ASSESSMENT OF THE IMPACT OF

INCINERATION OF CHEMICAL WASTES

IN THE

PROPOSED NORTH ATLANTIC INCINERATION SITE

ON ENDANGERED AND THREATENED SPECIES

by

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I. INTRODUCTION

Incineration-at-sea is the practice of thermally destroying liquid hazardous wastes through high temperature incineration onboard an ocean going vessel. Ocean incineration is currently regulated by EPA under the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA), as amended, U.S.C. §1401 et seq., regulations promulgated thereunder in 40 CFR Parts 220-228, and Annexes to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Dumping Convention (LDC)). If incinerating polychlorinated biphenyls (PCBs), the requirements of Section 6(e) of the Toxic Substances Control Act, 15 U.S.C. §2605(e), apply. On February 28, 1985 a regulation was proposed specifically for incineration-at-sea. This proposed regulation (EPA 1985a) containing detailed requirements for incineration-at-sea operations, was developed to be consistent with the regulations and requirements for land-based incineration under the Resource Conservation and Recovery Act (RCRA).

Under EPA regulations, incineration sites must be designated by EPA and operating permit applications for incineration at designated sites evaluated by EPA individually. Each applicant must meet several requirements, including proving the destruction efficiency of shipboard incinerators on specific wastes before being granted a permit to use a particular site. Both the designation and permitting process both include several opportunities for public review and participation.

Section 7(a)(2) of the Endangered Species Act (ESA), 16 U.S.C.S. §1536(a)(2), requires each federal agency, in consultation with and with the assistance of the Secretary [of Interior or Commerce, depending on the species involved], to ensure that any action authorized, funded, or carried out by it is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of a habitat of such species which is determined by the Secretary, after consultation with appropriate states, to be critical. The United States Fish and Wildlife Service (Department of the Interior) and the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration (NOAA), (Department of Commerce) share responsibilities for implementation of the requirements of the ESA. Generally, marine species are under the jurisdiction of the National Marine Fisheries Service (NMFS).

A Draft Environmental Impact Statement (EIS) was prepared by EPA in January 1981 describing the potential impacts of incineration activities at the North Atlantic Incineration Site (NAIS). This document was distributed for comment to Federal, state and local agencies and to the public. A Final EIS was prepared in December 1981 (EPA, 1981). This EIS discussed the activities that could occur at the site and the potential effects of these activities on the environment, including an analysis of impacts on threatened and endangered species. The Final EIS described the organic and inorganic (metals, HCl, etc.) substances which could be in incinerator emissions, estimated their quantities and evaluated potential environmental exposures and effects, and concluded that because of the low concentration of released materials and the fact that marine mammals and turtles generally do not linger in a single location, "the likelihood of impacts from residues is remote". This finding was based upon emissions research and information available at the time of writing which described the occurrence of threatened and endangered species. The EIS did note, however, that the proximity of rich feeding grounds along the north-south migration route of many species would make the slope waters an attractive region to the cetaceans (whales). Taking this into consideration, the "no effect" conclusion was reached, and was not challenged in comments on the draft or final EIS nor the proposed designation package. In addition, the analysis in the EIS was based upon a destruction efficiency of only 99.96% whereas EPA's proposed regulations require from at least 99.99% to 99.9999% (for PCBs) destruction of waste materials which would cause even less material to be released and accordingly reduced potential for environmental impact than discussed in the EIS.

In 1982, EPA proposed designation of the site in the North Atlantic Ocean for incineration-at-sea (47 FR 51769). A public hearing was held in Ocean City, Maryland on April 14, 1983 and the Agency is now planning to complete the site designation.

On February 22, 1985, the Agency contacted the National Marine Fisheries Service (NMFS) (Appendix A) and Fish and Wildlife Service (FWS) to inform them of the intent to designate the site. The FWS responded on March 11, 1985 stating that the only endangered species under their jurisdiction which might use the NAIS area was the Arctic peregrine falcon which migrates over the ocean in the Fall. They concluded, however, "we do not anticipate any impacts to the population to result from these incidental contacts, therefore the proposed project will not jeopardize the continued existence of the Arctic peregrine falcon (Appendix B)." NMFS responded on March 20, 1985 suggesting that EPA "reassess" the finding of no effect as stated in the Final EIS using "new information" describing the occurrence of endangered species (particularly the sperm whale) in the vicinity of the site, and included documents necessary for this reassessment (Appendix C).

A full list of threatened or endangered species, or critical habitats which may be affected by the proposed incineration of wastes in the NAIS was requested from the National Marine Fisheries Service (NMFS) on March 27,1985 to update the list in the 1981 EIS. In a March 29, 1985 letter to EPA, NMFS identified the following species to occur in the site area (Appendix D):

Listed Species	Scientific Name	Status
fin whale	Balaenoptera physalus	Endangered
humpback whale	Megaptera novaeangliae	Endangered
right whale	Eubaleana glacialis	Endangered
sei whale	Balaenoptera borealis	Endangered
sperm whale	Physeter macroephalus	Endangered
blue whale	Balaenoptera musculus	Endangered
green sea turtle	Chelonia mydas	Threatened
hawksbill sea turtle	Eretmochelys imbricata	Endangered
kemp's (Atlantic) ridley sea turtle	Lepidochelys kempi	Endangered
leatherback sea turtle	Dermochelys coriacea	Endangered
loggerhead sea turtle	Caretta caretta	Endangered

EPA compiled the documents and on April 24, 1985 asked NMFS if the received documents were complete and represented the best available information for the re-assessment (Appendix E). The NMFS response dated April 24, 1985 (Appendix F) stated that EPA had received all but one document which was desirable, however, this document, a status review for the sperm whale, was not publicly available.

EPA then contacted the Washington, D.C. office of NMFS and on April 30, 1985, and was informed that this document was not available and was not expected to be finalized in the near future. This status review is therefore not incorporated into this document, but is largely based upon the data cited herein. Other documents were subsequently received from the Washington office of NMFS including status reviews of other endangered species (NOAA (1984a), a letter from NMFS to Minerals Management Service describing whale sitings near an offshore oil drilling platform (NOAA, 1984b), and the NMFS biological opinion for Outer Continental Shelf lease sale 111 (NOAA, 1981). These documents have been used in the preparation of this assessment.

EPA has re-evaluated the potential effects of the ocean incineration activities at the NAIS and has concluded, based on the best available scientific and technical evidence, that the permitted activities will not affect the listed species. The basis for this conclusion will be explained in detail herein. In general, however, several factors lead EPA to this conclusion.

With respect to the five whale species listed as endangered, based on the information evaluated, only one of these species may regularly inhabit the site area. Siting information indicates that sperm whales may exist in the vicinity of the proposed site year-round. There is, however, no evidence to indicate that any individual or group of individuals live within the site permanently, and the data indicate that the 1981 EIS statement regarding the use of the slope area by whales as a migratory path due to the rich food supply there is still appropriate.

With respect to the endangered or threatened turtle species, the available information suggests that these species may migrate through the site area but are not year-round residents and occur mostly farther inshore than at the proposed site (in agreement with the 1981 EIS).

Based on monitoring conducted during previous trial burns, EPA believes that, even if these species were to solely inhabit the area of the incineration site, no adverse impact would occur from the incineration activity or from exposure to the plume. Additionally, more sensitive environmental monitoring is proposed for the future at incineration sites which will include observation of endangered species occurrence and activities. Finally, EPA believes that the likelihood of a catastrophic spill occurring which could endanger the continued existence of the listed species, should they wander into the transportation route or burn zone, is remote.

The analysis herein explains the proposed action to be permitted by EPA, describes the endangered species which may exist in the incineration site area, including their distribution, if known, and analyzes potential effects on these species which can reasonably be expected from this permitted activity. This document is not intended to duplicate the 1981 EIS or any of the studies which the Agency has conducted. It is a review document which outlines the information available to EPA describing the impacts of incineration-at-sea on endangered or threatened species at the North Atlantic Incineration Site.

II. IMPLICATIONS

Potential adverse effects to threatened or endangered species resulting from incineration-at-sea activities include:

(1) collision of the vessel with animals;

(2) effects of hydrochloric acid (HCl) through contact with the skin, in the air and in the water column; and

(3) bioaccumulation or acute and chronic effects from plume constituents or released materials.

Collisions

Collisions of endangered species with incineration vessels enroute to the site are possible, but unlikely. The increased vessel traffic caused by incineration voyages is unlikely to obstruct or modify migrating patterns of any of the species in the area. Any one incinerator vessel can make only about 14 voyages per year due to the time it takes to load, travel to and from the site and burn a full load. Therefore, incineration vessel traffic will only be a small percentage of ship traffic in the mid-Atlantic area.

HCl Effects

One area of potential exposure to endangered species would result from direct contact with the incinerator plume. Research burns demonstrate that potential hazards of atmospheric acid (HCl) are rapidly diminished by atmospheric diffusion, and rapidly neutralized by seawater. Monitoring has shown that beyond 2 to 4 nmi (3.7 to 7.4 km) downwind of the emission source, any HCl remaining in the air rapidly disperses to ambient conditions (EPA, 1981).

Grasshoff's (1974) estimate of the concentration of HCl fallout due to incineration operations is discussed in the EIS. Assuming a burn rate of 25 tonne/hr of waste, containing approximately 63% chlorine, the HCl emissions would be approximately 16 tonne/hr. Moderate wind speeds will disperse the waste plume over a sea surface area of at least 250,000m^2 before the HCl condenses and falls to the water surface. Once the HCl has settled out of the plume into the surrounding waters, it is neutralized by the alkaline properties of seawater and no adverse effects are expected. One cubic meter of seawater is capable of neutralizing 80g HCl (80 ppm). Paige et al. (1978) predicted that with a 20m mixed layer depth the resultant HCl concentration would be 0.197 ppm (neglecting neutralization) (see EPA, 1981).

The EIS also discussed the results of modeling exercises and actual samples collected in plumes during test burns at sea, and shows that HCl concentrations are predicted to be less than 2.9 ppm in the air, 2.2 nmi from the vessel, and were actually less than 7 ppm 0.5 nmi from the vessel during the test burns.

Studies on pigeons, rabbits, and guinea pigs, as described in the EIS for the site (EPA, 1981), showed that exposure to concentrations of 4,000 parts per million (ppm) acid for 30 minutes, resulted in death; whereas exposure to concentrations of 100 ppm for 6 hours per day for 50 days, produced only slight unrest and irritation to soft tissues such as the eyes and nose.

These values suggest that animals could only be adversely affected in very close proximity to the stack, (and at such close distances, both heat and acid could be detrimental). Due to the thermal energy in the emissions the plume is expected to rise and disperse to the levels that have been measured in the past as described above. It is possible however that certain weather conditions such as inversions, rain, fog, etc. could cause the plume to fall more rapidly. As discussed in the EIS, concentrated acids released into the acid waste disposal site in the New York Bight have been shown to dissipate rapidly.

Whales or turtles may be adversely affected if they were to surface immediately behind the incinerator vessel, coming into contact with the plume under some weather conditions. Farther downwind, lower concentrations of HCl would be encountered. The avoidance reaction of these organisms to high HCl levels is unknown, but due to their apparently low abundance in the site (see Section VI) it is unlikely that a significant number of individuals will surface immediately behind the vessel and remain in the plume long enough to be harmed by the HCl. During the 39-month survey of URI (1982), it is estimated that less than 10 of the 341 sperm whale sitings occurred within the NAIS which encompassed an area of 1240 nmi^2 indicating that the site is sparsely populated with this endangered species, for which concern has been expressed and hence the low potential for this type of an impact.

The 1981 EIS prepared by EPA (EPA, 1981) studied the reactivity of HCl emissions in seawater. It states that no detectable pH shifts are expected due to incineration activities because of the neutralization capabilities of sea water and the atmospheric dispersion. Section 4 of the EIS explains that water samples collected during previous burns showed no significant pH differences between areas in the emission plume and control stations. Section 4 of the EIS also evaluates the potential effects of chlorine gas which would be emitted at trace levels from organochlorine incineration. Based on the discussions in the EIS, no environmental effects are expected due to either HCl or chlorine gas resulting from the combustion process.

Bioaccumulation and Toxic Effects

Bioaccumulation of incineration-related substances in the tissues of endangered species could result from waste released due to a spill, or from emissions from long-term continuous burning of the wastes.

The primary constituents found in the emissions plume are hydrochloric acid, carbon dioxide, carbon monoxide, and water vapor. There may be present, however, traces of unburned organic waste material or recombined organic materials also present. To date, EPA has not been able to detect specific unburned waste materials in the emissions (i.e., PCBs,) at the detection limits of the analytical methodologies used. The EIS discusses these expected concentrations at length. Possible recombination products of incomplete combustion such as dioxins and furans have also been looked for in emissions (TRW 1977, TRW 1978, EPA 1975, EPA 1983a, EPA 1983b). EPA is currently implementing a research strategy (EPA 1985c), to determine if other substances can be identified in the emissions which could be of environmental concern.

EPA's Office of Policy, Planning and Evaluation (OPPE) has recently completed a study to estimate the potential risks of incinerating hazardous wastes at sea and on land (EPA, 1985b) and concluded that incineration, whether at-sea or on land, is preferable to other forms of land disposal now available. This risk evaluation considered the transport and incineration of two types of wastes: PCBs and ethylene dichloride (EDC). The assumptions used in developing the risk estimates were environmentally conservative, and based on Gulf of Mexico meteorology, currents, etc. EPA believes that the basic conclusions are also relevant for the North

Atlantic site as well because many of the assumptions used in making these estimates, such as ship characteristics, emission composition, etc, could also be used at the NAIS.

The OPPE study considered risks from spills. Although a massive spill of PCBs from an incineration vessel due to a collision could cause adverse environmental effects on the food chain, the past record of incineration vessels operating in Europe, combined with vessel construction requirements such as double hulls, separate tanks, etc., and the restrictions placed on these vessels in the U.S. by the Coast Guard such as escorts, safety areas around vessels and radio broadcasts have led EPA to conclude that the probability of waste release due to a collision is "remote" (EPA 1985b). The proposed site does not lie in the path of any major shipping lanes and is in fact 40 nmi (74 km) south of the nearest shipping lane.

If a major spill of a waste containing bioaccumulative substances such as PCBs were to occur, the levels of PCBs in the plankton and higher level organisms, such as squid, would increase if these organisms were exposed to elevated environmental levels. This could result in carnivores, such as sperm whales which feed in the area, accumulating the substance in their tissues while ingesting organisms that were exposed to the spilled waste. The effect of a spill would depend on where and when it occured. A spill at the NAIS would have less impact on endangered species than one over the shelf edge due to the higher whale and squid populations over the shelf edge than at the site.

Because the likelihood of waste release due to a collision is remote, possible bioaccumulation effects are more likely to occur as a result of emissions constituents lingering in the water column after incineration activities.

Studies have been done to compare the levels of PCBs in the incinerator plume to that of background levels. The EIS prepared by EPA in 1981 (EPA, 1981), discussed possible effects of emissions on the environment at the NAIS. A "worst case" analysis was conducted in Appendix D of the EIS and modeled atmospheric concentrations of various substances exiting incinerator stacks assuming only 99.96% Destruction Efficiency (DE). At this DE, the analyses show that atmospheric concentrations of PCBs in the plume would be less than 100 times background levels. Because EPA will require 99.9999% DE (100 times more destruction than contemplated in the EIS), atmospheric concentrations in the plume should approximate background levels (approximately 0.5 ng/m^3 for PCBs thus causing no significant increase in air or water concentrations due to fallout.

For the purpose of this analysis, in addition to the work described in the EIS, EPA has estimated aquatic dispersion of emissions by using a model developed by EPA's Narragansett, R.I. laboratory. This model was originally developed to help EPA estimate impacts of sludge disposal at the 106-Mile deepwater dumpsite immediately north of the NAIS. EPA adapted this model to describe transport and fate of PCBs resulting from ocean incineration (Appendix G).

This model makes several extremely conservative assumptions. For instance, the model assumes continuous, direct input to the water (as would be the case for sludge dumping) and thus considers no atmospheric dilution or dispersion of emissions prior to entering the sea. The initial input, therefore, far exceeds the concentration realistically entering a given volume of sea water. The model also assumes that there is a ship operating at the site every day of the year burning approximately 6,000 metric tons of waste in 7 days, composed of approximately 25% PCBs. Other assumptions are described in Appendix G.

For this exercise, the point of input to the ocean in the model is within the 106-Mile disposal site due north of the NAIS, EPA ran the model using PCBs, assuming three different destruction efficiencies; 99.999%, 99.9999% (minimum required by regulations), and 99.99999%. These three destruction efficiencies (DE) were used to show how operation at the minimum DE allowed could effect levels of PCBs in the sea water of the site, and how the model reacts to orders of magnitude increase or decrease in DE.

The model estimates PCB concentration in the water at various distances from the source of input, and calculates estimated increases in PCB body-burdens in the top carnivore of the indigenous food web, (assumed to live in this concentration for extended periods of time) assuming various bioconcentration factors ranging from $2X10^4$ to $2X10^6$. This range includes the value reported by Tanabe et al. (1984) for the minke whale liver ($9.8 X 10^4$).

The results of this modeling effort indicate that at a 99.9999% destruction efficiency, PCB concentrations in sea water with no atmospheric dilution at all would increase by 0.025 ng/l at the location of input and by 0.005 ng/l, 360 km from the source. Background levels of PCBs at the site are approximately 0.05 ng/l (Boehm, 1983). This combined total (0.025 plus 0.005 = 0.03) is one thousand times lower than the 0.030 mg/l (30 ng/l) EPA water quality criteria guideline for PCBs (EPA, 1980). Levels above this concentration have the potential for causing toxic effects to marine organisms. Top carnivore body burdens would only increase by 0.123 ppm at 30 meters from the source assuming a bioconcentration factor of $2X10^6$. As described previously in this document and the EIS for the site (EPA, 1981), the plume from these incinerators does not fall directly to the sea. As stated in the EIS, part of the emissions in fact stay in the atmosphere for days or months depending on meteorological conditions. Increases in atmosphere residence times would greatly decrease the above estimated concentrations in the water and biota of the site. The EIS (EPA, 1981) discusses atmospheric residence times for emission products and shows that emissions may stay in the atmosphere up to several months. Thus, no effects are expected on endangered species resulting from emission products.

The 1985 Supplementary Information section to the proposed Ocean Incineration Regulation (EPA, 1985a) discusses the carrying capacity of incineration sites, and proposes a formula for this calculation. EPA has applied this calculation to the Proposed North Atlantic Site for the incineration of PCBs (EPA, 1985d). The results of this analysis agree with the previously stated results from other modeling exercises, and show that the estimated concentration of PCBs that could result in surface waters from the incineration of PCBs at the site is several orders of magnitude below the EPA water quality criterion for PCBs.

A monitoring plan has been developed for the NAIS by EPA which will aid in protecting the biota of the site, including endangered species. The purpose of the monitoring plan is to detect incineration products in the environment and to assess the potential for resultant effects. Discharge plums and the surface water will be sampled to determine concentrations of unburned wastes or incineration products. Indigenous species will also be sampled to assess bioconcentration of waste materials or incineration products. The plan also includes observation of endangered or threatened species, and their preferred food source (i.e., squid) will be monitored for organic substance body burdens.

III. ONGOING AND COMPLETED EPA STUDIES

- PROPOSED REGULATION FOR INCINERATION-AT-SEA (EPA, 1985a)

On February 28, 1985, EPA proposed specific regulations for incineration-at-sea (EPA, 1985a). This proposed rule would modify the provisions in the Ocean Dumping Regulations (40 CFR Parts 220-228) to the extent that the Ocean Dumping Regulations govern the issuance of ocean incineration permits and the designation and management of ocean incineration sites. EPA is taking this action to propose more specific criteria to regulate ocean incineration activities. Explicit information is included in the proposed rule on the contents of a permit application, the permit processing procedures, how EPA would review the application, the performance standards and operating requirements to be imposed in a permit, and the incineration site selection and management process.

- SCIENCE ADVISORY BOARD REPORT ON THE INCINERATION OF LIQUID HAZARDOUS WASTE (SAB, 1985)

The Science Advisory Board is an independent organization of scientists and engineers established by Congress in 1978 to advise the EPA Administrator on scientific and technical issues before the Agency. Since February 1984, one of the Board's standing committees, the Environmental Effects, Transport and Fate Committee, has compiled information on the public health and environmental impacts associated with the incineration of liquid hazardous wastes on land and at sea.

The purpose of this review, as requested by the Administrator and Deputy Administrator of EPA, was to evaluate the overall adequacy of existing scientific data for use in future decision making and to recommend areas for improvement.

For this review, the Committee was composed of 22 scientists and engineers from across the country to obtain a balanced, independent and expert assessment of the scientific issues involved. During the course of its review, the Committee held public meetings in California, Florida, Louisiana, and Washington, D.C. to solicit information from the public. The Committee also interviewed EPA staff at its headquarters and regional offices and laboratories, heard testimony from other federal agencies, and made site visits to incinerators that are in operation.

The Committee considered six areas in its evaluation of incineration on land and at sea. These areas include:

1. Transfer of wastes
2. Combustion and incineration processes
3. Stack and plume sampling
4. Environmental transport and fate processes
5. Health and environmental effects
6. Research needs.

Among the Committee's major conclusions and recommendations are:

- The emissions and effluents of hazardous waste incinerators need to be analyzed in such a way that the identity and quantity of the chemicals released into the environment, including their physical form, can be estimated.
- The assessment of potential effects of incineration products requires a coordinated approach involving both laboratory toxicity studies and field assessments. These investigations need to be coupled in a research strategy which addresses both short-term and long-term effects.

- The committee has uncovered no information which leads it to conclude that hazardous waste incineration on land and at sea has produced adverse public health or ecological effects. However, appropriately designed field studies are needed to provide assurance that the long-term operation of incinerators does not produce significant adverse ecological effects. The possible long-term consequences to human health of a continuing program of incineration should be evaluated.

The study was made available to the public in April, 1985.

- OPPE INCINERATION STUDY (EPA, 1985b)

The Office of Policy, Planning and Evaluation of the U.S. Environmental Protection Agency has completed a year-long assessment of incineration as a method for destroying liquid organic hazardous wastes. The final report (EPA 1985b) presents a summary of information currently available on the advantages and disadvantages of incineration, both on land and at sea, and to provide better information for EPA decisions on hazardous waste management options, particularly decisions related to ocean incineration.

The study addresses five major areas:

1. Regulatory Programs - This section describes the regulatory framework for incineration, including a discussion of statutory authorities, regulations, and federal, state, and local responsibilities. The description includes responsibilities for regulation of transportation, handling, and storage of wastes to be incinerated, as well as the actual destruction of the wastes.

2. Description of Incineration Technology - This section describes the key design, performance, and waste handling features of land- and ocean-based incinerators. It identifies similarities and differences, addresses technical issues related to incinerator capabilities, and discusses ongoing and planned research.

3. Market Considerations - This portion of the study describes the current capacity and usage of incinerator facilities, and estimates the projected changes in demand and capacity usage due to implementation of regulatory changes under the 1984 RCRA Amendments. It also addresses the potential impact on the market of emerging alternative technologies.

4. Comparison of Risks from Ocean and Land-Based Incineration - This analysis compares the potential human health and environmental risks from all aspects of the incineration. A case study is used to compare land-based and ocean systems that are equal in size and burn identical wastes.

5. Public Concerns - This section identifies and compares public concerns with ocean and land-based incineration. The concerns are based on discussions with members of the public who have been most vocally opposed to, or at least concerned about, specific incineration operations.

Conclusions of the OPPE Study

Based upon the analysis in the five major areas discussed, the study reached the following conclusions:

- Incineration, whether at sea or on land, is a valuable and environmentally sound treatment option for destroying many liquid organic hazardous wastes.

- In terms of health and environmental risks, there is no clear preference between ocean- and land-based incineration.
- Future demand for incineration capacity is likely to exceed current capacity as land disposal alternatives are increasingly restricted under new RCRA regulations. New alternative methods are unlikely to provide major capacity increases in the near future.
- Although previous research has verified the destructive capacities of incinerators, and risk studies suggest that their impacts on health and the environment are minimal, a program of continuing research is needed to improve our current knowledge of combustion processes and effects.
- In order to better address the concerns of citizens regarding incineration, EPA needs to improve its public communication efforts and provide more visible leadership in the area of hazardous waste management.

The study was made available to the public in March, 1985.

- RESEARCH STRATEGY FOR INCINERATION-AT-SEA (EPA, 1985c)

The U.S. Environmental Protection Agency has been involved in ocean incineration for more than 10 years. Beginning in 1974, a series of four incineration research burns have been conducted under EPA permits to gather scientific information about the incineration of liquid hazardous waste at-sea and to evaluate ocean incineration as an alternative to various land-based disposal options. Incineration-at-sea is an ongoing, permitted activity in Europe.

These U.S. research burns were conducted under the authority of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended (Ocean Dumping Act) and the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention).

During these past 10 years, the scientific community has developed several different methods for sampling incinerator emissions for destruction efficiency. These basic procedures have been used in the ocean incineration research burns. The complexities of sampling at sea and the peculiarities of ocean incinerators have led to the use of modifications of the accepted land-based methods. The research burn results indicated that incineration at-sea could be a viable technology for destroying hazardous wastes and was capable of destroying over 99.99 percent of the waste substances of concern (99.9999% for PCBs) . However, the previous studies did not address a number of questions and issues which have subsequently emerged. A research strategy was prepared (EPA 1985c) to address the questions raised by the public and the EPA Science Advisory Board as previously described.

Under this research strategy, the agency will conduct preliminary studies on land to develop and field test appropriate emissions sampling and bioassay procedures for aquatic toxicology testing.

The agency will conduct a hazardous waste research burn at sea using the minimum amount of waste required, for collection of emission samples. Environmental samples will also be collected simultaneously in the plume from the incinerator.

Emissions collected directly from the incinerator will then be used in various bioassay tests. The potential for environmental effects resulting from at-sea incineration will be evaluated by comparing the environmental effects found at sea to background environmental exposure levels, using a risk assessment procedure. The strategy also includes conducting long term toxicity studies which will follow the preliminary activities and continue for several years.

The strategy was made available to the public in February, 1985.

IV. INCINERATION PROCESS

Incineration vessels which could potentially utilize the proposed site must meet stringent safety requirements. These may include separate or compartmentalized storage tasks, double hulls, double bottom construction and the use of variable pitch propellers and bow thrusters as well as operating restrictions imposed by the Coast Guard such as escorts by tug boats and a Coast Guard Vessel, a 300 foot moving safety zone around the vessel and limitation of transits to daylight hours. There would also be a notice to mariners broadcast on marine radio channels and an EPA ship rider on the incinerator vessel at all times to assure that permit conditions are met.

Using historical spill records for vessels transporting liquid chemicals the EPA/OPPE study estimated that in a port such as Mobile, Alabama (which has been used by incineration vessels in the past), the estimated probability of a spill of any size in the harbor is about one in 3,000 operating years, one in 10,000 operating years in Mobile Bay, one in 4,000 operating years in transit in the Gulf of Mexico and one in 6,000 operating years at the Gulf incineration site. These estimates are for all size spills. Larger spills involving two, three or more tanks would be extremely unlikely events. For example, the estimated probability of spills in Mobile Bay including two tanks (up to 500 cubic meters each) is about one per 67,000 operating years and about one per 200,000 operating years for spills in the Bay involving three or more tanks. EPA believes that these estimates can be roughly representative for the area of the NAIS and therefore expects the likelihood of a spill in the NAIS to be remote.

The incinerator systems presently used for incineration-at-sea are refractory lined furnaces consisting of two chambers; a combustion chamber for internal mixing, and a stack to ensure that adequate retention time for complete combustion is available. Combustion gases pass through these two chambers sequentially and enter the atmosphere. The wastes are fed from storage tanks in the vessels to the combustion system by means of electrically driven pumps. Proposed systems include waste storage in tanks on the deck of a vessel and sea water scrubbers which will "scrub" hot exhaust gases with sea water which is then returned to the ocean. Existing systems do not contain scrubbers.

Wastes are fed into the incinerator when the incinerators have reached the operating conditions specified in the permit. The temperature of combustion will be approximately 1300°C. The average waste residence time in the incinerator will be on the order of one second or longer. Presently existing incinerator systems can process up to 20-25 metric tons of wastes per hour.

Due to the enormous variety of chemical compounds which might be present in wastes that are considered candidates for incineration, considerable chemical analysis will be necessary to establish the acceptability of specific wastes. All chemical wastes approved for at-sea incineration will comply with the criteria in 40 CFR 227.4, 228.8, 227.11, 227.12, and 227.27, and the compounds which can be incinerated by any individual ship will be determined through trial burns. Acceptable wastes will include a variety of organic substances including chlorinated organics.

EPA will limit the amounts of certain materials such as metals in the wastes and restrict other materials as appropriate, to meet London Dumping Convention requirements.

Chlorinated organic substances constitute the majority of compounds for incineration-at-sea which may be toxic to aquatic organisms. Although at least 99.99 percent of the organic substance in the waste will be destroyed through the incineration process, (99.9999 percent for PCBs) trace amounts of these substances may be present in the emissions exiting the incinerator.

During incineration operations, the ship may be required to be moving at a rate of 3 knots into the wind. This will keep the ship away from the plume and help disperse the exhaust gases.

The plume exiting the incinerator stack has been modelled by EPA during a previous research burn. This model and the data from previous monitoring studies have shown that the plume tends to hit the surface of the ocean as it trails out behind the ship and eventually dissipates to undectable HCL levels within 3 nautical miles. The attached Figure (1) (page 56) outlines the plume as described by HCL concentrations during a previous test burn.

Other technologies have been proposed for incineration-at-sea which include the scrubbing of stack emissions with seawater prior to release to the environment. This process would remove HCL and other substances from the hot gasses and release them directly into the sea surface behind the vessel rather than emit them to the atmosphere. The properties of sea water enable it to rapidly neutralize the HCL whether it is released directly into the sea or emitted into the atmosphere where it is highly dispersed prior to falling into the ocean.

As discussed in the research strategy (1985) tests are planned to determine the effects of scrubbers on emission transport, fate and toxicity.

V. INCINERATION SITE DESCRIPTION

General

The proposed North Atlantic Incineration Site is beyond the Continental Shelf and overlies the upper Continental Rise (Figure 2). The figure shows the 18 sampling stations utilized during the July, 1983 survey of the site. The site measures approximately 30 nmi by 40 nmi in area; the center of the site is 140 nautical miles (nmi) from Delaware Bay, and 155 nmi (290 km) from Ambrose Light (entrance to New York Harbor). The site is oceanic in nature; it is deep (2,400 to 2,900 meters), and the water masses and biology of the area more closely resemble the open ocean to the east, rather than the coastal environment to the west. The site is not a highly productive biological area and is limited in commercial or recreational fisheries (EIS, 1981). An inactive munitions dump site and an inactive low-level radioactive waste dump site exist within the boundaries of the site, but other types of wastes have not been dumped here.

This chapter describes the environmental setting of the northeastern mid-Atlantic oceanic region. An Environmental Impact Statement has been prepared for the proposed site which contains more detailed information than that presented in this plan, and should be consulted if additional information is required (EPA, 1981). The 106-Mile Site characterization update (NOAA, 1984) provides additional information about the area around the 106-Mile Site which is due North of the NAIS. The proposed Incineration Site, the 106-Mile Ocean Waste Disposal Site, and the area around them are examined simultaneously to acquire a wide regional profile of the northwest Atlantic Ocean. It is recognized that the Continental Shelf break to the west of the site provides the major environmental shifts in physical, chemical, and biological oceanographic phenomena, whereas the

Gulf Stream to the east of the site causes similar effects by serving as a buffer between the region and the Sargasso Sea.

The information in this section shows that the site is situated in a highly studied and complex area of various currents and climatic conditions, but also shows it to be a useful location for incineration activities. The following information will also be useful in designing monitoring programs and in modelling the transport and fate of emissions.

Meteorology

The proposed North Atlantic Incineration Site is seaward of the Continental Shelf, 120 miles off the Delaware-Maryland coast. The site lies within a mid-latitude zone of prevailing westerlies, where the daily wind flow generally moves from west to east. Polar air dominates the region about two months each year, whereas annual warmer tropical Atlantic air dominates during the other ten months. In general, the climate of the region can best be described as modified continental, due to the greater influence of the westward land mass, as opposed to the eastward ocean.

Marine air temperature is strongly influenced by the Atlantic Ocean. During winter months warm sea surface temperatures tend to increase air temperatures proportionately with distances from shore. Summer months are conversely affected; thus, temperatures decrease proportionately with distances from shore. Precipitation over the offshore regions is uncertain due to the lack of data. Most rainfall occurs between November and March and is generally associated with widespread storm systems varying in intensity and coverage. Cloudiness is minimal during late summer and early autumn, at which times the Bermuda High dominates weather patterns, and is maximal during winter months when northeasterlies prevail. Visibility depends on the presence or absence of advection, fog, and haze. Visibility greater than 5 nmi (9.3 km) ranges from about 80% (late spring) to more than 90% (autumn and winter).

Meteorological data indicate that atmospheric temperature inversions are weak and infrequent occurrences in the site region. Air temperature inversions of 2°C or greater rarely occur below 1,000 m, and are generally restricted to spring and summer. Above 1,000 m, inversions of 2°C or more occur less than 3% of the time year-round.

Relative humidity is normally high. The annual average value is 81%, summer being slightly higher than winter due to persistent southerly winds.

Water Masses

A water mass may be defined as a large seawater parcel having unique properties (temperature, salinity, and oxygen content) or a unique relationship between these properties. Each water mass, thus defined, is given a name qualitatively describing its location or place of origin. Water masses are produced in their source areas by either or both of two methods: (1) alteration of their temperature and/or salinity through air-sea interchange; and (2) mixing of two or more water types. This occurs after formation of the water masses spread to a depth determined by their density, relative to the vertical density gradient of the surrounding water.

The National Oceanic and Atmospheric Administration (NOAA) has characterized the physical oceanographic environment in the region of the proposed Incineration Site as being extremely complex and variable in all but the near-bottom waters. Normally the surface layer of the site is Slope Water, which lies between less saline Shelf Water to the west and more saline Gulf Stream Water to the east. However, conditions change periodically, allowing shelf water to enter the site from the west, or permitting Gulf Stream Water (in the form of southerly moving Gulf Stream eddies) to be present about 20% of the time.

Shelf Waters

The waters overlying the Continental Shelf of the mid-Atlantic Bight are of three general types: Hudson River Plume Water, surface Shelf Water, and bottom Shelf Water. Hudson River Plume Water results from the combined discharge of the Hudson, Raritan, and various other rivers into the northwest corner of the Bight Apex. This low-density water floats over Shelf Waters as it moves into the Bight. During periods of high runoff, the plume may spread over large areas of the Bight, and produces large vertical and horizontal gradients of salinity. This water type persists throughout the year, but its extent and depth are highly dependent on Hudson and Raritan Rivers flows. Generally, the plume flows southward between the New Jersey coastline and the axis of Hudson Canyon. The plume direction is sensitive to wind stress and reversals in the residual flows. Consequently, the plume may flow eastward between the New Jersey coastline and the axis of the Hudson Canyon, or it may occasionally split and flow both eastward and southward.

With the onset of heavy river discharges in the spring, surface salinities in the Bight decrease and a moderate, haline-maintained (i.e., maintained by salinity differences) stratification occurs initially, separating the coastal waters into upper and lower layers. These two layers are the surface Shelf Water and the bottom Shelf Water. Decreasing winds and increasing isolation (solar radiation) increase the strength of the stratification and cause it to undergo a rapid transition (usually within a month) from a haline-maintained (i.e., maintained by salinity) to a thermalmaintained (i.e., maintained by temperature differences) condition. This two-layer system becomes fully developed and reaches maximum strength by August.

Surface Shelf Water is characterized by moderate salinity and high temperature. During the winter, water is essentially vertically homogeneous over most the Bight Shelf. With the rapid formation of the surface Shelf Water layer during the spring, bottom waters become isolated until sufficient mixing takes place the following winter. A "cool cell" (having a temperature typically less than 10°C) of the bottom Shelf Water layer has been observed to extend from south of Long Island to the opening of Chesapeake Bay, then seaward, nearly to the Shelf edge. This cold water persists even after the surface layers have reached the summer temperature maximum. The cool cell may be surrounded on all sides by warmer water.

The upper layer of the bottom Shelf water is usually between 30 and 100m deep in the summer. Seaward near the Shelf edge, strong temperature/salinity/density gradients occur, limiting large-scale mixing between the Shelf Water and the waters over the Continental Slope.

Slope Waters

Slope Water is a highly complex, dynamic body of water representing an area of mixing between Shelf Waters and Gulf Stream. Shelf waters border the slope water on the north and west, and the Gulf Stream, which forms the eastern and southern boundary. These boundaries (frontal zones) are not stationary, but migrate seaward and landward when the Gulf Stream shifts its axis during meanderings.

The Gulf Stream frequently meanders in such a way that anti-cyclonic (clockwise) loops of current are formed. Occasionally, these loops detach and form separate entities, known as eddies. The eddies are rings of Gulf Stream Water surrounding a core of warm Sargasso Sea Water (which originates to the east of the Gulf Stream), or trapped Gulf Stream Water. Great amounts of this water may be advected to depths as great as 800 to

1,000m. After detachment the eddies may migrate into the Slope Water region, usually in a southwesterly direction. In addition, the eddies may interact with Shelf Water, causing considerable disturbances in the water within the proposed site region. While there appears to be no seasonal pattern in the occurrence of these eddies, the region of the proposed Incineration Site may contain any eddy 20% of the time, which is either quasi-stationary or migrating, and capable of occupying the entire site. The eddies dissipate or are reabsorbed by the Gulf Stream, usually in the region of Cape Hatteras.

Like many deepwater oceanic regions, the water of Slope Water can be divided into three general layers: the upper or surface layer (where variability is great), the near-surface thermocline region (where temperature changes rapidly with depth), and the deep water (where seasonal variability is slight).

For Slope Water in general, stratification forms in the upper water layers early in May and persists until mid or late autumn, when cooling and storm activities destroy it. A permanent thermocline is usually at a depth of 100 to 200m. During the period when the upper layers are stratified, a second, seasonal thermocline forms in the upper water layers and reduces the mixed-layer thickness from the surface to merely 30 to 40m deep. From autumn until early spring water is isothermal to the depth of the permanent thermocline.

Gulf Stream Water and Eddies

To the east of the Slope water is the Gulf Stream, a moving current with core velocities 200 cm/s (3.9 kn) or greater. The Gulf Stream is a continuation of the Florida Current (a northward-flowing current extending from Florida to Cape Hatteras), flowing northeastward from the Continental Slope off Cape Hatteras to east of the Grand Banks. The Gulf Stream meanders throughout this region over great horizontal distances north of Cape Hatteras. Occasionally, the Gulf Stream cuts through a meander neck, much like river meander cutoffs. When the fast-moving Gulf Stream abandons its previous route, after cutting through a meander neck, it isolates a large mass of Sargasso Sea Water, which is distinctly warmer than surrounding Shelf Water and Slope Water. These warm-core eddies, or Gulf Stream rings, contain enormous energy imparted from the Gulf Stream. They continue to rotate clockwise (anticyclonic) as they migrate in a southwestward direction through the Slope Water, until they either dissipate or join the Gulf Stream in the vicinity of Cape Hatteras. The Gulf Stream may also form cold-core (cyclonic) eddies by trapping cold water located to the north of the Gulf Stream; however, this type of eddy occurs only to the south or east of the Gulf Stream and is not to be found at the proposed Incineration Site. It should be noted that warm-core eddies are not simply near-surface phenomena. The thermal and rotational characteristics are often manifested near the sea bottom, in water depths of thousands of meters.

Current Regimes

The westward-flowing Labrador Current loses its distinctiveness somewhat west of the Grand Banks. Current measurements have been made by several researchers, using neutrally-buoyant floats, parachute drogues, and moored current meters in the region of the Shelf Break and Slope, south of New England. The mean currents in this area are generally of the order of 10 to 20 cm/s westward, following the bottom bathymetry. This direction is similar to the direction taken by currents over the Continental Shelf.

Along the northern boundary of the Slope, Slope Waters flow slowly to the southwest, following the bathymetry to Cape Hatteras, where the water mass turns and flows seaward, joining the Gulf Stream. Evidence of a slow northeastward flow along the Gulf Stream in the southern part of the Slope Water region was also found. The Gulf Stream and Shelf Water from a cul-de-sac near Cape Hatteras, and while some interchange of water occurs across these boundaries, most of the water entering the Slope Water region from the east probably exists along the same path.

The presence of a deepwater counterclockwise (cyclonic) gyre system is located between the Continental Shelf and Gulf Stream. This system transports as much as 10^7 m^3/s of water through the region of the proposed Incineration Site (equivalent to the volume of 500 Mississippi Rivers).

The mean surface current speed is 25 cm/s near the proposed Incineration Site. The direction of the flow is either east-northeast or south-southwest.

Geological Conditions

The Continental Slope within the Incineration Site area has a gentle (4%) grade, leveling to 1% in the region of the upper Continental Rise. Sediments just north of the incineration site, within the 106-Mile Ocean Waste Disposal Site are principally sand and silt, with silts predominating. Sediment composition is a major factor which determines the amounts and kinds of animals capable of colonizing the sea bottom at the site. Generally, greater diversities and abundance of fauna are associated with finer sediments (e.g., silt), although unusual physical conditions can play an important role. Fine-grained sediments are more likely to contain higher concentrations of heavy metals due to increased surface area and ionic charges of silts and clays. Sand, gravel, and rocky bottoms rarely contain metals in high concentrations.

Continental Slope sediments in various parts of the region are subject to different dynamic forces. The upper Continental Rise is in an area of tranquil deposition, whereas the lower Continental Rise is in an area of shifting deposition. Several erosional areas (caused by currents) occur between these two provinces. The different regimes will greatly determine the ultimate fate of the amount of waste products reaching the bottom, which is anticipated to be minimal. In areas swept by currents, incinerator emissions would be carried out of the limits of the disposal site, dispersed, and greatly diluted. In erosional and shifting depositional areas, similar conditions would exist, although the emitted materials could remain temporarily motionless before further transport. In areas of tranquil or slow deposition, emission products would be slowly buried.

Chemical Conditions

The amount of dissolved oxygen in seawater is generally an indicator of the life-supporting capacity of the waters. Dissolved oxygen (DO) levels below 4 mg/l may cause stress in animals. Dissolved oxygen concentrations observed at the 106-Mile Ocean Waste Disposal Site are higher than 4 mg/l in surface water and experience vertical gradients similar to the temperature gradients previously described. Thus, the permanent stratification level at 100 to 200 m divides the water column into upper and lower regimes. The different water densities and salinities prevent the two layers from mixing and thus influence the distribution of dissolved oxygen concentrations. Dissolved oxygen levels are minimal at depths of 200 to 300 m and slowly increase with distance (up or down) from the stratification boundary.

Dissolved oxygen gradients are similar for both summer and winter at the Incineration Site and the 106-Mile Ocean Waste Disposal Site. Surface DO concentrations are higher during winter at both sites than they are during summer months.

Chemical baseline and monitoring surveys conducted at the adjacent 106-Mile Ocean Waste Disposal Site have examined trace metal levels in sediments, water, and selected organisms. Metals in the sediments and water are potentially available to site organisms. Within the fauna, these contaminants could possibly be assimilated (bioaccumulated) and concentrated in toxic quantities.

Numerous metals are present as a natural occurrence in seawater; therefore, only concentrations of metals exceeding natural background levels that approach known or suspected toxicity levels would be considered possible threats to marine organisms and mankind. During the most recent studies of trace metals levels in the 106-Mile Ocean Waste Disposal Site waters, background levels typical of other uncontaminated Shelf-Slope regions were found. These background levels are discussed in EPA (1981).

Estimates of organic substance concentrations in the air over the middle North Atlantic Ocean are highly variable. Biddleman et al. (1981) cite PCB concentrations from various sources ranging from less than 5 picograms per cubic meter (pg/m^3) over the Barbados to as high as 1.6 nanograms per cubic meter (ng/m^3) between the U.S. and Bermuda. EPA (1981) describes atmospheric background concentrations of other organic substances at the site.

The concentration of organic substances in surface waters are also quite variable. Boehm (1983) however, estimates the background PCB concentration in waters outside the New York Bight to be approximately 0.05 nanograms per liter.

Biological Conditions

Plankton are microscopic flora and fauna drifting passively with currents or swimming weakly. Plankton are either plants (phytoplankton) or animals (zooplankton). Since the plankton are primary sources of all food in the ocean, their health and ability to reproduce are of crucial importance to all life in the ocean, including commercially important fish, shellfish, and marine mammals.

Plankton at the 106-Mile Ocean Waste Disposal Site and surrounding region are highly diverse due to the influences of Shelf, Slope, and Gulf Stream water masses. The high-nutrient Shelf Waters primarily contribute diatoms to the region, and the lower nutrient Slope Waters contribute coccolithophorids, diatoms, dinoflagellates, and other mixed flagellates. Mixed assemblages of zooplankton common to the different water masses have been found to occupy the 106-Mile Ocean Waste Disposal Site and surrounding areas during winter, spring, and summer.

Fish have been surveyed at various depths within the 106-Mile Ocean Waste Disposal Site. The diversity and abundance of fish found only in surface water are similar inside and outside the 106-Mile Ocean Waste Disposal Site limits. Fauna found primarily at mid-depths (mesopelagic fish) are predominantly Slope Water species. Also, Gulf Stream anti-cyclonic (clockwise) warm-core eddies contribute some north Sargasso Sea species. Several migratory oceanic fish usually associated with the Gulf Stream often occur in midwater regions of the proposed site and the 106-Mile Ocean Waste Disposal Site. Benthic (bottom) fish within the site are similar to assemblages in other Slope areas.

Several endangered species of whales and turtles inhabit the area near the proposed site and are discussed later in this document.

Abundance and diversity of invertebrates at the 106-Mile Ocean Waste Disposal Site are similar to most other Slope localities of the mid-Atlantic Bight. As in similar areas, the organisms on the bottom (the epifauna) of the proposed incineration site and the 106-Mile Ocean Waste

Disposal Site are dominated by echinoderms (e.g., starfish), with segmented worms (polychaetes) as the dominant burrowing (infaunal) organisms.

Many species of birds are known to frequent the offshore and coastal waters of the mid-Atlantic Bight. Several pelagic species are regular inhabitants of the ocean region containing the proposed incineration site. Other species are only occasionally observed. Summer months produce the greatest number of pelagic bird sightings.

Birds migrate through the entire region. During September and October many avian species of marine and terrestrial environments leave northeastern coastal areas for southern wintering grounds. The actual numbers of species using the routes are still uncertain.

Squid which are a major food source to several whale species (i.e., sperm whale) inhabit the shelf area to the west of the site from the shelf break shoreward (NOAA, 1983).

VI. PROPOSED MONITORING PROGRAM

Previous sections of this document have described the types of materials expected to be emitted into the area of the Incineration Site, the basic environment of the site and the basic effects of possible emission related materials on the marine environment.

EPA is developing a monitoring plan (EPA, 1984) which incorporates these three issues into a sampling and analysis scheme designed to detect incineration products in the environment and to assess the potential for resultant effects. The plan contains: procedures for sampling air to determine plume locations and to determine air concentrations of unburned wastes or incineration products; procedures for sampling surface water for detection of unburned wastes or incineration products; determination of ATP, chlorophyll and pH in surface water at the site; and collection of zooplankton and other indigeous species for determination of bioconcentration of waste materials or incineration products. The plan will also include observation of endangered or threatened species and their preferred food sources such as squid. Additional tests will be incorporated into the monitoring plan as they are shown to be useful based on ongoing and planned research activities (see EPA 1985c). Ongoing studies of the National Oceanic and Atmospheric Administration and other Agencies will also be very useful in the implementation of a thorough monitoring plan.

Monitoring activities will be conducted in an exploratory mode at first and will largely be directed by the results of research which is being conducted by EPA. Methods are currently being developed for collecting incinerator emissions for laboratory aquatic toxicity testing. Once this method is developed, tests can be conducted during research burns, trials burns and during normal operation of at-sea incinerators to determine if and what effects are caused by the emissions on various aquatic test species. These tests could then be run on indigenous species to determine which are the most sensitive species and what are the effects that could be monitored in the environment. EPA is also conducting research to better chemically define the substances in the emissions and estimate its bioaccumulation potential. The results of these tests will yield information describing what specific substances and biological effects should be monitored in the environment. Air and aquatic transport models are also being developed and verified for future use in describing plume location and fate.

The results of these research activities will be incorporated into EPA's monitoring plan as they become available and monitoring activities will be altered accordingly.

Although the separate outputs from the research programs will be useful in developing future monitoring programs for the site, the major product of these research activities is the development of an aquatic risk assessment for emissions from at sea incineration. During the research, dose-response tests will be conducted by dosing various organisms with real emissions at several concentrations and noting the levels necessary to cause measurable adverse toxicological or behavioral effects. By combining this dose-response information with the expected environmental concentrations of the emissions based upon dilution models, a risk assessment will be conducted to estimate the possibility of environmental concentrations of emissions reaching levels capable of causing adverse effects. The rate of incineration at the site would be dictated by the possibility of causing effects, and the monitoring activities will be used to ensure that these effects are not being manifested at the site. The dose-response tests will be run using both acute and long term chronic and bioaccumulation bioassays. These tests will provide more useful information and require less resources than implementing a major monitoring effort to try to identify chronic effects down stream from the incineration site.

This monitoring program will use the initial risk assessment as a null hypothesis and seek to observe effects or elevated concentrations of emissions products in the environment. As information from these monitoring activities and additional research studies becomes available, the initial risk assessment will be updated and the site managed accordingly. Any time that the rate of emissions entering the site exceeds that which could cause adverse effects, incineration activities could be reduced in frequency, duration, or site limitations imposed. Such steps might be necessary to mitigate adverse effects which are not in compliance with regulatory criteria (see EPA (1985a) for a description of the proposed calculation of carrying capacity of a site).

A log will be kept of all endangered or threatened species observed during monitoring cruises at the site.

EPA is planning a cruise to the North Atlantic Incineration Site and 106-Mile disposal Site in late 1985 to collect additional baseline information from the area. Samples of air, water, plankton, and sediment will be collected for analysis of organic and metallic substances. Squid will also be collected to be analyzed for trace organics and metals to provide background information as they are a major food source of sperm whales in the area. There will also be constant observation for endangered species during the cruise.

VII. DESCRIPTION OF THREATENED AND ENDANGERED SPECIES

A. Mammals

There are 6 species of mammals listed as endangered in the vicinity of the proposed site. These are the fin, humpback, right, sei, sperm and blue whales. A description of each has been taken directly from Schmidly (1981) and others, as noted, and included below.

1. Fin Whale (Balaenoptera physalus):

Description and Identification

Fin whales may reach a length of 79 ft (24 m), and females are slightly longer than males of the same age. From blue whales, with which they are most likely to be confused, fins differ in: (1) having a narrower, more V-shaped rostrum, but with the same sort of single distinctive head ridge; (2) having a dorsal fin that is longer (up to 24 inches, 61 cm, tall) and located slightly more than one-third forward from the tail; (3) having a coloration that is dark gray to brownish-gray on the back and sides with none of the mottling present on the blue whales; (4) having a grayish-white chevron evident along the back just behind the head, which may be visible as the animals surface to breathe; and (5) having a yellowish-white coloration to the right lower lip, including the mouth cavity, and the right from baleen.

Distribution

Fin whales are cosmopolitan and occur in all oceans. In the western North Atlantic they occur from Greenland south to the Gulf of Mexico and the Caribbean. Two subspecies are recognized.

Fin whales have stranded along the coasts of North Carolina and Florida in the Atlantic and along Florida, Texas, and Louisiana in the Gulf.

Seasonal Movements

In the western North Atlantic, fin whales summer from below the latitude of Cape Cod, Massachusetts, north to the Arctic Circle, where they are usually concentrated between shore and the 2000 meter curve.

The area east of the Delmarva Pennsula maybe a winter and spring habitat for fin whales with the population moving farther north during the rest of the year. (McKenzie, et al., 1985).

Status and Abundance

These whales are considered endangered by U.S. authorities. The finback population in the north Atlantic is estimated to be approximately 2,686 in spring, 2,655 in summer, 790 in fall and 1663 in winter (McKenzie, et al., 1985).

Life History

No data are available on life history parameters from the proposed site. Fin whales mate and calve from November to March. Females probably bear a calf every third year after a gestation period of 11 to 12 months. Lactation lasts 7 months. Canadian fin whales are sexually mature at 17.6 to 18.3 m (females) and 16.9 to 17.5 m (males). Life span could be over 50 years.

Fin whales in the North Atlantic feed mostly on pelagic crustaceans, capelin, and herring. Euphausids are the main food, and both Thysanoessa inermis and Meganyctiphanes norvegic are important food species. Fish are eaten more exclusively in the winter months. Fin whales come close to shore in pursuit of fish which may account for their frequent strandings. Their appearance in New England appears to coincide with times when herring are plentiful. Large feeding frenzies, comprising 30 to 50 animals, are often seen during the spring, summer and fall in areas of high productivity along the New England coast.

2. Humpback Whale (Megaptera novaeangliae)

Description and Identification

Humpback whales reach a length of 53 ft (16.2 m). They are easily identified by their long (nearly a third as long as the body), nearly all-white flippers that are knobby and irregular on the leading edge; the fleshy "knobs" or protuberances randomly distributed on the top of the head and on the lower jaw; and the small dorsal fin, located slightly more than two-thirds towards the back, which frequently includes a step or hump. Humpback whales are black with a white region of varying size on the belly; the flippers and the undersides of the flukes are also white.

Distribution

These whales may occur in all oceans. In the western North Atlantic, they are widely distributed from north of Iceland, Disko Bay and west of Greenland, south to Venezuela and around the tropical islands of the West Indies.

There are several records of humpbacks from the Atlantic, and all correlate with the known time and route of migrations for this species. Humpbacks are a coastal species, a fact accounting for their long history of exploitation by hunters. Their occurrence is mainly in depths less than 2000 meters.

Seasonal Movements

Humpbacks migrate in distinct seasonal patterns. They spend spring, summer, and early fall feeding from Cape Cod to Iceland. In late fall and early winter they begin to migrate southward to the Caribbean for calving and breeding. Their return northward migration begins in early spring.

Status and Abundance

Humpbacks are considered endangered by U.S. authorities. The number of existence at the end of the 19th century, based on cumulative catch data from 1903 to 1915, was at least 15,000 animals. By 1915 the population had been decimated, and it is reasonable to infer that only a few hundred animals remained by 1915. The total population around the world is now estimated at 5,000 animals. There have been noted 1,259 humpbacks in the western North Atlantic on their feeding grounds. The same population was estimated on its southern breeding grounds at 785 to 1,157 animals. McKenzie, et al. (1985) estimates the spring population in the North Atlantic to be approximately 60.

Life History

No data are available on life history parameters from the proposed site. Breeding and calving occur in Caribbean waters from January to March. Gestation lasts approximately 10 to 12 months, with lactation lasting from 10.5 to 11 months. Since yearling-size animals are seen with adults in the Caribbean, it is possible that the young stay with the cow after weaning.

In the western North Atlantic humpback feed only in the northern waters and not while they are in the Caribbean. Limited data from Newfoundland indicate that they feed mainly on capelin, with krill as second choice. Herring and cod are also eaten. Humpbacks approach or follow trawlers rather commonly, presumably for escaping fish or because the trawlers scare and school fish tightly, making them easier to capture in cooperative hunting and feeding. This may also explain why they approach stationary ships. Humpbacks emit sounds in long, predictable patterns ranging over frequencies audible to humans. The function of the songs is unknown.

3. Right Whale (Eubalaena glacialis)

Description and Identification

Right whales reach a length of about 53 ft (16.2 m). The rotund body lacks a dorsal fin or dorsal ridge, and the upper jaw is long, narrow, and together with the lips, highly arched. A series of bumps or callosities, referred to as the "bonnet", is on the top of the head in front of the blowholes. The two blowholes are widely separated; consequently, the blow is projected upwards in a V-shape as two distinct spouts. The dark body is sometimes black, but more often brown or mottled with a region of white on the chin and belly, and sometimes with numerous small grayish-white scars.

Distribution

Right whales occur in the temperate waters of the North Atlantic, the North Pacific, and the Southern Hemisphere. The southern populations are distinguishable as a separate subspecies (e.g., australis) from e.g., glacialis of the North Atlantic. In the western North Atlantic, right whales are distributed from Iceland to Florida and the Gulf of Mexico, but their range was probably greater during prewhaling days.

Seasonal Movements

Right whales pass the New England coast in fair numbers in spring and continue as far north as Nova Scotia. Not much is known of the southbound migration, but apparently it occurs much farther offshore, which would account for the scarcity of records in the southern areas from April through December. From October to January right whales are sighted off Massachusetts, New Jersey, and New York, probably on a southward migration.

Status and Abundance

Right whales were once very common in the western North Atlantic; however, overhunting, up until 1953, reduced them to near extinction. The western North Atlantic population may number in the "high 10's to low 100's", although no accurate information is available.

Increased sighting reports over the past 25 years at the northern and southern coastal approaches in New England and Florida, respectively, may be cause for some optimism regarding the population's recovery and recolonization of their historic range. They were protected by international agreement in 1929, and since then the western North Atlantic population has evidently increased. These whales are considered endangered by U.S. authorities.

Right whales approach very close to the coast on the United States eastern seaboard where pairs and females with calves are often sighted only several hundred meters offshore. Because of these habits, they are threatened by pollution, habitat destruction, and ship traffic nearshore. They are not easily startled and may be readily approached by vessels.

Life History

No data are available on life history parameters from the proposed site. Mating probably occurs in late summer; the gestation period is assumed to be about a year, and the length of the young at birth is about one-fourth that of the mother. Calves are suckled for about a year. Right whales feed by "skimming", at or below the surface, on copepods and euphausids. Specific dietary items include *Calanus finmarchius* and

Thysanoessa inermis. One instance has been recorded of a right whale taking small pelagic pteropod mollusks.

4. Sei Whale (Balaenoptera borealis):

Description and Identification

Sei whales may reach a total length of 62 ft (19 m). Their color is dark steel gray on the back sides, and they often have a shiny or galvanized appearance due to the presence of ovoid, grayish scars. They differ from all other balaenopterids by the very fine bristles of their baleen (about 0.1 mm in diameter at the base of the bristle, as opposed to about 0.3 mm or greater for the other species). Their relatively short ventral grooves distinguish them from all other species except the minke whale (B. acutorostrta). In B. borealis and B. acutorostrata, the ventral grooves reach a point about midway between the flipper and the umbilicus, whereas they reach the umbilicus in the other species. B. borealis may be readily distinguished from B. acutorostrata on the basis of size, pigmentation, and the color and texture of the baleen. Their right lower lip and mouth cavity, unlike those of fin whales (B. physalus), is uniformly gray. Their head is intermediate in shape between that of blue (B. musculus) and fin whales. Their tall, falcate dorsal fin, located more than one-third forward from the tail, distinguishes them from blue whales. From Bryde's whale (B. edeni), they differ in having a single head ridge instead of three.

Distribution

Sei whales occur in all oceans, but they are rare in tropical and polar seas. Two subspecies are distinguished: a smaller one, B. b. borealis, in the Northern Hemisphere and a larger one, B. b. schlegelli, in the Southern Hemisphere. Sei whales are widely distributed in nearshore and offshore waters of the western North Atlantic from the Gulf of Mexico and the Caribbean to Nova Scotia and Newfoundland. Three stocks may exist: a Newfoundland/Labrador stock probably limited to the waters around Newfoundland and Labrador to Davis Strait; a Nova Scotia stock that probably migrates southward along the U.S. coast; and a Caribbean/Gulf of Mexico stock that may migrate and overlap with the Nova Scotia stock.

Seasonal Movements

The distributions and migrations of sei whales during most of the year are poorly known. Apparently they winter south of Cape Cod, but little information is available for movements south of New England. There was a report of a whale of this species that stranded alive at Eastham, Massachusetts, on 21 July 1974; the animal was towed back to sea, released, and subsequently washed ashore dead near Currituck light, Corolla, North Carolina, on 5 April 1975. The December record of this species from South Carolina may have come from a southward migration of this population during the winter months.

Status and Abundance

McKenzie, et al. (1985) estimates that the population of these whales in the North Atlantic is approximately 237 in spring and 101 in summer. No population estimates are available for the proposed site. These whales are considered endangered by U.S. authorities.

Life History

No data are available on life history primarily from the proposed site area. In the eastern North Atlantic, sexual maturity in females is reached at 13.6 m as compared to 13 m for males. The mean age at sexual maturity is 7.5 years for males and 8.4 years for females in southern oceans. There may exist a 3-year breeding cycle. Calving could occur every other year. Gestation lasts 1 year, and, calves are born during February and March and measure 4.8 m at birth. Peak pairing is from November to February with lactation lasting 6 months after birth.

In the North Atlantic, sei whales feed primarily on copepods (Calanus finmarchius and Thysanoessa inermis), although they also take euphausids as a preferred food (possibly due to an absence of copepods), as well as various small schooling fish.

Sei whales usually travel in groups of two to five individuals, though they may concentrate in larger numbers on their feeding grounds. They usually do not dive very deeply, and the head rarely emerges at a steep angle except when the whales are chased.

5. Sperm Whales (Physeter catodon)

Description and Identification

Male sperm whales may reach a length of 69 ft (20.9 m) although individuals larger than 50 ft (15.2 m) are rare; females are much smaller, rarely exceeding 38 ft (11.6 m). These large whales are easy to identify. They are bluish-black except for occasional small areas of white on the lower jaw and venter. The head is rectangular in profile and comprises from a fourth to a third of the total length. The dorsal fin is replaced by a hump and a series of longitudinal ridges on the posterior part of the back. The lower jaw is small, narrow, and decidedly shorter than the snout. Pectoral flippers are exceedingly small. The single blow hole is located well to the left of the midline and far forward on the head; consequently the small bushy blow hole emerges forward at a sharp angle from the head and towards the left.

Distribution

Sperm whales occur throughout the oceans of both Eastern and Western Hemispheres, ranging from the Arctic to the Antarctic, but occurring mostly in the temperate and tropical latitudes of the Atlantic and Pacific Oceans. They occur along the edge of the continental shelf at approximately the 1000 meter contour but rarely on the shelf itself since they are basically limited to deeper waters.

Seasonal Movements

Seasonal distributions and migrations vary between males and females. Along the Atlantic coast, harem and nursery schools (females, calves, juveniles, and young and old "harem master" bulls) move north from tropical and subtropical winter grounds to breed in temperate waters. Consequently, sperm whales are fairly abundant near the continental shelf edge off the mid-Atlantic. Young bulls, sexually mature but unable to maintain harems, and older bulls move farther north into polar waters. McKenzie, et al. (1985) notes that sperm whales are abundant throughout the midAtlantic shelf region in spring and early summer and that during summer and fall they are relatively abundant south of New England to the west of the site on the shelf edge and occur in lesser numbers in the site and eastward.

Status and Abundance

Sperm whales are considered endangered by U.S. authorities. The number of observations and stranding records has decreased in recent years, suggesting that populations have declined. Due to their size and unique character, they are more likely to be recognized and reported than most other whales, so stranding records may be biased in their favor. McKenzie, et al. (1985) estimates the population in the Mid-Atlantic region to be approximately 450 in spring, 692 in summer, 83 in fall and 65 in winter. NOAA (1981) and Schmidley (1981) estimates the population of the North Atlantic to be approximately 22,000.

Life History

Sperm whales are polygamous. During the spring mating season, harems are formed when "harem master" bulls join the predominantly female nursery schools. Mating occurs in spring during migration north. Gestation lasts 14 to 16 months, with a 1 to 2 year lactation period, followed by a resting period of 8 to 10 months.

The primary food of sperm whales is squid, supplemented by deepwater species including octopus, sharks, cod, scorpaenids, snapper, barracuda, sardines, ragfish, skates, albacore, angler fish, rattails, and bottom dwellers, such as spring lobsters, crayfish, crabs, sponges, and tunicates. Most food is taken in the open ocean and at great depths, with some taken from the bottom sediments by scraping the lower jaw along the bottom. Sperm whales feed throughout the year, with no noticeable fasting period. URI (1982) describes sitings of sperm whales feeding in the vicinity of the proposed site, and shows approximately 10 sperm whale sitings in the 39 month period from November 1, 1978 through January 28, 1982 within the site boundary (see figure in Appendix H). The total number of sitings for this period in the URI study area, which extends from Nova Scotia to south of Cape Hateras, was 341 sperm whales with most sitings occuring along the 2,000 meter depth contour. The number of sitings within the NAIS is therefore a small percentage of the total number of sitings in the URI study area which represents a small part of the overall North Atlantic population of 22,000 (NOAA, 1981).

Sperm whales may be found singly or in groups of up to 35 to 40 individuals. Older males are usually found solitary except during the breeding season. During the remainder of the year large groups may include bachelor bulls (sexually inactive males) or nursery schools containing females and juveniles of both sexes.

Sperm whales are among the longest and deepest divers of all cetaceans. Dive-durations estimates of up to 90 minutes are recorded and depend on the size of the individual. Depths have been reported as deep as 620 fathoms (1,145 m).

6. Blue Whale (*Balaenoptera musculus*)

Description and Identification

Blue whales are the largest living mammals. In the North Atlantic, they may reach lengths of 80 to 85 ft (24.4 to 25.9 m); females are slightly larger than males of the same age. These whales are easily distinguished by their large size; bluish, often mottled coloration; broad, flat, U-shaped head with a single ridge extending from just in front of the blowholes, almost to the tip of the snout; and a small dorsal fin (only 13 inches, 33 cm. tall) which is positioned well aft on the animal.

Distribution

Blue whales occur in all oceans of the world but are partial to cold water and seem to avoid warmer waters. Three subspecies are recognized: a small one, *B. m. musculus*, in the North Atlantic and North Pacific; a large one, *B. m. intermedia*, that spends the summer in Antarctic waters; and a pygmy subspecies, *B. m. brevicauda*, in the southern Indian Ocean.

Seasonal Movements

Blue whales concentrate in the northern portion of their range, from Newfoundland to the Arctic Circle, during the spring and summer where they feed on the krill which is abundant in those waters. In fall and winter they move south into temperate and perhaps to tropical waters.

Status and Abundance

Blue whales were extensively hunted throughout the North Atlantic until the early 1950's and they only now are beginning to recover from this exploitation. They have been protected by international agreement since 1966. Blue whales are listed as endangered by U.S. authorities. DOI (1984) states that Blue whales are extremely uncommon in the mid Atlantic region.

Life History

No data are available on life history parameters from the proposed site. Blue whales usually occur singly or in pairs. In the southern oceans peak pairing occurs between April and June. After a gestation period of about 11 months, calving occurs between March and June with a lactation period of 7 months. Blue whales are relatively shallow feeders, feeding almost exclusively on krill, most of which is distributed 100 m below the surface. Specific dietary items in the North Atlantic include Thysanoesa inermis, Temora longicornis, and Meganyctiphanes norvegica.

B. Reptiles

There are five sea turtle species that are listed as endangered or threatened that may occur in the study area. These are the green, hawksbill, Atlantic ridley, leatherback, and loggerhead sea turtles. Information described in Hain et al. (1984) indicate that hawksbill, green and Atlantic ridley sea turtles may occur in the region of the proposed site, but have not been observed there (Hain, et al. 1984, DOI (1984), NOAA (1983). Leatherback sea turtles seasonally occur in the vicinity of the site in transit to or from waters further north (Hain, et al. 1984). This species remains nearer shore than the proposed incineration site and, a majority of sitings occur in the summer when their major food source, jellyfish, are near shore. The estimated average number of leatherback turtles that may occur in the mid-Atlantic region are 15 in spring, 541 in summer and 102 in fall (McKenzie, et al. 1985).

Loggerhead sea turtles are common in the vicinity of the proposed site in spring, summer and fall particularly closer to shore. Loggerheads feed primarily on benthic invertebrates (Hain, et al. 1984). McKenzie, et al. (1985) estimates that the mid-Atlantic population is 2,155 in spring, 10,912 in summer and 2,357 in fall. During winter, these poikilothermic turtles migrate south to warmer waters.

VIII. CONCLUSIONS

Documents regarding endangered species in the NAIS area, which are available to EPA, indicate that most of the whales and turtles that occur in the site itself are transient, migrating to the north or south. Only one species, the sperm whale, appears to have a migratory pattern which results in numerous sitings of the species in the vicinity of the NAIS year round. Although sitings of sperm whales in the site year round could be indicative of a permanent year round population there, these sitings are much more likely to represent whales whose migratory pattern causes different individuals to pass through the site during various seasons. Because there are no data to indicate that any one individual or group of individuals may reside in the vicinity of the site or use the site as a critical habitat, EPA believes that the waters of the site serve as a migratory path for endangered species and that at no time is a significant portion of the population there at any one time. However, even if there was a year round population of sperm whales or other species near or in the site, the low levels of emissions and the dispersion characteristics of the site are expected to result in no measurable biological effects or chemical alteration in the organisms or water of the site area.

EPA has conducted studies to estimate potential effects of incineration-at-sea on the marine environment. Available data indicates that measurable effects are unlikely due to the extremely low levels of substances which could actually be emitted into the environment. EPA studies considered the entire marine ecosystem including food chain bioaccumulation.

In addition, our evaluation here of the potential effect of incineration on endangered species indicates that the extremely low levels of substances which could be present in the emissions will not add measurable levels of contaminants to the marine ecosystem. There will be no expected increase in contaminant levels in the food chain of the area (including squid) and therefore, there will be no expected impact on species which are high on the food chain such as whales.

As stated previously, EPA is currently conducting research to supplement the emission data currently available, and intends to monitor the site chemically and biologically to ensure that incineration activities are in fact causing no measurable long term environmental effects. EPA believes that the available information describing the presence of endangered species in the proposed site is adequate to assess the possibility of impacts from incineration at the present time. However, EPA plans to add to the existing data base by logging all sitings of endangered species during monitoring surveys at the site and during other incineration related activities at the site.

In conclusion, EPA finds that incineration activities at the proposed North Atlantic Incineration Site are not likely to jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of a habitat of such species.

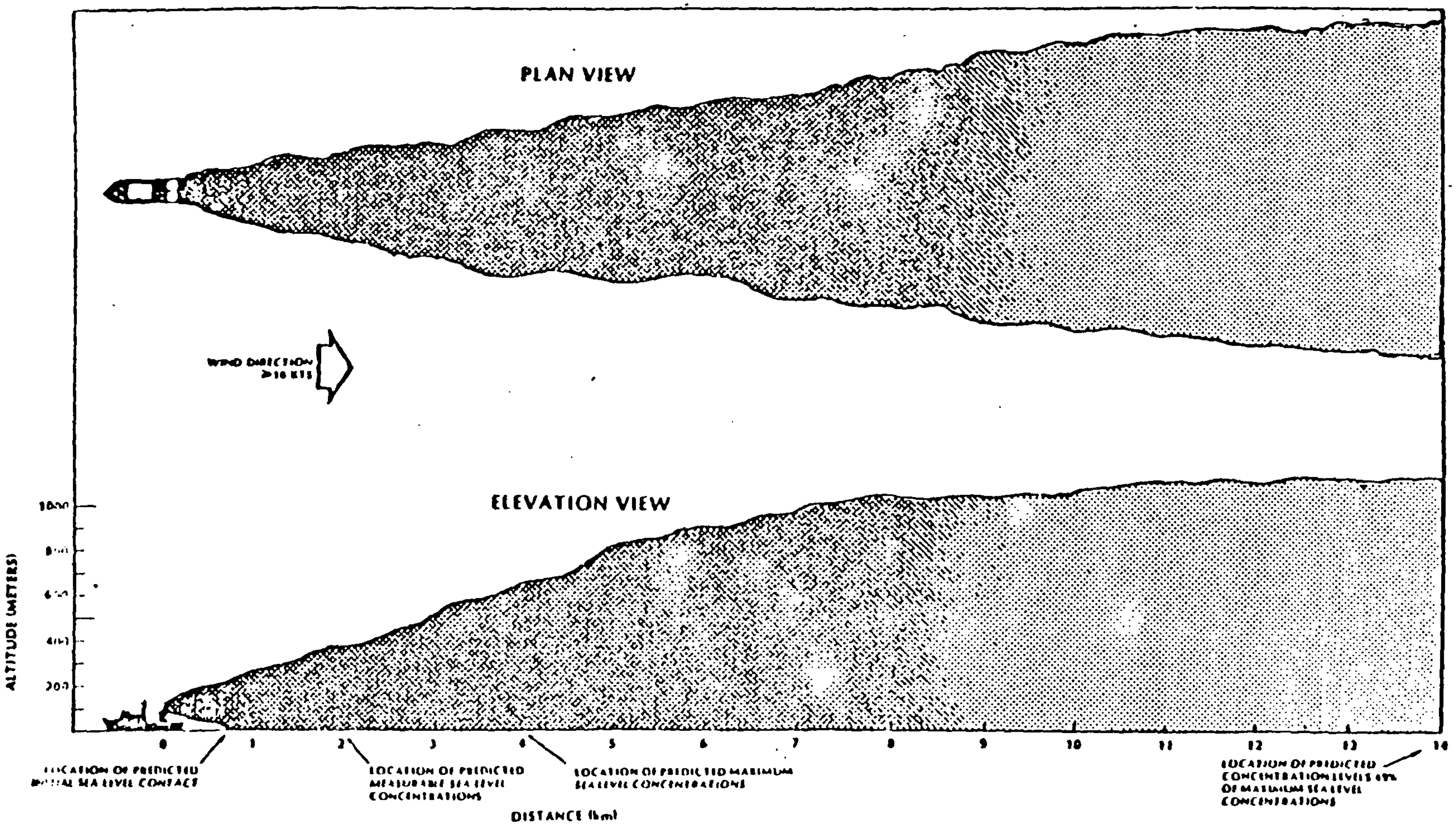

Figure 1. Plume Dispersal (M/T VULCANUS) Gulf of Mexico
Research Incinerations, Research Burn II

NOTE: During actual incineration, the gaseous plume is virtually colorless and invisible

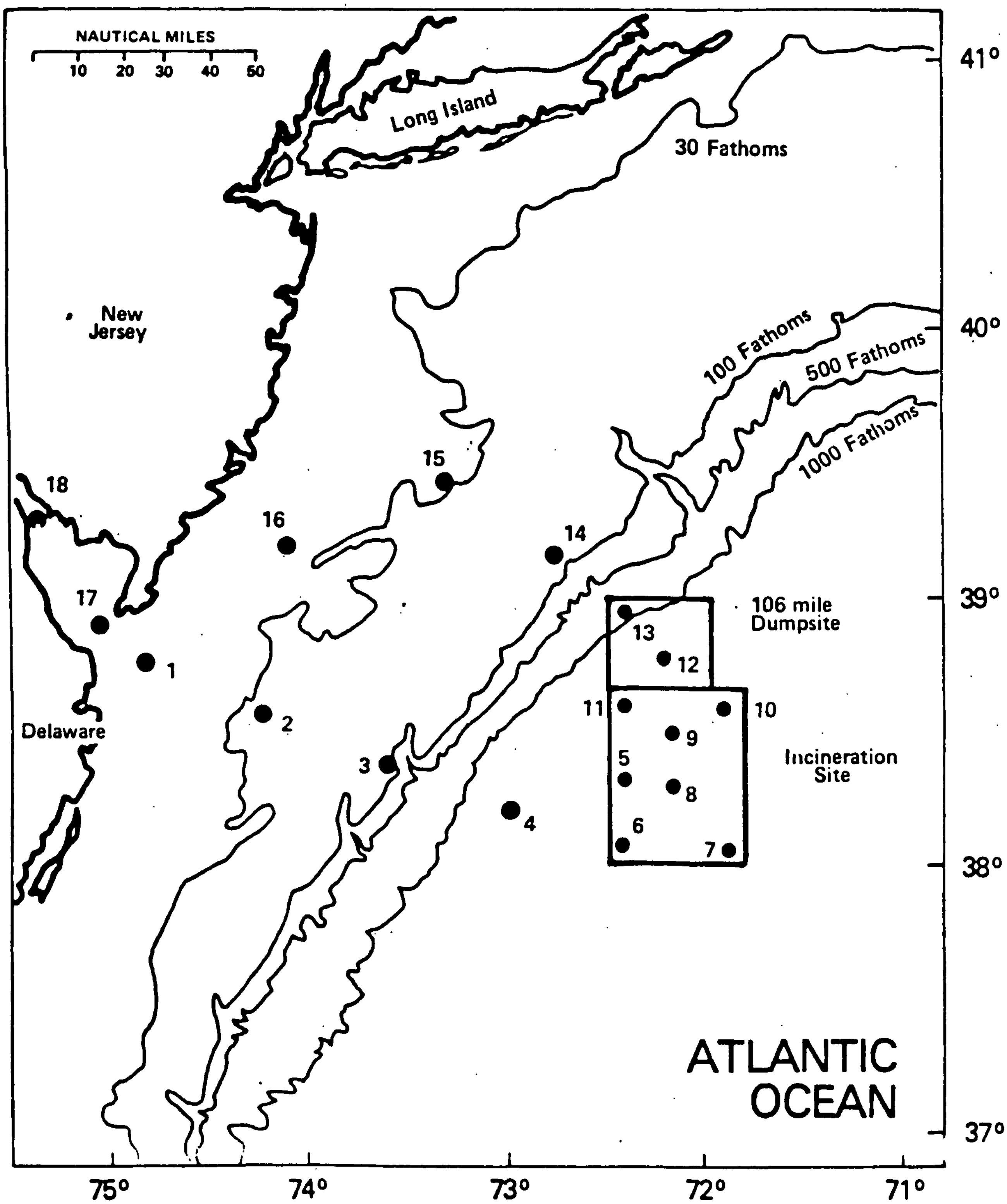

Figure 2. Proposed North Atlantic Incineration Site. For key to numbered dots, see text (pg. 25).

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U.S. EPA. 1984. Draft Monitoring Strategy for the North Atlantic Incineration Site.

U.S. EPA. 1985a. Ocean Incineration Regulation; Proposed Rule. Federal Register. (50 FR 8222, February 28, 1985).

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U.S. EPA. 1985d. Application of a Formula for Calculating Carrying Capacity of an Incineration Site. Office of Marine and Estuarine Protection, Washington, DC.

APPENDIX A

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

FEB 22 1985

OFFICE OF
WATER

Mr. Richard Schaefer
Acting Regional Director
Northeast Region
National Marine Fisheries Service
14 Elm Street
Glouster, MA 01930

Dear Mr. Schaefer:

The Environmental Protection Agency (EPA) is currently preparing final rulemaking for the designation of an ocean incineration site located off the New Jersey Continental Shelf for the incineration of liquid hazardous wastes. Pursuant to Section 7 of the Endangered Species Act, EPA wishes to coordinate with your Agency to insure that designation of the North Atlantic Incineration Site will not jeopardize the continued existence of endangered and threatened species.

The proposed North Atlantic Incineration Site (NAIS) is located 120 nautical miles east of the mouth of Delaware Bay. The site covers 4,250 Km^2 and is bounded by latitudes 38°00'N to 38°40'N, and longitudes 71°50'W and 72°30'W. The site is beyond the Continental Shelf where water depth ranges from 2,400m to 2,900m.

A Draft Environmental Impact Statement (EIS) for incineration at sea operations at this site was made available to the public, the Department of Commerce, and other Federal and State Agencies on January 9, 1981, and a final EIS was available on December 18, 1981. These EIS's discuss the endangered and threatened species of whales and turtles that can occur in the site and concluded that, while these species may be present at the site, they are migratory and would be present for only a few hours. The comments EPA received concerning the draft EIS are contained in the final EIS (enclosed) along with EPA's responses.

Designation of this site was proposed on November 17, 1982, and a public hearing was held in Ocean City, Maryland on April 14, 1983. EPA is now preparing final actions for designation of the site.

The designation of this site does not in itself allow incineration operations to be conducted at the NAIS. Each vessel intending to operate in this site needs to first obtain a permit from EPA which will require applicants to follow additional regulatory requirements.

As described in the enclosed EIS there will be no direct dumping of materials at this site. The site will serve as a designated area where incineration vessels must navigate while incinerating liquid wastes. Emissions from the incineration process will consist mainly of hydrochloric acid, carbon dioxide, carbon monoxide and water vapor and may contain trace levels of surviving organic compounds. These emissions will be released from the incinerator and be subsequently dispersed in the atmosphere and surface waters at the site. The hydrochloric acid will be neutralized upon contact with sea water and other substances which may be emitted are not expected to be in quantities capable of causing any environmental effects.

For the above reasons, the Agency concludes that the proposed site designation will have no effect on populations of threatened or endangered species under the purview of the National Marine and Fisheries Service. If there is need for further communication on this matter, I can be contacted at 202/755-9231.

Sincerely,

David P. Redford

David P. Redford
Marine Biologist
Marine Permits and
Monitoring Branch (WH-556)

Enclosure

APPENDIX B

United States Department of the Interior

FISH AND WILDLIFE SERVICE
ONE GATEWAY CENTER, SUITE 700
NEWTON CORNER, MASSACHUSETTS 02158

MAR 11 1985

RECEIVED 3-19-85
85030

Mr. David P. Redford
Marine Permits and Monitoring
Branch (WH-556)
Environmental Protection Agency
Washington, DC 20460

Dear Mr. Redford:

This letter responds to your request of February 22, 1985 seeking information on endangered and threatened species that might be impacted by the incineration of liquid hazardous wastes off the New Jersey Continental Shelf. The only endangered species under U.S. Fish & Wildlife Service jurisdiction that might be using the project area is the Arctic peregrine falcon (Falco peregrinus tundrius). These falcons spend considerable time over the ocean during fall migration, and some individuals could be expected to come in contact with the emission plume. However, we do not anticipate any impacts to the population to result from these incidental contacts, therefore the proposed project will not jeopardize the continued existence of the Arctic peregrine falcon.

We suggest that you coordinate with the National Marine Fisheries Service for information on species of whales and turtles under their jurisdiction that could be in the project area.

Sincerely yours,

ACTING Regional Director

APPENDIX C

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Services Division
Habitat Conservation Branch
14 Elm Street
Gloucester, MA 01930

RECEIVED 3-27-85
MOD
85047

March 20, 1985

Mr. David P. Redford
Marine Biologist
Marine Permits and Monitoring Branch
U.S. Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Redford:

We have reviewed the information provided in your letter of February 22, 1985, requesting coordination with the National Marine Fisheries Service (NMFS) pursuant to Section 7(c) of the Endangered Species Act (ESA) of 1973, as amended, to insure that designation of the North Atlantic Incineration Site (NAIS) 120 nautical miles east of the Delaware Bay in water depths of 2,400-2,900 m will not jeopardize the continued existence of any threatened or endangered species under our jurisdiction.

Based on the enclosed new information that has become available since publication of the Final Environmental Impact Statement (FEIS) for the NAIS in November 1981, it is apparent that some, and perhaps all, of the proposed NAIS may be a high use area for several odontocete marine mammal species, including the endangered sperm whale (Physeter catodon). Therefore, statements made in the FEIS describing the area as used by these species only as a migration route are no longer valid. The conclusion of "no effect" to threatened or endangered species stated in your letter of February 22, 1985, which was based on the FEIS statements should be reassessed given the new information.

We recommend that the Environmental Protection Agency (EPA) consult further with the NMFS to assess the effects of the proposed NAIS designation and its related activities on the endangered sperm whale and protected marine mammal species that may be resident in the area. Tracey McKenzie of my staff (FTS 837-9239) should be contacted to assist the EPA in carrying out the consultation process and to provide any additional information the EPA may require.

Sincerely

Thomas E. Bigford

Thomas E. Bigford
Chief, Habitat Conservation Branch

Enclosure

APPENDIX D

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Services Division
Habitat Conservation Branch
14 Elm Street
Gloucester, MA 01930

March 29, 1985

RECEIVED 4-5-85

Mr. David P. Redford
Marine Permits and Monitoring Program
U.S. Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Redford:

This is in response to your March 27, 1985, request for a list of endangered and threatened species present in the proposed North Atlantic Incineration Site (NAIS) area, pursuant to Section 7(c) of the Endangered Species Act of 1973, as amended. We have identified the presence of the following endangered and threatened species within and adjacent to the proposed project area:

Species	Status
Humpback whale *Megaptera novaeangliae*	endangered
Right whale *Eubalaena glacialis*	endangered
Fin whale *Balaenoptera physalus*	endangered
Sei whale *Balaenoptera borealis*	endangered
Blue whale *Balaenoptera musculus*	endangered
Sperm whale *Physeter catodon*	endangered
Turtles	
Atlantic ridley sea turtle *Lepidochelys kempii*	endangered
Green sea turtle *Chelonia mydas*	threatened/endangered

Hawksbill sea turtle *Eretmochelys imbricata*	endangered
Leatherback sea turtle *Dermochelys coriacea*	endangered
Loggerhead sea turtle *Caretta caretta*	threatened

Sincerely,

Tracey McKenzie

Tracey McKenzie
Biologist

APPENDIX E

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

APR 2 1 1985

OFFICE OF
WATER

Tracey McKenzie
Biologist
Habitat Conservation Branch
Services Division
National Marine Fisheries Service
14 Elm Street
Gloucester, MA 01930

Dear Ms. McKenzie:

This letter is in response to the correspondence from Thomas E. Bigford, dated March 20, 1985. That correspondence indicated that additional information had become available since the issuance of the Environmental Protection Agency's (EPA) Environmental Impact Statement for the North Atlantic Incineration Site, and requested that EPA use this information to reassess the "no impact" finding for endangered or threatened species.

The following is a list of documents we subsequently received from the National Marine Fisheries Service to be used in the reassessment. I would like to request that you review this list of documents and verify that we have received all the relevant information referred to in Mr. Bigford's March 20, 1985 letter.

The documents received are:

1. Draft Environmental Impact Statement for OCS Lease Sale 111 - various pages from page 31 to page 331 (44 pages total) .

2. NEMP-EPA/NOAA 106-Mile Deepwater Disposal Site Characterization Update, August 1983 - pages 11-1 through 11-92.

3. Kenny, R. and H. Winn. 1985. A quantitative description and analysis of cetacean high use habitats on the Northeast U.S. Continental Shelf. University of Rhode Island - pages 1 through 31.

4. McKenzie, T. and J. Nicolas. 1985. Draft - Cetaceans, Pinipeds and Sea Turtles. NMFS, Northeast Fisheries Center, Habitat Conservation Branch. Entire document received.

5. URI. 1982. (CETAP). A Charactorization of Marine Mammals and Turtles in the Mid and North Atlantic Area of the U.S. Continental Shelf. U.S. Department of the Interior, BLM Contract No. AA51-CT8-48 - pages 153 through 167.

6. Hain, J., M. Hyman, R. Kenney and H. Winn. 1984. The Role of Cetaceans in the Shelf Edge Region of the Northern United States. URI, Kingston, RI - pages 1 through 9.

7. FAO of the United Nations. 1978. Mammals in the Sea. Report on the Food and Agricultural Organization of the United Nations Advisory Committee on Marine Resources Research. FAO Fisheries Series No. 5, Volume I - pages 80 and 81.

8. Draft copy of Part 402 - Interagency Cooperation - Endangered Species Act of 1973, as amended - pages 168 through 206.

Thank you for your assistance in our assessment activity.

Sincerely,

David Redford

David Redford
Marine Biologist
Office of Marine and
Estaurine Protection (WH-556M)

APPENDIX F

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Services Division
Habitat Conservation Branch
14 Elm Street
Gloucester, MA 01930

RECEIVED 5/2/85

April 24, 1985

Mr. David Redford
Marine Biologist
Office of Marine and Estuarine Protection
U.S. Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Redford:

This is in response to your April 24, 1985 letter requesting verification that the Environmental Protection Agency (EPA) has received all the relevant information referred to in Thomas Bigford's March 20, 1985 letter. I have reviewed the list of documents and, with the exception of one document, EPA has received all the relevant information that is available from the National Marine Fisheries Service (NMFS), Northeast Region, Habitat Conservation Branch. NMFS recently conducted status reviews of endangered and threatened species, including the sperm whale, under their purview. However, the final report of the sperm whale status review has not been made available to the public. I recommend that you contact Charles Karnella, NMFS, Office of Protected Species and Habitat Conservation, Washington, D.C., (202)634-7529 to inquire about availability of a draft status review.

Sincerely,

Tracey McKenzie

Tracey McKenzie
Biologist

APPENDIX G

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE 13 May 1985

SUBJECT Preliminary Assessment of Transport and Fate of PCBs from Ocean Incineration at the 106-Mile Ocean Disposal Site

FROM Victor J. Bierman, Jr., Ph.D., Environmental Scientist ERL-Narragansett

Victor J Bierman, Jr.

TO Tudor T. Davies, Director Office of Marine and Estuarine Protection, OWP (WH-556)

THRU: William A. Brungs, Director ERL-Narragansett

Erich W. Bretthauer, Director OEPER-ORD (RD-682)

Models for describing transport and fate of contaminants resulting from ocean incineration do not currently exist. In the interest of expediency, existing models for transport and fate of ocean dumped contaminants were adapted, through certain assumptions, to provide estimates of transport and fate of PCB's from ocean incineration. This memo contains results of such a preliminary analysis.

The principal source documents used for this analysis were the following:

Boehm, P.D. 1983. Coupling of organic pollutants between the estuary and continental shelf and the sediments and water column in the New York Bight region. Canadian Journal of Fisheries and Aquatic Sciences. 40(Suppl. 2): 262-276.

de Lappe, B.W., W.R. Histec, E.F. Letterman, M. Firestone-Gillis, and R. Risebrough. 1980a. Pre-discharge studies: San Francisco south-west ocean outfall project - distribution of high molecular weight hydrocarbons in the coastal environment. Report to CH2M Hill, San Francisco, California. Bodega Marine Laboratory, Bodega Bay, California. 100p.

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Paul, J.F., V.J. Bierman, Jr., H.A. Walker, and J.H. Gentile. 1983. Application of a hazard assessment research strategy for waste disposal at the 106-Mile Ocean Disposal Site. Presented at the Fourth International Ocean Disposal Symposium, Plymouth, England, April 11-15, 1983. Submitted for publication in Wastes in the Ocean, Wiley-Interscience.

Thomann, R.V. 1981. Equilibrium model of fate of micro-contaminants in diverse aquatic food chains. Canadian Journal of Fisheries and Aquatic Sciences. 38: 280-296.

Walker, H.A., J.F. Paul, V.J. Bierman, Jr. 1984. A stochastic-convective dispersive transport model for wastes disposed at the 106-Mile Ocean Disposal Site. Presented at the Fifth International Ocean Disposal Symposium, September 10-14, 1984, Corvallis, Oregon. Submitted for publication in <u>Oceanic Processes in Marine Pollution</u>, Krieger.

An extreme-case approach is adopted throughout this analysis because there are considerable uncertainties, and a paucity of data, for the important physical, chemical, and biological processes involved. The objective is to develop results which constitute upper bounds on the far-field, long-term, time-average concentrations of PCB's in the surface mixed layer of the water column. In addition, estimates are made of PCB's tissue residues corresponding to long term, steady-state conditions.

Transport and Fate Model

A model was developed to relate mass inputs of sludge constituents at the 106-Mile Site to concentration distributions in the water column (Paul et al. 1983; Walker et al. 1984). The assumptions and limitations inherent in this modeling approach are the following:

1. The model results are two-dimensional in the horizontal plane. Constituents are assumed to be uniformly distributed over depth in the upper mixed layer of the water column. Losses due to settling of particulate materials out of the upper mixed layer are not included in the model.

2. The model results correspond to far-field concentrations in space, and to long-term, time-average concentration values.

3. The constituent concentrations are completely conserved in the water column. No transformation or degradation processes are included in model.

4. No exchange processes across the air-sea interface (e.g., volatilization) are included in the model.

5. No explicit distinction is made between dissolved and particulate phases of a constituent. Only the total concentration of the constituent is considered.

6. The Gulf Stream represents the ultimate downstream sink for material disposed at the 106-Mile Site.

The following additional assumptions were made to adapt this modeling approach to the case of ocean incineration of PCB's:

1. All stack emissions from the incineration process are assumed to be discharged directly to the surface mixed layer of the water column at the incineration site. This assumption avoids the necessity of modeling the transport and fate of stack emissions in the atmosphere.

2. The mass input rates of PCB to the water column at the incineration site are based on the following assumptions:

    a. initial mass of 1500 metric tons of PCB on the incineration vessel
    b. this entire initial mass is incinerated at a uniform rate over a 7-day period
    c. this same uniform incineration rate occurs at the site on a continuous daily basis

The minimum destruction efficiency required by existing regulations for ocean incineration is 99.9999 percent. Results of the analysis are sensitive to the value for destruction efficiency. To illustrate this sensitivity, results are presented for a range of destruction efficiencies from 99.999 to 99.99999 percent.

A value of 0.05 ng/L was used as the background concentration for PCBs in the water column at the 106-Mile Site. Boehm (1983) reported a value of 0.05 ng/L for particulate phase PCB concentration in the outer New York Bight. We estimated that particulate and dissolved phase concentrations of PCB's were equivalent (de Lappe et al. 1980a, 1980b). Our value for background concentration represents an estimate for the available, dissolved phase PCB concentration at the 106-Mile Site.

The U.S. FDA Tolerance Level for PCB residues in the edible portions of fish and shellfish is 2.0 ppm (wet weight basis). In applying this level to the present analysis, a range of bioaccumulation factors from 20,000 to 2,000,000 (wet weight basis) was used to relate environmental PCB concentrations to tissue residues in biological organisms. Tissue residues can result from water uptake and/or food chain uptake. Measured bioaccumulation factors can vary over a wide range, depending on the type and length of the exposure conditions, and whether measurements are conducted in the laboratory or the field. The bioaccumulation factors used in this analysis were based on results summarized by Thomann (1981). A value of 200,000 was used as an upper bound on tissue residues from water uptake only. A value of 20,000 was used as an estimate of the median bioaccumulation factor from water uptake only. A value of 2,000,000 was used to account for the additional increment due to food chain uptake.

Results

Tabular results are presented for estimated water concentrations and PCB tissue residue values at various distances from the 106-Mile Site, in the direction of the mean flow. Results are presented for both summer and winter environmental conditions. Summer conditions correspond to a depth of 20 meters for the upper mixed layer, and to mixing of constituents between slope water and water on the continental shelf. Winter conditions correspond to a depth of 100 meters for the upper mixed layer, and to no mixing of contaminants between shelf and slope waters.

Within the framework of the assumptions and limitations of this analysis, the overall results indicate that there would be no violations of the U.S. FDA Tolerance Level for PCB tissue residues. Results close to the incineration site are likely to be overestimates because of the assumption that stack emissions are discharged directly to the water column.

cc. D. Baumgartner
A. Beck
W. Brungs
R. Garnas
J. Gentile
R. Latimer
J. Paul
H. Walker

PCB CONCENTRATIONS FOR SUMMER CONDITIONS

DESTRUCTION EFFICIENCY = 99.999%
RESULTANT LOADING = 2.14285 (KG/DAY)

DIST. (KM.)	BACKGROUND (NG/L)	PCB ELEVATION (NG/L)	TOTAL PCB (NG/L)	TISSUE PCB (PPM-WET) BIOACCUMULATION FACTOR		
				2×10^4	2×10^5	2×10^6
30.	0.05	0.1159	0.1659	0.003	0.033	0.332
60.	0.05	0.0821	0.1321	0.003	0.026	0.264
90.	0.05	0.0678	0.1178	0.002	0.024	0.236
120.	0.05	0.0621	0.1121	0.002	0.022	0.224
150.	0.05	0.0591	0.1091	0.002	0.022	0.218
180.	0.05	0.0573	0.1073	0.002	0.021	0.215
210.	0.05	0.0559	0.1059	0.002	0.021	0.212
240.	0.05	0.0546	0.1046	0.002	0.021	0.209
270.	0.05	0.0532	0.1032	0.002	0.021	0.206
300.	0.05	0.0519	0.1019	0.002	0.020	0.204
330.	0.05	0.0507	0.1007	0.002	0.020	0.201
360.	0.05	0.0496	0.0996	0.002	0.020	0.199

DESTRUCTION EFFICIENCY = 99.9999%
RESULTANT LOADING = 0.21428 (KG/DAY)

DIST. (KM.)	BACKGROUND (NG/L)	PCB ELEVATION (NG/L)	TOTAL PCB (NG/L)	TISSUE PCB (PPM-WET) BIOACCUMULATION FACTOR		
				2×10^4	2×10^5	2×10^6
30.	0.05	0.0116	0.0616	0.001	0.012	0.123
60.	0.05	0.0082	0.0582	0.001	0.012	0.116
90.	0.05	0.0068	0.0568	0.001	0.011	0.114
120.	0.05	0.0062	0.0562	0.001	0.011	0.112
150.	0.05	0.0059	0.0559	0.001	0.011	0.112
180.	0.05	0.0057	0.0557	0.001	0.011	0.111
210.	0.05	0.0056	0.0556	0.001	0.011	0.111
240.	0.05	0.0055	0.0555	0.001	0.011	0.111
270.	0.05	0.0053	0.0553	0.001	0.011	0.111
300.	0.05	0.0052	0.0552	0.001	0.011	0.110
330.	0.05	0.0051	0.0551	0.001	0.011	0.110
360.	0.05	0.0050	0.0550	0.001	0.011	0.110

PCB CONCENTRATIONS FOR SUMMER CONDITIONS

DESTRUCTION EFFICIENCY = 99.99999%
RESULTANT LOADING = 0.02143 (KG/DAY)

DIST. (KM.)	BACKGROUND (NG/L)	PCB ELEVATION (NG/L)	TOTAL PCB (NG/L)	TISSUE PCB (PPM-WET) BIOACCUMULATION FACTOR 2×10^4	2×10^5	2×10^6
30.	0.05	0.0012	0.0512	0.001	0.010	0.102
60.	0.05	0.0008	0.0508	0.001	0.010	0.102
90.	0.05	0.0007	0.0507	0.001	0.010	0.101
120.	0.05	0.0006	0.0506	0.001	0.010	0.101
150.	0.05	0.0006	0.0506	0.001	0.010	0.101
180.	0.05	0.0006	0.0506	0.001	0.010	0.101
210.	0.05	0.0006	0.0506	0.001	0.010	0.101
240.	0.05	0.0005	0.0505	0.001	0.010	0.101
270.	0.05	0.0005	0.0505	0.001	0.010	0.101
300.	0.05	0.0005	0.0505	0.001	0.010	0.101
330.	0.05	0.0005	0.0505	0.001	0.010	0.101
360.	0.05	0.0005	0.0505	0.001	0.010	0.101

PCB CONCENTRATIONS FOR WINTER CONDITIONS

DESTRUCTION EFFICIENCY = 99.999%
RESULTANT LOADING = 2.14285 (KG/DAY)

DIST. (KM.)	BACKGROUND (NG/L)	PCB ELEVATION (NG/L)	TOTAL PCB (NG/L)	TISSUE PCB (PPM-WET) BIOACCUMULATION FACTOR $2x10^4$	$2x10^5$	$2x10^6$
30.	0.05	0.0232	0.0732	0.001	0.015	0.146
60.	0.05	0.0164	0.0664	0.001	0.013	0.133
90.	0.05	0.0136	0.0636	0.001	0.013	0.127
120.	0.05	0.0124	0.0624	0.001	0.012	0.125
150.	0.05	0.0118	0.0618	0.001	0.012	0.124
180.	0.05	0.0115	0.0615	0.001	0.012	0.123
210.	0.05	0.0113	0.0613	0.001	0.012	0.123
240.	0.05	0.0111	0.0611	0.001	0.012	0.122
270.	0.05	0.0108	0.0608	0.001	0.012	0.122
300.	0.05	0.0106	0.0606	0.001	0.012	0.121
330.	0.05	0.0104	0.0604	0.001	0.012	0.121
360.	0.05	0.0102	0.0602	0.001	0.012	0.120

DESTRUCTION EFFICIENCY = 99.9999%
RESULTANT LOADING = 0.21428 (KG/DAY)

DIST. (KM.)	BACKGROUND (NG/L)	PCB ELEVATION (NG/L)	TOTAL PCB (NG/L)	TISSUE PCB (PPM-WET) BIOACCUMULATION FACTOR $2x10^4$	$2x10^5$	$2x10^6$
30.	0.05	0.0023	0.0523	0.001	0.010	0.105
60.	0.05	0.0016	0.0516	0.001	0.010	0.103
90.	0.05	0.0014	0.0514	0.001	0.010	0.103
120.	0.05	0.0012	0.0512	0.001	0.010	0.102
150.	0.05	0.0012	0.0512	0.001	0.010	0.102
180.	0.05	0.0011	0.0511	0.001	0.010	0.102
210.	0.05	0.0011	0.0511	0.001	0.010	0.102
240.	0.05	0.0011	0.0511	0.001	0.010	0.102
270.	0.05	0.0011	0.0511	0.001	0.010	0.102
300.	0.05	0.0011	0.0511	0.001	0.010	0.102
330.	0.05	0.0010	0.0510	0.001	0.010	0.102
360.	0.05	0.0010	0.0510	0.001	0.010	0.102

PCB CONCENTRATIONS FOR WINTER CONDITIONS

DESTRUCTION EFFICIENCY = 99.99999%
RESULTANT LOADING = 0.02143 (KG/DAY)

DIST. (KM.)	BACKGROUND (NG/L)	PCB ELEVATION (NG/L)	TOTAL PCB (NG/L)	TISSUE PCB (PPM-WET) BIOACCUMULATION FACTOR $2x10^4$	$2x10^5$	$2x10^6$
30.	0.05	0.0002	0.0502	0.001	0.010	0.100
60.	0.05	0.0002	0.0502	0.001	0.010	0.100
90.	0.05	0.0001	0.0501	0.001	0.010	0.100
120.	0.05	0.0001	0.0501	0.001	0.010	0.100
150.	0.05	0.0001	0.0501	0.001	0.010	0.100
180.	0.05	0.0001	0.0501	0.001	0.010	0.100
210.	0.05	0.0001	0.0501	0.001	0.010	0.100
240.	0.05	0.0001	0.0501	0.001	0.010	0.100
270.	0.05	0.0001	0.0501	0.001	0.010	0.100
300.	0.05	0.0001	0.0501	0.001	0.010	0.100
330.	0.05	0.0001	0.0501	0.001	0.010	0.100
360.	0.05	0.0001	0.0501	0.001	0.010	0.100

APPENDIX H

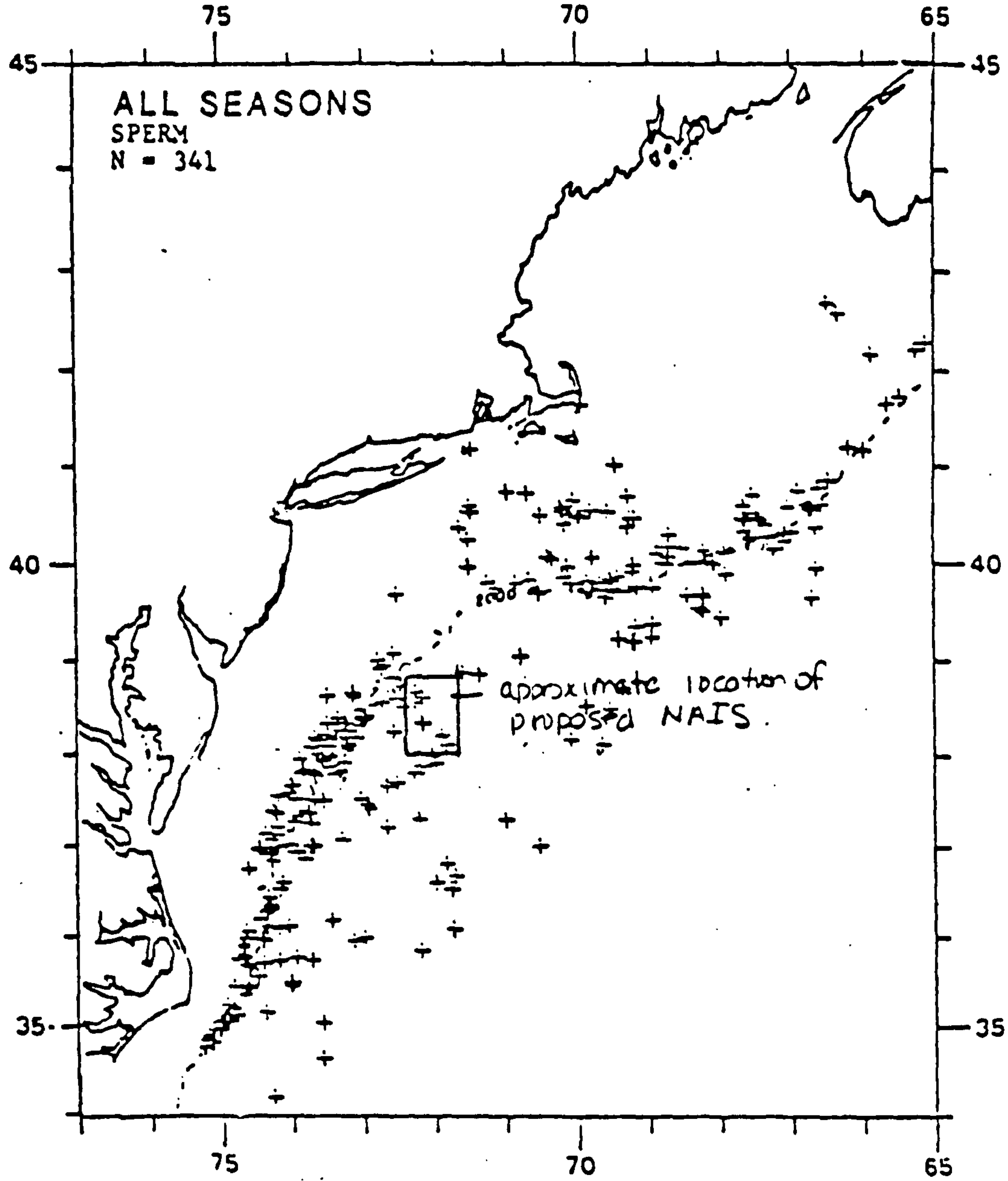

Figure 15a. All sightings of the sperm whale, Physeter catodon, for the 39 month period -- 1 November 1978 through 28 January 1982.

DRAFT

DRAFT

MONITORING PLAN

FOR THE

PROPOSED

NORTH ALANTIC INCINERATION SITE

JULY 1985

DAVID REDFORD

MARINE PERMITS AND MONITORING BRANCH

MARINE OPERATIONS DIVISION

OFFICE OF MARINE AND ESTUARINE PROTECTION

US EPA

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INTRODUCTION

Purpose and Scope

Incineration-at-sea is the practice of thermally destroying liquid hazardous wastes through high temperature incineration on board an ocean going vessel. Presently, there is one site in the Gulf of Mexico designated for this use, and one proposed site in the North Atlantic. A third site is under consideration in the Pacific. This document presents a plan for monitoring the proposed North Atlantic Site for the presence of emission products or environmental effects.

The wastes expected to be burned at these sites may contain PCBs or other chlorinated organic material, in a solution with an oil or solvent. Emissions tests during previous research burns have shown that the principal constituents of the hot gases leaving the incinerator are CO_2, H_2O, and HCl. Traces of unburned waste may also be present as well as degradation products of the wastes.

This monitoring plan is designed to obtain data that can be used to determine if incineration activities cause environmental impacts, to assess the magnitude of any such impacts, and to provide the basis for a determination as to whether or not the site may continue to be used. It will also assist in the determination of whether changes in the magnitude or frequency of incineration are necessary to mitigate adverse impacts, or whether incineration at the site should be terminated.

The EPA Ocean Dumping Regulations, Sections 228.10 and 228.11 describe the types of impacts that should result in modification or termination of disposal site use. Based on these regulations, the following types of effects, in addition to other necessary or appropriate considerations, must be considered in determining to what extent the marine environment has been impacted by incineration activities at the site:

(1) Movement of materials in estuaries of marine sanctuaries, or onto oceanfront beaches, or shorelines;

(2) Movement of materials toward productive fishery or shellfishery areas;

(3) Absence from the disposal site pollution-sensitive biota characteristic of the general area;

(4) Progressive, non-seasonal, changes in water quality or sediment composition at the disposal site, when these changes are attributable to materials disposed of at the site;

(5) Progressive, non-seasonal, changes in composition or numbers of pelagic, demersal, or benthic biota at or near the disposal site, when these changes can be attributed to the effects of materials disposed of at the site;

(6) Accumulation of material constituents in marine biota at or near the site.

The data collected in the monitoring program must be of the type necessary to assess such impacts based on the types of material anticipated to be incinerated.

Due to the enormous variety of chemical compounds which might be present in wastes considered candidates for incineration, considerable chemical analysis will be necessary to establish the acceptability of specific wastes. All chemical wastes approved for at-sea incineration will comply with the criteria in 40 CRF 227.4, 228.8, 227.11, 227.12, and 227.27, and the compounds which can be incinerated by any individual ship will be determined through trial burns. Acceptable wastes will include a wide variety of organic substances including chlorinated organics.

EPA will limit the amounts of certain materials such as metals in the wastes and restrict other materials as appropriate, to meet London Dumping Convention requirements.

Environmental Effects of Waste Materials

Chlorinated organic substances constitute the majority of compounds proposed for incineration-at-sea which may be toxic to aquatic organisms. Although at least 99.99 percent of the organic substance in the waste will be destroyed through the incineration process, trace amounts of these substances may be present in the emissions exiting the incinerator. The following discussion of environmental effects is based upon the substances which may be present in the waste because these are the types of substances which could potentially be emitted to the environment.

One group of substances proposed for incineration at sea are the polychlorinated biphenyls (PCBs). PCBs comprise a group of chlorinated hydrocarbons which are only slightly soluble in seawater and possess marked affinities for particulate matter. These compounds are lipophilic and extremely long-lived in the environment. These properties have resulted in their appreciable accumulation in marine organisms. The uptake and accumulation of several chlorinated hydrocarbons have been measured in marine organisms including phytoplankton, mollusks, fish, and in marine food chains.

PCBs can inhibit photosynthesis and cell division of marine phytoplankton at concentrations as low as 1.0 ng/l to 10.0 ug/l.

There are several integrated factors affecting bioaccumulation of organic substances in fish species. These include: concentration in the environment; duration of exposure; temperature; solubility of the pollutant; species age, weight, feeding habits and lipid content; trophic level variations; and absorption. Bioaccumulation can occur through both ingestion of contaminants or by direct absorption through the gills and skin. Various organic substances have been shown to have acute effects on fish at various life stages.

Phytoplankton are capable of accumulating substantial amounts of organics and therefore constitute an important means for the introduction of these compounds into marine food webs.

INCINERATION PROCESS

The incinerator systems presently used for incineration-at-sea are refractory lined furnaces consisting of two chambers - a combustion chamber for internal mixing, and a stack to ensure that adequate retention time for complete combustion is available. Combustion gases pass through these two chambers sequentially. The wastes are fed from storage tanks in the vessels to the combustion system by means of electrically driven pumps.

Wastes are fed into the incinerator when the incinerators have reached the operating conditions specified in the permit. The temperature of combustion will be approximately 1300°C. The average waste residence time in the incinerator will be on the order of one second or longer. Presently existing incinerator systems can process 20 - 25 metric tons of wastes per hour (as opposed to land-based incinerators which process up to 2 - 4 metric tons per hour).

The emissions resulting from the incineration of mixed liquid organic compounds consists primarily of hydrochloric acid, carbon dioxide, carbon monoxide, and water vapor with minute amounts of metallic oxides, silicate ash, partially combusted organic compounds and possibly trace amounts of surviving organics.

During incineration operations, the ship must be moving at a rate of 3 knots into the wind. This will keep the ship away from the plume and help disperse the exhaust gases.

The plume exiting the incinerator stack has been modeled by EPA during a previous research burn. This model and the data from previous monitoring studies have shown that the plume tends to hit the surface of the ocean as it trails out behind the ship and eventually dissipates to undetectable HCl levels within 3 nautical miles. The attached figure (2) outlines the plume as described by HCl concentrations.

Other technologies have been proposed for incineration at sea which include the scrubbing of stack emissions with seawater prior to release to the environment. This process would remove HCl and other substances from the hot gasses and release them directly into the sea surface behind the vessel rather than emit them to the atmosphere. The properties of sea water enable it to rapidly neutralize the HCl whether it is released directly into the sea or emitted into the atmosphere prior to falling into the ocean.

INCINERATION SITE DESCRIPTION

A - General

The proposed North Atlantic Incineration Site is beyond the Continental Shelf and overlies the upper Continental Rise (Figure 1). The center of the site is 140 nautical miles (nmi) from Delaware Bay, and 155 nmi (290 km) from Ambrose Light (entrance to New York Harbor). The site is oceanic in nature; it is deep (2,400 to 2,900 meters), and the water masses and biology of the area more closely resemble the open

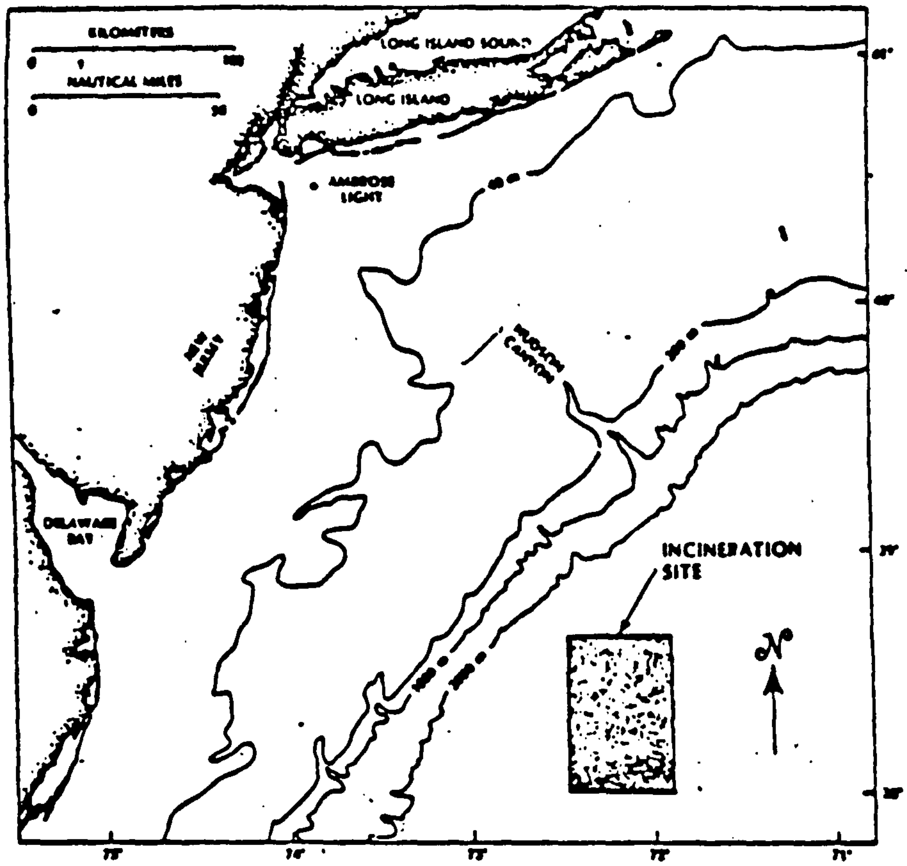

Figure 1 . Location of Proposed North Atlantic Incineration Site Bounded by 38°00' to 38°40'N Latitudes and 71°50' to 72°30'W Longitudes. Distance from Ambrose Light to Center of Site is 155 nmi.

ocean to the east, rather than the coastal environment to the west. The site is not a highly productive biological area and is limited in commercial or recreational fisheries. An inactive munitions dump site and an inactive low-level radioactive waste dump site exist within the boundaries of the site, but other types of wastes have not been dumped here. An Environmental Impact Statement (EIS) has been prepared for the site which contains more detailed information than that presented in this plan, and should be consulted if additional information is required.

B - Water Masses

A water mass may be defined as a large seawater parcel having unique properties (temperature, salinity, and oxygen content) or a unique relationship between these properties. Each water mass, thus defined, is given a name qualitatively describing its location or place of origin. Water masses are produced in their source areas by either or both of two methods: (1) alteration of their temperature and/or salinity through air-sea interchange, and (2) mixing of two or more water types. This occurs after formation the water masses spread at a depth determined by their density, relative to the vertical density gradient of the surrounding water.

NOAA has characterized the physical oceanographic environment in the region of the proposed Incineration Site as being extremely complex and variable in all but the near-bottom waters. Normally the surface layer of the site is Slope Water, which lies between less saline Shelf Water to the west and more saline Gulf Stream Water to the east. However, conditions change periodically, allowing shelf Water to enter the site from the west, or permitting Gulf Stream Water (in the form of southerly moving Gulf Stream eddies) to be present about 20% of the time.

Shelf Waters

The waters overlying the Continental Shelf of the mid-Altantic Bight are of three general types: Hudson River Plume Water, surface Shelf Water, and bottom Shelf water. Hudson River Plume Water results from the combined discharge of the Hudson, Raritan, and various other rivers into the northwest corner of the Bight Apex. This low-density water floats over Shelf Waters as it moves into the Bight. During periods of high runoff, the plume may spread over large areas of the Bight, and produces large vertical and horizontal gradients of salinity. This water type persists throughout the year, but its extent and depth are highly dependent on Hudson and Raritan Rivers flows. Generally, the plume flows southward between the New Jersey coastline and the axis of Hudson Canyon. The plume direction is sensitive to wind stress and reversals in the residual flows. Consequently, the plume may flow eastward between the New Jersey coastline and the axis of the Hudson Canyon, or it may occasionally split and flow both eastward and southward.

With the onset of heavy river discharges in the spring, surface salinities in the Bight decrease and a moderate, haline-maintained (i.e., maintained by salinity differences) stratification occurs initially, separating the coastal waters into upper and lower layers. These two layers are the surface Shelf Water and the bottom Shelf Water. Decreasing winds and increasing isolation (solar radiation) increase the strength of the stratification and cause it to undergo a rapid transition (usually within a month) from a haline-maintained to a thermal-maintained (i.e., maintained by temperature differences) condition. This two-layer system becomes fully developed and reaches maximum strength by August.

Surface Shelf water is characterized by moderate salinity and high temperature. During the winter, water is essentially vertically homogeneous over most the Bight Shelf. With the rapid formation of the surface Shelf Water layer during the spring, bottom waters become isolated until sufficient mixing takes place the following winter. A "cool cell" (having a temperature typically less than 10°C) of the bottom Shelf Water layer has been observed to entended from south of Long Island to the opening of Chesapeake Bay, then seaward, nearly to the Shelf edge. This cold water persists even after the surface layers have reached the summer temperature maximum. The cool cell may be surrounded on all sides by warmer water.

The upper layer of the bottom Shelf water is usually between 30 and 100m deep in the summer. Seaward near the Shelf edge, strong temperature/salinity/density gradients occur, limiting large-scale mixing between the Shelf Water and the waters over the Continental Slope. The mechanism by which bottom Shelf Water is replenished is presently under study.

Slope Waters

Slope Water is a highly complex, dynamic body of water representing an area of mixing between Shelf Waters and Gulf Stream. Shelf waters border the slope water on the north and west, and the Gulf Stream, which forms the eastern and southern boundary. These boundaries (frontal zones) are not stationary, but migrate seaward and landward when the Gulf Stream shifts its axis during meanderings.

The Gulf Stream frequently meanders in such a way that anticyclonic (clockwise) loops of current are formed. Occasionally, these loops detach and form separate entities, known as eddies. The eddies are rings of Gulf Stream Water surrounding a core of warm Sargasso Sea Water (which originates to the east of the Gulf Stream), or trapped Gulf Stream Water. Great amounts of this water may be advected to depths as great as 800 to 1,000m. After detachment the eddies may migrate into the Slope Water region, usually in a southwesterly direction. In addition, the eddies may interact with Shelf Water, causing considerable disturbances in the water within the proposed site region. While there appears to be no seasonal pattern in the occurrence of these eddies, the region of the proposed Incineration Site may contain an eddy 20% of the time, which is either quasi-stationary or migrating, and capable of occupying the entire site. The eddies dissipate or are reabsorbed by the Gulf Stream, usually in the region of Cape Hatteras.

Like many deepwater oceanic regions, the water of Slope Water can be divided into three general layers: the upper or surface layer (where variability is great), the near-surface thermocline region (where temperature changes rapidly with depth), and the deep water (where seasonal variability is slight).

For Slope water in general, stratification forms in the upper water layers early in May and persists until mid or late autumn, when cooling and storm activities destroy it. A permanent thermocline is usually at a depth of 100 to 200m. During the period when the upper layers are stratified, a second, seasonal thermocline forms in the upper water layers and reduces the mixed-layer thickness from the surface to merely 30 to 40m deep. From autumn until early spring water is isothermal to the depth of the permanent thermocline.

Gulf Stream Water and Eddies

To the east of the Slope water is the Gulf Stream a moving current with core velocities 200 cm/s (3.9 kn) or greater. The Gulf Stream is a continuation of the Florida Current (a northward-flowing current extending from Florida to Cape Hatteras), flowing northeastward from the Continental Slope off Cape Hatteras to each of the Grand Banks. The Gulf

Stream meanders througout this region over great horizontal distances north of Cap Hatteras. Occasionally, the Gulf Stream cuts through a meander neck, much like reiver meander cutoffs. When the fast-moving Gulf Stream abandons its previous route, after cutting through a meander neck, it isolates a large mass of Sargasso Sea Water, which is distinctly warmer than surrounding Shelf Water and Slope Water. These warm-core eddies, or Gulf Stream rings, contain enormous energy imparted from the Gulf Stream. They continue to rotate clockwise (anticylonic) as they migrate in a southwestward direction through the Slope Water, until they either dissipate or join the Gulf Stream in the vicinity of Cape Hatteras. The Gulf Stream may also from cold-core (cyclonic) eddies by trapping cold water located to the north of the Gulf Stream; however, this type of eddy occurs only to the south or east of the Gulf Stream and is not to be found at the Incineration Site. It should be noted that warm-core eddies are not simply near-surface phenomenons. The thermal and rotational characteristics are often manifested near the sea bottom, in water depths of thousands of meters.

C - Current Regimes

Well-defined circulation patterns are unknown in the surface layers of the Slope water region in which the proposed site is located. Paucity of long-term current records, in addition to large natural variabilities, limit the usefulaness of estimates of mean currents for this region. The westward-flowing Labrador Current loses its distinctiveness somewhat west of the Grand Banks. Current measurements have been made by several researchers, using neutrally-buoyant floats, parachute drogues, and moored current meters in the region of the Shelf Break and Slope, south of New England. The mean currents in this area are generally of the order of 10 to 20 cm/s westward, following the bottom bathymetry. This direction is similar to the direction taken by currents over the Continental Shelf.

Along the northern boundary of the Slope, Slope Waters flow slowly to the southwest, following the bathymetry to Cape Hatteras, where the water mass turns and flows seaward, joining the Gulf Stream. Evidence of a slow northeastward flow along the Gulf Stream in the southern part of the Slope Water region was also found. The Gulf Stream and Shelf Water from a cul-de-sac near Cape Hatteras, and while some interchange of water occurs across these boundaries, most of the water entering the Slope Water region from the east probably exists along the same path.

The presence of a deepwater counterclockwise (cyclonic) gyre system is located between the Continental Shelf and Gulf Stream. This system transport as much as 10^7 m^3/s of water through the region of the proposed Incineration Site (equivalent to the volume of 500 Mississippi Rivers).

The mean surface current speed is 25 cm/s near the proposed Incineration Site. The direction of the flow is either east-northeast or south-southwest.

RATIONAL FOR MONITORING PROGRAM

Previous sections of this document have described the types of materials expected to be emitted into the area of the Incineration Site, the basic environment of the site and the basic effects of possible emission-related materials on the marine environment.

This monitoring plan incorporates these three issues into a sampling and analysis scheme designed to detect incineration products in the environment and to access the potential for resultant effects. The plan contains: procedures for sampling air to determine plume locations and to determine air concentrations of unburned wastes or incineration products; procedures for sampling surface water for detection of unburned wastes or incineration products (includes water, phytoplankton, and zooplankton); determination of ATP, chlorophyll and pH in surface waster at the site; and collection of zooplankton and other indigenous species for determination of bioconcentration of waste materials or incineration products. There will also be constant observation for threatened and endangered species. Additional tests will be incorporated into the monitoring plan as they are shown to be useful based on ongoing and planned research activities.

Monitoring activities will be conducted in an exploratory mode at first and will largely be directed by the results of research which is being conducted by EPA. Methods are currently being developed for collecting incinerator emissions for laboratory aquatic toxicity testing. Once this method is developed, tests can be conducted during research burns, trials burns and during normal operation of at-sea incinerators to determine if and what effects are caused by the emissions on various aquatic test species. These tests could then be run on indigenous species to determine which are the most sensitive species and what are the effects that could be monitored in the environment. EPA is also conducting research to better chemically define the substances in the emissions. The results of these tests will yield information describing what specific substances and biological effects should be monitored in the environment. Air and aquatic transport models are also being developed and verified for future use in describing plume location.

The results of these research activities will be incorporated into this monitoring plan as they become available and monitoring activities will be altered accordingly.

Although these separate outputs from this research program will be useful in developing a meaningful monitoring program for the site, the major product of these research activities is the development of an aquatic risk assessment for emissions from at sea incineration. During the research, dose-response tests will be conducted by dosing various organisms with real emissions at several concentrations and noting the levels necessary to cause measurable adverse toxicological or behavioral effects. By combining this dose-response information with the expected environmental concentrations of the emissions based upon dilution models, a risk assessment will be conducted to estimate the possibility of environmental concentrations of emissions reaching levels capable of causing adverse effects. The rate of incineration at the site would be dictated by the possibility of causing effects and the monitoring activities will be used to ensure that these effects are not being manifested at the site. The dose-response tests will be run using both acute and long term chronic and bioaccumulation bioassays. These tests will provide more meaningful information and require less resources than implementing a major monitoring effort to try to identify chronic effects down stream from the incineration site.

This monitoring program will use the initial risk assessment as a null hypothesis and attempt to observe effects or elevated concentrations of emissions products in the environment. As information from these monitoring activities and additional research studies becomes available, the initial risk assessment will be updated and the site managed accordingly. Any time that the rate of emissions entering the site exceeds what could adverse effects, incineration activities could be reduced in frequency or the site closed.

STRUCTURE OF THE MONITORING PLAN

The overall strategy of the monitoring plan is to make full use of ongoing monitoring and research activities, such as the Northeast Monitoring Program (NEMP) of the National Marine Fisheries Service

(NMFS), and the Incineration-at-sea research program developed by EPA to the extent feasible and to supplement these with such additional monitoring operations as may be needed to obtain all the necessary information to assure EPA that incineration at the site is safe. It is recognized that parts of the monitoring plan as initially implemented must be conducted in an exploratory mode to identify those techniques and measurements which are most scientifically valid and cost effective in obtaining the necessary information.

The monitoring plan itself consists of a hierarchy of monitoring activities which have the structure presented pictorially in Figure 3 and summarized in Table I. This structure may be regarded as showing the time and space relationship of the components of the monitoring plan, going from sampling at the time and place of incineration to wide geographic studies of marine resources over a long period of time. The purpose of each of these components of the overall monitoring program may be described as follows.

A - Compliance Monitoring

The purpose of compliance monitoring is to assure that the permit conditions are being met. This involves sampling the waste in the vessel before it is loaded and monitoring combustion efficiency onboard the vessel. These are conditions of individual permits and must be conducted by the Permittee. Compliance Monitoring can also be though to include activities conducted during trial or research burns for specific vessels and wastes.

Table 1
Overall Monitoring Program
Sampling Location

Type of Monitoring	Time Scale	Purpose
Compliance Monitoring	Disposal site; during disposal operations	To assure that permit conditions and combustion efficiency are being met
Near-field Monitoring	Disposal site; during and up to 24-48 hrs. after disposal operations	Monitor short-term impacts; follow dispersion and diffusion characteristics of the plume
Par-field Monitoring	Wide geographic area; long-term, periodic sampling	Determine movement of combustion products
Marine Resource Monitoring	Wide geographic area; long-term, periodic sampling	Determine long-range impacts and trends associated with health/availability of marine resources
Ocean Process Monitoring	Wide geographic area; long-term, periodic sampling	Monitor progressive changes in physical, chemical, biological characteristics

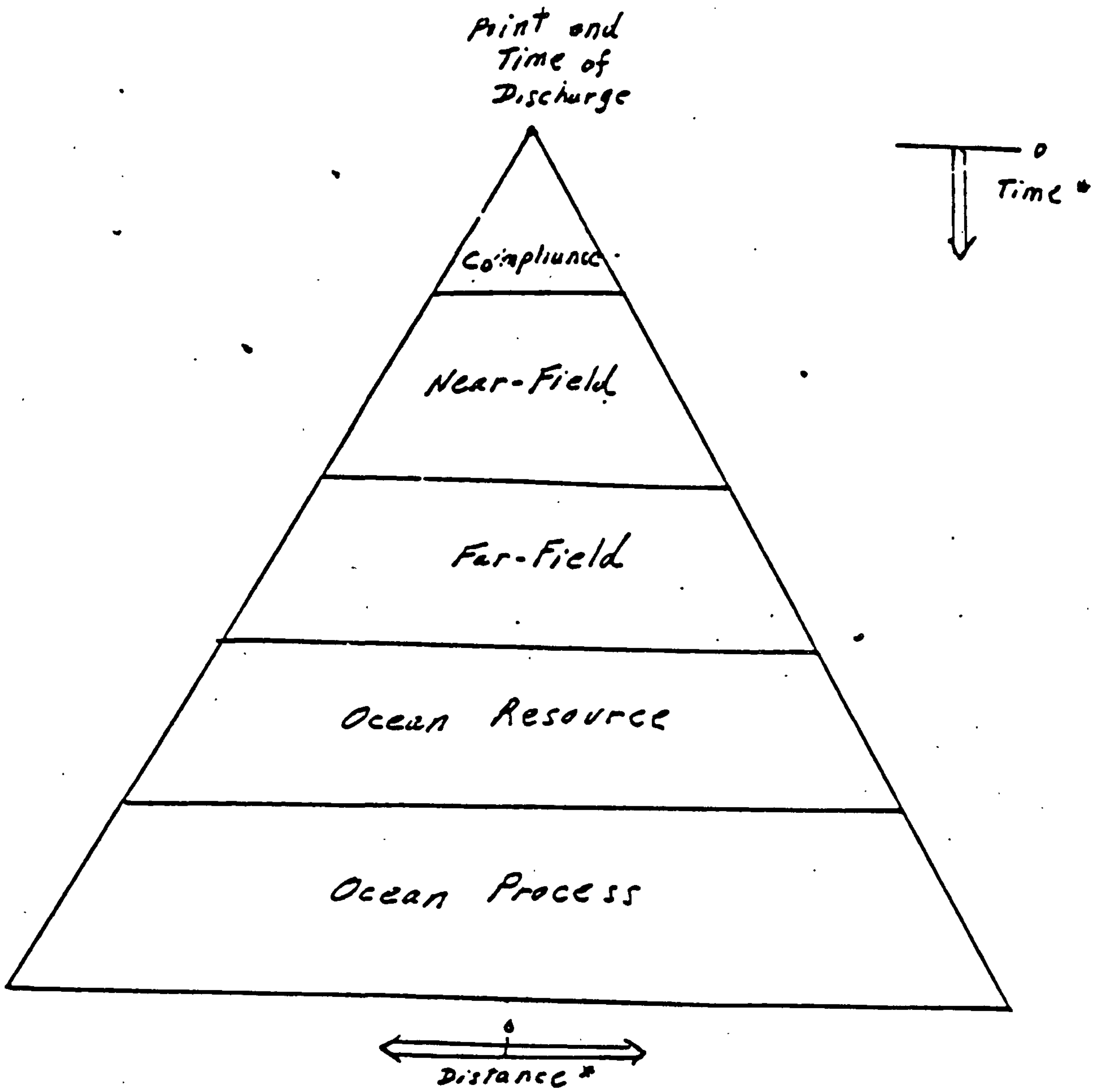

Figure 3. Conceptual Structure of Monitoring Program

* Both Time and Distance may be considered to be on Logarithmic Scales

B - Near-field Monitoring

The purpose of near-field monitoring is to follow the dispersion and diffusion of the discharge plume until it is no longer identifiable so as to assess the magnitude of immediate impacts of incineration on the marine environment as described in the initial risk assessment. This involves taking chemical, physical, and biological samples in the area immediately impacted by the stack plume or scrubber effluent. The time period for such measurements will depend on the characteristics and length of the incineration activity and weather conditions, but will generally be on the order of the length of burning and 24-48 hours afterwards.

The approach will be to make transects across the air/sea discharge plume for as long as the plume can be identified, either visually, by parameters that can be determined rapidly on shipboard, by tracers, or by prediction of diffusion based on calculated diffusion rates.

Sampling locations will be determined using a mathematical model developed for EPA in 1978 and models currently being modified. These models will be useful in defining locations where the plume from the stack should be. More information describing the 1978 model can be found in:

U.S. EPA, Environmental Assessment: At-Sea and Land Based Incineration of Organochlorine Wastes. EPA-600/2-78-087, April 1978.

Figure 2 shows an example of an HCl isopleth "footprint" at sea level determined from the previous studies.

Chemical and physical parameters to be determined will be those standard oceanographic measurements necessary to characterize the water masses and determine stratification, and to determine if emission substances reach detectable levels in the environment. Sampling extent will be based on the predicted behavior of the aerial plume, and will generally be at the surface.

Biological studies will include neuston and plankton sampling for chemical body burden analysis and the search for effects as dictated from direct toxicity testing of the emissions in ongoing laboratory bioassay research. There will be constant observation for endangered species during monitoring cruises, and the principle food source of these organisms (i.e., squid) will be sampled and analyzed for body burden information.

Sampling transects will be centered in the area estimated to be contacted by the areal plume or in the plume from scrubber discharge, and will extend beyond the detectable limits of the plume. The actual sampling patterns run will depend on the size of the plume, the tract of the incineration vessel and on weather conditions during the sampling.

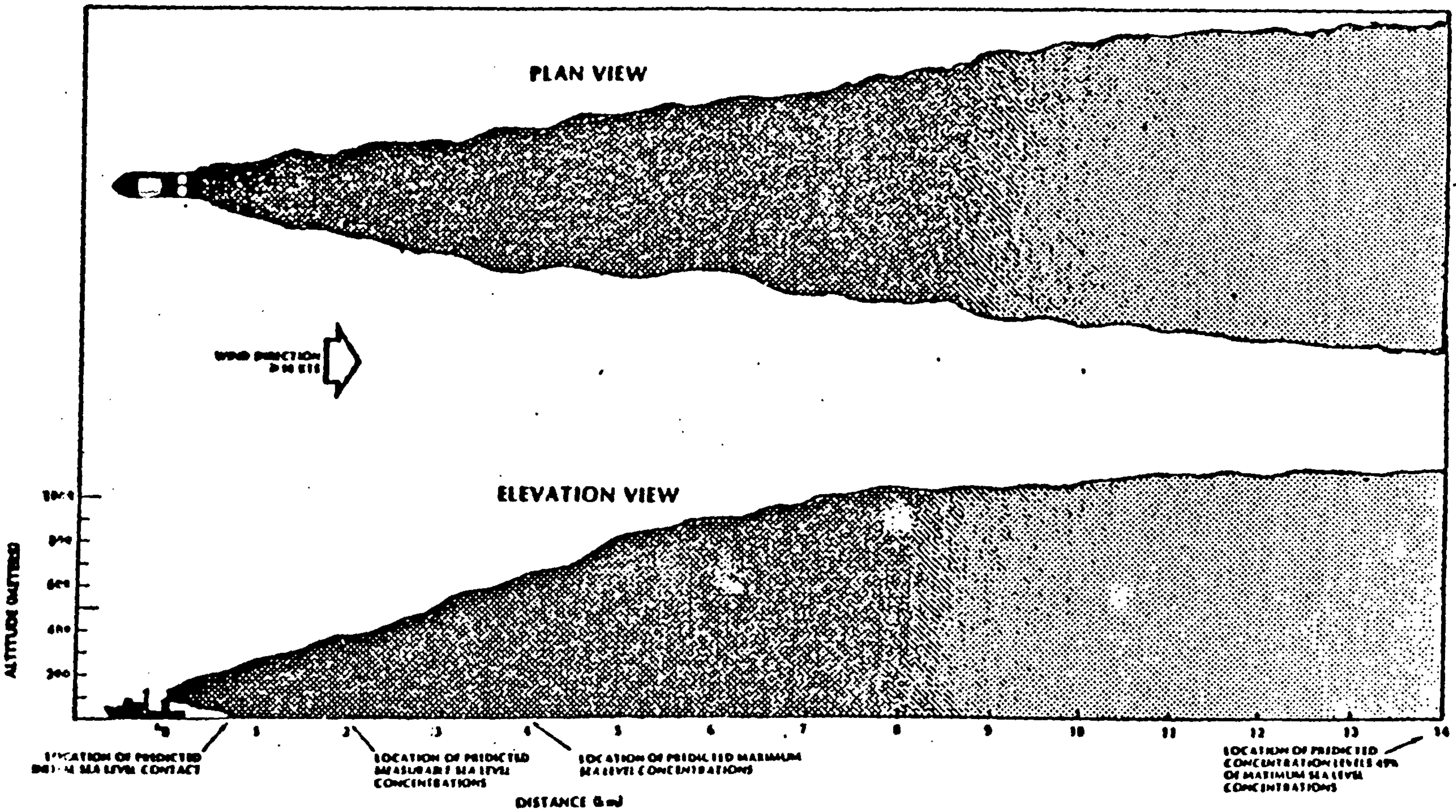

Figure 2 . Plume Dispersal (M/T VULCANUS) Gulf of Mexico
Research Incinerations, Research Burn II

NOTE: During actual incineration, the gaseous plume is virtually colorless and invisible

The intent will be to follow the diffusion of the plume over as wide an area as possible, both to observe impacts from the incineration products and to map the extent of the plume as it disperse. Sampling station spacing will be variable depending on the rate of spreading of the plume. Stations will be spaced closely near the incinerator, and then will be spread out as the plume diffuses.

C - Far-field Monitoring

Much of the far-field monitoring will necessarily be exploratory in nature in the initial stages of the program. The objective is to determine whether any of the unburned wastes of HCl discharged at the site are transported in detectable quantities outside the dumpsite, in which direction they move, and whether there is any potential for wastes to reach shore or cause adverse impacts outside the incineration site itself.

Planning of the far-field monitoring program is based upon knowledge of the large scale transport mechanisms affecting the site and the parameters to be monitored. Mathematical modelling of the overall transport processes provides the basis for predicting far-field transport of unburned wastes discharged a the site. An initial selection of sampling stations is made based on the mathematical modelling predictions; adjustments will be made in sampling station numbers, locations, and frequency of sampling when field data from near field studies etc., indicate changes would result in more applicable data (see figure 5).

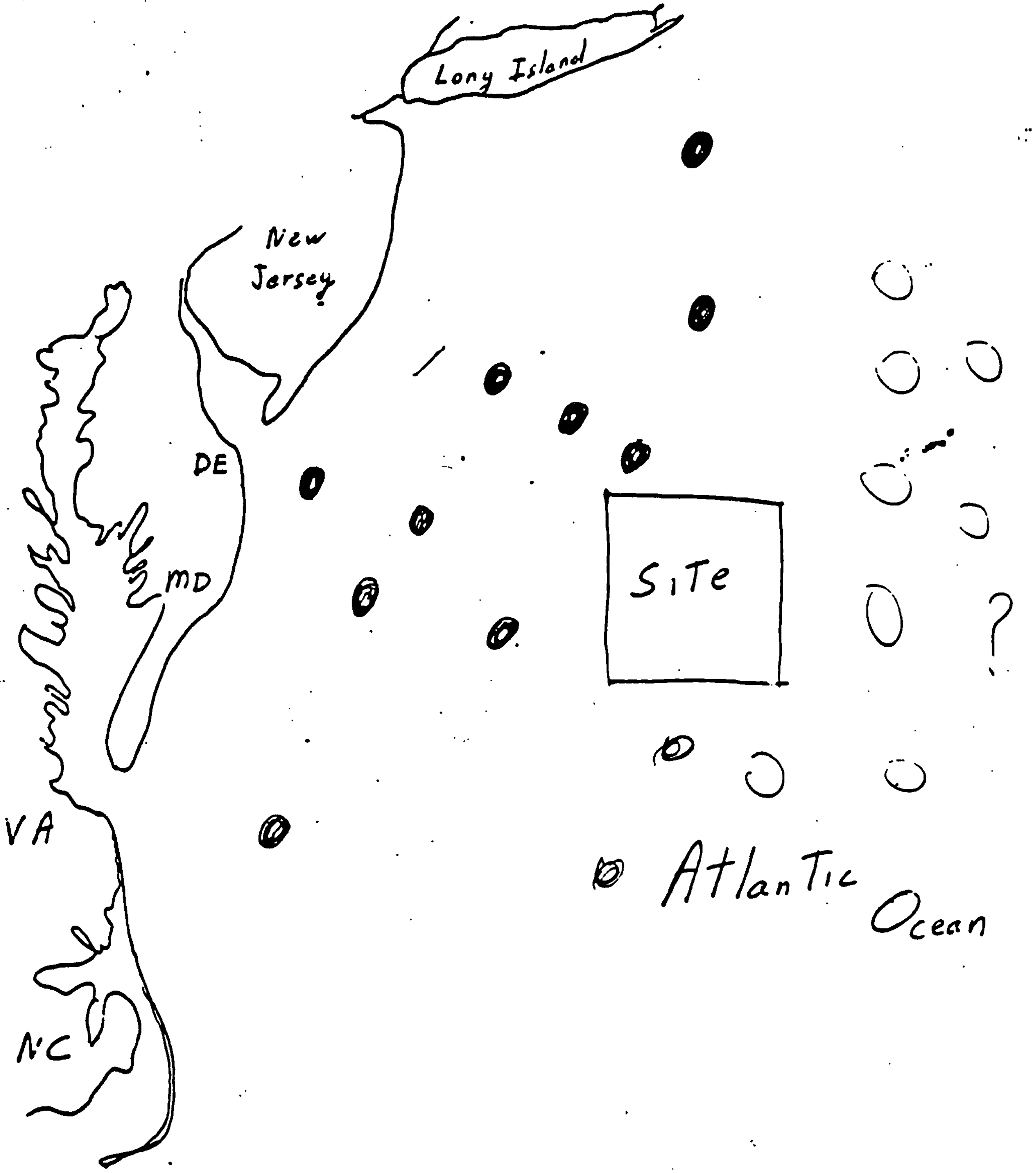

Figure 5 Examples of Far-Field Monitoring Sites

Specific long term effects to be monitored in the far field will be determined during near field testing and during ongoing bioassay research with emissions.

The program will be directed toward assessing three aspects of transport of materials from the incineration site: (1) movement of floatable materials; (2) movement of materials entrained in the water column; and (3) movement of substances in air.

(1) Movement of Floatable Materials

Surface drifters will be deployed at the time of each monitoring survey by EPA. These will be post cards placed in sealed plastic bags to be filled out with time and place finding and returned to EPA through the mail. This is a simple, but effective, technique for determining surface water movement over a long period of time.

Several thousand cards will be cast into the area where the incineration plume contacts the sea surface at the beginning of the monitoring survey; these will help to mark the area during near-field monitoring phases of the operation. To the extent feasible, the areal extent and direction of movement of the cards will be determined at the conclusion of near field monitoring.

While drift cards will provide useful information in the near field monitoring phase, their primary purpose is to determine to what extent materials contacting surface waters may be driven toward shorelines and beaches by wind-driven transport.

(2) Movement of Materials Entrained in the Water Column

Transport of emissions materials away from the incineration site toward coastal areas is a matter of primary concern in the far-field monitoring activities. Any such materials would likely be transported in the near surface mixed layer of the ocean down to the seasonal thermocline when it exists.

This aspect of the monitoring program will be accomplished by occupying a series of stations surrounding the incineration site and sampling for persistent constituents of the emissions. Sampling will be done below the themocline, at or slightly above the thermocline, and at three additional levels between the thermocline and the surface. Satellite imagery will also be useful in describing surface current patterns.

Parameters to be measured will be determine by using the Permittees analysis of wastes loaded on the ship, near-field monitoring results and trial burn emissions results. Very large volume samples of the water will be taken to lower the detection limits for organic substance and increase accuracy. Aquatic dispersion models will be developed and verified using these data and the results of various ongoing research studies.

(3) Movement of Unburned Waste and HCl in Air

In order to assess the movement of the plume in air, high volume air samples will be collected in the area of the plume and during transit to and from shore for HCl analysis or analysis of plume tracers, and for emission-related substances. Air sampling may also be conducted on shore in areas where the plume may contact land. These activities and other research activities will be used to develop and verify air dispersion models.

D - Marine Resource Monitoring

The purpose of marine resource monitoring is to determine if there are long range impacts on health and/or availability of marine resources in the areas surrounding the site as a result of the waste discharges. This involves periodic sampling of harvestable living marine resources and the food webs which support them, and the collection at a network of fixed stations, of chemical, physical, and biological data which may be indicative of long range environmental trends. This will be done as a continuing program over a very large geographic area including locations unlikely to be impacted by waste discharges.

Part of the overall NOAA ocean research and monitoring program is to develop a data base, through long-term monitoring, that will allow the assessment of the effects of pollutants on ecosystems and resources, and will enable early detection of and response to significant environment changes.

By drawing upon several ocean related elements of NOAA an integrated program has evolved which provide a system of physical, chemical, and biological monitoring at selected stations in waters of the northeast Continental Shelf from the Gulf of Maine to Cape Hatteras. Monitoring approaches include both standard measurements of physical-chemical factors, including contaminant levels, and newer approaches to biological effects monitoring, using behavioral, physiological, biochemical, pathological, and genetic criteria. This program is designated the Northeast Monitoring Program (NEMP). The program emphasizes the development of products essential to meet the objectives of State and Federal programs concerned with fisheries and fisheries habitat management, general marine environmental quality, and coastal zone management.

The NEMP program monitors variables of importance to fisheries resources management and pollution assessment at approximately 140 stations along the Continental Shelf from Cape Hatteras to the Gulf of Maine. Special emphasis is given to nearshore stations affected by waste discharges.

A critical aspect of the program is the selection of a proper array of variables to be monitored. Several international, Federal, State, regional, and local agencies have in the past recommended monitoring activities for site- or problem-specific reasons. Such recommendations were highlighted as priority needs in the Federal Plan for Ocean Pollution Research, Development and Monitoring and in task forces within the Council on Environmental Quality (CEQ). Variables measured were selected because of their impacts on resource organisms and human health, or because they serve as indicators of contamination or processes leading to it. Many of the variables selected were recommended by NOAA research programs following consideration of the results of several years of research and monitoring in the region by the International Council for the Exploration of the Sea (ICES) workshop on monitoring of biological effects of marine pollution, and by a UNESCO (GESAMP) working group concerned with similar problems. The list of variables will be evaluated and modified as the significance of additional variables or indicators is understood, and it will be amended if experience shows some variables to be less important or sensitive than anticipated. Interaction between research and monitoring components of the program will provide the principal guidance for addition or deletion of variables.

In addition to the selection of variables to be monitored, it is important that monitoring be conducted at appropriate locations and time intervals. Monitoring sites that are located near major estuaries have been designated as fixed sites at which specific contaminants are monitored on a regular basis. Heavy metals in sediment and water vary seasonally; thus it is important that such variables be monitored quarterly. Guidance provided by discipline review committees has suggested that ecological measurements involving benthic community structure should be made only twice a year. Plankton measurements must be made frequently to understand temporal and spatial variability. Initial biological effects monitoring measurements are made quarterly, and for certain variables more frequently.

Stations that are located offshore over the Continental Shelf have been selected to represent specific habitat types or are representative areas likely to be affected by major environmental events. Measurements made a these stations reflect general dispersion and movement of low levels of contaminants from the coastal zone to the Shelf and beyond. Since only limited information exists on the generalized patterns of movement of specific contaminants, offshore stations have been located within selected bathymetric regimes. An exception to this is the 106-Mile Dumpsite, located off the Continental Shelf, which is affected by present or past dumping, and may receive increase amounts of wastes in the near future.

The NEMP monitoring area includes that part of the Continental Shelf included in the area near the 106-Mile Dumpsite and the nearshore and estuarine areas important for fishery propagation and use. The results of the NEMP are made available to Federal and State agencies and to the public through a series of reports and meetings. An annual report is prepared which summarizes the monitoring results in terms of water quality, sediment quality, biological effects, and resource contamination. The past reports of the NEMP provide a baseline against which to measure future impacts of incineration on marine resources in the Northeast coastal waters of the United States.

E - Ocean Process Monitoring

The purpose of ocean monitoring is to maintain an awareness of progressive changes in ocean water movement and chemical and biological characteristics of ocean water that may effect use of the site and the fate of wastes discharged there. The involves determining the formation and decayed of seasonal thermoclines over a large area and Gulf Stream eddies, and changes in the characteristics affecting the site. In a pragmatic sense, this is the crossover between basic research on ocean processes and application of this research in solving practical problems.

The diffusion, dispersion, transport and ultimate fate of waste materials is controlled to a large extent by physical processes in the ocean. Among the features and processes which could affect what happens to wastes incinerated at these sites are estuarine effluent plumes, upwelling, warm core rings and Gulf Stream meanders, meterological fronts, density stratification, the cold pool, and bottom currents.

Effluent plumes from the bays estuaries, and rivers are significant present or potential sources of pollutants, or as features influencing distributional patterns of pollutants. Plume configurations are complex and dynamic, varying significantly in time scales ranging from tidal to seasonal. Upwelling has been detected and reported seasonally present along the Virginia - New Jersey Coastline, and in other areas.

MONITORING OPERATIONS

A - Baseline and Control Sampling

Baseline studies will be conducted before any actual monitoring begins. The baseline study will attempt to determine conditions present at the site before incineration operations are conducted on a continuous basis. This preliminary sampling is required to establish statistical variability in data and to serve as a "control" situation. Other "control" samples will be collected during normal monitoring operations from locations upstream and upwind from incineration activities.

Baseline cruises will collect samples in the site (near-field area) and around the site (far-field area). Samples of air, water and plankton will be collected.

High volume air samples will be analyzed for trace organics and HCl.

Water samples will be collected for organics analysis using high volume water samplers which draw over 1,000 liters of sea water through polyeurethane foam plugs (figure 6). Other water samples will be analyzed for trace metals, chlorophyll, and ATP content (or other appropriate parameters as described in results of direct emission toxicity testing), and for the basic physical and chemical characteristics of the water.

Neuston (organisms living on the air-sea interface) will be collected and analyzed for trace organics and metals and appropriate toxicological parameters, and identified to species where possible. Plankton will similarly be collected from a depth just above the thermocline.

Current will be determined using drift cards, satellite imagery and other methods.

Observers will be stationed on the survey vessel during baseline cruises to identify and log all sitings of endangered or threatened species. This information will be used in the assessment of endangered species occurrence at the site.

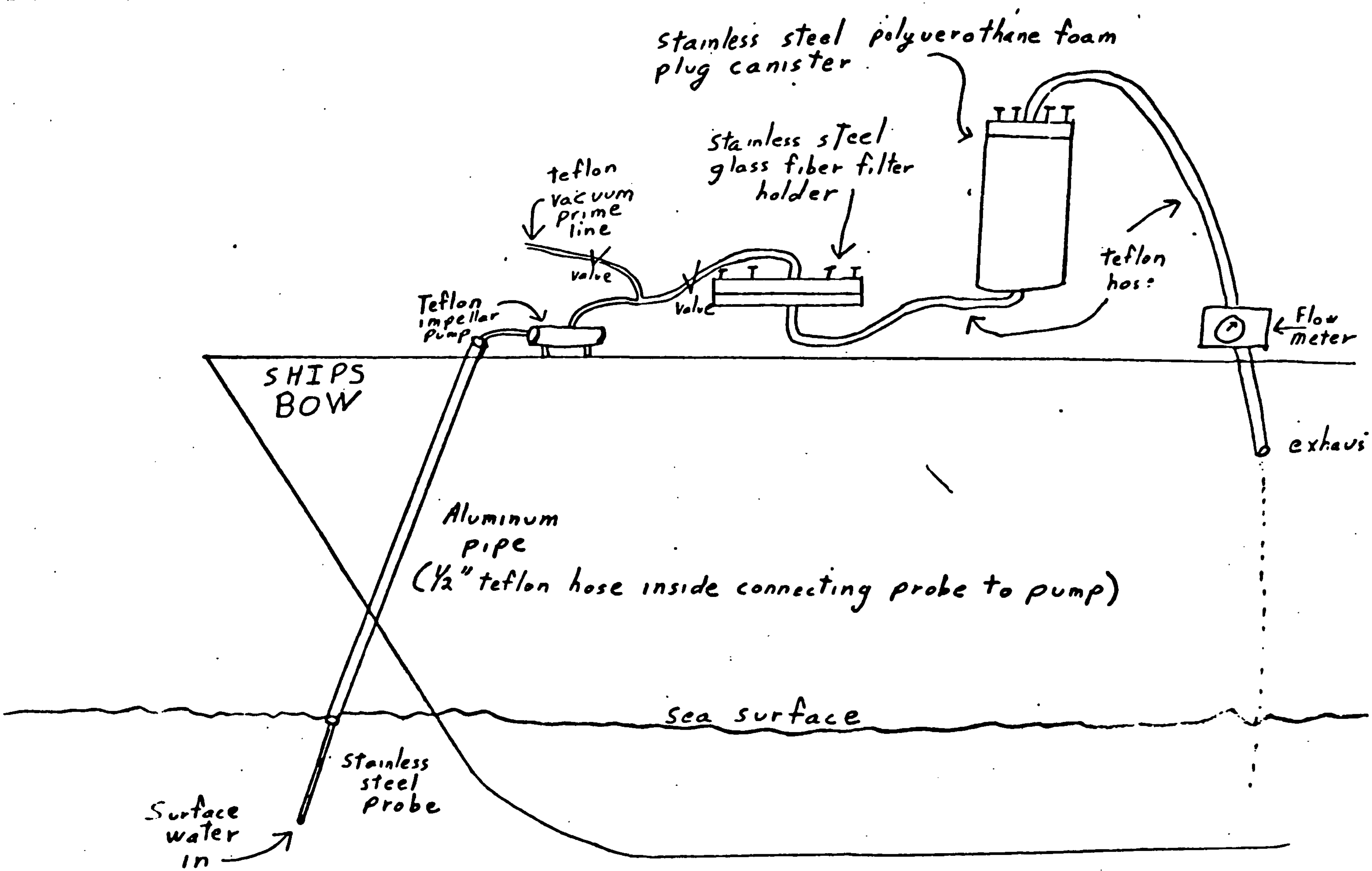

Figure 6— High-volume trace organic filtration system

B - Tier I

When incineration activities are initiated at a site, Tier I monitoring will begin. This will consist of an intensive sampling program directed toward near-field activities. Far-field and other activities will be taking place, but the primary goal of Tier I is to assess the impact of the incinerator plume on the site where it is most likely to be detected. This will require: sampling air, water, and organisms in the plume area in a manner similar to that in the baseline cruise and observation of endangered species in the site and surrounding area. Samples would also be taken from a "control" area. The goal of Tier I sampling is to verify the initial risk assessment prepared by EPA and to assure that no environmental effects or emissions concentrations can be detected. Tier I monitoring cruises should be conducted at the site quarterly.

C - Tier II

If no impacts are noted in Tier I, and no elevations in chlorinated organics or metals levels in water or tissue are observed, Tier I will continue to be implemented during monitoring cruises. If, however, possibly elevated contaminant levels or effects are observed, Tier II will be put into place. Tier II will include extensive far-field monitoring in addition to the Tier I monitoring. EPA will need to evaluate the resultant data to determine if permit modifications are required or if the use of the site should be terminated.

By using this tiered approach, resources can be directed toward the area where they can be used most effectively.

D - Survey Design and Quality Control/Quality Assurance

The actual location of sampling (stations), times of sampling (seasonal), and other design parameters will be determined using modelling approaches coupled with resource limitations. The design will be such that true deviations from normal background occurrences will be detectable at a known level. Data will be of a known quality based upon a QA plan with duplicate analyses, blank samples, spike samples and standards. Results of preliminary sampling and analysis (baseline studies etc.) will be used to establish variability estimates and ongoing research will be used in developing the framework for the chemical and toxicological tests which will be used.

Calculation of Carrying Capacity of the NAIS for PCBs

equation:

$$X = \frac{V}{(1-D)} \frac{C}{F}$$

where:

V = volume of top 20 meters of site in liters

F = flushing rate of site in hours (length of site/surface current)

C = water quality criterion (g/l)

D = DE (0.999999) for PCBs

X = max amount of waste (g/hr) incinerated to research C

and for PCBs:

$V = 4.250\ Km^2 \times 20m$
$= 4.25 \times 10^9\ m^2 \times 20m$
$= 8.5 \times 10^{10}\ m^3 \times 10^3\ l/m^3$
$= 8.5 \times 10^{13}$ liters

$F = 40$ nmi - 25 cm/sec
$= 74 \times 10^3 m$ - .25 m/sec
$= 74 \times 10^3 m$ - 900 m/hr
= 81.7 hours

C = PCB water quality criterion (wqc) = 0.03 ug/l
$= 3 \times 10^{-8}$ g/l

D = 0.999999

SO

$$X = \frac{8.5 \times 10^{13}\ (l) \times 3 \times 10^{-8}\ (g/l)}{1 \times 10^{-6} \times 81.7\ (hours)}$$

$$= \frac{25.2 \times 10^5 \text{ grams}}{81.7 \times 10^{-6} \text{ hours}} = 0.31 \times 10^{11} \text{ g/hour}$$

$= 3.1 \times 10^{10}$ g/hr
$= 3.1 \times 10^4$ metric tons/hr of PCBs burned

<u>and</u>

<u>if</u>

1. ship burns 25 metric tons of waste/hour
2. waste is <35 percent PCBs

<u>then</u>

1. ship burns about 8 metric tons of PCBs per hour

<u>conclusion</u> 8 metric tons/hr is <u>0.026</u> percent of the calculated maximum of 3.1×10^4 mt/hr and 3875 vessels could be operating at the same time without meeting water quality criterion.

<u>or</u> emissions from one vessel are over 4 orders of magnitude below EPA wqc.

<u>and</u> The calculation in Narragansett model shows that at 30m down wind, the highest estimate is 0.06 mg/l, thus estimating the concentration to be over 3 orders of magnitude below wqc.

wqc = 0.03 ug/l
= 0.03×10^{-6} g/l
Narragansette estimate = 0.06 ng/l
= $0/06 \times 10^{-9}$ g/l
difference = between 2 and 3 orders of magnitude

<u>Thus: both estimates are similar</u>

- Narragansett model = 2 to 3 orders of magnitude below wqc.
- Carrying capacity equation = 4 to 5 orders of magnitude below wqc.

AUG 30 1985

Mr. William G. Gordon
Assistant Administrator for Fisheries
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Washington, D.C. 20235

Dear Mr. Gordon:

The Environmental Protection Agency (EPA) is proposing to issue research permits to incinerate chemical wastes at sea. The permits will be effective for a six month period and will authorize the applicants to participate in research activities that have been designed by EPA. A total of two test burns are proposed to be conducted at either the proposed North Atlantic Incineration Site or a site approximately 155 nautical miles east of Daytona Beach, Florida. The burns are designed to evaluate environmental impacts of ocean incineration as well as conduct research on technical and operational aspects of ocean incineration. Our action authorizes research activities only. Permits for commercial operations will not be issued until a regulatory regime for ocean incineration is in place.

Emission of hazardous waste are expected to be minimal. We expect that each permittee will achieve a destruction efficiency of 99.9999%. Based on the volumes needed to conduct the research burns and expected PCB concentrations, we have calculated that less than 0.25 gallons (0.95 liters) of PCB's will enter the atmosphere during the 38 days that are needed to conduct the research. This is equivalent to about 25 ml per day which will be dispersed in the atmosphere and ocean waters. Furthermore, we have concluded from a model developed by our Narragansett Laboratory that uses conservative assumptions that there will be no impact on endangered or threatened species.

Pursuant to Section 7(a) of the Engangered Species Act of 1973 (ESA), the Environmental Protection Agency must, in consultation with the Secretary of Commerce, ensure that that its actions are not likely to jeopardize the continued existence of endangered or threatened marine species or result in adverse modification of critical habitats of such species. To fulfill our Section 7(a) obligations, we have prepared a biological assessment which analyzes the potential impacts of the proposed test incineration burns on all listed species which occur in the project areas. Based upon that assessment (copy enclosed) we have determined that the proposed activity will not affect any endangered or threatened species under NMFS jurisdiction.

If you have questions or comments concerning the proposed action or the enclosed document, please contact Dave Redford at 755-9231 or Darrell Brown at 382-7166.

Sincerely,

/s/

Tudor Davies, Director
Office of Marine and
Estuarine Protection

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Washington, D.C. 20235

SEP 13 1985

F/M41:PAC

Dr. Tudor Davies
Director
Office of Marine and
Estaurine Protection
United States Environmental
Protection Agency
Washington, D.C. 20460

Dear Dr. Davies:

Thank you for your letter of September 4, 1985, concerning the Environmental Protection Agency's (EPA) proposal to issue research permits authorizing incineration of chemical wastes at sea.

We have reviewed the biological assessment forwarded with your letter pursuant to Section 7 of the Endangered Species Act. Based upon that review, we find that the assessment adequately addresses the potential impacts to endangered and threatened marine species associated with incineration of chemical wastes at sea.

The assessment indicates that at least 99.99 percent of the organic substances in the waste will be destroyed through the incineration process (99.9999 percent for PCB's). Based upon that projected destruction efficiency rate and the small number of test incineration burns (a total of two) being authorized, we concur with your determination that the proposed activity will not affect any endangered or threatened species under the jurisdiction of the National Marine Fisheries Service (NMFS).

This concludes EPA's Section 7 consultation responsibilities concerning issuance of the subject permits authorizing test incineration burns in the North and/or South Atlantic. However, the designation of sites for long-term at-sea incineration activities in the North and South Atlantic will require initiation of formal consultation. The NMFS recommends that EPA consider its Section 7 responsibilities early in the designation process so that activities are not delayed. Appropriate times to initiate the consultation process are during the NEPA scoping process or during the development of a Draft Environmental Impact Statement. Initiation of consultation early in the designation process would enable NMFS to provide EPA with a complete list of species that occur in a proposed project area, and would provide NMFS an opportunity to identify high-use habitats in the project area that may be important to listed species. This also would allow NMFS to provide EPA with the most current and best available scientific information concerning listed species and their habitat within and near the project area. I look forward to earlier and closer coordination on projects and permits in the future. If you have any questions or need additional information concerning this matter, please contact Pat Carter, Office of Protected Species and Habitat Conservation, NMFS, Washington, D.C. 20235 (FTS 634-7529).

Sincerely,

William G. Gordon
Assistant Administrator
for Fisheries