simple system. We happen to have this on board the Mobile Noise Barge (MONOB), a Navy craft based in Ft. Lauderdale, Florida. This system shown in Figure 9 consists of a macerator transfer pump, a control panel, a reduced volume flush commode and evaporator tank. It's a very simple system as can be seen in Figure 10. The reduced volume flush operates with about a pint and a half of water. Gravity feeds the waste to a macerator-transfer pump, the transfer pump pressurizes the fecal waste and moves it into the evaporative tank. The evaporative tank boils off some of the liquid leaving a slurry behind. Some of these systems are installed, incidentally, aboard some of the Great Lakes ore carriers. After a given period of time has transpired, we pump the tank either over the side, out at sea, or to a sewer line on the pier. This system has the benefit of also being able to use gravity through valving arrangements, for gravity discharge over the side should we have some mechanical problems on board. Thus far we have experienced no mechanical problems with our technical and operational evaluation. So we are quite pleased with this. This is a small sized unit and handles a crew of up to 25 men. It is pumped out about every 15 days, depending upon whether they use a fresh or salt water flush. With a fresh water flush you can probably let it go 30 days before pump-out. Examples of the potential for this are the two PG's you saw down in the parking lot before you boarded the bus this morning, and various mine craft, tugs, harbor tugs, etc.

The JERED unit, shown in Figure 11, shows the major components of the unit. The lower right is the incinerator, and we have some difficulty there. On the lower left is a vacuum collection unit and the combination of the vacuum collection unit near the control panels are shown in the upper section of the picture. Figure 12 is a schematic of the vacuum collection unit and shows a commode which uses about a pint and a half of water to flush, with a 15–20 inch vacuum when the flush mechanism is activated. The waste is drawn off by vacuum through the piping into a vacuum collection tank. When the waste reaches a certain level, it is then pumped into an incinerator where it is incinerated, leaving a very small amount of sterile gray ash. This unit is being tested in preparation for its installation aboard the DD963 class destroyers. Smaller versions of this have been installed aboard yachting-size craft. I assume it would also have potential for mine sweeps, PG's, etc. Like I say, it still has a few bugs to iron out.

I hope that we never see pollution like that shown in Figure 13, in our fair Chesapeake Bay. Oil is a problem and it's probably one of our more leading problems at this time. In combating the oil problem we will take all the actions shown in Figure 14. Ship alterations have already been written for installation aboard Navy craft of items 1, 2, 4, and 5. They are being accomplished on just about every destroyer that gets an overhaul. These are interim measures to help reduce the bilge generation rate and to reduce the possibility of accidental overflow. As shown in Figure 15, our major objective is to handle our bilge oil problem. Next, we need oil/water separators, to handle bilge and ballast problems and finally, we need them monitored.

Water pollution is o[illegible]ly a serious problem as you can see in Figure 16. The Navy bilge problem is quite serious if you have ever had occasion to see a Navy bilge. This next figure will give us an indication of what we have to contend with. Figure 17 is actually a photo of a bilge, the U.S.S. Yellowstone, a destroyer tender whose vintage is approximately 30 years. It has a tremendous bilge generation rate. What are we going to do about it? Some of the generation rates, shown in Figure 18, are absolutely staggering and as a result we have found most filter/coalescers have difficulty in handling the large volumes. Some of them have been relatively successful. We have had problems with particulates going through the filter/coalescers.

At the present time we have narrowed our field of interest on oil/water separators down to three separators: (1) a unit which received its inception here in Annapolis, we refer to it as the Annapolis Unit, a filter/coalescer using an in-depth filter media; (2) a VELCON Unit, another filter/coalescer, and (3) a GENERAL ELECTRIC Unit, which is a parallel plate separator.

Figure 19 is a very rough schematic of the Annapolis unit. It has received a few modifications and it shows considerable promise. Its throughput is very low; so we do not anticipate receiving hundreds of thousands of gallons of bilge effluent going through this separator and the separator never having to be serviced. The effluent is of high quality usually less than 10 parts per million of oil in water. Unfortunately it is affected somewhat by particulates.

Figure 20 shows another filter/coalescer type. Mike Grant, shown here, from the Navy Petroleum Office had a great deal to do with setting up this VELCON separator. It also is a filter/coalescer and, once again, it has a low throughput but it has a very high quality effluent, in the neighborhood of some 10 parts per million or less. It is also very sensitive to particulates. At the present time I envision these types of separators in use in our smaller craft. That's provided they satisfactorily get through their technical and operational evaluation which is scheduled to begin in November 1974.

Figure 21 is a photograph of the G.E. parallel plate separator. It is not the best view in the world but it will give you some idea of the size. It is 3 ft 9 in. wide and 4 ft 4 in. long, roughly 5 1/2 ft high. This makes use of the parallel plate, laminar flow principle. It has no moving parts and consequently is very desirable in the area of logistics support. We don't have to worry about changing filters and that sort of thing. Figure 22 is a plan view of the second generation unit which will be tested aboard the L.Y. SPEAR in Norfolk. It will be a technical evaluation. The effluent from an earlier unit that we had on the SPEAR, (a first generation parallel separator), had an effluent in the general range of always less than 20 ppm on its last run up to Nova Scotia. That's pretty good. We have had this type of separator on the line on the Yellowstone and it was handling the bilge you saw in the picture and was producing usually less than 22 ppm oil in water. It was a hands-off operation for roughly 7 months time. The unit was easy to operate, requiring only to open up a valve, line it up, run the bilge water through the separator, good water out one side, and collect the oil on the other side. We are very impressed with that.

Figure 23 shows the effluent that was coming out of the G.E. separator on board the Yellowstone. It took the bilge water and it turned out to be pretty good stuff. The test tank was where we could see it. We had a turbidity meter on it and it was reading fairly low also.

Unfortunately, with surfactants we have a problem, Figure 24. The surfactants poison the filter/coalescers and circumvent the parallel plate separator. Fortunately, when we get rid of the influent with the surfactants the filter/coalescers recover and, of course, the parallel plate separator recovers. It appears as though we will have to either "legislate" against surfactants for use in the bilge area or we will have to come up with a different type of surfactant or a different type of product. The white area seen in Figure 24 is foam due to the surfactants.

The black box monitor–Figures 25 and 26, that's what we are looking for–something with a direct readout so that when a bell rings or a light flashes or the needle hits a certain number we can determine when we have passed what is acceptable and stop it, and find out what our problem is. Thus far, we have not had much luck with our monitors.

Figure 27 shows a view of the parallel plate separator which was evaluated in conjunction with fueling a 1040 class destroyer. The destroyer has a compensated fuel system. For the benefit of you who are not familiar with the compensated system; when a gallon of fuel is burned it is immediately replaced with a gallon of salt water so there is not much change in the overall weight of the ship and this gives you optimum stability. When a gallon of fuel is taken aboard, obviously a gallon of salt water is displaced, and when that gallon of salt water goes over the side after co-mingling with fuel in a tank, it takes an oil sheen with it. At high fueling rates that's bad news. Consequently, the parallel plate separators seem to be a natural. In another evaluation on a barge that had fueling rates up to 1000 gpm; the effluent was about 20 parts per million as the compensating water was discharged over the side and the fuel was taken aboard.

Figure 28 shows how a compensated fuel system looks–fuel in the tanks, water in the last tank, as the fuel comes aboard the water is discharged over the side.

Figure 29 is a mock-up of an actual fuel tank. It is a scale model in size. We put the parallel plates arrangement in the center section and separate the oil, such that the oil stays in the last tank and the discharged water goes over the side. This would then meet the requirements of the Oil Pollution Act. We have yet to run our final testing in this area but it is showing great promise at this time.

Trash. (Figure 30). Bad news. Three pounds per man per day–we've got to do something with it! Many things.

Package reduction. (Figure 31). Some things we can make smaller. Do away with some of the standard packing that we are used to, the cardboard boxes and whatnot.

Shrink Wrap. (Figure 32). You have all seen the six packs of Coca Cola and the collophane type wrapper–that's known as shrink wrap. It is very strong. As you can see, these cans are sitting in a cardboard container with the shrink wrap over them. As a result, we do not have the entire cardboard box to contend with. The Naval Supply Systems

Command has worked quite diligently in this area. In either case, we have to work with an incinerator of some kind or another. Another system is the Ventomatic Marine Trash Burner shown in Figure 33. The operator has to raise the can over his head and dump it into some automatic feed, which is the negative aspect of the thing. Hopefully, we will be able to set this up so that we can feed it from the deck above, however that also gives us problems. We are working in the areas of incinerators, automatic feeds, automatic stoking, external heat source, etc.

Figure 34 is a shot of the Saxlund incinerator. This one is installed aboard the U.S.S. DEBUQUE for test. We had a little problem with the feed portion of it and no problem at all with the incinerators, so far.

Compactors. (Figure 35). We are getting ready to purchase compactors and put them aboard ship. We have tested several and have found some that are acceptable to us. The big secret with compactors is that it's got to be accessible, the slug of waste has to come out and have negative buoyancy so that it can be dropped over the side. On the other hand, the slug cannot be so big that the sailor cannot carry it.

Essentially, all of these new ideas are something that we have to make attractive to the sailor because, bear in mind, it is awfully easy to take that garbage can back to the fantail and dump it over the side. Then we end up with milk cartons, etc. on the beach and of course this is unsatisfactory. We have got to watch that very closely and make these equipments attractive to the sailor, which is probably one of the more difficult problems, as difficult as the actual piece of equipment itself. The human engineering aspect of it cannot be overlooked.

Figure 36 is a picture of an encapsulator. Something of this nature is being worked on for use aboard our submarines. With this unit, the compactor compacts into a plastic container. We have to seal it because we don't want to throw it over the side. We have to store it for some time and bring it back to shore for disposal. Consequently, it also has to be gas tight. It's amazing the amount of pressure that deteriorating or degrading food wastes can build up. And, so that's another problem we have to contend with.

As I mentioned earlier, an area we are just getting into is noise pollution, Figure 37. Our OSHA standards for noise reduction are now in the neighborhood of no greater than 85 DBA exposure for no longer than 8 hours. If you go in any engine room, whether it be a carrier, destroyer, or what not, you will find that they are nowhere near in compliance with the OSHA standards. Consequently, we are really looking to quiet machinery, making use of some of the submarine quieting technology that we have, using the Mickey Mouse or other large ear protectors that you see around airports, ear plugs, etc. It is one of our major areas of concern now and we are just beginning to scratch the surface on noise pollution.

If you have any pollution problems, and are interested in more details concerning the Navy's abatement systems, catch me after the show here or give me a call. I would be more than happy to discuss any of these areas of concern with you and can go into more detail as required. I have several able assistants, Larry Koss who has worked with me now for 3 years, and Jim Marcisz who has been with us for the past two years. Thank you.

TYPICAL AIR AND WATER SHIP POLLUTION PROBLEM AREAS

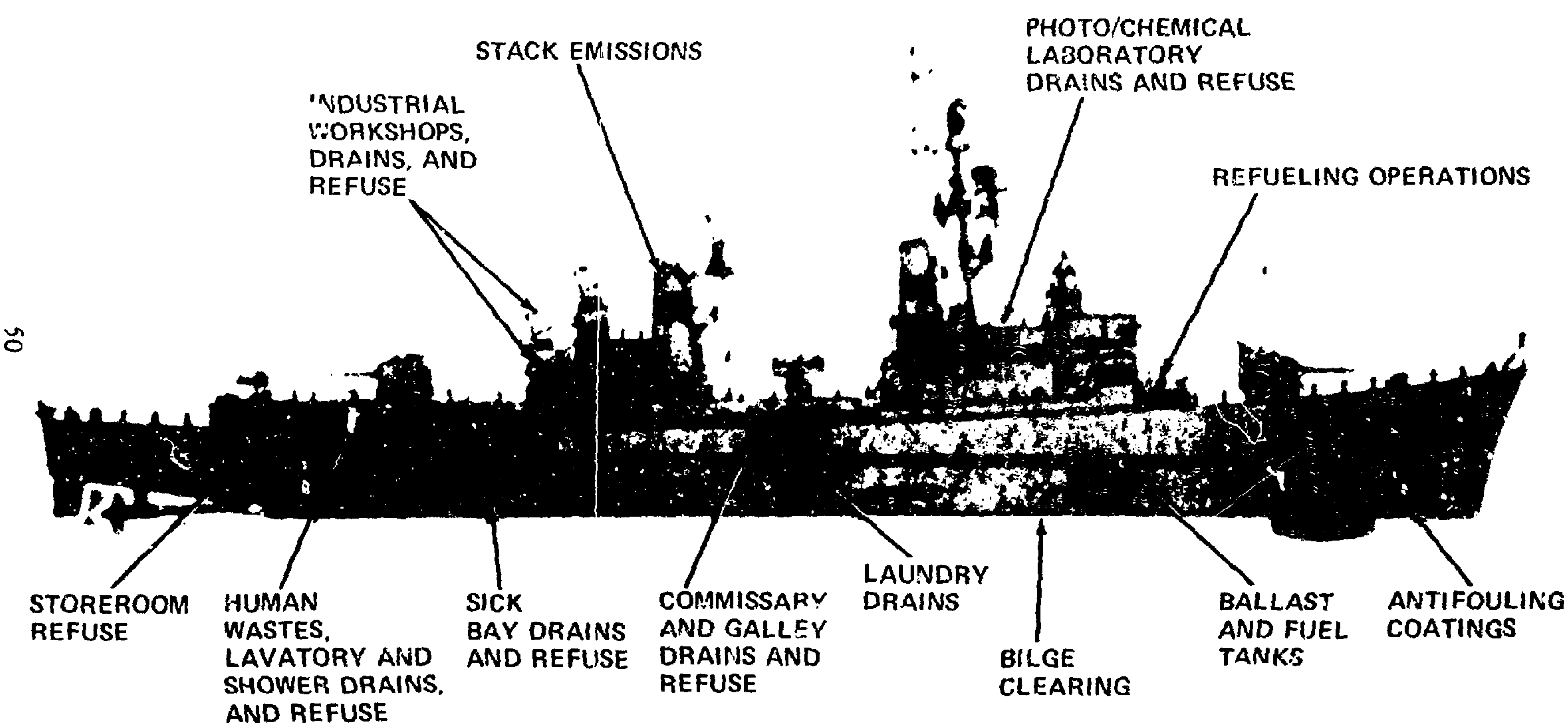
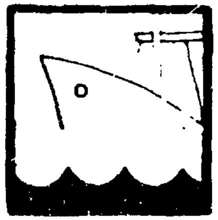


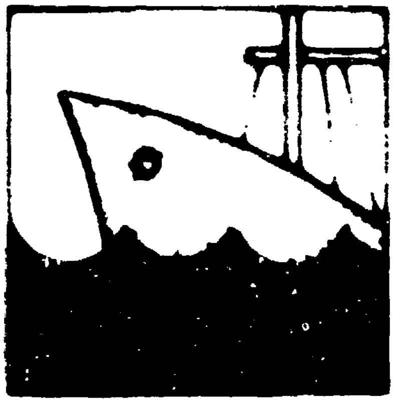
Figure 1



WATER POLLUTION CONTROL STANDARDS AND POLICY

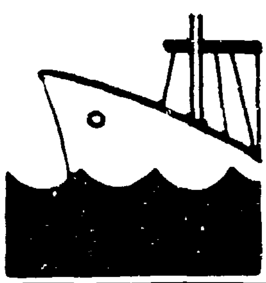
SHORE	HARBOR	3-MILE LIMIT (Navigable Zone)	12-MILE LIMIT (Contiguous Zone)	50-MILE LIMIT (Prohibited Zone)	OPEN SEA
• Transfer of Liquid and Solid Wastes to Pier	• Barges Collect Ships' Wastes	NO • Sewage • Oil - no sheen standard • Garbage • Trash or Rubbish	NO • Oil - no sheen standard • Garbage • Trash or Rubbish	NO • Oil < 100 ppm • Trash or Rubbish	• Oil < 100 ppm or 15 gallons/nautical mile • Trash or Rubbish regulated dumping (compaction, negative buoyancy) • No Plastics

Figure 2



- **SEWAGE TREATMENT**
- **OIL POLLUTION ABATEMENT**
- **SHIP WASTE MANAGEMENT**

Figure 3



REPRESENTATIVE EFFLUENT QUANTITIES

EFFLUENT	QUANTITY	CONSTITUENTS
BILGE WATER	3500 gal/day (DD in port) 210,000 gal/day (CVA at sea)	0.1% oil; 100mg/ℓ particulates
SEWAGE	10 – 20 gal/MAN/DAY	BOD 600mg/ℓ Suspended solids 800mg/ℓ
GARBAGE	1.1 lbs/MAN/DAY	
TRASH	1.9 lbs/MAN/DAY	Paper, wood, glass, metal, plastic
LIQUID DOMESTIC WASTES	30 gal/MAN/DAY	Detergents
INDUSTRIAL WASTES	150 lbs/DAY (CVA) 20 lbs/DAY (CVA)	Cleaning agents Boiler treatment chemicals
COMBUSTION PRODUCTS	Varies with power plant and operation	CO, NO_x, SO_2, particulates, hydrocarbons

Figure 4

COLLECTION HOLDING TANK SYSTEM FOR LARGE SHIPS

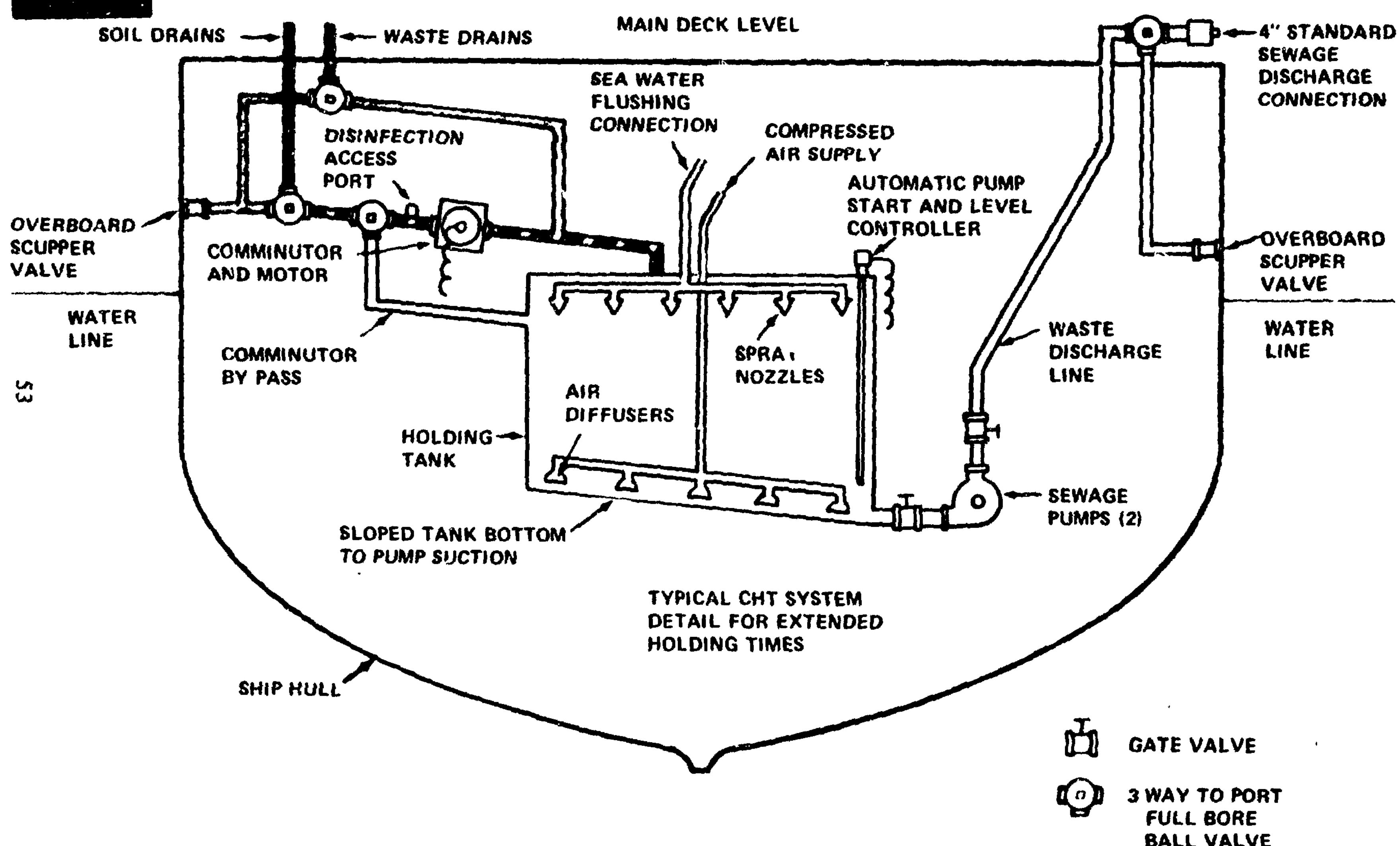


Figure 5

MAJOR COMPLEXES

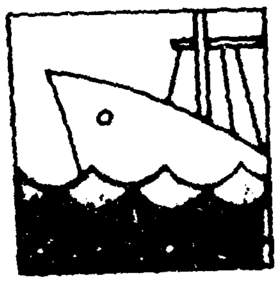
NAVAL COMPLEX \ COMPLETION DATE	% COMPLETION BY CALENDAR YEAR (ESTIMATED)				
	1974	1975	1976	1977	1978
NORFOLK	9	43	62	94	100
CHARLESTON				100	
JACKSONVILLE		100			
PUGET SOUND	8		92	100	
SAN FRANCISCO	17				100
LONG BEACH			100		
SAN DIEGO	[illegible]		66		100
PEARL HARBOR				60	100

Figure 6

SHIP WASTEWATER COLLECTION ASHORE

ACTIVITY	EST. COMPLETION
NSY PHILADELPHIA	1977
NAS PENSACOLA	1977
N[illegible]L PANAMA CITY	1977
NS. ROOSEVELT ROADS	1977
NWS CONCORD	1977
NCBC PORT HUENEME	1978
NUC SAN CLEMENTE IS.	1978
NWS SEA BEACH	1978

Figure 7



SIX SYSTEMS UNDER DEVELOPMENT

KOELHER-DAYTON (160 MAN)	RECYCLED FLUSH EVAPORATION/INCINERATION
CHRYSLER (200 MAN)	RECIRCULATING NON-AQUEOUS FLUSH INCINERATION
GATX (25 MAM)	REDUCED FLUSH EVAPORATION
JERED (200 MAN)	VACUUM FLUSH INCINERATION
THIOKOL (200 MAN)	ELECTRO-CHEMICAL INCINERATION
GENERAL DYNAMICS (200 MAN)	AEROBIC DIGESTION ULTRAFILTRATION

Figure 8

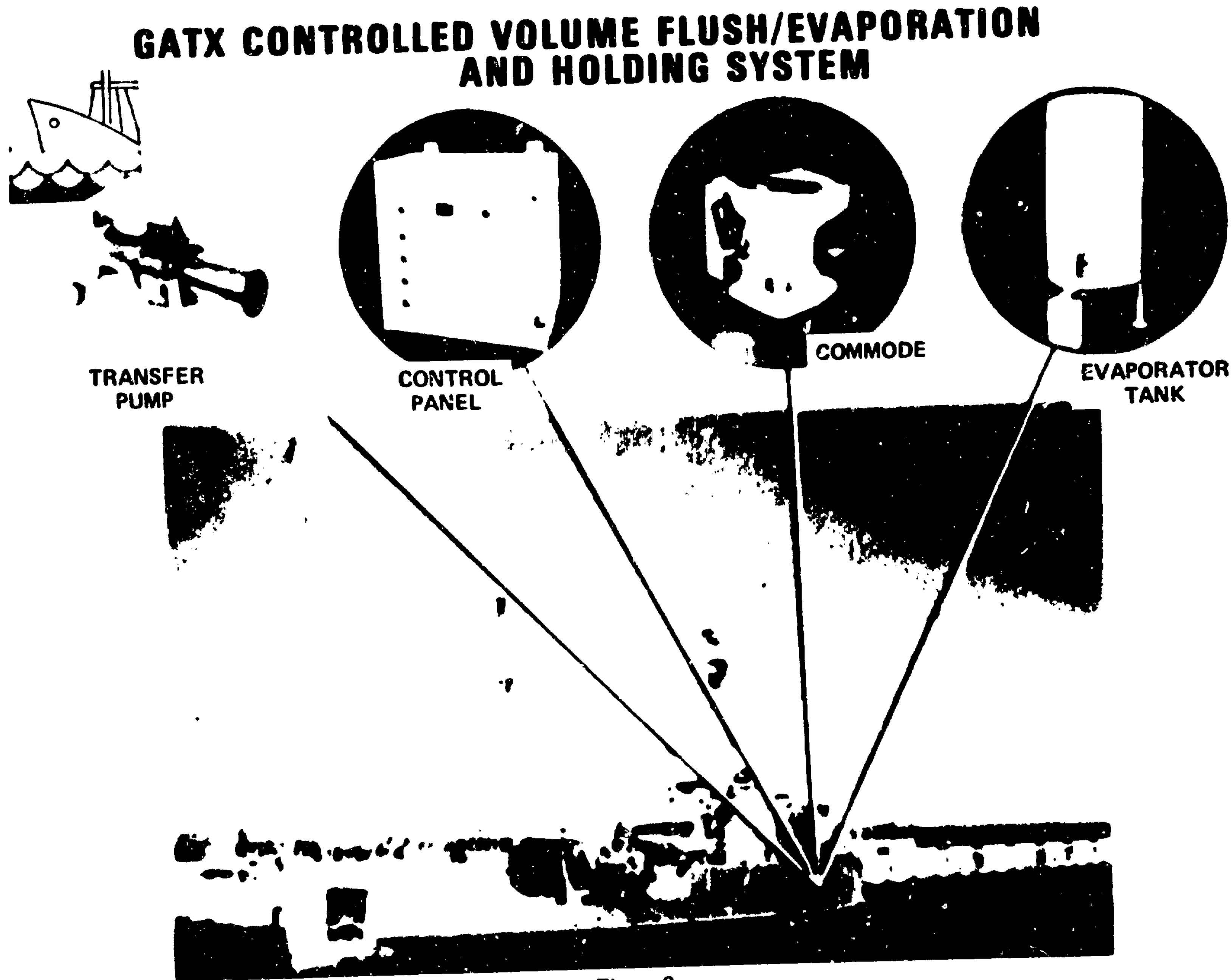

GATX CONTROLLED VOLUME FLUSH/EVAPORATION
AND HOLDING SYSTEM
TRANSFER
PUMP
CONTROL
PANEL
COMMODE
EVAPORATOR
TANK

Figure 9

GATX CONTROLLED VOLUME FLUSH/EVAPORATION AND HOLDING SYSTEM

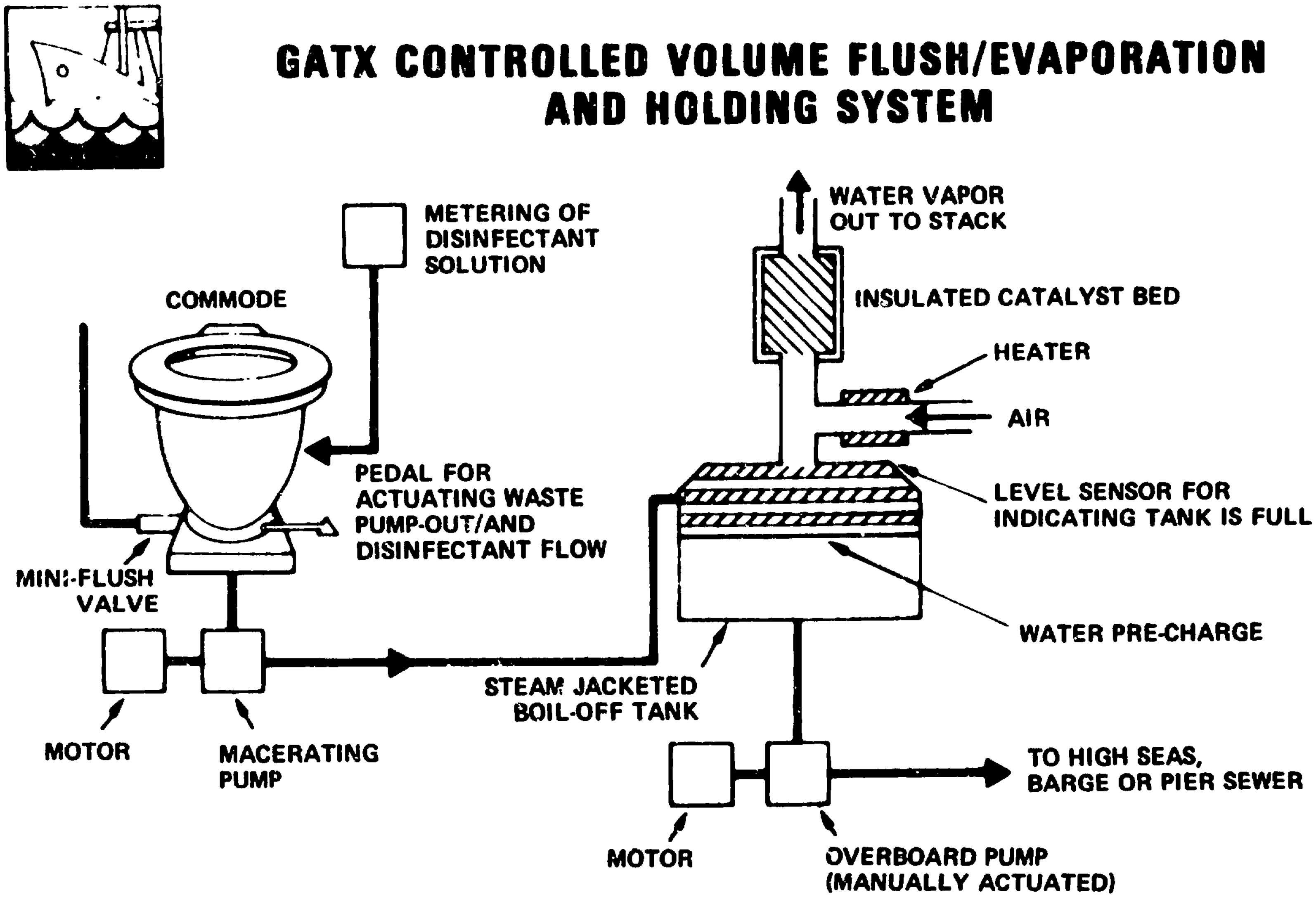


Figure 10

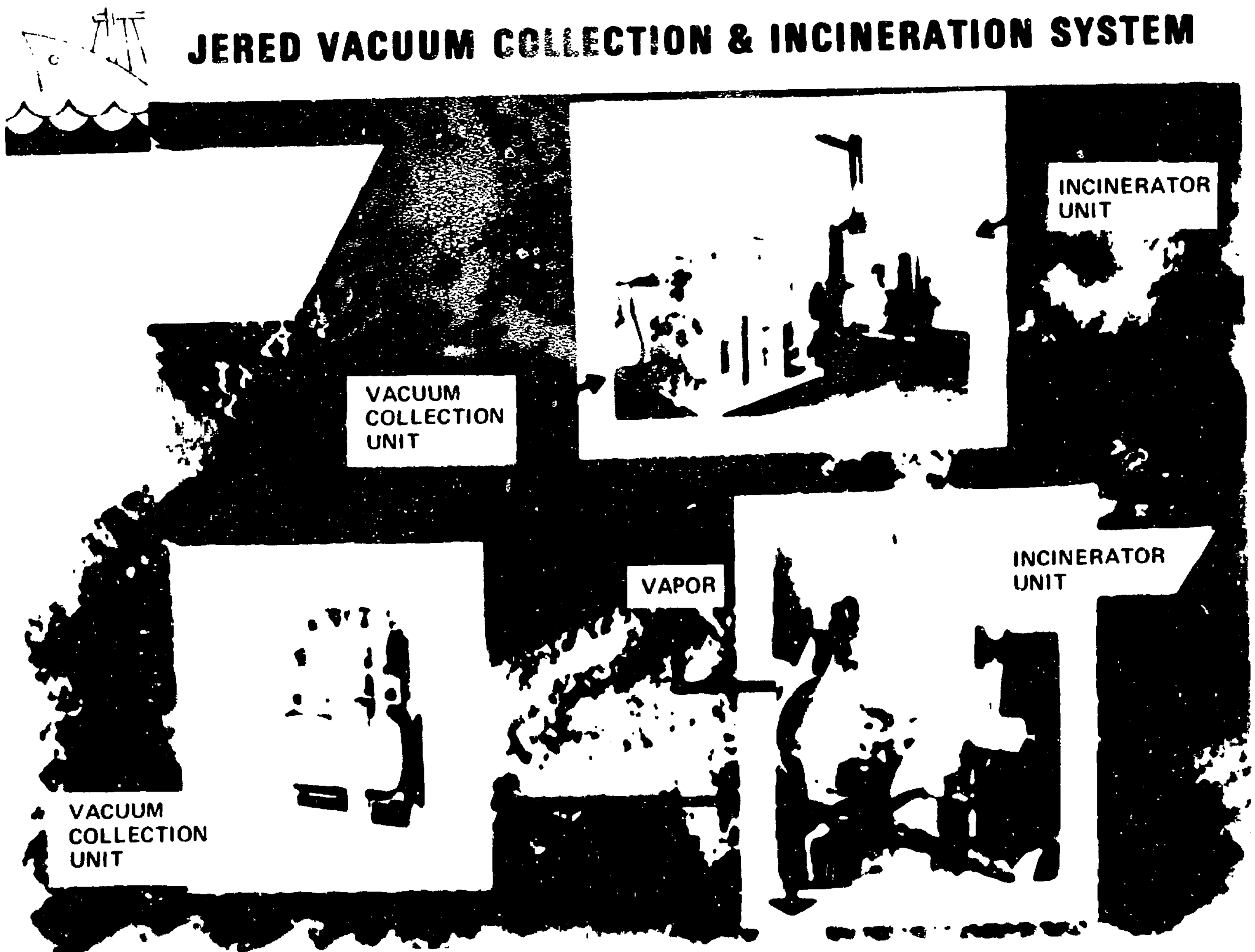

JERED VACUUM COLLECTION & INCINERATION SYSTEM
INCINERATOR UNIT
VACUUM COLLECTION UNIT
INCINERATOR UNIT
VAPOR
VACUUM COLLECTION UNIT

Figure 11

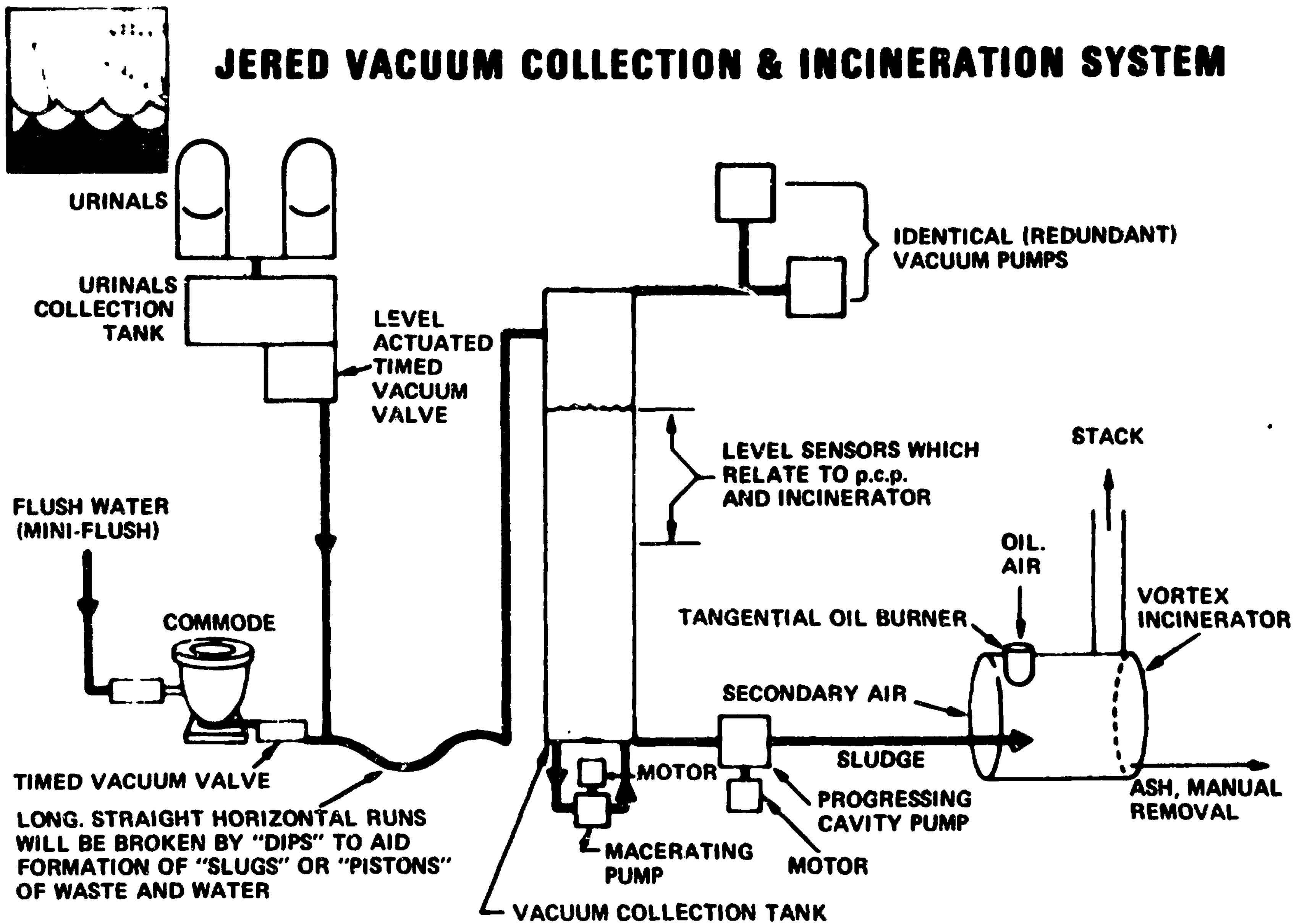

JERED VACUUM COLLECTION & INCINERATION SYSTEM
URINALS
URINALS COLLECTION TANK
LEVEL ACTUATED TIMED VACUUM VALVE
IDENTICAL (REDUNDANT) VACUUM PUMPS
LEVEL SENSORS WHICH RELATE TO p.c.p. AND INCINERATOR
STACK
FLUSH WATER (MINI-FLUSH)
COMMODE
OIL. AIR
TANGENTIAL OIL BURNER
VORTEX INCINERATOR
SECONDARY AIR
SLUDGE
MOTOR
ASH, MANUAL REMOVAL
TIMED VACUUM VALVE
LONG. STRAIGHT HORIZONTAL RUNS WILL BE BROKEN BY "DIPS" TO AID FORMATION OF "SLUGS" OR "PISTONS" OF WASTE AND WATER
MACERATING PUMP
PROGRESSING CAVITY PUMP
MOTOR
VACUUM COLLECTION TANK

Figure 12

Figure 13

ACTION UNDERWAY FOR EXISTING SHIPS

1.	INSTALLATION OF TANK LEVEL INDICATORS
2.	BILGE PIPING RISERS
3.	JP-5 RECLAMATION SYSTEM
4.	REDESIGNATION OF TANKS FOR OILY WASTE
5.	MINIMIZE TANK OVERFLOWS
6.	PUMP SEAL BACKFIT
7.	SEGREGATED DRAIN SYSTEMS
8.	BILGE PUMP IMPROVEMENT
9.	BALLAST PIPING RISERS

Figure 14

OIL POLLUTION ABATEMENT

MAJOR OBJECTIVES

BILGE OIL WATER SEPARATOR

BALLAST OIL WATER SEPARATOR

OIL CONTENT MONITOR

Figure 15


"It's more serious than I thought...
the water on your knee is polluted."

Figure 16

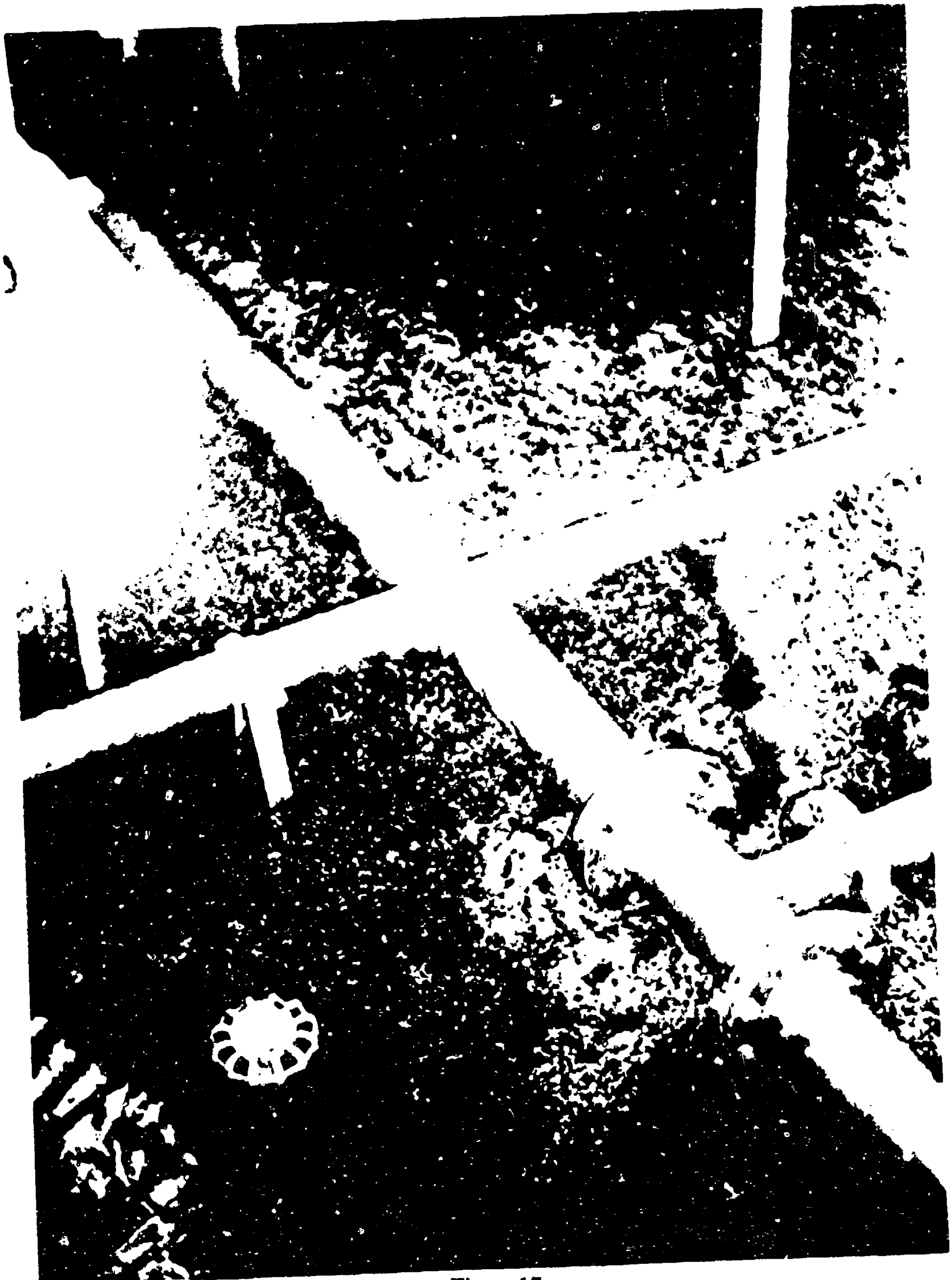


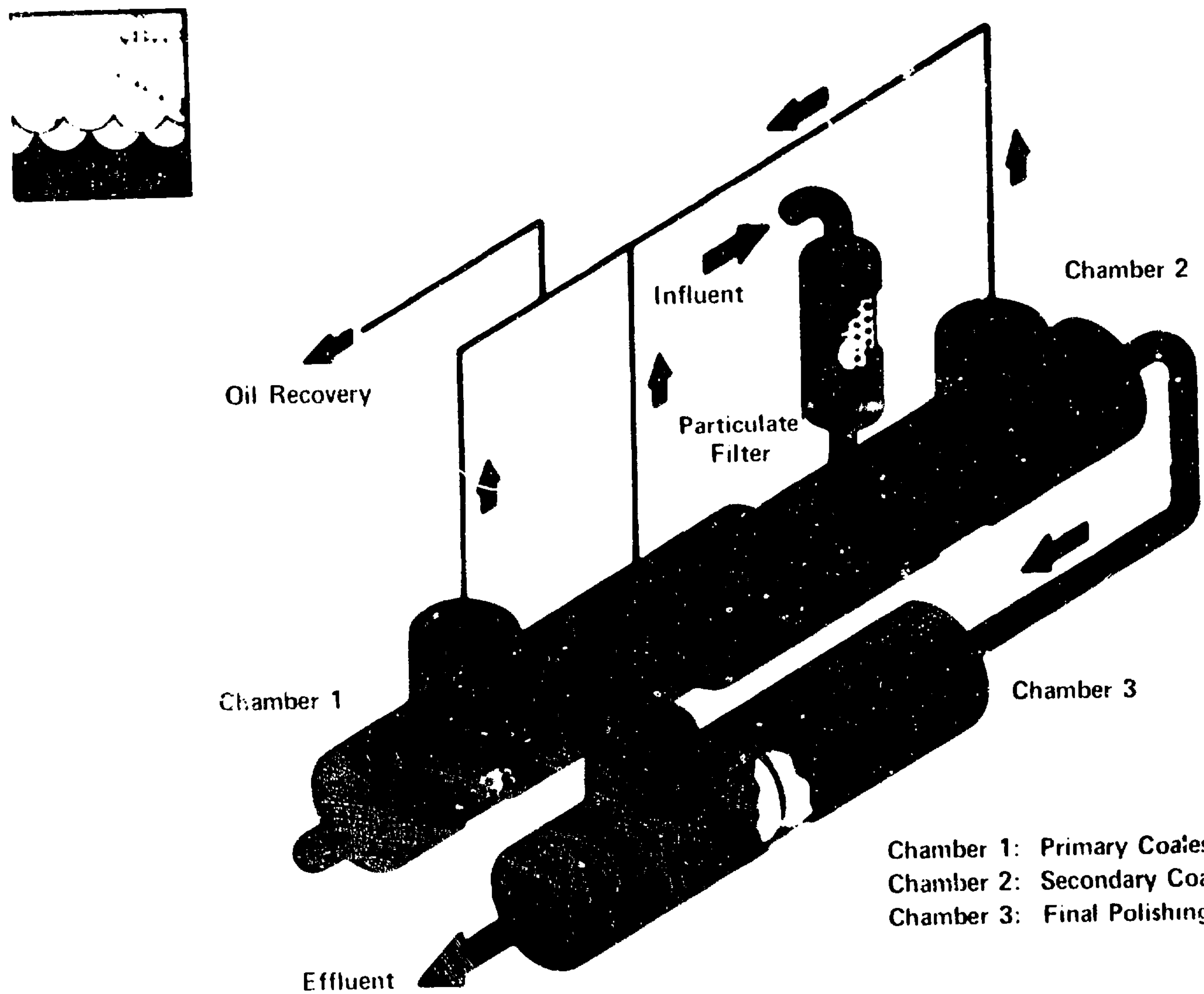
Figure 17

BILGE OILY WASTE GENERATION RATES

SHIP TYPES	RATES (GAL/DAY)	
	COLD IRON	AUXILIARY STEAMING
CVA	79,000	139,000
AO	21,000	25,000
AF, CG	15,000	20,000
AD, AS, LSD	4,800	13,250
DD, DE	3,500	10,000
ARS, MSO, LST	500	2,000
SS	500	1,000

Figure 18

NSRDC 20GPM OIL/WATER SEPARATOR



Chamber 1: Primary Coalescence
Chamber 2: Secondary Coalescence
Chamber 3: Final Polishing

Figure 19

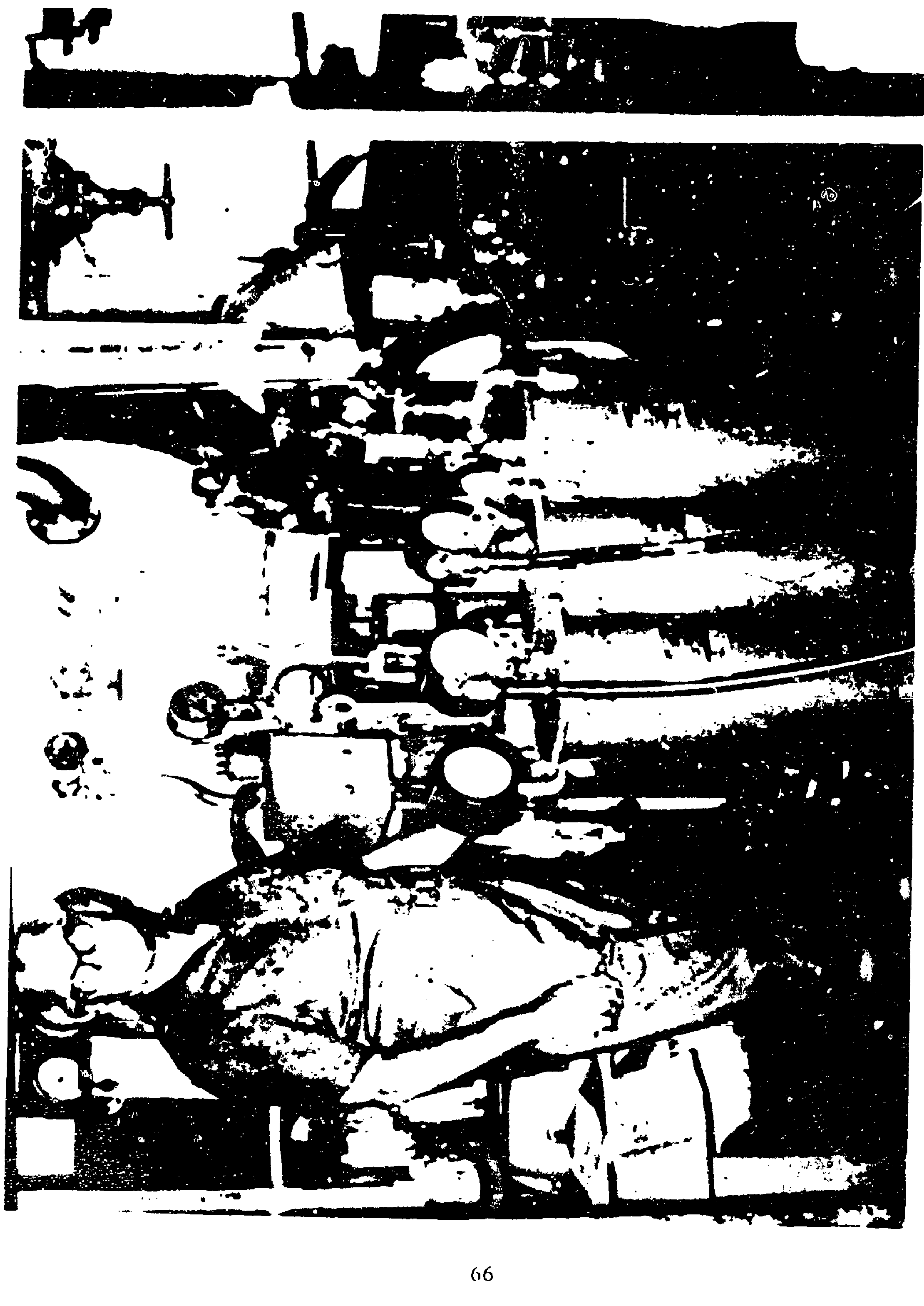


Figure 20

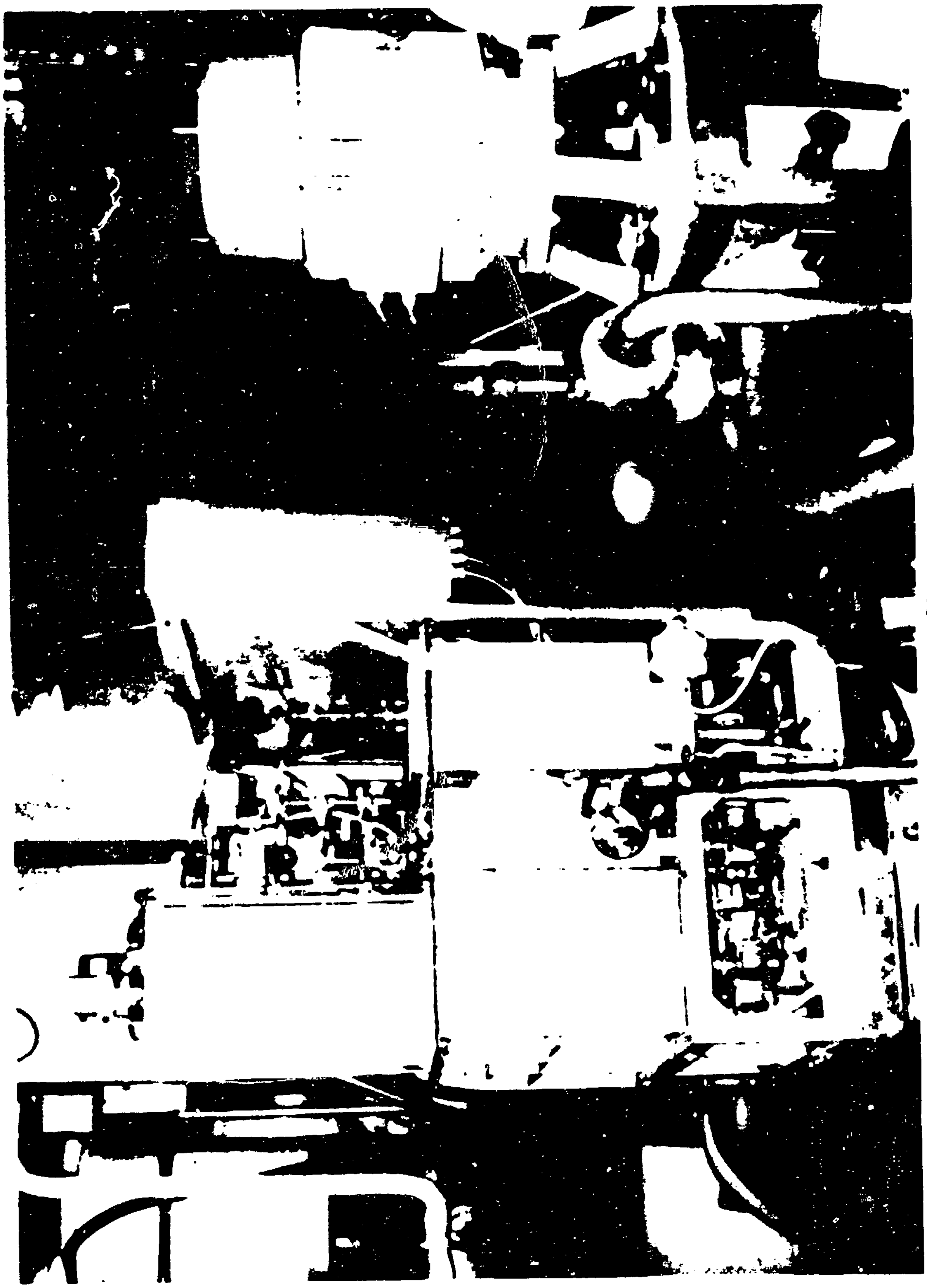
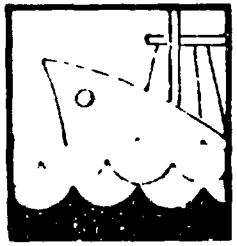


Figure 21

GE PARALLEL PLATE BILGE OIL/WATER SEPARATOR



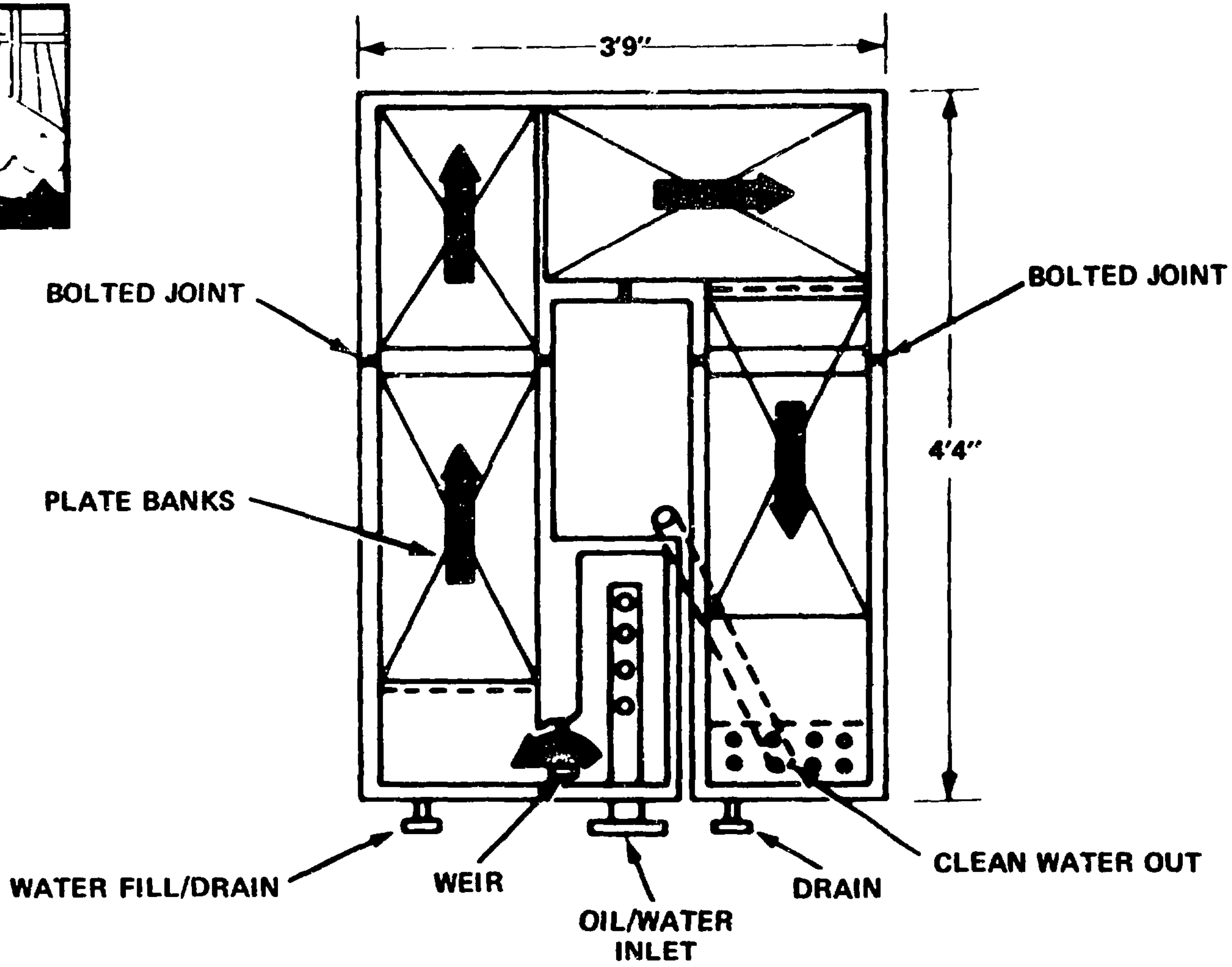


Figure 22

Figure 23

Figure 24

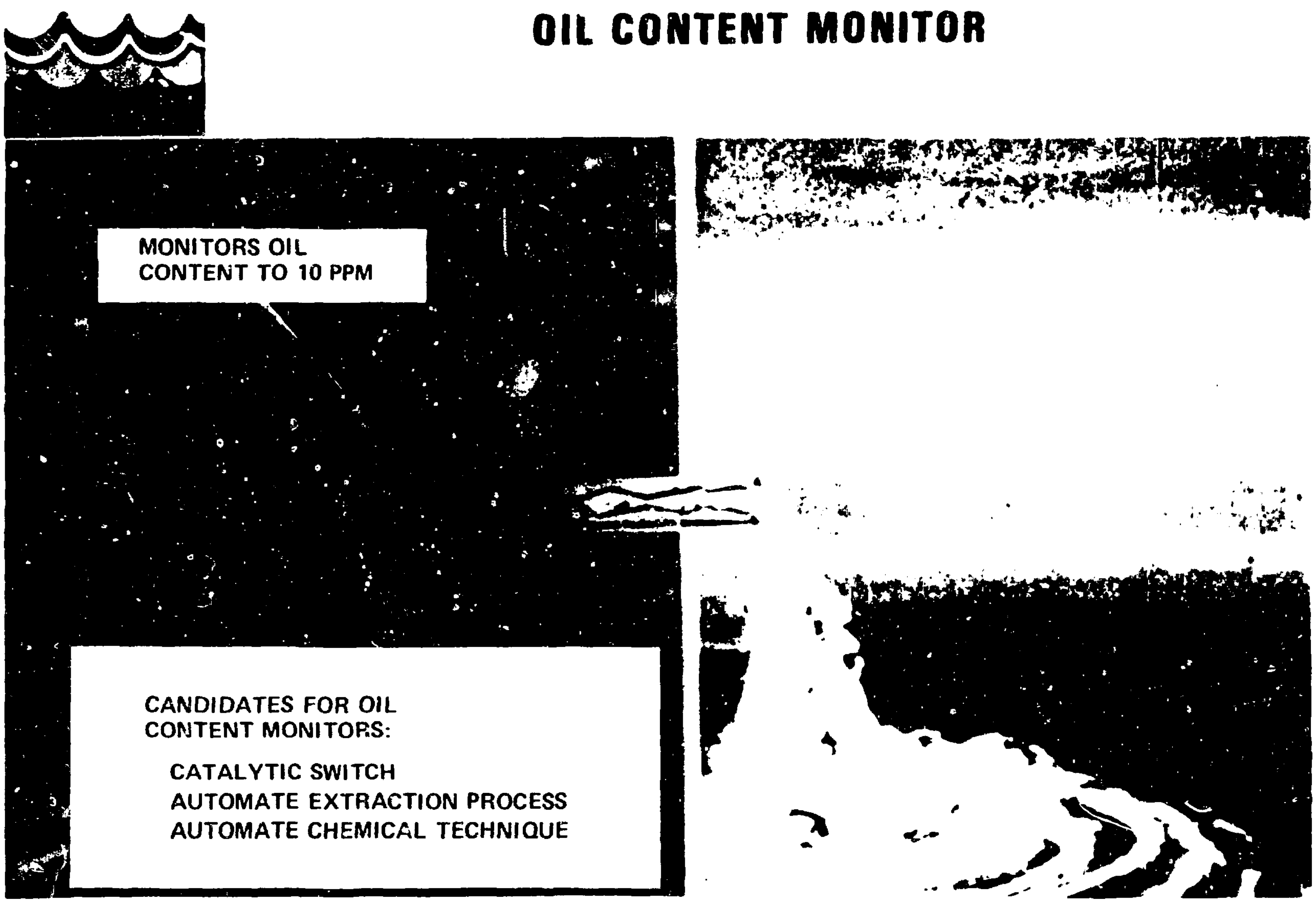
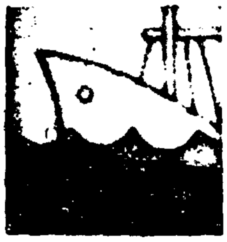

OIL CONTENT MONITOR
MONITORS OIL
CONTENT TO 10 PPM
CANDIDATES FOR OIL
CONTENT MONITORS:
CATALYTIC SWITCH
AUTOMATE EXTRACTION PROCESS
AUTOMATE CHEMICAL TECHNIQUE

Figure 25



OIL-IN-WATER MONITOR

- REQUIRED TO ASSURE COMPLIANCE WITH REGULATION AND STANDARDS
- DESIRED CHARACTERISTICS:
  - INDEPENDENT OF TYPE OF OIL, FREE OR DISSOLVED
  - INDEPENDENT OF SALINITY
  - OPERATE IN PRESENCE OF PARTICULATES
  - RUGGED
  - EASILY CLEANED AND CALIBRATED
  - HIGH SENSITIVITY, 0 – 125 PPM RANGE
  - SHORT RESPONSE TIME
- NO STATE-OF-THE-ART MONITOR IS ACCEPTABLE FOR FLEET USE

Figure 26

Figure 27

PASSIVE BALLAST OIL WATER SEPARATOR

INSTALL COALESCING PLATE SEPARATORS IN THE LAST TANK OF EACH OF THE FOUR BANKS OF TANKS

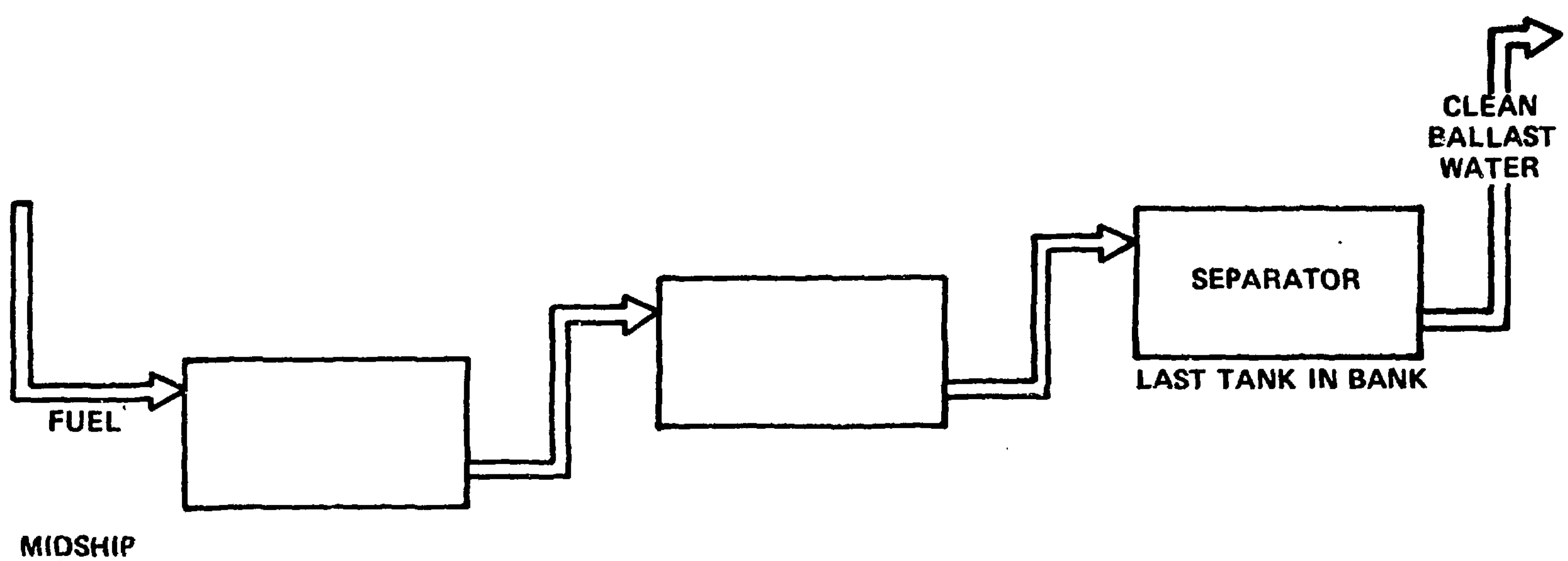


Figure 28

PASSIVE BALLAST OIL WATER SEPARATOR

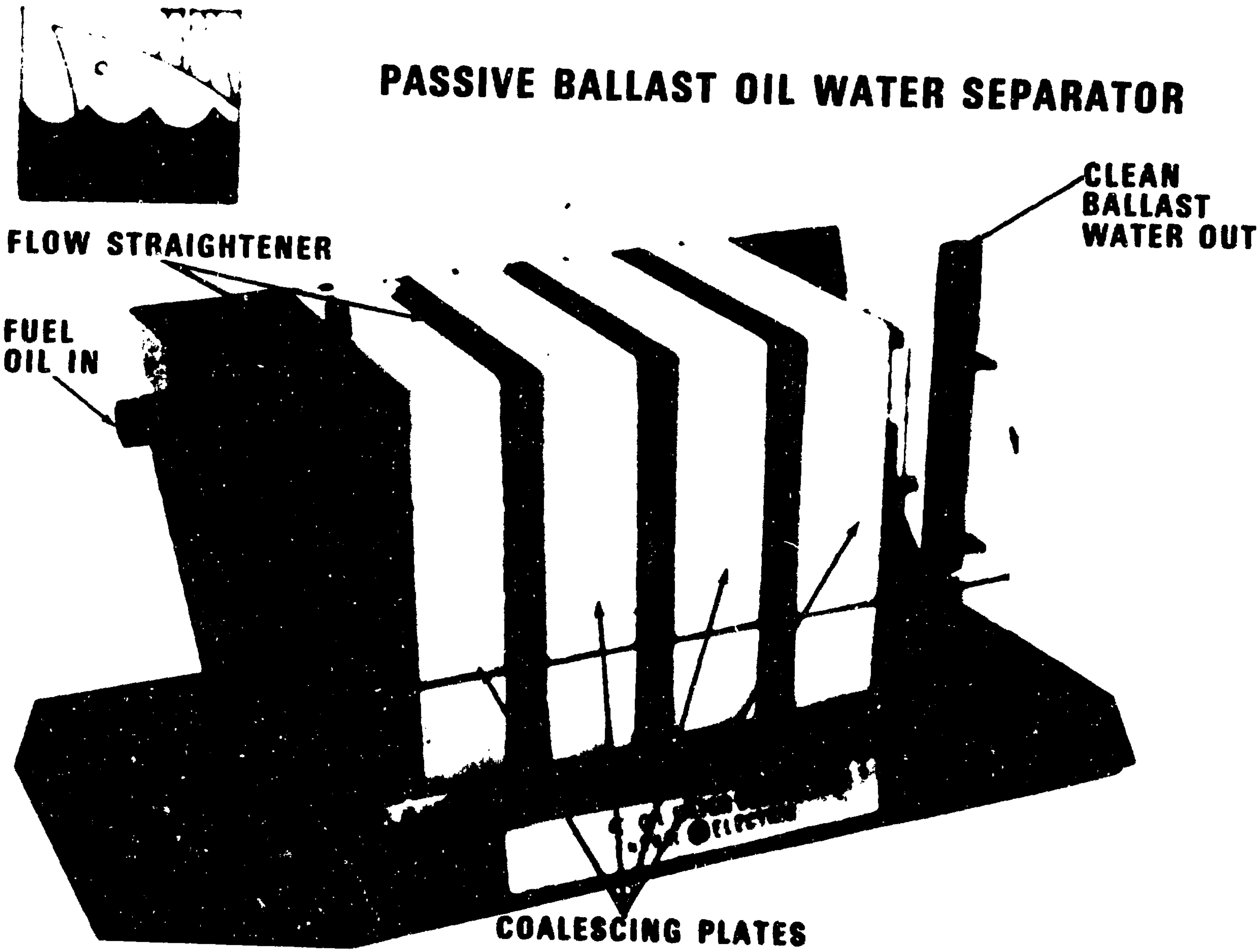
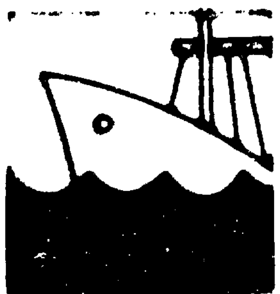


Figure 29

SOLID WASTE (REFUSE/RUBBISH)

3 LBS. PER MAN PER DAY

Figure 30



PACKAGE REDUCTION

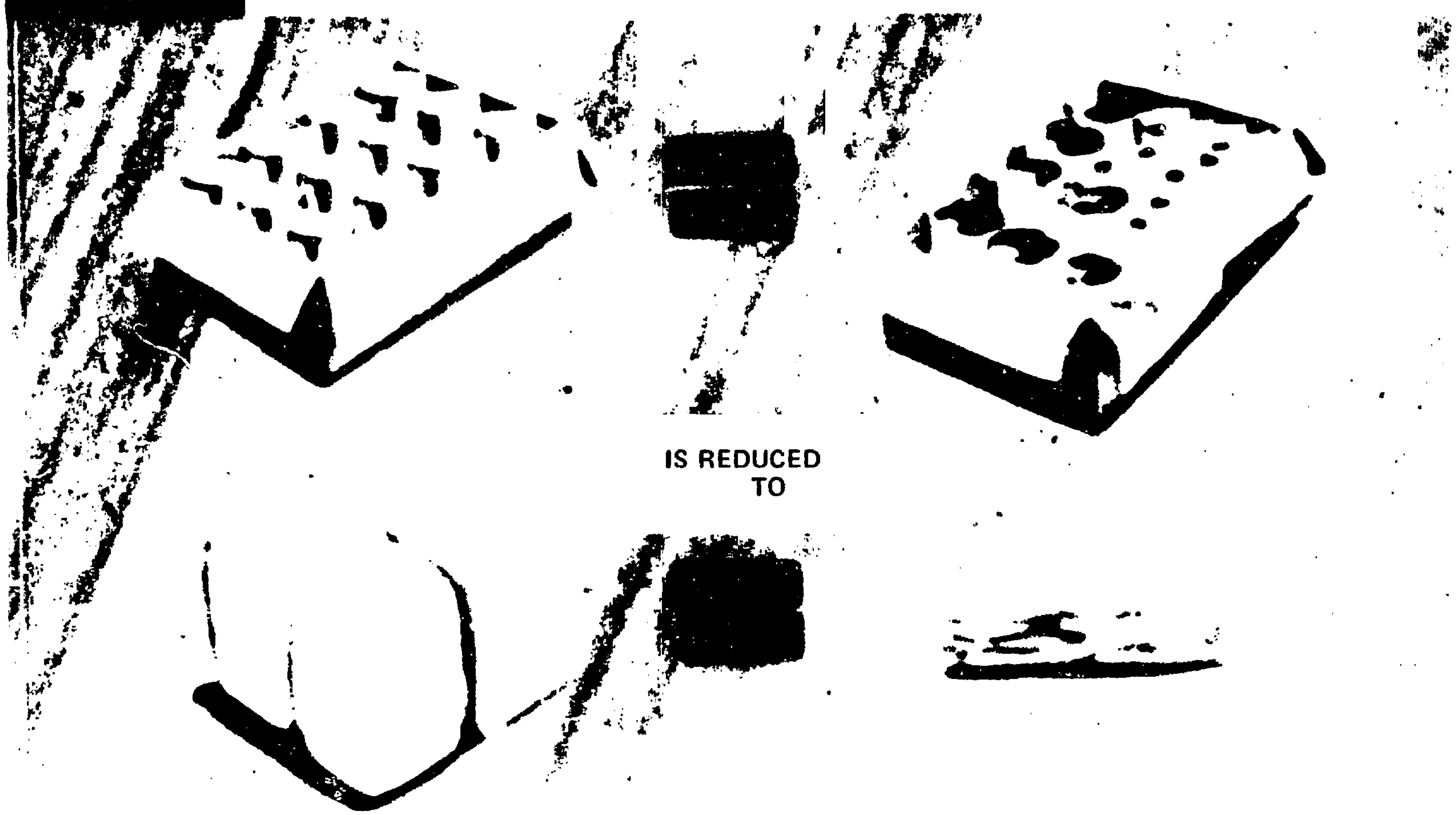


Figure 31

Figure 32

VENTOMATIC MARINE TRASH BURNERS

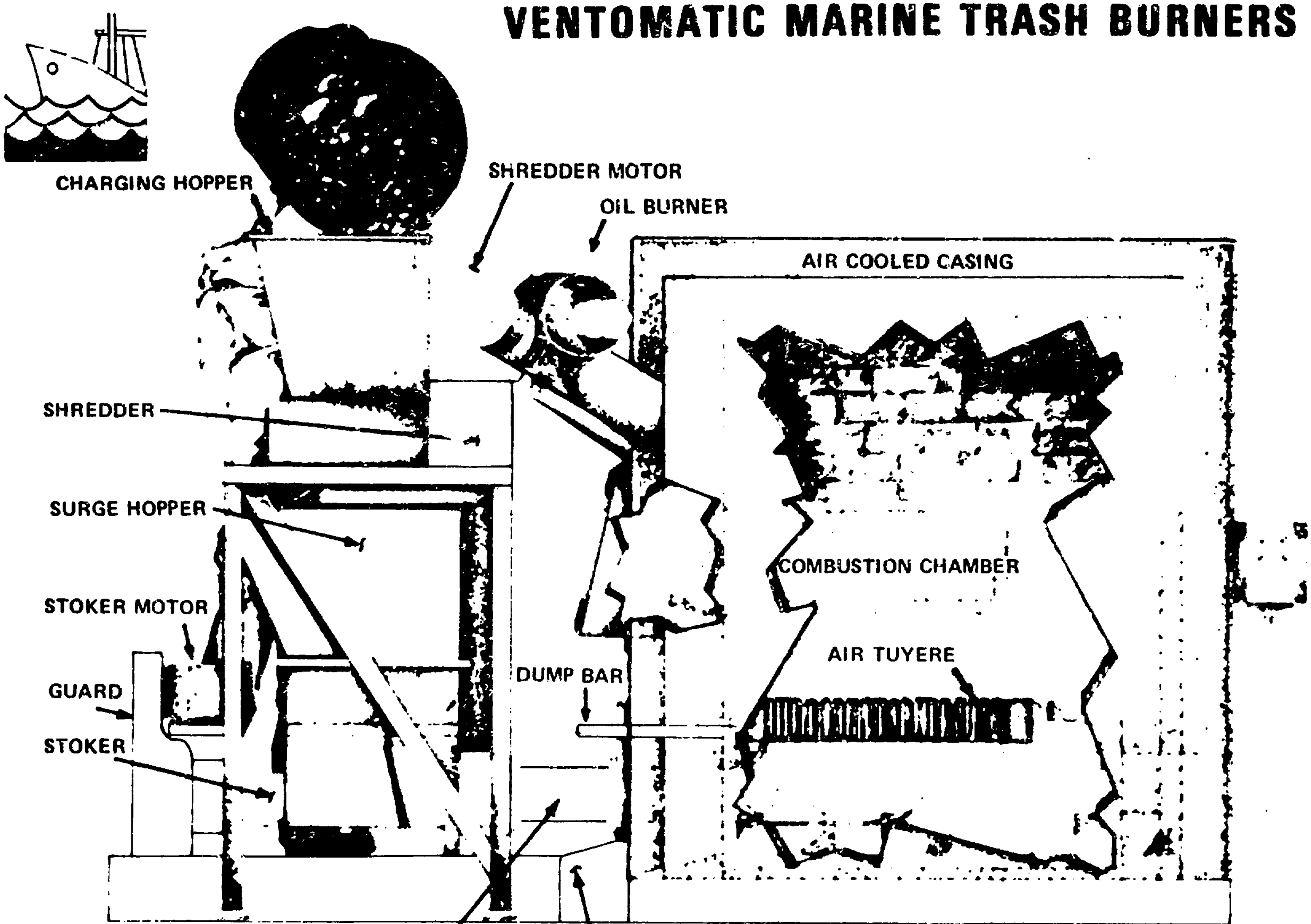


Figure 33

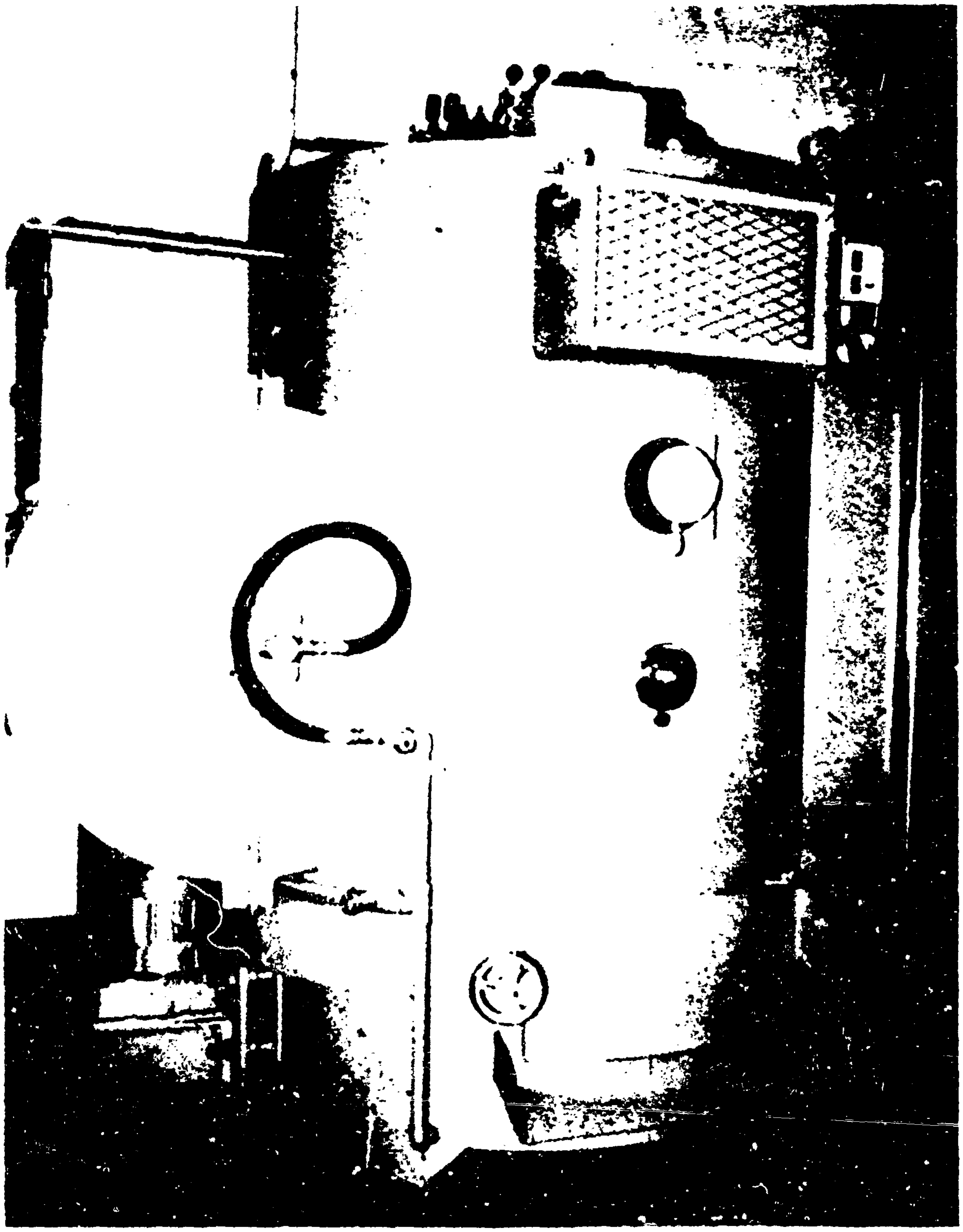
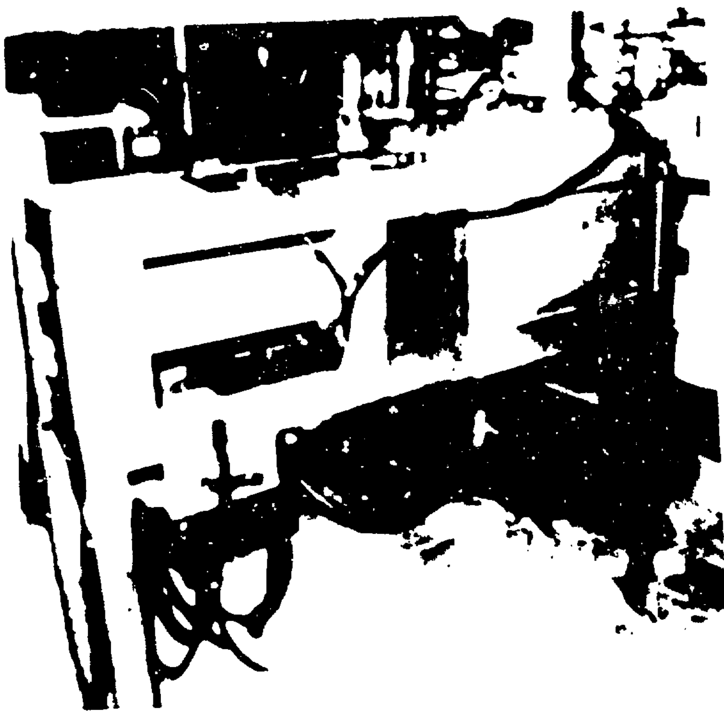


Figure 34 – Saxlund Incinerator

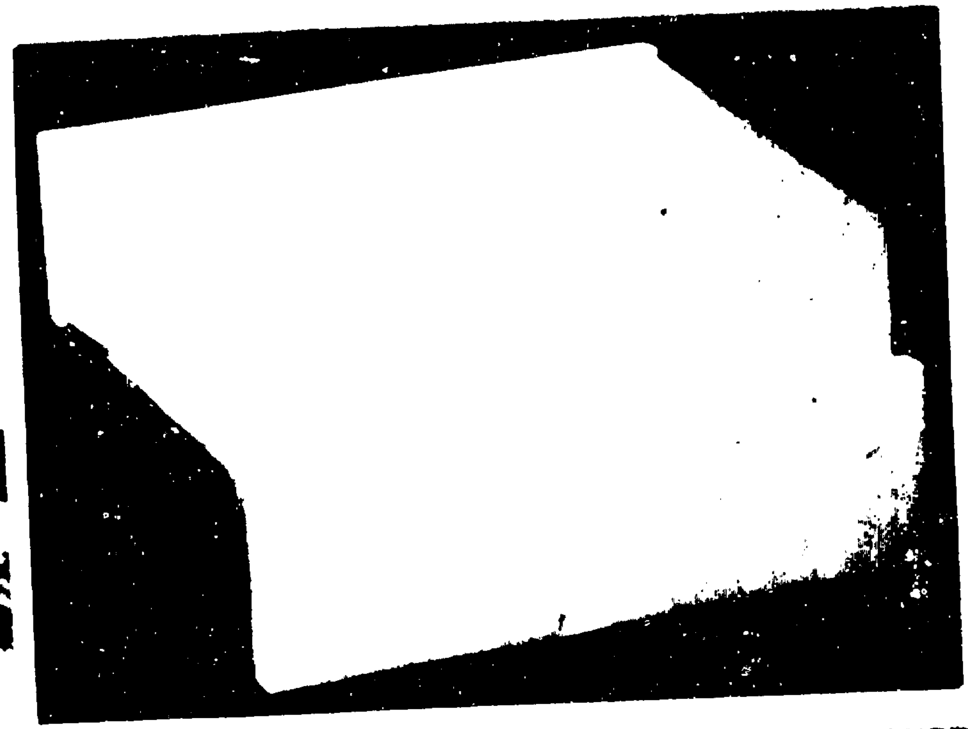
Figure 35 – Horizontal Compactor

THE VORIK COMPACTOR/ENCAPSULATOR

FINISHED CELCON CAPSULES
(12''×3''×14'') 15 LBS.EST.



COMPACTION RATIO 10:1



COVERS ARE SEALED HERMETICALLY BY GASKET OR BONDING, LOCKED BY ULTRASONICS OR INDUCTION HEAT.

Figure 36

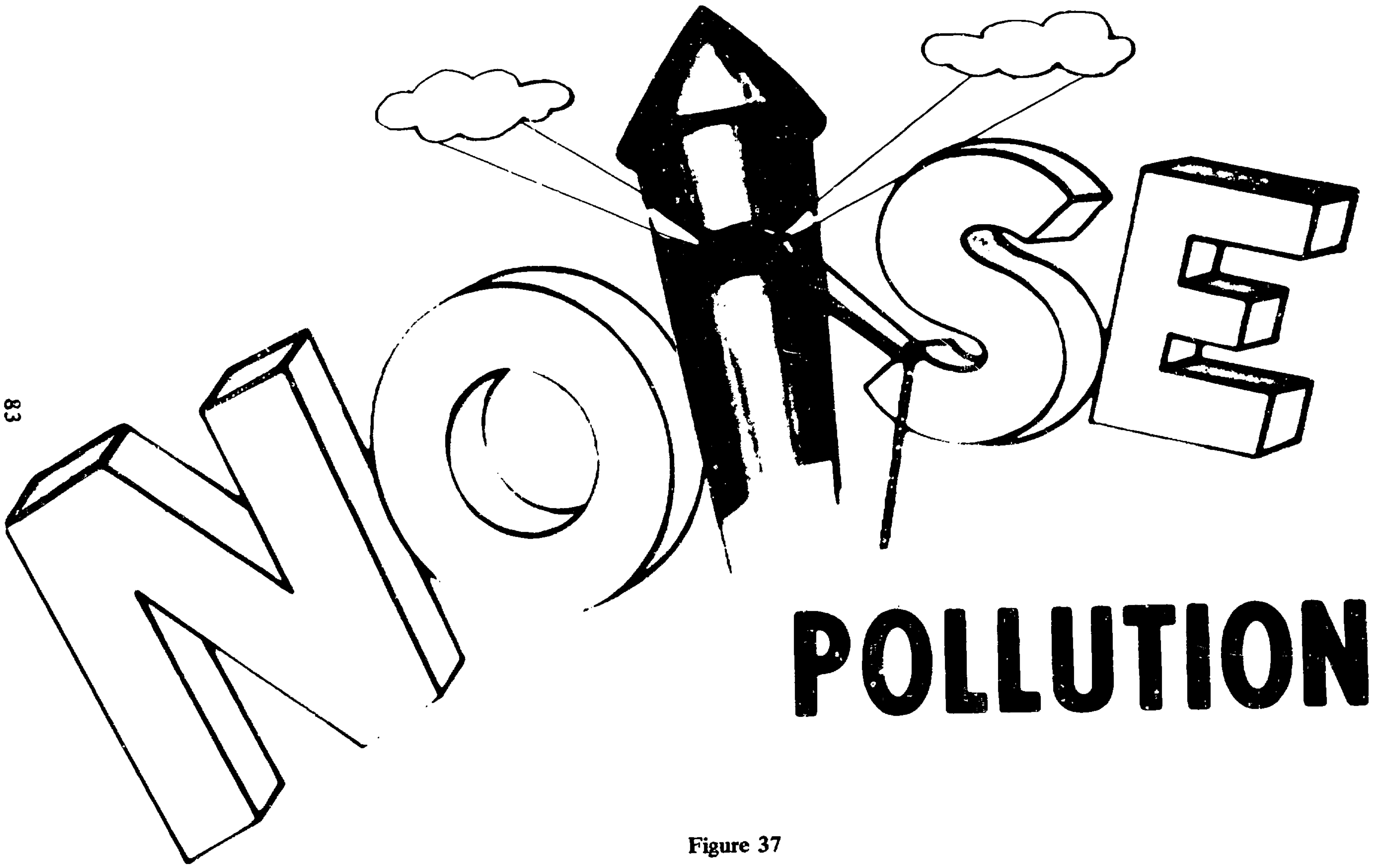


Figure 37

POLLUTION ABATEMENT CONCERNS ON THE STATE LEVEL

Mr. Kenneth E. McElroy, Jr.
Chief of Planning
Maryland Environmental Service

Editor's Note: Mr. McElroy's presentation was delivered by Mr. Douglas Phillips, P.E. (Captain, USN Ret.), Public Health Engineer, Maryland Environmental Service.

Thank you, Commander Farrell. The State Government appreciates the opportunity to be on the agenda for this workshop and to share with each of you some of the State's concerns over pollution abatement. There are four areas of concern I want to cover–Planning, Financing, Regulation, and the Need for Cooperation Among Various Levels of Government. Each of these areas of concern affects all three levels of government–Federal, State, and local. My comments are intended to be both informative and critical – The criticism is intended to be constructive criticism and will hopefully result in this and other forums of Federal, State, and local officials, and concerned citizens responding to these concerns. These concerns will have to be responded to if the benefits of technology transfer are to be brought to bear in accomplishing pollution abatement.

There are three levels of water quality and wastewater management plans which the State is involved in. These are (1) the County Water and Sewer Plans required by State Health Law, (2) Water Quality Management Basin Plans which are intended to satisfy Section 303 (e) and 208 of FWPCA as well as the Maryland Environmental Service Law and (3) Facilities plans, which satisfy Section 201 of FWPCA. Local governments are involved in all three types of plans and have direct responsibility for preparation of the County Water and Sewer Plans and most of the facilities plans. The State prepared the water quality management basin plans with input from government and citizen advisory groups.

The Federal government (EPA) has to approve the water quality management basin plans and the facilities plans. They are not involved in the review of the County water and sewer plans.

Now what are some of our concerns with this planning program? Let's look at Section 303 (e) and 402 of FWPCA first. This sets up a process of wasteload allocations by reaches, so that a segment analysis is made of present and future wasteloads, stream quality standards are taken as constraints, and allowable wasteloads are assigned to each segment. The Federal law and regulations require that discharge permits be issued based on this analysis by December 31, 1974. Yet, the basin plans which are to establish the wasteload allocations are not scheduled for completion until June 30, 1975. So the cart seems to be before the horse. Our concern, more specifically, is that the wasteload allocations need more time for completion than the Federal regulations have allowed. This may result in higher treatment requirements and associated investment than further analysis would indicate.

Next, I'd like to express some concern over Section 208 of the Federal law which establishes a procedure for setting up agencies for areawide wastewater management planning. The State's primary concern with 208 is that it introduces another level of government, regional government, that may conflict with the prerogatives of local government as provided for in existing State law.

Facilities planning is a new requirement of Section 201 of the Federal law. It is a project–specific report to assure that (1) the planned facilities are cost-effective, (2) the treatment requirements satisfy all the provisions of the Federal law, and (3) the facilities environmental impacts are adequately evaluated. This type of planning has a direct relationship with technology transfer. The facilities plans are to consider all alternatives for meeting the allocated wasteload limits. So relatively new methods of wastewater disposal such as land disposal, electrodialysis, reverse osmosis and others should be considered where they are viable alternatives. This means that all levels of government must see to it that consultants preparing the facilities plans have the best possible information available to them.

On the subject of the County Water and Sewer plans, our primary concern is that they not conflict with the water quality management basin plans. This means that MES and the Counties will have to work closely together to avoid such conflicts. Joint hearings on the annual amendments to the County water and sewer plan and on the water quality management basin plan would be one way to avoid conflicts.

The State is very concerned at the present time on where the money will come from to finance needed treatment works. The recently completed needs survey indicated the State can expect to have pollution control needs of over 13 billion dollars between now and 1990. Of this amount, nearly 4 billion dollars is for sewage treatment plans and interceptors. This averages out to expenditures of $250 million per year for the sewage treatment and interceptor portion of the total program. By contrast, Federal and State expenditures have been running about $142 million for water pollution control in Maryland which represents about 80% of the total construction costs of these facilities.

The State is currently pursuing the release of impounded Federal money by asking our Congressional delegation to override the President's deferral of water pollution control appropriations. If this effort is successful, it could increase Maryland's Federal construction grant money by $160 million considering both Fiscal Years 1975 and 1976. Additional State bond money will probably also be needed to meet Maryland's needs. Local governments will also be asked, in some cases, to proceed with projects without the benefit of a Federal grant. It is hoped that technology transfer will help us to reduce our costs of meeting the treatment requirements. It also appears that some incentives are needed to reduce wasteloads reaching our treatment plants.

One of the difficulties we have had over the years in Maryland State government is keeping sewage transmission and treatment facilities from getting overloaded. The current moratoria in the Washington and Baltimore areas bear witness to this fact. In the last session of the Legislature a law was passed emphasizing the General Assembly's concern that no zoning, issuance of permits, etc. be made which would overload facilities. This strengthens the authority of both State and local governments in regulating sewage flows.

The State's concern is simply that the law be understood and enforced. This is essential if our treatment works are to achieve their design removal efficiencies. If developers and local Boards of County Commissioners will work with State government to implement this law uniformly throughout the State, we in State government can spend more of our time on planning, research, and analysis of cost-effectiveness and environmental impacts and less time on enforcement.

In the area of regulation, it should also be pointed out that the Water Resources Administration recently got permission from EPA to administer the discharge permit program, thereby simplifying some of the red tape involved in getting permits. The WRA also recently issued revised water pollution control regulations establishing a non-degradation policy Statewide, a policy regarding wasteload allocation and restrictions on discharging effluents to intermittent streams.

There is a need for cooperation among the various levels of government. This concern alone could cover the rest of the time we have here today. I want to cite some of my experiences as illustrations of cooperation—some good and some not so good. I had the privilege of assisting the State government in negotiating a solution to a law suit in the Washington Metropolitan area. It is sometimes referred to as the Sewerage Agreement of June, 1974. At numerous times in these negotiations Prince Georges County was opposed to Fairfax County, and so on. In spite of this, an agreement was hammered out which should enable us to get on with providing permanent solutions to the lack of adequate sewerage capacity in that area. I think, however, the Agreement could have been reached much sooner had local governments been more flexible.

There are numerous examples that come to mind where regional cooperation between County and Town governments will be necessary if facilities planning is to accomplish its objectives of satisfying Federal and State law, cost-effectiveness, and considering environmental impacts—for example, Port Tobacco, Elkton, and St. Michaels.

In closing I would like to point out the interest and role of Maryland Environmental Service in accomplishing this transfer of Federal technology to local governments in Maryland. We have staff assigned to each of 18 basins in the State to provide planning and utility services as requested by local governments or as ordered by the State regulatory agencies. Part of our job is to assimilate what comes out of this seminar/workshop session and make it available to local governments throughout the State, and we welcome the opportunity to do so. Thank you.

POLLUTION ABATEMENT CONCERNS OF ANNE ARUNDEL COUNTY

Mr. Guenter Spohr
Chief, Wastewater Division, Utility Operations Bureau

Good Morning Ladies and Gentlemen. On behalf of Anne Arundel County, I would like to welcome you to this very important seminar to transfer technology in the area of pollution abatement techniques. My name is Guenter Spohr, Chief of the Wastewater Division of Anne Arundel County in the Bureau of Utilities. The pollution abatement in the County is a function of the Utility Bureau and was founded in July of 1965. Before this date, the Sanitary Commission of Anne Arundel County was the main principal body concerned with pollution abatement. For 300 years the County was governed by a form of Commissioners and in 1964 at the election, in political science terms, a strong County Executive was elected and the transfer from the Sanitary Commission to the new duly formed Public Works Department, was accomplished in July, 1965.

Anne Arundel County, a County more or less termed as the bedroom community for the Baltimore/Washington area, is situated right between Baltimore and Washington, and comprises an approximate area of 270,000 square acres. In the beginning of 1960, the County had a population around 270,000 people, so we had a ratio of about 1 acre per person. But with the growing influx of people into this County, we are now reaching a population of well over 300,000 people. At the present time, the Wastewater Division is responsible for 10 plants, with the latest addition of the Annapolis Wastewater treatment plant which has a design capacity of 10 million gallons. The Utility Bureau is headed by retired Commander George Hoffman, who is incidentally, the number two man of the Class of 1948 at the Naval Academy and is also here today. So we feel very much at home in these halls here and we hope we can contribute to some better understanding between the interplay or the dialog between the government and the private sectors.

In chronological sequence, the first secondary plant in Anne Arundel County was installed at Maryland City. Now Maryland City, located right at the Baltimore/Washington Expressway, was considered as one of the vanguards of new building and living spaces between the two metropolitan areas. A plant of 250,000 gallons daily capacity was built but later was substituted in 1966 with a more modern concrete plant of 750,000 gallons. The old steel structure was abandoned and later transferred, cut to pieces, and erected again down at Sylvan Shores on the South River.

Another major concentration in population took place in the Crofton area. Here in 1962, a builder from Baton Rouge, Louisiana came along, bought up the acres, and had envisioned to provide a living symbol of his own imagination. He almost succeeded, but this community more or less was taken over later on, by Levitt Enterprises. Serving this

Community and also the Odenton area, the Patuxent plant was initiated in December 1962 with a designed capacity of 2 million gallons. At the present time, the Patuxent plant is undergoing a major change and added capacity which will provide treatment for about 4 million gallons daily.

In the northeast, we had the old Patuxent plant, we call it the Cox Creek plant, which was put into operation in 1957 as a primary treatment plant with separate aerobic sludge digestion. In the late 1960s, the plant was converted to a secondary plant with a capacity of about 8 million gallons.

Going further down County, a new plant was built in the eastern section of the County at the approach of the Bay Bridge. We call it the Broad Neck Wastewater Treatment Plant. It was started in the beginning of the 1970s. This plant is unique. It has a different aeration system. Instead of using compressed air at approximately 4–8 psi, we utilize the Swedish Inka system where you have aeration by low pressure (under 1 psi).

Further down in the County, we have the Broad Water Plant with the Oliver fluidized bed incineration system. The problem in this area is the nonavailability of public water. It is an area where the water table is very high and the people down there experience serious problems during the rainy season. This plant is one of the most modern and will give us excellent service for the near future.

In all, the Wastewater Division is responsible for the operation of 10 treatment plants with the latest addition of the Annapolis plant, where installation of the most modern equipment in view of incineration and also of instrumentation, will take place. The instrumentation system is one of the most modern on the East Coast, and when the plant is in operation, ladies and gentlemen, we welcome you for a visit. You will see that our money is well spent for that particular area, which encompasses that section of the County and the service for the City of Annapolis. This plant is a joint venture of the County with the City of Annapolis.

Ladies and Gentlemen, I would like to now mention briefly some of the County problems which relate to pollution. Certain problems are with the disposal of the sludges generated by these County plants. We have various choices to get rid of digested sludges; aerobically, anaerobically, you can burn them, or you can carry them away in some form and put them on the land where the soil will be enriched with nutrients again. This method is as old as mankind. Furthermore, we are interested in the beautification of the streams, lakes, estuaries and rivers carrying the wastewater effluents to the Bay. High concern is generated to eliminate these nutrients leaving the wastewater treatment plants with the effluents. The removal of these effluents, or the nutrients from these effluents, we call advanced treatment, either in the form of phosphorous removal or nitrogen removal. Nutrients contribute to the enhancement of algae buildup and the algae, due to photosynthesis, will react with the nutrients and after awhile, when the rivers get choked up with algae, the algae will sink to the bottom and will produce a secondary pollution. These nutrients are essential for the algae buildup. New technology came from Europe in the form of the Thomas process from Switzerland, where you add directly into the aeration tanks, minerals in the form of ferric chlorides, and good results can be achieved with this kind of process. The Swedes utilize aluminum sulphate to do the same thing. We in the County, did research using, both phosphorous removal by ferric chlorides and by aluminum sulphate addition to the aeration tanks. So, with the advent of the new NPDES permit limitations of the old Harbor Act, (which I think was enacted in the late 1890s), these are useful tools for the government to force industry and the public not to pollute the waterways of the nation.

In the R&D category, various papers were presented and appeared in magazines. Our own research comprised the use of electrical stimulation where you have low power alternating current (45 ma) stimulating gas production or aerobic bacteria production. A new approach is underway at the present time at the only underground plant at Woodland Beach, with the utilization of bromine chloride as a disinfectant. This will take place in the Spring of 1975. The Dow Chemical Co. is interested in sponsoring the program and what we know so far, from bromine chloride, we won't have the toxic effect on the aquatic life in the river or in the Bay, where there is disinfection by chlorine with resulting chloramine buildup, a residual toxic effect occurs. Additional research in the plants includes the utilization of activated carbon and hydrogen peroxide.

Ladies and Gentlemen, this gives you some insight into what Anne Arundel County is doing at the present time. As we all are aware, nothing can be done alone, and we must emphasize that we need the cooperation of the basic structures in society; the business, the industry, the Government, the Navy, the Army, and also the educational institutions. We don't want to have any dominance of one party over the other and I would like to close this morning with the thought that we should enjoy the environment and we have to make sure that we do not destroy it now and for the future. Thank you very much.

POLLUTION ABATEMENT CONCERNS AT THE CITY LEVEL (ENVIRONMENTAL PROBLEMS–CITY OF ANNAPOLIS)

R. Reece Corey
Chairman, Annapolis Environmental Commission

There are two broad environmental problems confronting Annapolis, namely, maintenance of water quality and retention of the aspects of nature within the city. Annapolis is a city oriented to the water. The city is situated where the Severn River enters the Chesapeake Bay and occupies a series of peninsulas separated by the creeks which inlet the city. This gives Annapolis a nautical flavor and scene found nowhere else.

Annapolis contains much historical and distinctive architecture from its colonial past. Most Annapolitans value the aspects of rural life retained in an urban setting, and the colonial architecture requires views of the water and tree lined streets to best compliment it and to retain some of the eighteenth century flavor.

Retaining groves of trees without them becoming a park on one hand or a dumping ground on the other becomes increasingly more difficult. How does a small city or any city retain its wetlands as productive wetlands and prevent them from becoming trash receptacles? Too often our marshes have more old automobile tires than ducks or muskrats, but both can still be found in some of the marshes in Annapolis. Marshlands on the tax roles are drains on the finances of their owners, who can only recoup their investment by bulkheading and filling to convert them into salable real estate. To the average citizen such wetlands have always been nothing more than mosquito sources, and much education as to their value remains to be accomplished.

More specifically the environmental problems of Annapolis are: storm water pollution, soil erosion, solid waste disposal, increasing number of pleasure boats, and loss of natural land features.

1. STORM WATER POLLUTION

Rainwater falling on an urban area will follow one of three routes. First, it may be absorbed into the ground, percolate down, and contribute to the water table. However, as an area becomes more urbanized, impervious surfaces such as streets, buildings, and parking lots increase, with concomitant decrease in water absorbed into the ground.

A second route for rainfall carries it along the natural drainage of the area through intermittent streams, to marshes, and to creeks. Urbanization disrupts natural flow, changing and blocking channels. As natural ground cover is removed or disturbed these flows increase with subsequent erosion of drainage areas and siltation of creeks and marshes.

As urbanization increases a third route becomes more and more important, namely, storm water drainage. Water flowing onto streets from parking areas and adjacent land and buildings contains dirt, fecal matter, chemicals and organic material. It further collects oil, petrochemicals, rubber particles, and salt or other substances used for ice control, together with what other debris may be along the way. This accumulation is then directed toward a creek either through a natural drainage area, increasing its erosion, or dumped directly into the creek. The problem is intensified because it is intermittent rather than constant. Pollutants accumulate during dry weather and then enter the creek in a concentration with the next rainfall.

2. SOIL EROSION

Soil erosion is a natural process, it increases due to improper use of ground cover and additional land being covered by impervious surfaces. Increased storm water runoff then accelerates filling of marshes and shoaling of creeks.

Erosion is a serious and increasing problem within Annapolis. The peninsulas on which the city is located are composed of easily erodable soil. Furthermore, closeness of the creeks allows flow directly into the creek, without chance of settling during passage.

Considerable development has occurred in recent years as Annapolis has become a part of the Washington-Baltimore urban fringe. Increasing amounts of land are covered with impervious surfaces resulting in increased runoff and erosion. As land development intensified, erosion during construction has increased dramatically. The same amount of silt may erode from poorly operated construction sites as in a thousand years of natural erosion. In the long run, erosion control is better than dredging of silted waterways, and development of water pervious pavements is better than storm water control.

3. LOSS OF NATURAL LAND FEATURES

Development has resulted in the loss of natural land features, as open fields and woodlands were developed. Stands of trees were removed for ease and economy in development and construction. Marsh areas and banks were filled and bulkheaded for waterfront and marina development.

The most easily developed parcels of land were utilized first. The remaining areas, which were avoided because of their difficulty, now face pressure, but they also present greater environmental problems as they are the steeper slopes, erodable soils, floodplains, and marsh areas. Loss of these areas in addition will result in a loss of much of the "character" of Annapolis as well, for much of its special nature is due to tree lined streets, mature trees, and open spaces with glimpses of the water.

4. SOLID WASTE DISPOSAL

Traditionally city dumps or land fills have been situated on so-called "worthless" land, which usually meant floodplans or wetlands. With growing knowledge of the ecological importance of such sites, sky rocketing land values, and increasing amounts of trash, alternative means of solid waste disposal are needed.

In addition to requiring space for disposal, much waste represents a finite portion of a non-renewable resource together with a certain amount of energy expended in its production. As energy and resources becomes more valuable, solid waste will present more and more of a conservation problem. Before mankind is reduced to picking over its dumps for salvagable materials, an attempt must be made to solve this problem. One approach has been source reduction, i.e., limitation of "throwaways"; the other has been the recovery of reusable material before disposal.

As far as Annapolis is concerned, the current landfill space will be used in the immediate future and no new sites are available for landfill. The current "state of the art" in recovery of reusable material is such that the process is the most costly method of disposal. Much improvement is required before recovery is an economically reasonable alternative.

5. PLEASURE BOATS

Much of the economic base of Annapolis and its environs is related to the water. Commercial vessels still operate from the harbor and harvest crabs, oysters, clams and fish. In addition many pleasure craft are docked within the city limits, and fifty percent of the pleasure craft on the Chesapeake Bay are within Anne Arundel County. In spring and fall, moreover, many transient boats on the intercoastal waterway lay over in Annapolis harbor. On a typical weekend the harbor and creeks are thronged with boats. A continuous traffic passes up and down the river, while a small city is afloat in the Chesapeake Bay within sight of Annapolis.

Small boats and yachts contribute pollutants in the form of litter, sewage, and petroleum products. Much of the litter sinks to the bottom and as the water is brackish disappears by electrolysis and oxidation. The remainder which floats accumulates in back waters and along the shoreline.

While the exact amount of untreated sewage contributed by boats is unknown and controversial, not all have holding tanks or properly operate them or contain wastewater from heads. In many of the smaller sail boats, space for a head, let alone a holding area, is almost nonexistent. As regulations for control of sewage are promulgated, the city and marinas will be faced with the problem of pumping sewage from boats of varying size and innumerable designs. Such pumping facilities will have to be designed with a great deal of flexibility in their operation.

Oil and petrochemicals can be found on the water in the creeks and harbor. While major oil spills may take place here, such an occurrence would be less likely than in a commercial harbor such as Baltimore. Instead, a continual release of gasoline and oil in small quantities takes place as tanks are filled and motors operated; outboard motors being particularly involved. Many of the smaller sailboats which abound in our creeks use outboards as auxiliary power and Annapolis is the sailing center of the Chesapeake.

The estuarine creeks of Annapolis have a limited ability to flush out pollutants. The load of soil from storm waters collects as sediment on the creek bottom, while litter from runoff accumulates along the creek banks and in the dock area. Petrochemicals from automobiles are introduced to the creeks in storm water runoff and are reinforced by petrochemicals from boats. Fecal material from storm water runoff, sewer leakage, and boats contribute sewage, evidenced by increased coliform counts after rains, weekends, and in the summer. The water quality decreases, most noticeably in Spa Creek, in which one could once catch crabs and see ducks as one still can in Back and Weems Creeks. Many places can pollute their material waters and get away with it as areas downstream suffer the effects, but in Annapolis with limited tidal flushing of the creeks, pollutants build up. "Fouling of our own nest" will result if we are unable to control these problems.

TECHNIQUES OF TECHNOLOGY TRANSFER

Joseph D. Antinucci
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Office of Intergovernmental Science
and Research Utilization
National Science Foundation

The time for action is NOW! This was the summary resolution of a conference held in Harrisburg, Pennsylvania in June 1972, at which 200 leaders in the field of intergovernmental science and technology met to discuss the subject of technology transfer. I am very happy to be here today, to report to you the progress and accomplishments since that conference in 1972. My "progress report" includes three principal points.

1. Federal policy definitively supports technology transfer activities.

There has been a good deal of talk about the efficiency of t... ..ology transfer since the 1930s when the Economy Act was passed, and then again ... 1960s during the Daddario hearings. More recently, in a Message to Congress, the President called for the formation of new partnerships between State, local, and Federal government, univer...ties, Federal laboratories, and the private sector for the solution of domestic problems. Subsequent studies by the Federal Council for Science and Technology recommended increased use of interagency cooperative programs, and also called for new, expanded uses of Fed al laboratories, as a resource for the delivery of science and technology to the local level. Moreover, studies by the United States General Accounting Office indicate that Department of Defense (DoD) laboratories are a valuable and vital national resource, and have capabilities v.. ich are relevant not only to the effective solution of defense problems but also to domestic problems. Just last week the Senate passed a new version of S.32 (National Policy and Priorities f r Science and Technology Act of 1974), which would establish a new Federal Coordinating Committee for Science and Technology to provide more effective planning, to iden... y research needs, and "to achieve more effective utilization of the scientific and technological resources and facilities of Federal agencies. . . ." (emphasis added). The resolution f the 1972 Action Now Conference supported all these developments, and made a strong plea for the elaboration of a definitive national science and technology policy. In that regard, the Department of Defense recently issued a policy statement which indicates that pro... ional manpower within the DoD can be applied—at the discretion of each service—to the solution of non-defense problems, and that a particular function would be provided within the National Science Foundation for liaison between non-Defense agencies and the DoD services.

2. There are technology transfer systems in place—nationally, at the state level and to some degree at the local government level.

In spotlighting four systems that look at the problem of technology transfer from slightly different vantage points, I will briefly mention two and then discuss the others in some detail.

The Technology Utilization Program of the National Aeronautics and Space Administration has been in operation for about ten years. The primary thrust of this program, of course, is to find new users for aerospace technology in a domestic problem solution context. The program is administered by NASA and has an annual budget of about $4 million.

The Extension Service for the United States Department of Agriculture is a mature program, having been in existence since 1917. It is primarily mission-oriented; that is, the objective is to bring new research and development results in agriculture to the farmer.

Let's turn now to the Urban Technology System and the Federal Laboratory Consortium. The Urban Technology System is a very new concept—it actually began full operation on 1 July 1974. It is a program which is funded by the National Science Foundation and is managed by Public Technology, Incorporated, a non-profit corporation located in Washington, D. C. The program is cost shared and valued at about $9 million and will run on an experimental basis over a three-year period. It is in fact a national program, and targeted exclusively to bring help, in the form of technology, to cities. The basic components of the program are: the cities, technology agents, and R&D back-up institutions. There are 27 cities throughout the nation, which have been randomly selected from a stratified base according to geography, population, and economic condition. The technology agents have professional backgrounds and have been selected and hired jointly by Public Technology Incorporated and by the city where they will work. The technology agent functions as the city manager's right-hand man, so to speak, with respect to bringing innovations into the particular city where he works. He is backed up by one of 15 R&D institutions: five universities, five private companies, and five non-profit institutions. The Federal Laboratory Consortium, which I will discuss in more detail in a moment, is one of the R&D back-up resources in the system. The technology agents can call upon these back-up institutions to help define and prioritize the problems of the city, access technology within and outside the system that can be applied to the solution of these problems, and then implement programs to effect solutions. An interesting aspect of the experiment is the existence of 27 control sites. The locations of these sites have not been disclosed, but they are cities and municipalities which parallel to come degree the characteristics of the 27 test site cities. They will operate independently of the Urban Technology System. The idea is to measure the performance of the city in terms of science and technological innovation over the three years, with and without the benefit of the Urban Technology System. The 27 cities are arranged into four major regions, and meetings have recently been held at the local and regional levels to discuss and define problem statements that have been developed up to this point. Public Technology, Inc., is now in the process of aggregating the problem definitions, at both the regional and national levels. Problem statements should be available for general distribution within the next few months.

In a large number of technology transfer activities throughout the Federal Government, it has been found that by far the most significant and effective aspect of technology transfer lies with person-to-person linkages. The fourth system that I want to discuss–the DoD Consortium of Laboratories–approaches technology transfer in terms of these personal linkages. The Consortium also recognizes the wisdom of building on existing information networks of technology transfer rather than constructing new networks. Through these techniques we hope to integrate the Federal laboratory R&D efforts into the national program for delivery of science and technology results to state and local government levels.

The overall objective of the Consortium is to facilitate the transfer of existing technology from the laboratories for use in the solution of nationally-defined problems. The concept of making use of existing technology is very important, and deserves emphasis. It it not our purpose to get into the business of redevelopment, or to act as a development agency for state and local government. We do, however, want to make available any existing technology–which has already been paid for by the taxpayer–if it can be used effectively to solve a problem.

In terms of resources, the Federal Laboratory Consortium now consists of over 35 laboratories located in 17 states, employing over 20,000 scientists and engineers. In addition to an annual budget of about $1 billion for research and development, there is extensive capital investment for testing and evaluation facilities supporting virtually every scientific and technological field. Each participating laboratory has designated a technology transfer specialist, whose functions include acting as a clearinghouse for that laboratory's technology, assisting in problem definition and implementation of solutions.

After two years of operation, we have initiated over 100 projects in seven general categories of science and technology, and we have received funding of about $12 million from non-Defense agencies. This points out two things:

(1) The non-Defense agencies feel that DoD-developed technology can be of some benefit in meeting their needs–this is indicated by their willingness to reimburse DoD for the necessary services and products.

(2) The wide spectrum of active science and technology programs in the Consortium indicates the viability of technology transfer from DoD to non-defense areas.

Here are just two examples of the over one-hundred projects that are in process. The Army Night Vision Laboratory in Virginia has spent considerable time, expertise, and development capability in designing and producing night vision goggles for use in night reconnaissance missions. These goggles are based on a rather simple but effective principle of image enhancement. Interestingly enough, use of these same goggles by people with retinitis pigmentosa (night blindness) dramatically improves their night vision. In fact, in some cases a person with night blindness can achieve equivalent daytime vision by wearing goggles. There are obvious biomedical applications for this device; moreover, there are several civil law enforcement agencies who have expressed interest in this device, after some refinements have been made, for search and seizure operations.

The second example comes from the Naval Weapons Center in China Lake, California, and involves technology in the field of microwave radiometry: a device used essentially for "seeing through smoke." This device does not involve ordinary photography or infra-red photography; its development was based on a radar mapping principle. The obvious military application is for the enhancement of the detection, identification, and localization of a military target. The Forestry Service has become quite interested in using the device for airborne fire fighting, since the process of identifying and localizing a fire through smoke is quite analogous to the process of identifying military targets and delivering bombs.

3. There is increased emphasis on research and development activity and applications at the state and local government levels.

With respect to specific state and local government projects, we have discovered numerous ways by which the DoD laboratories can help state and local government agencies. In fact, the number of ways almost equals the number of projects that are now in progress. For example, in Indiana, the Commanding Officer of the Naval Ammunitions Depot at Crane is the Chairman of a statewide science and technology committee, and the DoD technology transfer agent is assisting in a technical advisory capacity. In New York City, the Naval Underwater Systems Center and the Naval Ordnance Laboratory are assisting the New York City Police Department and their Advanced Technology Unit. They are attempting to bring new technology to the operating force in the Police Department through training and new systems implementation. In Florida, the Naval Coastal Systems Laboratory is sponsoring a program called, "The Scientist and the Sea." Coordinated with the State of Florida, the U. S. Department of Commerce, and Florida State University, this program is aimed at training marine biologists in scuba diving skills. In Rhode Island and Connecticut, the Naval Underwater Systems Center is designing and evaluating a statewide emergency communications system for improved delivery of medical services. In Wisconsin, the Starlight Scope developed by the Night Vision Laboratory is being used to research the history and ecology of wildlife. Those are but a few examples.

I would like to conclude by indicating some of the ways by which you can participate and become active in technology transfer. First, there is information exchange. There are mechanisms for creating a no-cost agreement between states, counties, cities, and a laboratory such as the Naval Ship Research and Development Center, where information is traded for problem definition and solution. Ways exist for disclosing patent information to industry, or through state and local government to industry. A memorandum of understanding or an inter-agency agreement (at Federal, state, or local levels) can be used for cooperative development. The reimbursement method can essentially be implemented by the execution of a purchase order (which most states and cities have), a contract, or a simple agreement. Finally, there is the personnel sharing system. In the case of industry the loaned executive type program would be employed and between governments, the Intergovernmental Personnel Act would be the vehicle. Several people from DoD laboratories are now physically located in state, local, and Federal government agencies in order to provide day-to-day assistance and advice.

Interest and participation in technology transfer activities is growing significantly at the Federal level, and in the Navy. The potential benefits to state and local governments are great, and many of the available resources are as yet untapped. I hope that the information brought to you during this seminar has stimulated your interest to the point of joining the effort.

WORKSHOP A

HARBOR OIL SPILL RECOVERY

Panel Leader: Mr. J. Wilson, Naval Facilities Engineering Command

Editor's Note: This workshop ran for 2 hours and most of the session consisted of a presentation by Mr. Wilson which recapped the Technical Development Program at the Civil Engineering Laboratory (CEL). Ensign Jake O'Neal of USCG headquarters was present and assisted in answering questions that were in the Coast Guard area. Mr. John Cunningham represented the EPA position and viewpoint. The following represents a summary of the material presented at this workshop and is included herein at the request of Mr. J. Wilson.

Executive Summary

for

HARBOR OIL SPILL REMOVAL/RECOVERY SYSTEMS–PHASE I

Civil Engineering Laboratory
Port Hueneme, California

Sponsored by

Naval Facilities Engineering Command

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EXECUTIVE SUMMARY

The Harbor Oil Spill Removal/Recovery Systems Development program was undertaken to develop systems to handle spills in the confined and open areas of harbors. During first phase of the program completed during FY-73, the best commercially available "off-the-shelf" items of equipments were identified through tests and evaluation conducted by six industrial firms under contract with the Naval Civil Engineering Laboratory, who planned and coordinated the tests and evaluated the test results. The best class of items were assembled into two viable in-harbor recovery systems for further testing, one for confined areas and one for open areas. The second phase of the program underway in FY-74 deals with investigations to improve the performance, logistics and deployment of the systems, as recommended here.

The oil spill clean-up systems are composed of four subsystems outlined below.

- Containment subsystems, which are used to prevent further spread of oil over a larger area of the water surface.
- Removal subsystems, which are used to skim or remove oil or the oil-water mixture from the surface of the water.
- Storage & transfer subsystems, which are used to transfer the oil or oil-water mixture from the removal subsystem and store it until it is delivered to a separation subsystem.
- Separation subsystems, which are used to separate the oil from the water in the oil-water mixture. The oil with low water content is sent for refining, whereas the water with low oil content is discharged to the body of water.

The various subsystems examined and the results of the test and evaluation program are summarized below and are illustrated by a short film available for viewing on request from NAVFAC.

Containment Subsystems

Comparative evaluation of the performance and operational effectiveness of six different types of booms was carried out by Battelle Northwest Laboratories. Each boom tested was 300 feet long and had a 2-foot draft and a 1-foot freeboard. Each was subjected to an intentional tear followed by recommended method of mending it, and tests to determine the deployment, towing and handling characteristics. Deployment and towing data were obtained in the Columbia river whereas the oil containment effectiveness data were obtained in laboratory tanks. The river tests consisted of deployment from a dock, straight line towing from one end at speeds up to 10 knots to determine the boom's ability to withstand stress, and towing from both ends in a catenary configuration with a 90-ft opening at speeds of 1 and 2 knots to determine the stability of each boom. The tests in laboratory basin using oil consisted of determining the capability of booms to contain oil while advancing at speeds of between 1/2 and 2 knots through a 1-mm-thick slick, at wave heights varying between 0 and 1 foot. These tests showed that:

- Four of the six booms could not retain stability with respect to the water surface at tow speeds over 1-1/2 knots in a catenary configuration. Only two booms could be towed at 2 knots without loss of freeboard and stability.
- Even under no waves, no boom could prevent oil leak from under it if speed exceeded 1 knot.

Based upon parametric evaluation and test results, Aqua Fence, manufactured by Pacific Pollution Controls, and Sea Curtain, manufactured by Kepner Plastics Fabricators, respectively, were selected as the primary and the secondary or back up containment subsystems for both, the confined and the open area systems tests.

Removal Subsystems

A total of ten (10) removal devices were selected for examination in this test program. Six of the ten removal devices were tested in a 370 x 33-foot section of a large wave tank at Battelle Northwest Laboratories, and the other four were tested in a 125 x 50-foot wave tank at Shell Pipeline Laboratory. The dry weight and the overall dimensions of the lightest and the heaviest removal device investigated were 38 pounds and 3.6 x 3.6 x 1.3 feet, and 35,000 pounds and 36 x 12.8 x 7.6 feet, respectively. Three removal devices were rotating oleophilic porous belt skimmers, two were gravity weir skimmers, two were stationary weir skimmers, two were inverted endless belt skimmers, and one was a rotating disc skimmer.

During tests, Navy distillate, Navy special fuel oil and diesel fuel No. 2 were used with slick depths varying between 0.57 mm and 24.9 mm. Towing speeds ranged between 0 and 3 knots, and wave heights varied between 0 and 2-1/2 feet. Tests were performed both with and without simulated debris of the type often found in harbors.

Depending upon the test conditions and the skimmer device used, the oil pickup rate varied between 0.03 and 152 gpm with Collection efficiency (percentage of oil in the oil-water mixture picked up) of between 0.1% and 90%. The throughput efficiency (percentage of oil encountered which was picked up) varied from less than 1% to over 99%. In general, the confined area skimmers tested were found to be effective only in relatively mild water conditions operating on thick oil layers.

Based upon the collection and throughput efficiencies, oil picked up per pass, and other operational considerations, JBF Scientific Corp's Model DIP-1001 was selected as a primary removal device for confined area system test, and the Coastal Services SLURP was selected as a back-up device. For open area system test, JBF Scientific Corp's Model DIP-3001 was selected as the primary removal device and their Model DIP-1001 was selected as the back-up device.

Storage and Transfer Subsystems

Storage and transfer subsystems consist of pumps and towable tanks. Three different pumps and two different towable tanks were tested by Oceanographic Services, Inc. The pumps were tested on land, and the towable tanks were tested in the Santa Barbara Channel to determine their towing characteristics. The suitability of pumps was determined through comparisons of the average flowrates of oil-water mixtures of varying composition, power consumption during these flowrates, pressure drops in the transfer hoses under standard flow conditions, ease of repair, durability, and susceptability to fouling and damage. Based upon parametric analysis, very little difference was found between the three pumps. Depending upon the availability of compressed air at the site, Parker System's air operated Model M8P was selected as a primary pump for both the confined and the open area systems, and an electric Blackmer pump Model GXS-2-1/2 was selected as the back-up pump.

The towable tanks were compared for their storage capacity, fluid retention, durability, maintenance requirements, personnel safety, ease of deployment, and a number of other parameters including maximum towing speed and towing power required. Based upon parametric analysis, there was little difference between the two tanks. However, during the test one of the tanks was found to be easier to deploy, narrower for a given volume, and more maneuverable in confined areas. Based upon these tests, Kepner Plastics Fabricators' Sea Container was selected as the primary transfer tank for both the confined and the open area systems tests with Firestone Coated Fabrics tank as a back-up.

Separation Subsystems

Three types of oil-water separators were subjected to tests by the Ben Holt Company. Two of the separators were of the coalescer type whereas the third was gravity type. The tests demonstrated that the coalescer type separators will not operate when the influent oil concentration exceeds about 2%. Consequently, two separators in tandem were selected for the system test: Heil CPS separator as the first stage and Dresser separator as the second stage, for both the confined and the open area systems tests.

The output from the Heil CPS separator contained about 200 ppm of oil and the Dresser separator reduced the amount of oil in the discharge to less than 10 ppm.

Systems Test

Following selection of components, the confined and open area systems tests were carried out by Battelle Columbus Laboratory at their Long Beach facility.

The confined area system test showed that it took nine men 20 minutes to deploy the Aqua Fence boom. Time required to tow the boom into circular configuration and to connect the ends of the boom together to form a closed area took 16 minutes. The removal of 100 gallons of Navy distillate, with NRL piston film and debris, using JBF DIP-1001 took another 128 minutes, followed by secondary removal of oil using SLURP which took an additional 84 minutes. Eleven people were needed to retrieve the boom, and retrieval was carried out in 20 minutes.

A similar procedure was used in the open area test. The results of this test showed that it took 5 men 14 minutes to deploy the boom, with an additional 9 minutes needed to secure the boom. The two removal devices were operated for about 30 minutes each to completely remove 75 gallons of Navy distillate.

Systems Cost

The complete purchase prices of the selected open and confined area systems were $81K and $209K, respectively. The noticeable difference of $128K between the two system costs was due largely to the difference of $119K in costs of JBF DIP-3001 and SLURP removal devices.

Based upon the parametric analysis and tests and evaluation, the following recommendations were developed.

- Statistically valid acceptance tests and evaluation procedures should be developed.
- The performance of booms and oil removal devices should be improved to make them effective under currents of 2 knots and waves of 1 foot.
- The equipment operation when debris is present in the oil slick should be improved.
- The operating procedures should be improved to reduce deployment time and, more important, to reduce personnel required for deployment.
- The system logistics should be improved for cleaning, storage, and mobility of equipment.
- Since no major problem was noted during test and evaluation of the storage and transfer subsystems, no further development need be undertaken in this area. Further development of oil/water separator subsystems should be discontinued and results of NAVSHIPS work on separators should be incorporated in the complete system.
- Development of devices for detection and surveillance of oil slicks in harbors and for volume estimation of the spills should be carried out.

CURRENT EQUIPMENT PROCUREMENTS

The following comments and figures relate to the oil spill containment equipment currently being procured for Navy-wide use in harbor waters. This equipment was selected as a result of the aforementioned research and development program.

Figure 1 shows the generic type of barrier being procured including a table with the dimensions of the three sizes being used by the Navy. The total system includes standard Navy end connectors, tow attachments, storage containers, bulkhead attachments and field repair kits.

Figures 2 and 3 show how a floating platform is utilized to stow and deploy boom. This platform further serves as a working surface near the water for operating small skimmer systems, deploying and retrieving absorbents and other cleanup equipment of materials. The platform may be towed as shown in Figure 3 or if increased mobility is desired, then engines can be placed on the platform. Figure 3 also illustrates the use of a lightweight mooring system for stationing boom and other equipment in open waters or away from piers, etc. Figure 4 is a cross section of the mooring system as employed with boom.

Boom is deployed, towed, and positioned with the assistance of a twenty-foot utility boat shown in Figure 5. This boat has a relatively flat cathedral hull with an open well for stowing equipment. This hull provides good stability for working over the side with boom, etc. The engine is 85 hp with a propeller designed for towing.

Figures 6 through 10 relate to the three size skimmers being procured for Navy use in harbor waters. Oil skimmers are used to remove oil from the water surface after an oil spill has occurred. This can be done with the skimmer in a mobile mode advancing through the oil slick, or with the skimmer in a stationary mode by pushing oil to the skimmer. Natural elements such as wind and current can push oil to a stationary skimmer. The expected quantity of oil spilled, wind and wave conditions, location of these expected spills, and the types of skimmer systems available must be considered prior to selecting an operating mode and a skimmer. Three types of skimmer systems, large, medium, and small, have been selected for central procurement. The proposed distribution of these systems is based on the size and type of activity, the frequency and size of oil spills, the existing cleanup capability, and where feasible, the wishes of the local activity.

The large and medium skimmers currently under procurement are being manufactured by the JBF Scientific Corporation of Burlington, Mass. Both skimmer systems use the Dynamic Inclined Plane (DIP) concept for skimming oil (Figure 6). The DIP concept is based on collecting the spilled oil under the surface of the water. This reduces the effect of surface currents and waves, and limits the amount of water entering the storage tanks. The system effectively collects different viscosity oils.

The LARGE SKIMMER, DIP 3001, is a self-contained oil skimming system, Figure 7. It is designed to harvest oil in the open harbor, with waves up to two feet in height. It can also operate effectively in between piers or in the stationary mode at the apex of a boom configuration. The DIP 3001 is approximately 25 feet long and 10 feet wide. Articulating sweeps extend the skimming width to 15 feet The unit is diesel powered, with twin screws for propulsion. All pumping, propulsion, and belt functions are hydraulically operated. One thousand gallons of storage capacity is provided onboard for collected oil. At least two personnel will be required to operate the system.

A debris transfer system is currently being developed for this type skimmer. After final acceptance, this system will be procured for retrofit on all large skimmers or for use when required.

The MEDIUM SKIMMER, DIP 1002, is a trailer mounted, self-contained oil skimming system, Figure 8. It is primarily designed for near-shore use in restricted environments, under piers and between nested ships. The unit will operate effectively in either the moving or the stationary mode. The entire trailer system will fit in an LCM-6 if in water transport or use is required. The DIP 1002 is 6 feet long and 3-1/2 feet wide. It is air operated with twin screws for propulsion, and is equipped with a double air diaphragm oil transfer pump. A 25 foot long wand is used to control skimmer in the oil slick and to transfer collected oil to a storage tank on the trailer, Figure 9. A hand held remote control box at the end of the wand provides the means to operate the skimming belt, transfer pump, and propulsion units. Two hundred feet of containment boom, a 200 gallon oil storage tank, a diesel engine driven air compressor, and a jib boom for launching the skimmer are included on the trailer, Figure 10. These components provide a complete cleanup capability. At least two people will be required to operate the system.

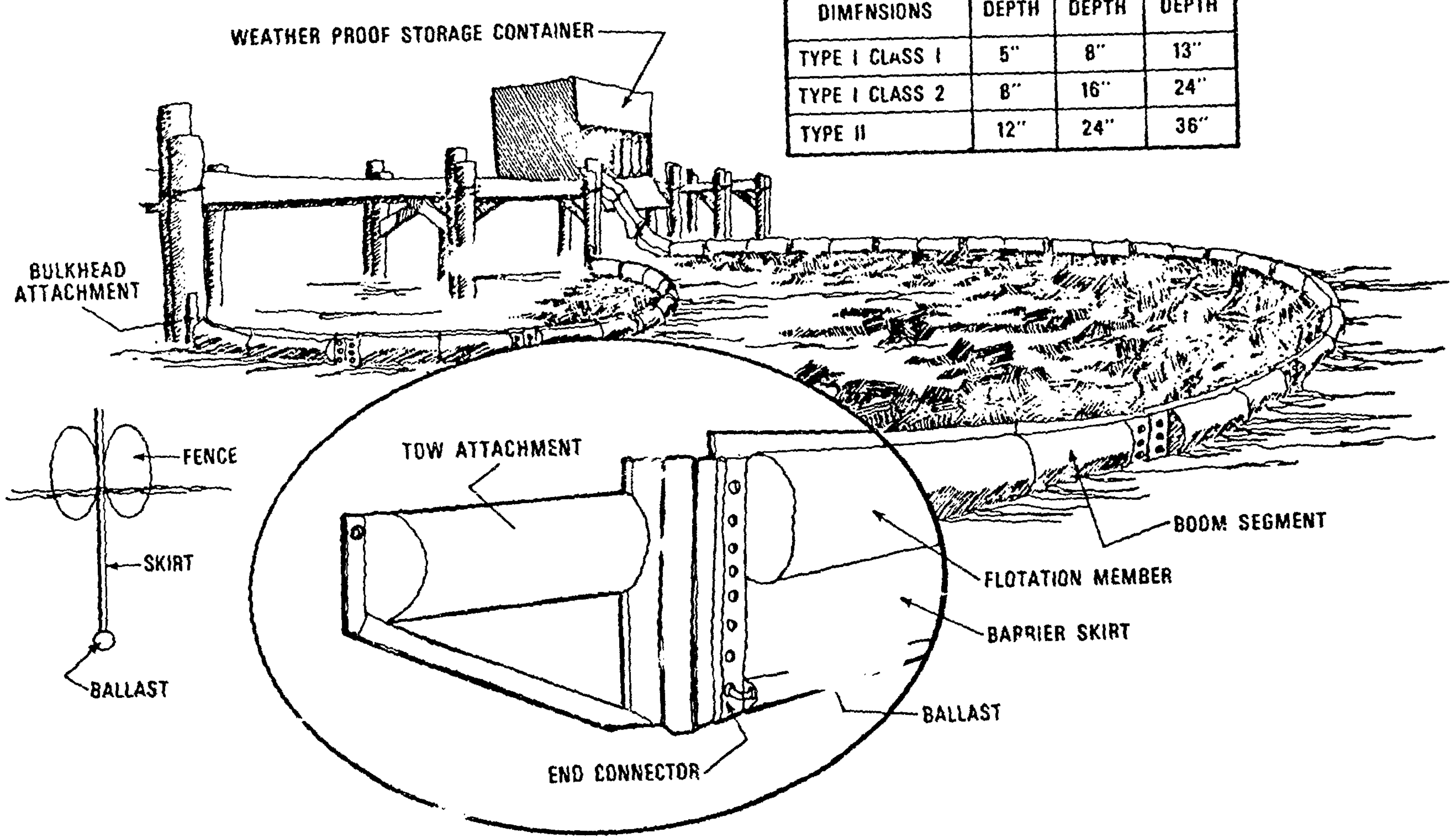
The small skimmer is for use in removing oil and contaminated particles floating on the surface of inner harbor waters. The system includes the following: "SLURP" RTM pickup device, 3-60 foot light weight plastic suction hoses with flotation collars, a single diaphragm diesel powered pump, floating oil/water separator, 300 gallon pillow type collapsible storage bag, weatherproof system storage container, 30 foot placement wand, and all other necessary piping, hose fittings, couplings, valving and repair parts necessary for its operation.

The oil retrieval system is a stationary type which makes use of a pickup device capable of removing oil within a confined area. The mode of operation of the pickup device is such that it removes a confined oil spill as the oil is induced toward the device. The system is small, portable, hand deployable, hand operable, and principally designed for minor spills in congested areas, but may be used on all spills, independent of size. The system, at minimum, is capable of being operated as shown in Figure 11. The system is completely self-contained in that all components may be stored in a furnished, weatherproof storage container, and that the system is furnished with all pumps, prime movers, power sources, valving, couplings, piping, and hosing necessary to remove oil from a confined water surface upon its delivery to the spill scene. The system is designed for simplicity in order to be operated by relatively untrained personnel and is capable of being operated in the configuration depicted.

The system is portable in that it can be carried and/or rolled, by two men to the spill, and fully deployed and manually operated by these men from a pier. The system is capable of being off-loaded, deployed into the water and operating in less than thirty (30) minutes from the time of arrival at the spill site excluding transit from pier to spill sites.

System Configuration and Operation Mode
(see Figure 11)

Figure 11 represents the primary operating configuration which is required of the skimmer system. The pick-up device operates in a stationary mode and removes oil as the oil is naturally induced toward the operating device. The suction hose transports the skimmed high water content oil/water mixture as it is pulled to the pump. The pump, via suction hose, discharges the mixture to the oil/water separator for gravity separation. Through adjustment of furnished valving after an appropriate retention time, the pump is used to pump out the higher concentrated oil in the separator via the separator's pick-up head. This high oil content oil/water mixture then returns through hosing and is finally loaded in the pillow storage container for removal to a reclamation site.



BOOM DIMENSIONS	FLOAT DEPTH	SKIRT DEPTH	TOTAL DEPTH
TYPE I CLASS I	5"	8"	13"
TYPE I CLASS 2	8"	16"	24"
TYPE II	12"	24"	36"

Figure 1 – Oil Spill Barrier System Components

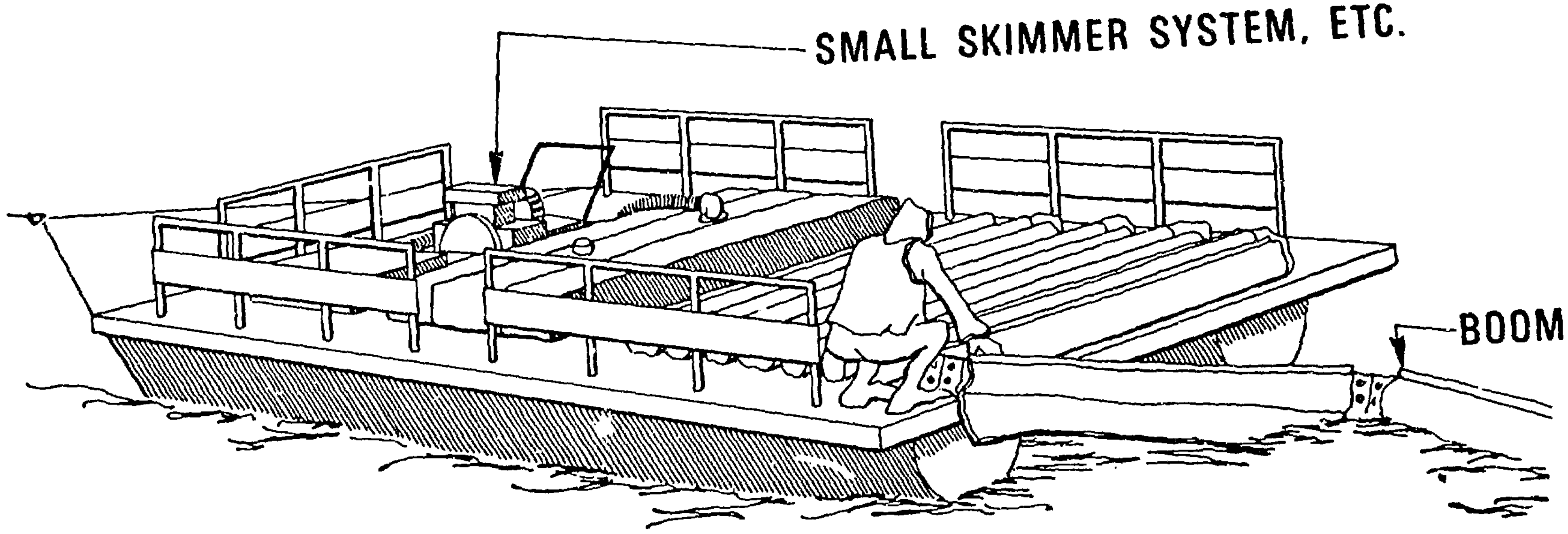


Figure 2 – Boom Floating Platform with Boom and Small Skimmer System

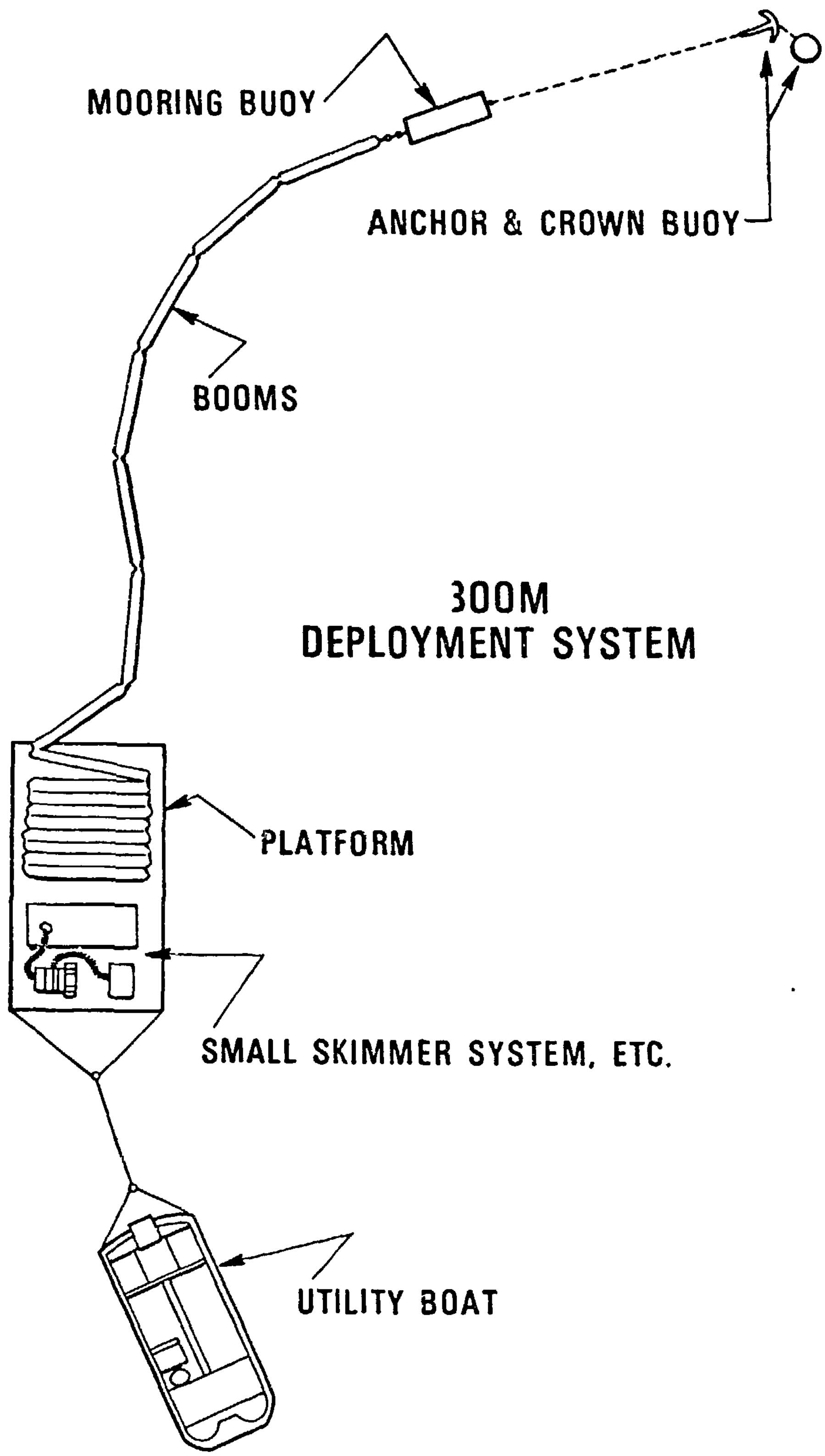


Figure 3 – 300M Deployment System

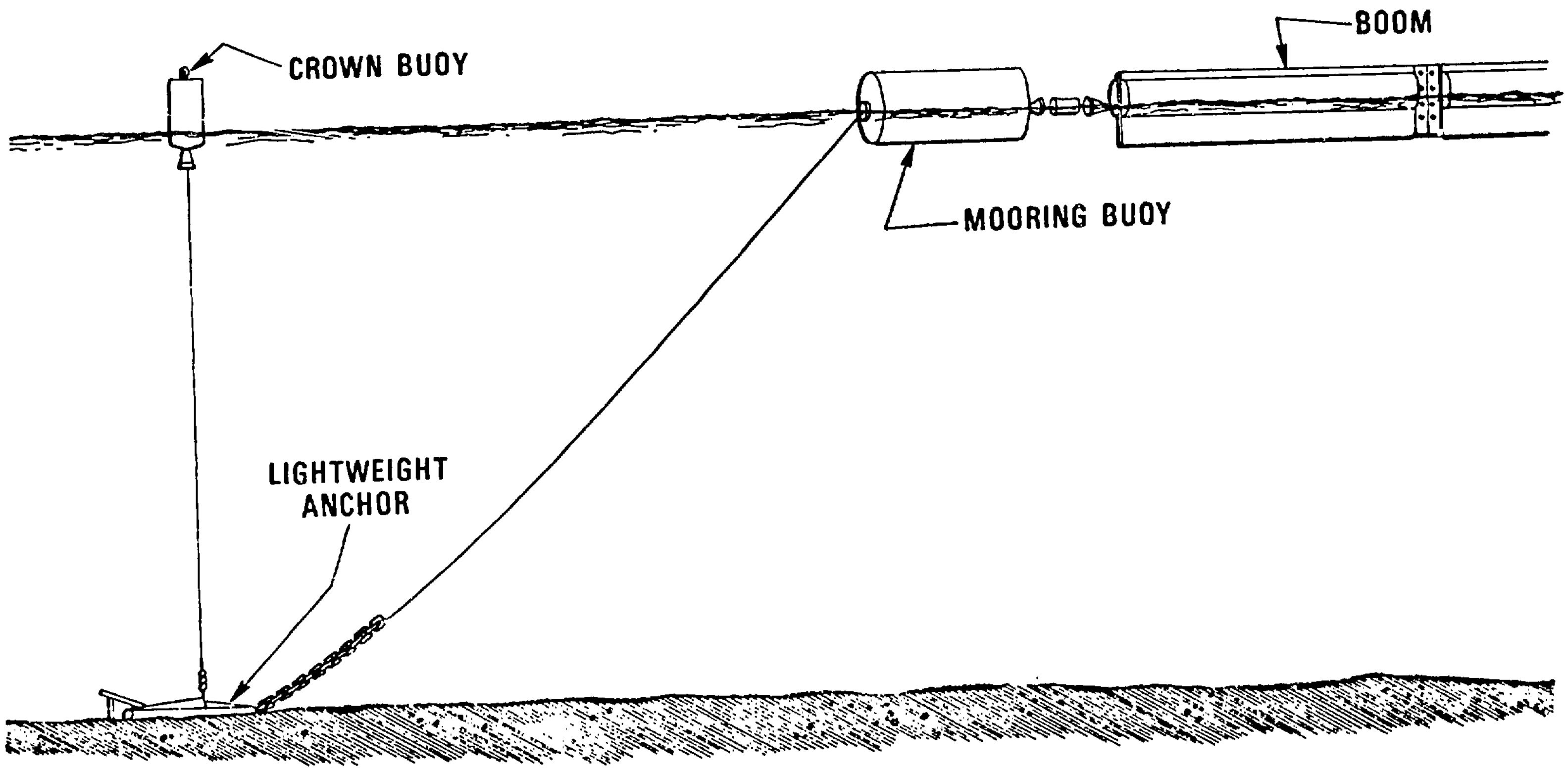


Figure 4 – Equipment Mooring System

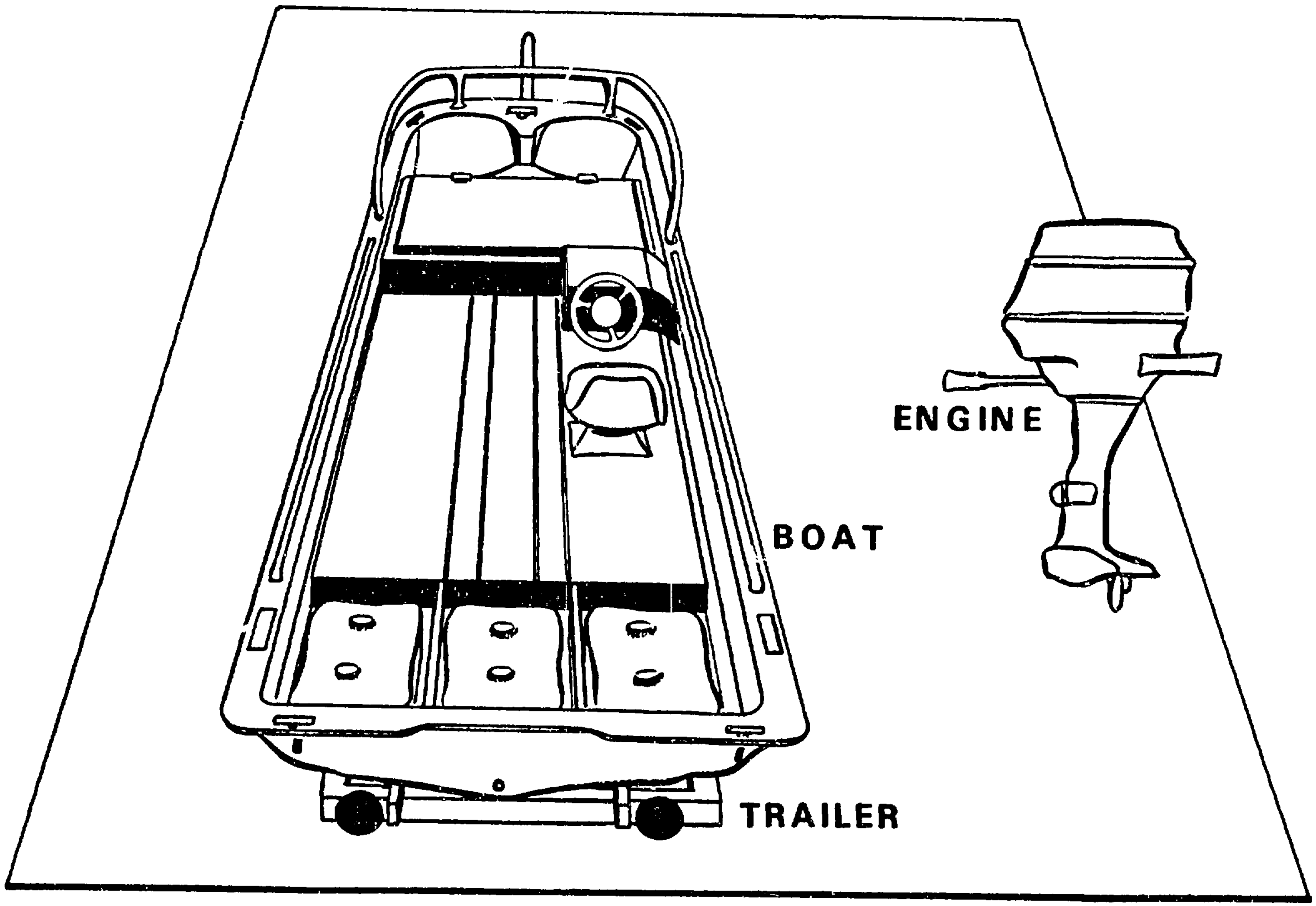


Figure 5 – FY-74 Utility Boat Package

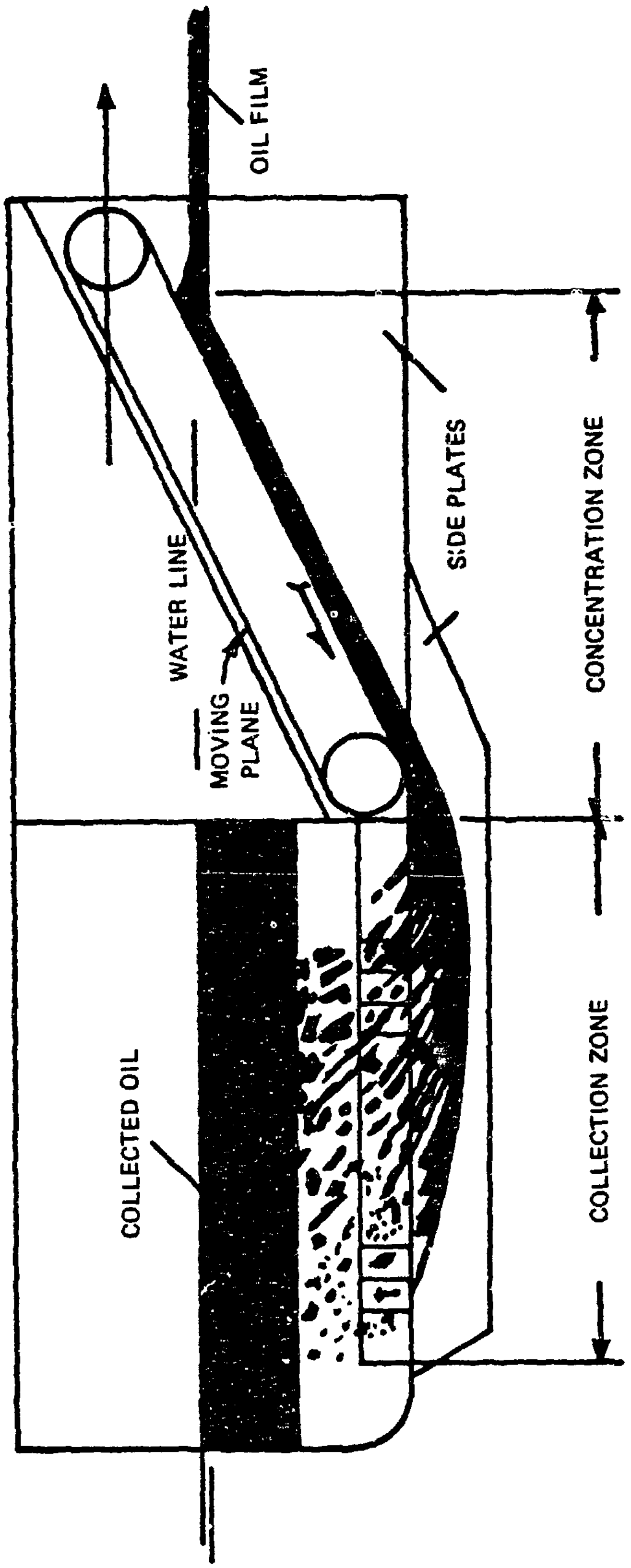

OIL FILM
WATER LINE
MOVING PLANE
SIDE PLATES
CONCENTRATION ZONE
COLLECTION ZONE
COLLECTED OIL

Figure 6

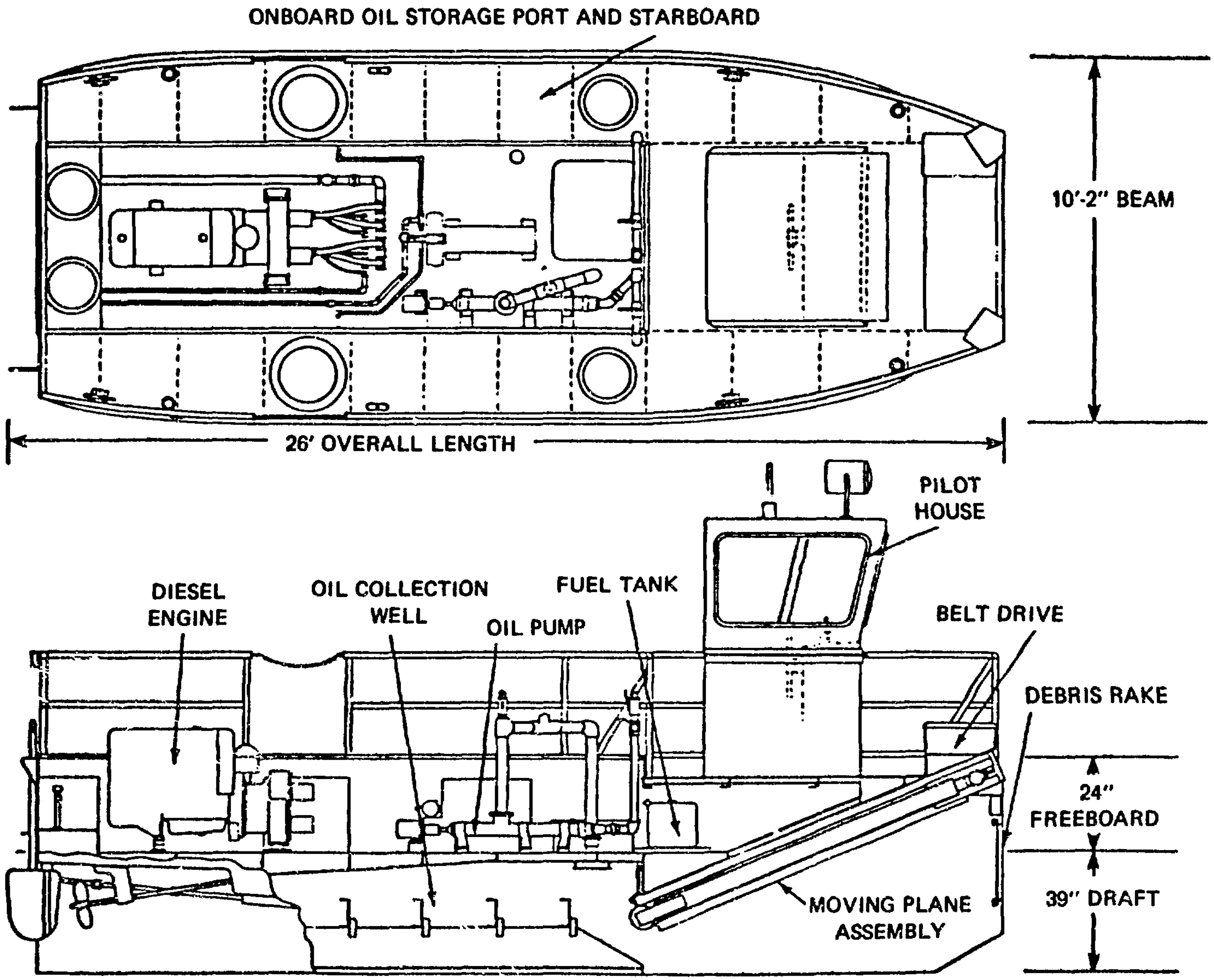


Figure 7 – DIP 3001 Recovery System

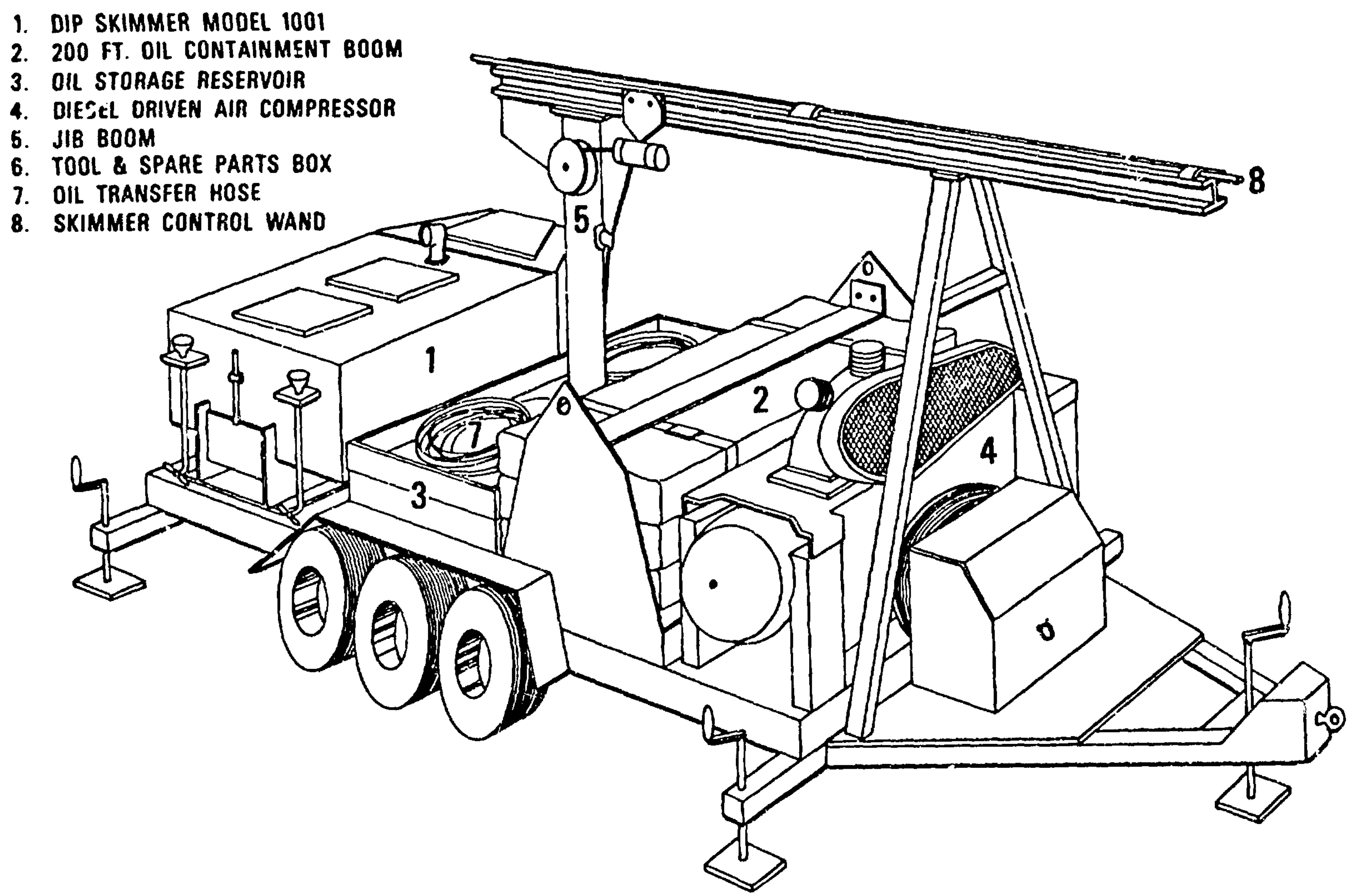


Figure 8 – DIP 1002 Oil Recovery System

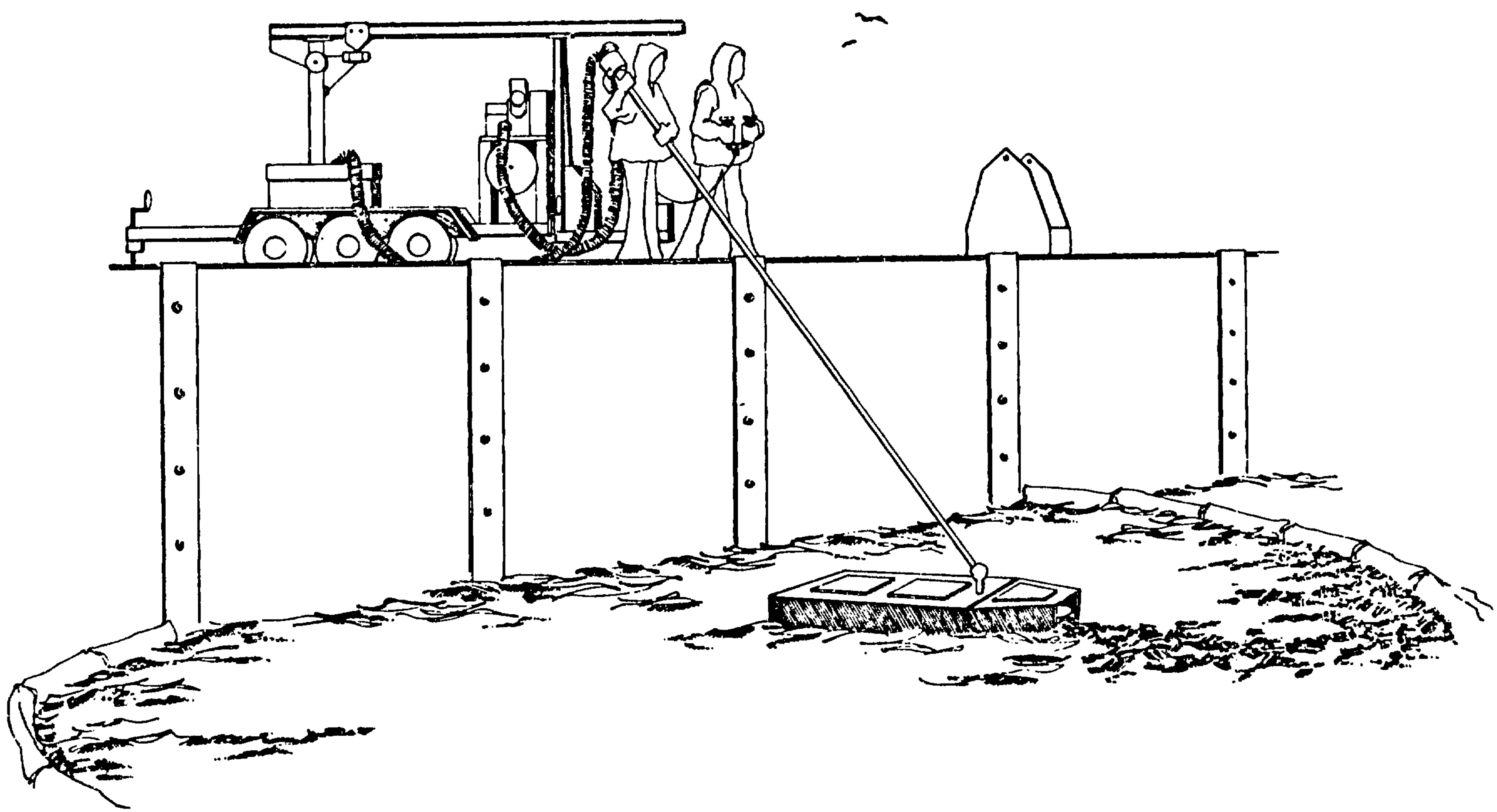


Figure 9 – DIP 1002 System Harvesting a Contained Oil Spill

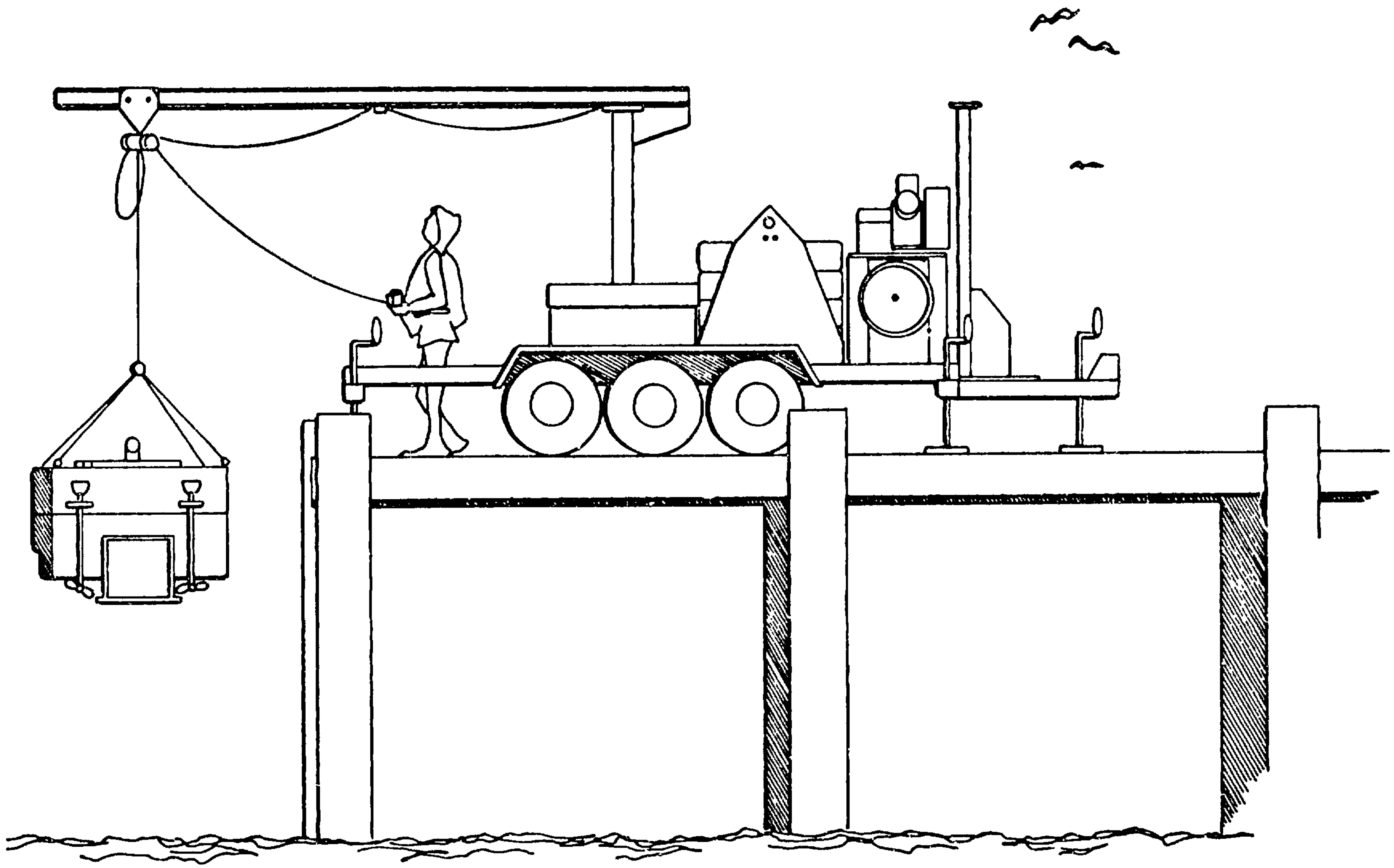


Figure 10 – Deployment of DIP Skimmer

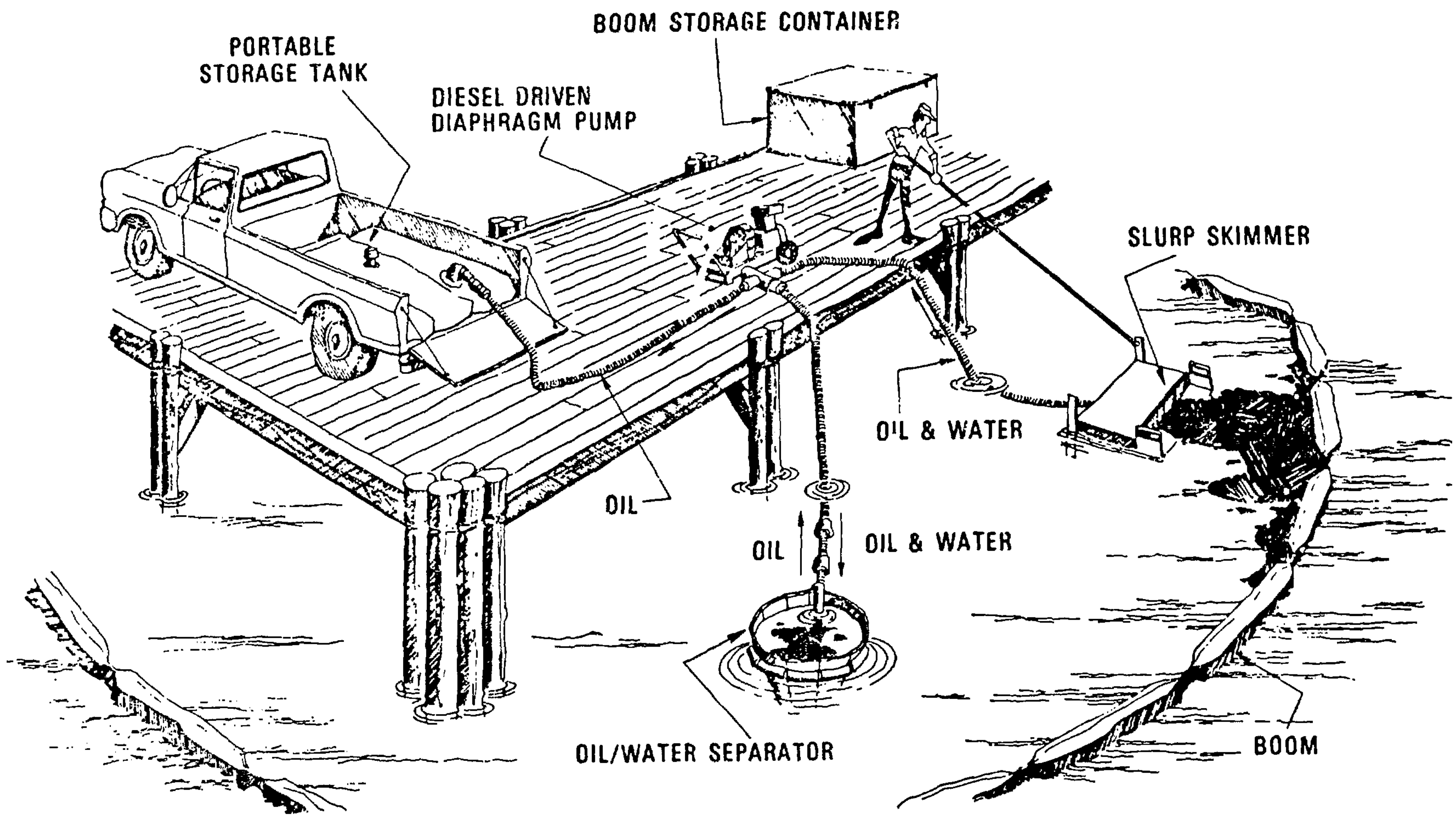


Figure 11 – Small Oil Spill Retrieval System

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Principal Investigator: A. Widawsky, (805) 982-5435

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Principal Investigator: D. E. Brunner, (805) 982-4173

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WORKSHOP A

WORKSHOP ON THE APPLICATION OF POLLUTION ABATEMENT TECHNOLOGY TO THE LOCAL GOVERNMENTS

HARBOR OIL SPILL RECOVERY

List of Attendees

Name	Affiliation
Jack E. Wilson	Naval Facilities Engineering Command, Alexandria, Va.
Wm. T. Lindenmuth	Hydronautics, Inc.
Joseph G. Small	NSRDC Annapolis Laboratory
E. M. Stanley	NSRDC Annapolis Laboratory
J. M. Cunningham	EPA Washington
Chuck Drasser	Attn SAREA-TDP; Edgewood Arsenal, Aberdeen Proving Ground, Md. 21010
Edwin C. Weber	Md. Water Resources Administration, Tawes Office Building, Annapolis, Md. 21401
James R. Maxwell	Baltimore City Health Department, Industrial Hygiene, 111 M Calvert Street, Baltimore, Md. 21202
Harry A. Jackson	Society of Naval Architects and Marine Engineers
H. D. (Jake) O'Neal	USGC, Commandant (G-WEP-4), U. S. Coast Guard, Washington, D. C.
Stephen Mainella	Anne Arundel County Department of Health, Annapolis, Md.
J. G. Giannotti	Westinghouse Oceanic Division, Annapolis, Md.
G. B. Nickol	NSRDC Annapolis Laboratory (Code 286)
Willem van Hees	NSRDC Annapolis Laboratory (Code 286)
Wm. C. McKay	U. S. Coast Guard Headquaters, Washington, D. C

WORKSHOP B

TEST AND EVALUATION PROCEDURES FOR SELECTING NEWLY DEVELOPED POLLUTION ABATEMENT EQUIPMENT

Panel Leader: Mr. F. Ventriglio, Naval Sea Systems Command

Editor's Note: This workshop consisted of presentations by the following speakers on the subjects listed.

F. Ventriglio	Naval Sea Systems Command	Panel Leader
J. Zauner	Naval Ship Engineering Command	The Jered System
A. Smookler	Naval Ship Research and Development Center	Oil Water Separators
A. Pontello	Naval Air Propulsion Test Center	Non Destructive Testing
H. Feingold	Naval Ship Research and Development Center	Design of Experiments
E. Timko	Naval Ship Research and Development Center	Design of Experiments
T. Scarano	U. S. Coast Guard	Coast Guard Methods

LIST OF ATTENDEES

Name	Affiliation
Frank Ventriglio	NAVSEA
J.F. Zauner, Jr.	NAVSEC
Henry Feingold	NSRDC
L. Patrick Wallace	Keene Corp.
Wm. C. McKay	Coast Guard
George M. Staples III	Century Engrg., Inc.
L.R. Harris	NSRDC
Daniel H. Fruman	Hydronautics, Inc.
E. Timko	NSRDC
Seymour I. Finkel	Vitro Laboratories
Guenter Spohr	Anne Arundel County
Gilbert V. Levin	Biospherics, Inc.
Bernard Bochenek	Balto. City Health Dept.
J.L. Kalinsky	Bradford Computer Systems
Arthur L. Smookler	NSRDC
Robert R. Elder	J.J. Henry Co.
Charles H. Evans	John J. McMullen Assoc. Inc.
Arthur Matthews	FRAM Corp.
John Powderly	NAVSEC
Larry Koss	NAVSEA

WORKSHOP C

PUMP-OUT WASTE TREATMENT METHODS

Panel Leader: Mr. W. Librizzi, Environmental Protection Agency

This workshop considered the transport, treatment and disposal of waste from vessel retentive systems. In summary, the participants considered:

(a) Characterization of pump-out waste;

(b) Toxicity of deodorizing chemicals added to vessel retentive systems; and

(c) Available technology to properly treat and dispose of pump-out waste.

EPA, who has conducted research in this area, presented to the workshop participants a brief summary.

Pump-out waste, as found through actual sampling and analysis of waste from vessel retentive systems, is highly concentrated and contains toxic elements such as formaldehyde, zinc sulphate and phenols. Typical waste pumpage from recreational watercraft had the following characteristic ranges:

SS	1400–3400 mg/1
BOD_5	1700–3500 mg/1
COD	4400–7900 mg/1
TOC	1500–2900 mg/1

Chemical additives were found in varying concentrations. For example, zinc sulphate concentrations ranged from 25–250 mg/1. Such additives, as indicated by laboratory testing, had various effects on aerobic respiration rate of activated sludge. With increased concentration, zinc additives were highly toxic, while formaldehydes were initially biodegradable but became toxic at higher concentrations. Biological treatability studies of pump-out waste indicate that wastewaters having more than 20 mg/1 zinc or 120 mg/1 formaldehyde caused significant disruption of the activated sludge process with loss of removal efficiency.

A physical/chemical treatment system was demonstrated at Lake Mead, Nevada. This system, which includes chemical addition (bacterialcidal agents, flocculating agents, and filter aid), mixing and vacuum filtration, provides greater than 90 percent removal of suspended solids, BOD_5, chemical oxygen demand and phosphate.

EPA also attempted to develop and demonstrate an evaporation-incineration process. This system presented some difficulties and was not fully evaluated.

Ensuing discussions between the participants revealed a deep concern for the proper handling and treatment of pump-out waste and the difficulties being encountered in discharge into municipal systems and the lack of alternatives for treatment of pump-out waste. There also was a vocal concern regarding the EPA "No Discharge Standard and the forthcoming Coast Guard regulations."

The participants also voiced an economic concern regarding the handling of pump-out waste. The question was raised—where would the money come from to construct the proper treatment facilities?

Finally, the workshop concluded that the pump-out problem exists today and will increase in significance if a no discharge standard is implemented.

Editor's Note: A list of attendees at Workshop C was not obtained.

WORKSHOP D

SOLIDS WASTE DISPOSAL

Panel Leader: Richard A. Boettcher, Civil Engineering Laboratory

I am Dick Boettcher, a combination Civil and Mechanical Engineer, doing research in Solid Waste Handling for the Navy at the Civil Engineering Laboratory (CEL), U. S. Naval Construction Battalion Center, (NCBC), Port Hueneme, California.

Our workshop chairman, Mr. H. H. Singerman, tells me that we are here today in this solid waste workshop to ask each other questions about our mutual problems; to share answers on those that we have solved and to tell how we are going about developing solutions to those problems that remain unsolved—as well as those we see coming up in the future. He also tells me that even though Navy solid waste problems may be unique, he will leave it up to me to select some aspects of our work in solid waste research for Navy shore stations that may have technology transfer possibilities.

To put any comments I may make in the proper perspective, I'd like to explain that our Laboratory in California with around 300 people is one of the smallest in the system of a dozen or so Navy laboratories. We are, however, the principal laboratory doing research in pollution abatement for the Naval Facilities Engineering Command (NAVFAC) who have charge of Public Works activities at all shore installations. Navy Public Works includes solid waste collection and disposal.

I would like you to understand also that the Navy and Military solid waste problems do differ from those of municipalities. Primarily, the handling and disposal of the solid waste, along with other services and supply functions, must of necessity remain subordinate to the Navy's primary mission of national defense.

Manpower utilization in the primary mission takes precedence over all other activities.

I would like you to understand further how our research relates to that of the Environmental Protection Agency—the Office of Solid Waste Management Programs of EPA. That office, as you know, is doing a great deal of research and development, including demonstrations, as one of their solid waste efforts. This work has totaled $60 million since its authorization by Congress in 1965. By comparison, the military solid waste efforts are very small—and the Navy's effort is only a fraction of that. We might say, roughly, it is in proportion to relative waste quantities handled and total expenditures. The total military tonnage of solid waste is less than 6 million tons per year; municipal tonnage is about 200 million tons. Military collection and disposal expenditures for this fiscal year are programmed at $50 million; the nation's municipal total may be several billion dollars. We take great pains to define our problems precisely; to know what the EPA is doing and what it is not doing about particular problems; and to work on only those things that are military mission oriented. Our research does not duplicate any EPA effort.

We are also careful that our Navy solid waste research is not duplicated between DOD laboratories. Under review at this time by Headquarters Commands is a comprehensive, Tri-Service Research Development Test and Evaluation Plan for Solid Waste Management developed jointly by Army, Navy and Air Force laboratories presently engaged in solid waste research.

In spite of the differences that I mentioned previously, we do find that the Navy shares a number of problems with municipalities–and, in particular the smaller municipalities. A Navy base is large if it exceeds 15,000 population. While there are a number of geographical complexes of this size in the 250 active Navy shore stations, there are only 25 U. S. bases and 10 overseas bases that exceed 1,500 population. These are hardly good sized villages. None of the Navy's largest complexes like San Diego or Pearl Harbor generates more than 300 tons per day. Sixty percent of Navy activities dispose of less than 60 tons per day. By comparison, an average city of 75,000 people would generate 200 tons per day. So the Navy has a problem related to scale of operations in disposal. In collection, there are problems with overaged equipment–not at all an uncommon problem in cities. The Navy has many pieces of good modern equipment–but 40 percent of the total equipment inventory used for solid waste is over 10 years old; 16 percent is over 20 years old.

Problem solutions, we find, are available through application of research results in three areas–standardization, mechanization and management. All three of these offer possibilities for technology transfer.

Editor's Note: Mr. Boettcher showed a number of slides on CEL solid waste work and provided the following narrative comments.

In 1971 CEL's Mechanical and Electrical Engineering Department formed and staffed an Environmental Protection Systems Division. This division was tasked to concentrate on research and development of hardware and systems to meet shore facility requirements for:

Solid Waste
Oily Waste
Wastewaters
Industrial Wastes
Water Supply
Air Pollution
Noise Pollution

The Environmental Protection Systems Division's FY-74 program is about one million dollars of which 25 percent is in the area of Solid Waste.

CEL's Solid Waste Handling and Disposal research is funded by NAVFAC. The program presented herein has been developing over the past two years.

To define the Navy's problems and to establish developmental priorities we have used questionnaires, field surveys and in-house expertise including the Navy's Engineering Field Division Engineers, Public Works Officers and special consultants. The general problem we ultimately defined can be simply stated as:

"A systems problem in cost/effective pollution abatement research."

Solid Waste Handling as practiced by Navy was found to be a complex interrelationship of as many as seven different unit operations involving:

Gathering
Storage
Collection
Transport
Transfer
Processing
Disposal

The Navy's costs for performing each of these various unit operations was estimated along with an estimate of the potential benefit that could result from cost/effective pollution abatement research and development. Our ongoing work program, which is pollution abatement oriented, does not encompass the "Gathering" operation.

In terms of pollution abatement we find there are five (5) different options for disposal of solids, all involving some form of ultimate recycling. These include:

Recycle/Reclamation
Incineration
Ocean Dumping
Composting
Sequestering

In a more practical sense the problem for the Navy is one of ecomonic pollution abatement. In our survey of the Navy's Solid Waste Handling operations we quantified the problem in terms of annual quantity, O&M costs, number of major equipment items, capital investments, personnel and in terms of a sampling of site inspections by control agencies and the number of sites that received deficiency notices.

Annual Waste Quantities	3 million tons
O&M Costs	$65 million
Vehicles and Equipment	1500 units @ $20 million
Personnel	2200
Contracts	500 @ $30 million

Citations	33 out of 79 inspections
Time Frame/Standards	EPA Guidelines

To establish the Navy's research priorities we prepared work sheets containing the many available techniques and technologies that could be associated with each of the unit operations. These work sheets were transmitted to 13 EFD/Public Works Engineers and five outside professionals all of which were qualified in solid waste handling. A general summary of these results is a priority listing of the areas where the participants consider R&D to be most relevant.

1. Disposal of Raw Refuse
2. Collection
3. On-site Gathering
4. Processing for Handling
5. Disposal of Processed Refuse
6. Transfer (Recycling)

The CEL Solid waste work program for FY-74 consists of seven (7) tasks of which five (5) are extended into FY-75.

Task Area	Funding ($K) FY-74	Funding ($K) FY-75
Mechanical Landfill Simulator	65	30
Sanitary Landfill Tech Data Sheets	10	–
Open Pit Incineration	30	25
Refuse Densification Process	90	45
Refuse Truck Attachment	35	50
Prototype Box Crusher	10	-
Emission Factors/Solid Waste Handling Facility (Recycling)	10	100
Totals	250	250

Editor's Note: Mr. Boettcher then described various CEL tasks in the fiscal 75 work program, including the Mechanical Landfill Simulator, the Pit Incinerator for base generated solid waste, the refuse densification task, the Laboratory's research project on Mechanized Residential Collection, and the Generation Factors and Solid Waste Transfer/Processing Facility task.

Mr. Boettcher continued mentioning two items pertinent to the purpose of the workshop that resulted from the work of others. Item 1 is called "A Briefing for Elected Officials" developed by the National Commission of Productivity, Washington, D. C., titled "Improving Productivity in Solid Waste Collection." It is slanted and somewhat superficial, but presents some interesting facts. Although it has received some negative comments, it is timely and is something with which municipal officials should be familiar. Item 2 is titled "Decision Makers Guide in Solid Waste Management." Just completed by EPA and tested in workshops similar to this with city managers and other local officials, it assembles in one place the data and results of experience in the industry and puts this information in a form readily accessible to decision-makers at the local level.

WORKSHOP D

WORKSHOP ON THE APPLICATION OF POLLUTION ABATEMENT TECHNOLOGY TO THE LOCAL GOVERNMENTS

SOLIDS WASTE DISPOSAL

List of Attendees

Name	Affiliation
H. V. Nutt	The George Washington University
D. G. Phillips	Maryland Environmental Service
Wm. H. Bishop	McNeill & Baldwin Cons. Engr.
R. D. White	McNeill & Baldwin Cons. Engr.
H. R. Rizner	McNeill & Baldwin Cons. Engr.
E. D. Anderson	National Science Foundation
W. C. McElwee	EPA Office of Solid Waste Mgmt. Prog.
J. B. Duvall	Anne Arundel County Public Works Quality Control and Compliance
H. E. Achilles	NSRDC Annapolis Laboratory
Bill Hooper	Div. Solid Waste Control, Maryland State Health Department
G. D. Hagedorn	Naval Ship Engineering Center
Bill Goode	NAVFAC
M. C. Malloy	Century Engineering, Inc.
C. M. Adema	NSRDC Annapolis Laboratory
R. G. Dagold	Baltimore City Health Department
H. LeRoy Marlow	Penna. Technical Assistance Program
S. J. Daugard	Hydronautics, Inc.
J. G. Giannotti	Westinghouse Oceanic Division
Fui-Man Hong	Maryland Surveying & Engineering Co.
R. H. Cassell	Maryland Surveying & Engineering Co.
I. R. Kramer	NSRDC Annapolis Laboratory
S. S. Morse	Atlantic Richfield Co.
Fred H. Touchton	Whitman, Requardt and Associates

WORKSHOP E

DEVELOPMENT OF ENVIRONMENTALLY COMPATIBLE ANTIFOULING MATERIALS (BOTTOM PAINTS FOR BOATS)

Panel Leader: Ms. J. A. Montemarano, Naval Ship Research and Development Center

Fouling and the biodegradation of ships and marine structures is still a major problem in the maritime industry. Due to excessive leaching rates, presently used antifouling coating systems, based on cuprous oxide, foul within 3 to 18 months in tropical waters. The resultant fouling build-up impedes ship performance by increasing hull friction and fuel consumption and decreasing maximum speed. Further, cuprous oxide coatings have proved to be disadvantageous for Navy use in that they do not repell algae build-up along the waterline and they create a galvanic corrosion problem where bare metal is exposed (especially on aluminum surfaces). On the basis of this evidence, presently used antifouling coatings are not as effective as desired for fouling protection for hulls of ships, but they are still the most economical solution to the problem as compared to other methods that do not include coatings. Inasmuch as the ineffectiveness of copper-based antifouling coatings is becoming evident, alternate coating formulations are being investigated. Organometallic salts, i.e., tri-n-butyltin oxide (TBTO), tri-n-butyltin floride (TBTF), have been found to be extremely powerful biocides, being toxic to a wide range of marine organisms. Consequently, organotin salts are also the basis of a variety of antifouling coatings.

In response to the evident need to mitigate the fouling of submerged surfaces in a fashion compatible both ecologically and performance-wise with the marine environment, we are developing low leaching, antifouling organometallic polymers (OMPs). OMPs have been recognized as a novel and proven advancement in the state-of-the-art of antifouling technology. By means of the chemical incorporation of biocidal organometallic groups, such as tri-n-butyltin and tri-n-propyltin, on polymeric backbones–as opposed to current methods which use physical mixtures of resins and organometallic salts as described above–a new generation of environmentally compatible antifouling materials has been produced. (1) OMP thermoplastic resins (acrylic, vinyl, styrene) and OMP thermosetting resins (polyester, epoxy) have been synthesized as coatings and in bulk castings. (2) The resultant organometallic polymeric materials are surface hydrolyzed in sea water to trigger their antifouling effectiveness. The chemically bound organometallic moieties are released at a controlled rate contingent on the type of polymer backbone, the degree of crosslinking, and the degree of substitution along the polymer backbone. To date, methacrylic, vinyl, epoxy and polyester OMPs have exhibited excellent antifouling performance during patch panel trials after 30, 29, 9 and 11 months exposure to severe fouling conditions in Pearl Harbor, Miami and Annapolis.

Organometallic methacrylic and vinyl polymers showing excellent film forming characteristics have been selected in formulating a new generation of low-pollution-risk antifouling coatings for full Fleet use in about 5 years. It is anticipated that the chemical conservation of the biocidal organometallic agent by the OMP will result in long term antifouling protection for ships' hulls while reducing the pollution hazards of antifouling coating systems by a factor of ten. In addition, antifouling OMP epoxies and polyesters are the basis for the development of inherently antifouling gel coats and nonfouling glass reinforced organometallic plastics (GROMPs). The manufacture of GROMP pipe and/or liners for conventional pipes using epoxy or polyester organometallic resins will furnish lightweight, corrosion resistant GRP piping systems with 5 to 10 years' protection against marine fouling.

WORKSHOP E

WORKSHOP ON THE APPLICATION OF POLLUTION ABATEMENT TECHNOLOGY TO THE LOCAL GOVERNMENTS

DEVELOPMENT OF ENVIRONMENTALLY COMPATIBLE ANTIFOULING MATERIALS (BOTTOM PAINTS FOR BOATS)

List of Attendees

Name	Affiliation
Leon D. Polland	Maritime Administration
John B. Hildebrandt	Vitro Laboratories
Rex A. Neihof	Naval Research Laboratory
F. E. Brinckman	National Bureau of Standards
Warren P. Iverson	National Bureau of Standards
Fred H. Touchton	Whitman, Requardt and Associates
H. H. Singerman	NSRDC

WORKSHOP F

ENVIRONMENTAL MEASUREMENT OF TOXICITY OF INDUSTRIAL CHEMICALS USING CHESAPEAKE BAY ORGANISMS

Panel Leader: Mr. G. L. Liberatore, Naval Ship Research and Development Center

The standard method used at the Naval Ship Research and Development Center, Annapolis, to determine the toxicity of industrial materials to marine organisms is essentially a determination of the LC_{50}–96 hr (lethal concentration to 1/2 population in 96 hours) of a static, single-compound spill situation on seven different marine organisms. The minnow, mussel, oyster, barnacle, diatom, brine shrimp and bacteria represent varied ecological and economical niches. Glass aquaria are used for the fish, oyster and mussel tests; small plastic tanks for barnacles; Petri plates for the brine shrimp, and glass test tubes for the algae and bacteria. Filtered Chespeake Bay water is used for all laboratory experiments with the exception of algal work in which artificial seawater is used and 3 percent NaCl for the bacteria. All the organisms are acclimated for at least one week. The fish, oyster, mussels and barnacles are locally collected. The brine shrimp are the San Francisco Bay strain and hatched 24 hours prior to use. The algae are subcultured from stocks, one week prior to testing. Bacteria are subcultured overnight from laboratory stocks before use. All vessels (tubes, dishes and tanks) are washed, rinsed, soaked in 5 percent EDTA or Acid wash and rinsed to eliminate trace contaminants from previous toxicity determinations.

Experiments to determine the LC_{50} are repeated several times for statistical purposes with each subsequent run further refining this limit. The pH, DO, temperature and salinity are monitored during the experiment. Dead organisms are counted and removed daily. The bacteriostatic concentration of material is reported as the LC_{50} in bacteriological exposures; the algae are counted in a Neubauer blood-cell counting chamber and the shrimp in a microscope. All the live and dead organisms are tabulated and the LC_{50} is calculated according to the Reed and Muench method. Recent emphasis is on modification of experimental conditions from the static mode of exposure to open system design, utilizing metering pumps to maintain experimental materials at a constant concentration under flowing conditions in the exposure tanks.

A variety of shipboard effluent chemicals have been submitted to the LC_{50}–96 hour procedure. Results were discussed including their value in engineering design and Environmental Impact Assessment.

WORKSHOP F

WORKSHOP ON THE APPLICATION OF POLLUTION ABATEMENT TECHNOLOGY TO THE LOCAL GOVERNMENTS

ENVIRONMENTAL MEASUREMENT OF TOXICITY OF INDUSTRIAL CHEMICALS USING CHESAPEAKE BAY ORGANISMS

List of Attendees

Name	Affiliation
Dr. Raymond P. Morgan, II	Chesapeake Biological Lab, Solomons, Md.
Dr. Gary S. Sayler	Department of Microbiology, University of Maryland
Andrew Styka	P. O. Box 669, Glen Burnie, Maryland, Public Works
ENS M. Nadel, USN	NSRDC
Jim Price	NSRDC
Dr. E. C. Fischer	NSRDC
Kent H. Hughes	Office of Environmental Monitoring and Prediction, National Oceanic and Atmospheric Administration
W. B. Mercer	NSRDC
O. M. Meredith	NAVSURWEPCEN (White Oak)
Daniel W. Leubecker	MARAD
Lawrence L. Heffner	Extension Service, U. S. Department of Agriculture, Wash., D. C. 20250
Dr. Brinckman	National Bureau of Standards
Dr. Iverson	National Bureau of Standards
Dr. J. Hannan	Naval Research Laboratory
G. L. Liberatore	NSRDC Annapolis Laboratory

APPENDIX A

LETTER OF AUTHORIZATION

DEPARTMENT OF THE NAVY
HEADQUARTERS NAVAL MATERIAL COMMAND
WASHINGTON, D. C. 20360

IN REPLY REFER TO
030/PBN
Ser 434
30 AUG 1974

From: Chief of Naval Material
To: Commander, Naval Ship Research and Development Center

Subj: Technology Transfer Workshop for Annapolis

Encl: (1) Letter from the Hon. Marjorie S. Holt HR to ADM I. C. Kidd, Jr. dated 21 August 1974

1. Enclosure (1) is forwarded for background information.

2. The Commander, Naval Ship Research and Development Center (NAVSHIPRANDCEN) is hereby assigned responsibilities to coordinate and host a technology transfer workshop in the Annapolis area involving the participation of other Navy and government agencies that would contribute to the success of the workshop.

3. The Commander, Naval Ship Research and Development Center is requested to actively explore the advisability of having other Navy activities participate, and to advise Headquarters Naval Material Command if assistance is required in this area.

4. Mr. Joe Antinucci, who coordinated the Connecticut technology transfer seminar referenced in enclosure (1), is currently assigned technology transfer duties in Washington and will be available to assist and advise the NAVSHIPRANDCEN staff as desired.

5. Mr. Perry B. Newton, Jr. (692-0515/6/7) will be the Headquarters contact for RADM Claude P. Ekas, Jr., USN, who is The Director of Technology Transfer for the Department of the Navy.

C. P. EKAS, JR.
Deputy Chief of Naval Material
(Development)

MARJORIE S. HOLT
4TH DISTRICT, MARYLAND

1510 Longworth House Office Building
Washington, D.C. 20515
202-225-8090

COMMITTEE:
ARMED SERVICES

Congress of the United States
House of Representatives
Washington, D.C. 20515

August 21, 1974

00 H/C

AR-03 Σ

00D1 H/C

Admiral Isaac C. Kidd, Jr.
Chief of Navy Material
Department of the Navy
Washington, D. C. 20360

Dear Admiral Kidd:

I have followed, with considerable interest, the technology transfer workshop held in Groton this spring, and the seminar being set up in San Diego for this October.

I believe that a similar workshop might prove of great value in Annapolis, particularly in the area of pollution abatement techniques. This technology transfer will provide small craft and commercial shipping vessels with packaged waste treatment systems and related pollution abatement equipment in order to meet EPA effluent standards and regulations.

The workshop would bring together the developers of the technology with the potential users - yacht builders, marine operators, architects, etc., and would establish a dialogue between the Government and the private sector. There might, perhaps, be other areas of interest in technology transfer which could be explored at the same time.

I would be extremely interested in your comments and suggestions toward an Annapolis technology transfer workshop.

With warm, personal regards, I am

Sincerely yours,

Marjorie S. Holt

Marjorie S. Holt
Member of Congress

MSH/sf

APPENDIX B

LIST OF ATTENDEES

Dr. Harold E. Achilles	Naval Ship Research and Development Center
C. M. Adema	Naval Ship Research and Development Center
Charles Albrecht	Maryland State Health Department
C. Alig	Naval Ship Research and Development Center
Evan D. Anderson	National Science Foundation
Steven Anderson	Student
J. D. Antinucci	National Science Foundation
LT Ross Ard	U. S. Coast Guard
Ralph Barra	National Bureau of Standards
E. F. Batutis	General Electric Company
Sid Beaman	Environmental Protection Agency
Frank J. Billovits	Thiokol Corporation
William H. Bishop	McNeill and Baldwin
Bernard Bochenek	Baltimore City Health Department
R. Boettcher	Civil Engineering Laboratory
Dr. Frederick E. Brinckman	National Bureau of Standards
CAPT Brian Brown USN	Office of Chief of Naval Materials
Arnold Bruno	Grumman Aerospace Corporation
Mark M. Bundy	United States Naval Academy
Richard H. Cassell	Maryland Surveying & Engineering Company
Walter Chappal	Maritime Administration
Dennis Conroy	Naval Ship Research and Development Center
I. Cook	Naval Ship Research and Development Center
Rhodes R. Capithorn	CADCOM, Inc.
Professor Reece Corey	Chairman, Annapolis Environmental Commission
Dennis Cotter	Naval Ship Research and Development Center
Fred Crowson	Naval Surface Weapons Center
John M. Cunningham	Environmental Protection Agency
Reuben G. Dagold	Baltimore City Health Department
S. J. Daugard	Hydronautics, Inc.
R. C. Dedrickson	U. S. Maritime Administration
Paul Dideir	Baltimore County Health Department
Cathy Dombrowski	Business Publishers, Inc.
Chuck Drasser	Edgewood Arsenal
Habib Durrani	George Washington University
John B. Duvall	Anne Arundel County Department of Public Works
D. K. Ela	Westinghouse Oceanographic Division

Robert Elder	J. J. Henry
Luther Elkans	Wastex Corporation
Glenn K. Ellis	Atomic Energy Commission
Donald Elmore	State Department of Health and Mental Hygiene
Charles Evans	John J. McMullen Assoc., Inc.
LCDR C. Farrell, Jr.	Naval Materials Command
H. Feingold	Naval Ship Research and Development Center
S. Finkel	Vitro Laboratories
Dr. Eugene C. Fischer	Naval Ship Research and Development Center
Dr. D. H. Fruman	Hydronautics, Inc.
CDR J. R. Gauthey	Naval Sea Systems Command
Andy Geyer	Naval Ship Research and Development Center
J. G. Giannotti	Westinghouse Oceanic Division
Bill Goode	Naval Facility Engineering Command
Steve Gyves	Naval Ship Engineering Center
Greg D. Hagedorn	Naval Ship Engineering Center
Dr. Patrick J. Hannan	Naval Research Laboratory
Jim Harden	Naval Ship Research and Development Center
Philip C. Hargraves	General Electric
L. R. Harris	Naval Ship Research and Development Center
Lawrence L. Heffner	Department of Agriculture, Extension Service Environmental Program
Charles O. Heller	CADCOM, Inc.
Frank Hetrick	University of Maryland
John B. Hildebrandt	Vitro Laboratories
George L. Hoffman	Anne Arundel County, Department of Public Works
Dr. John F. Hoffman	Department of Environmental Sciences, U. S. Naval Academy
Congresswoman Marjorie S. Holt	
Fui-Man Hong	Maryland Surveying & Engineering Co.
Bill Hooper	Maryland State Health Department
Kent H. Hughes	National Oceanic and Atmospheric Administration
Dr. Warren P. Iverson	National Bureau of Standards
Harry A. Jackson	Society of Naval Architects and Marine Engineers
J. Kalinsky	Bradford Computer Systems
Art Keimel	Naval Ship Research and Development Center
Gene Kennedy	Naval Sea Systems Command

Tom King	R. P. Mueller Company
W. Scott Kirkpatrick	Mansfield Sanitary, Inc.
L. Koss	Naval Sea Systems Command
Dr. I. R. Kramer	Naval Ship Research and Development Center
Steven Kuhta	U. S. General Accounting Office
Daniel W. Leubecker	Maritime Administration
C. Scott Lewis	Annapolis Chamber of Commerce
G. L. Liberatore	Naval Ship Research and Development Center
William Librizzi	Environmental Protection Agency
W. T. Lindenmuth	Hydronautics, Inc.
W. C. McElwee	Environmental Protection Agency
William C. McKay	U. S. Coast Guard
Archie McPhee	Naval Ship Research and Development Center
S. McPherson	Naval Ship Research and Development Center
Tom McVicker	Naval Ship Engineering Center
Stephen Mainella	Anne Arundel County Health Department
Michael C. Malloy	Century Engineering
J. Marcisz	Naval Sea Systems Command
Dr. H. Leroy Marlow	Penn State University, Technical Assistance Program
Dr. Richard Mathieu	U. S. Naval Academy
Art Matthews	Fram Corporation
James R. Maxwell	Baltimore City Health Department
W. B. Mercer	Naval Ship Research and Development Center
Dr. O. M. Meredith	Naval Surface Weapons Center
John G. Merryman	General Electric Company
A. M. Miller	Naval Ship Research and Development Center
CDR R. R. Miller	Naval Sea Systems Command
Wade Miller	Public Technology
Ms. Jean A. Montemarano	Naval Ship Research and Development Center
Dr. Raymond P. Morgan, II	Chesapeake Biological Laboratory
Samuel S. Morse	Atlantic Richfield Co.
D. Muntz	Naval Air Propulsion Test Center
ENS Marshall Nadel USN	Naval Ship Research and Development Center
Rex A. Neihof	Naval Research Laboratory
CAPT P. W. Nelson USN	Naval Ship Research and Development Center
Barbara Neustadt	Annapolis Environmental Commission
Perry B. Newton, Jr.	Office of Chief of Naval Materials

G. B. Nickol	Naval Ship Research and Development Center
Professor H. V. Nutt	George Washington University
CDR E. Ogden	Naval Ship Research and Development Center
H. D. O'Neal	U. S. Coast Guard
Douglas Phillips	Maryland Environmental Services
Leon D. Polland	Maritime Administration
A. Pontello	Naval Air Propulsion Test Center
J. Powderly	Naval Ship Engineering Center
James Price	Naval Ship Research and Development Center
Robert Priest	Naval Ship Engineering Center
Professor Robert Ressler	U. S. Naval Academy
R. Revell	Naval Ship Research and Development Center
H. R. Rizner	McNeill and Baldwin
J. Ross	MCA Engineering Corp.
Dr. Gary S. Sayler	University of Maryland
T. Scarano	U. S. Coast Guard
Dale Schell	General American Transportation Company
L. M. Schlosberg	M. Rosenblatt & Son, Inc.
David Schwinabart	Anne Arundel County Health Department
R. L. Sharrah	Hydronautics, Inc.
Harold H. Singerman	Naval Ship Research and Development Center
Joseph G. Small	Naval Ship Research and Development Center
Bob Smith	JERED
A. Smookler	Naval Ship Research and Development Center
H. Snyder	Environmental Protection Agency
Guenter Spohr	Anne Arundel County Department of Public Works
E. M. Stanley	Naval Ship Research and Development Center
George Staples	Century Engineering
CAPT George Steinman	Chief, Environmental Action Group, Maritime Administration
Andrew Styka	Anne Arundel County Department of Public Works
Dr. T. R. Sundaram	Hydronautics, Inc.
E. Timko	Naval Ship Research and Development Center
Fred H. Touchton	Whitman, Requardt and Associates
William van Hees	Naval Ship Research and Development Center
Dr. F. Ventriglio	Naval Sea Systems Command

Patrick Wallace	Keene Corporation
Donald K. Walter	City of Annapolis, Department of Public Works
R. Ward	Naval Ship Research and Development Center
E. C. Webber	Maryland Water Resources Administration
R. D. White	McNeill and Baldwin
A. Widasky	Construction Battalion Center
Dr. Jerome Williams	U. S. Naval Academy
Jack E. Wilson	Naval Facilities Engineering Command
Dr. A. A. Wolf	Naval Ship Research and Development Center
J. Wootton	Naval Ship Research and Development Center
LCDR L. Yeske	Office of Oceanography of the Navy
D. J. Yuengling	M. Rosenblatt & Son, Inc.
Joe Zauner	Naval Ship Engineering Center
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