OCEAN INCINERATION OF HAZARDOUS WASTES: REGULATORY ASPECTS

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ABSTRACT

The paper reviews the various U.S. and international environmental regulations dealing with the incineration of hazardous wastes on the high seas. The permit conditions designed to protect the environment are discussed both from the viewpoint of normal incineration at the burn site as well as under emergency situations. A comparison is made between land based and ocean-going incineration. The paper includes a description of the complete permitting cycle from initial submittal to final approval.

INTRODUCTION

The growing need for safe disposal of hazardous wastes has focused attention on various approaches, both old and new. Incineration on the high seas ("ocean incineration") is emerging as a viable alternative to traditional land-based methods. Apart from possible economic advantages, the principal attraction of ocean incineration is location: the burn site is far removed from populated areas and from vulnerable environments directly impacting human habitation (water and air resources, etc.). Although environmental risks also exist during loading in port and sailing to the burn site, these risks are no different from those associated with the daily movement of chemical tankers carrying dangerous chemical cargo.

This paper reviews U.S. and international regulations and practices designed to safeguard the marine environment during the ocean incineration mission, including loading, sailing, and incineration. Ocean incineration is performed on ocean-going vessels specifically designed to carry and incinerate hazardous chemicals.

Currently designed vessels typically contain 8 to 12 cargo tanks and carry two or three vertical combustion chambers discharging directly into the atmosphere. The vessel may have a gross tonnage of 5000 tons (4536 t) and a cargo capacity of 1.3 million gal (5.0 million L). Burn rates may be as high as 2500 gal/hr (9500 L/h) for each incinerator providing a capacity of 11 tons/hr (10 t/h) each. At this rate, a typical voyage would require approximately ten days to consume the cargo, assuming continuous burning on two incinerators. One incinerator vessel of this size may annually perform 20 missions and dispose of some 26 million gal (115 million L) of hazardous waste or 110,000 tons (100,000 t). Presently, four ships are in operation or scheduled to be in operation shortly.

Burning of U.S.-produced waste is permitted only at burn sites designated or approved by the U.S. Environmental Protection Agency (EPA). One is currently available in the Gulf of Mexico which covers an area of 1892 square miles (1425 n. sq. miles), has a depth of 4500 ft (1370 m) and is located 190 miles (165 n. miles) offshore. A North Atlantic site is being considered off the coast of New Jersey, and another site is being studied in the Pacific Ocean. Presently, only one ship at a time is permitted to burn at a given site.

National and international regulations govern the transportation and incineration of hazardous wastes by ship. National regulations, where they exist, are administered under various federal statutes by the EPA concerning the incineration system and by the U.S. Coast Guard (USCG), concerning navigation, ship construction and safety. International regulations are jointly developed by several nations and are administered by the International Maritime Organization (IMO). The storage and handling of
U.S. OCEAN DUMPING ACT AND LONDON DUMPING CONVENTION

• Waste destructibility
  • Incineration system

Ocean Incineration Permit

• Site
  • Environmental effects
  • Need assessment
  • Other impacts

• RCRA permit by rule
• USCG marine transporation
• TSCA re PCB's
• FIFRA re pesticides
• RCRA, state, and local land-based support
• NEPA statements

FIG. 1 REGULATORY FRAMEWORK
wastes on shore are covered by the Resource Conservation and Recovery Act (RCRA).

Ocean incineration regulations require approval of the design and construction of incineration vessels as well as of the incineration system. Before a given volume of waste may be transported to a burn site for incineration, appropriate permits must be issued by EPA and USCG.

**REGULATORY OVERVIEW**

**REGULATORY FRAMEWORK**

Figure 1 provides an overview of the current regulatory framework for EPA issuance of an ocean incineration permit. The left side shows six areas that must be addressed before issuance of a permit, while the right side lists other regulatory programs directly related to permit issuance. The key operative regulations are authorized by the U.S. Ocean Dumping Act (formally called the Marine Protection, Research and Sanctuaries Act of 1972, as amended), and the London Dumping Convention (formally called the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, drafted in 1972). The U.S. Ocean Dumping Act expressly incorporates the London Dumping Convention.

Ocean incineration permits are required by the U.S. Ocean Dumping Act and by the London Dumping Convention. EPA regulations set forth administrative procedures and technical requirements under the U.S. Act and IMO regulations and technical guidelines establish requirements under the Convention. EPA regulations may be more (but not less) stringent than IMO regulations. Under both EPA and IMO regulations, the six items listed on the left side of Figure A-1 must be addressed before an ocean incineration permit is issued.

Related regulatory programs include several other EPA programs and USCG marine transportation regulations. EPA regulations under RCRA (the federal Resource Conservation and Recovery Act), which governs the generation, transportation, storage, treatment, and disposal of hazardous waste, provide that a vessel permitted under the U.S. Ocean Dumping Act is deemed to have a RCRA permit. However, a permitted ocean incineration vessel must comply with RCRA regulations regarding:

- an identification number;
- use of manifest;
- manifest discrepancies;
- operating records;
- biennial report; and
- an unmanifested waste report.

Other RCRA regulations govern the construction and operation of land-based facilities needed to support ocean incineration vessels (i.e., storage and handling facilities).

EPA regulations dealing with specific materials would come into play if such materials are proposed for ocean incineration. For example, regulations promulgated by EPA under TSCA (the Toxic Substances Control Act) govern the disposal by incineration of materials containing PCBs in concentrations greater than fifty parts per million. EPA regulations under FIFRA (the Federal Insecticide, and Rodenticide Act) set forth requirements for disposal of pesticides. Environmental impact statements under NEPA (the National Environmental Policy Act of 1969, as amended) are not generally required for EPA regulatory activity under the U.S. Ocean Dumping Act because of the functional equivalent exception. However, EPA policy calls for the preparation of such statements when sites are designated.

USCG regulations govern safety and transportation fitness of the ocean incineration vessel as well as safety of the crew. A key distinction is drawn between U.S.-built and foreign-built vessels. Basically, U.S.-built vessels must meet design and construction standards of the American Bureau of Shipping and USCG covering the hull, main propulsion, and vital auxiliary equipment. Foreign-built vessels, on the other hand, must meet the requirements of one of the international classification societies, such as DET NORSKE VERITAS, Lloyds of London, North German Lloyd, etc., as well as the IMO Bulk Chemical Code.

**MAJOR AREAS OF CONCERN**

Before an ocean incineration permit is issued by EPA, the following major issues must be resolved:

(a) Equipment: The proposed incineration system must comply with various IMO and EPA requirements, including combustion and destruction efficiency levels, monitoring and recording capabilities, automatic controls, laboratory capabilities, and other items.

(b) Waste: Characteristics of the proposed waste must be analyzed for combustibility and destructibility in the proposed incineration system as well as environmental effects of stack emissions, alternative methods of disposal (such as land-based disposal and recycling), and other impacts. A key threshold issue is whether existing data are adequate or a trial burn is necessary to evaluate combustibility and destructibility.

(c) Site: Specific sites for ocean incineration are designated by EPA on the basis of environmental and other studies. The management of such sites, including monitoring and periodic assessment of impacts, is also EPA's responsibility. At present, only one site (Gulf of Mexico) is designated for ocean incineration, but two others (one in the Pacific Ocean, the other in the North Atlantic) are in the process of being designated.
LAND-BASED VERSUS OCEAN INCINERATION

Land-based and ocean incineration are regulated by EPA under two quite different statutes (RCRA for land-based and the U.S. Ocean Dumping Act for ocean). However, since basic engineering principles and hazardous waste combustion concepts are essentially the same, permits for land-based and ocean incineration systems are governed by similar technical requirements. This is particularly true in the areas of waste characterization and waste destructibility.

When it comes to the question of environmental effects of stack emissions, some differences exist. Land and marine environments bear little similarity in their response to such stack emissions. While RCRA experience for land-based incineration systems is helpful in evaluating the combustibility of wastes in ocean incineration systems, environmental impact questions must be addressed from a different perspective.

Other significant differences between permitting land-based facilities under RCRA and ocean incineration systems under the U.S. Ocean Dumping Act include the following:

(a) RCRA applies only to hazardous waste, while ocean incineration regulations cover all wastes;
(b) a land-based facility normally operates continuously, while ocean incineration is carried out in discrete burn cycles;
(c) a land-based facility must meet 99.99 percent destruction and removal efficiency (DRE) of Principal Organic Hazardous Compounds (POHCs). While IMO regulations called for a destruction efficiency (DE) of wastes and other compounds in “excess of 99.9 percent”, new EPA permits call for a destruction efficiency of 99.99 percent (Note: DE versus DRE).

(d) Vessel: Seaworthiness of the vessel is regulated by the USCG. A U.S. flag ship must obtain a USCG “Certificate of Inspection” before sailing and a foreign flag ship must have a “Certificate of Fitness” issued by one of the classification societies before calling on a U.S. port. In either case, a USCG “Letter of Compliance” must also be obtained from the USCG, certifying compliance with international and U.S. Maritime regulations for transportation of dangerous chemicals.

(e) Contingencies: A contingency plan, describing what to do if an accident or mishap occurs, must be prepared by the permit applicant. Of specific concern are spills while loading or transferring cargo, tank ruptures, and situations that may call for jettison of cargo. Communication channels must be well established among the ship’s crew, ship’s owners and EPA through the U.S. Coast Guard.

(d) RCRA specifies a maximum particulate emission level of 0.08 grains/dscf (corrected to 12 percent CO₂) and a maximum emission level for hydrogen chloride of more than 1.8 kg (4 lb) per hour, but no such limitations exist for ocean incineration;
(e) permits for ocean incineration are restricted to a limited time period (maximum three years) and are waste-specific, whereas permits for land-based facilities are more broadly drafted;
(f) ocean incineration is restricted to burn sites designated by EPA, while the siting of land-based facilities is less directly controlled by EPA;
(g) land-based incineration is subject to State and local regulations which may be more restrictive than Federal regulations.
(h) EPA permitting jurisdiction over land-based incineration is relatively free of control by other federal agencies, whereas EPA permitting for ocean incineration is closely tied to certain federal and international agencies (including USCG, IMO, NOAA, DOT, various international classification societies, and the American Bureau of Shipping).

PERMIT TYPES

EPA ocean dumping regulations provide for several types of permits, two of which apply to ocean incineration: Special Permit and Research Permit. The Special Permit authorizes routine day-to-day operation of an ocean incineration system for a specific waste characteristic and volume at a designated site. It may be effective for up to three years (subject to a “survey” every two years). The Research Permit, on the other hand, authorizes limited operation of an ocean incineration ship to conduct one or more trial burns, typically one shipload. It is intended to generate performance and other data for a given waste characteristic to assist in evaluating the merits of issuing a Special Permit.

A Research Permit may be issued for one of several purposes:
(a) to test a new incineration system as part of the “initial survey” required by IMO regulations;
(b) to test the performance of an incineration system on wastes not previously burned by it or by a similar incinerator,
(c) to demonstrate operating conditions that differ from previous burns (e.g., lower flame temperature); or
(d) to develop additional incinerator performance or other data where an application for a Special Permit was rejected.

In most cases, early in the ocean incineration permit program, it is expected that Special Permits will be issued...
on the basis of trial burns conducted under Research Permits. However, as performance data and other indices of incinerability are developed, the number of trial burns may be lessened.

ADMINISTRATIVE PROCEDURE FOR PERMIT ISSUANCE

Under the U.S. Ocean Dumping Act, 40 CFR Part 222 defines the administrative procedure for EPA permit issuance for ocean incineration. Under the London Dumping Convention, administrative procedures are left to each nation, but IMO must be notified after the permit is issued. Figure 2 schematically describes the federal administrative process governing EPA issuance of ocean incineration permits.

The procedure for a given permit application may vary because several of the steps shown in Fig. 2 are optional. Such optional steps include the pre-application conference, the public hearing, the adjudicatory hearing, and the appeal to the administrator. The optional steps utilized will depend upon the particular circumstances of each permit application. Mandatory steps in the administrative procedure include the completeness and technical evaluation, the notice of tentative determination (draft permit), and the notice of permit issuance or denial. These three steps comprise the minimum procedure that must be followed before an effective permit can be issued.

RESEARCH PERMIT: TECHNICAL ASPECTS

GENERAL

When proposing to incinerate a “new” waste or to operate a “new” incinerator an applicant applies for a Research Permit to develop a data base for issuance of a Special Permit. A “new” waste has no demonstrated operating conditions or has constituents significantly different than those specified in a previously issued permit. A “new” incinerator has either not been previously tested under a Research Permit, or has been tested but been newly constructed. In these instances, a Research Permit would demonstrate (through a trial burn) that incineration of the proposed waste by the proposed incineration system can be carried out on the high seas within EPA and IMO regulations and guidelines.
TRIAL BURN

A “trial burn” may consist of one or more test burns. A test burn consists of the incineration of a specific waste under one set of operating conditions. A trial burn may have incinerator operating conditions or waste feed compositions that differ from one test burn to another in order to demonstrate a range of conditions that comply with regulatory standards. Alternatively, a trial burn may be proposed under only one set of conditions. Although a Research Permit is normally required, a trial burn may be conducted under a Special Permit during a voyage. However, the trial burn cannot occur at the same time as permitted waste incineration.

The trial burn tests whether an incinerator is capable of meeting the performance standards without adverse effects on the marine environment and, if so, identifies the operating conditions necessary to ensure that the performance standards will be met throughout the life-time of a Special Permit. Since the trial burn results directly influence the decision to issue a Special Permit and its conditions, careful and detailed planning of the trial burn is necessary.

A Research Permit is valid only for incineration of specific wastes under specific conditions. If an applicant proposes to incinerate a new waste or to conduct incineration under conditions not specified in a permit, a permit modification must be sought and may require a trial burn under a Research Permit. A permit modification application is evaluated the same way as an initial permit application.

To comply with the performance standard of 99.99 percent destruction of organic waste constituents, EPA may request identification and testing of principal organic hazardous constituents (POHCs) for each waste feed. POHCs are the hazardous organic substances in the waste feed that are the most difficult to burn and the most abundant in the waste. The destruction efficiency of only the designated POHCs needs to be measured. The incinerator’s ability to destroy POHCs is considered indicative of its ability to destroy other wastes. This not only simplifies the necessary sampling and analysis efforts, but reduces the cost and complexity of the trial burn without sacrificing reliability.

This procedure may be repeated as often as necessary to obtain a satisfactory trial burn plan. Figure 3 outlines the technical elements comprising the EPA review of a Research Permit application.

WASTE ANALYSIS

Data from chemical and physical analyses of each hazardous waste proposed for incineration are submitted with a trial burn plan. This is the first technical step in the technical evaluation procedure. The type of auxiliary fuel and the proposed fuel feed rate used during each test burn must be specified in a trial burn plan. When the auxiliary fuel is a waste fuel, the feed to the incinerator should be considered a blended waste requiring analytical data.

IMO regulations assume that hazardous wastes, including organochlorine compounds, may be incinerated without adverse effects on the marine environment, if the IMO Regulations and Technical Guidelines are observed. This assumption may not be consistent with EPA regulations under the U.S. Ocean Dumping Act.

Where doubts exist as to the thermal destructibility of particular wastes, special evaluation is necessary. Such wastes that are specifically rated in the IMO Regulations include:

- Polychlorinated biphenyls (PCBs)
- Polychlorinated triphenyls (PCTs)
- Tetrachloro-dibenzo-p-dioxin (TCDD)
- Benzene hexachloride (BHC)
- Dichlorodiphenyl trichloroethane (DDT)

Where these and other doubtful wastes are to be incinerated at sea, IMO regulations require a study to determine whether the residues entering the marine environment during incineration are “rapidly rendered harmless.” Of particular concern are the following possible residues:

- Organohalogen compounds
- Mercury and its compounds
- Cadmium and its compounds
- Oil of any kind or in any form
- Substances known or suspected to be carcinogens, mutagens and teratogens

However, if such materials are present only as “trace contaminants,” it is presumed that no harmful effect on the environment will occur. Such study can include mathematical plume and dispersion modeling, comparing predicted ambient concentrations against allowable limits. If a Research Permit is issued, the incineration system must be subjected to “intensive stack monitoring.”

EQUIPMENT DESIGN

IMO requirements pertaining to incinerator design include the following:

(a) The incinerator system must be designed to operate continuously at a “flame temperature” not less than 1250°C (2280°F) and at a “minimum wall temperature of 1200°C (2200°F).” although certain wastes may be capable of safe destruction at lower temperatures.

(b) The volume of the combustion chamber must be such as to ensure “a residence time of at least one second at a flame temperature of 1250°C (2280°F) when operating at normal firing rates.”
FIG. 3 COMPLETENESS & TECHNICAL EVALUATION OF RESEARCH PERMIT
(c) If waste is to be fed into the incinerator in containers, containers must be introduced at a rate that does not exceed "the capacity of the combustion air fan and stay within the minimum oxygen requirements of 3 percent."

(d) Containers must be fed to the incinerator via an "air lock chamber."

(e) The capacity of the combustion air fans must be adequate to provide a minimum of 3 percent oxygen "near the incinerator stack exit" at all firing rates.

(f) Although shipboard incinerators have used an air rate based on the maximum firing rate, an air modulating control system may be used in the future. This system automatically adjusts the air flow with the firing rate to maintain a constant oxygen supply. In this case, the air flow rate should be recorded.

CONTROLS

According to IMO, the following controls are required:

(a) An automatic feed shut-off must be provided if the combustion chamber temperature drops below approved minimum temperatures and in the event of a flame-out sensed by the flame sensors.

(b) The temperature measurements should be based on at least three different wall temperatures and should be 1200°C (2200°F) unless the test results demonstrate that the required combustion and destruction efficiencies can be achieved at a lower temperature.

(c) Consideration should be given to the possibility of non-homogenous burning caused by vortex formation or dissimilar blends of wastes. The number and location of sensors may have to be increased to monitor this.

PROCESS MONITORING PROVISIONS

Comprehensive sampling and monitoring during a trial burn must be carried out to determine compliance with the performance standards and to ensure safety. Trial burn monitoring and sampling specified by IMO include:

(a) Continuous temperature measurements, using approved temperature measuring devices, of wall temperatures in three different locations on the combustion chamber and stack walls.

(b) Continuous measurement of the following parameters:

   (1) CO, CO₂, and O₂;
   (2) liquid waste feed rate;
   (3) auxiliary fuel feed rate, if used;
   (4) air feed rate;

   (5) meteorological conditions (including wind direction and speed).

(c) During the trial burn, the following measurements must be taken either continuously or periodically:

   (1) concentration of principal organic hazardous and non-hazardous constituents in both the feed stream and stack gases;
   (2) opacity and appearance of stack exit gases;
   (3) where the waste contains appreciable amounts of solid containinants or any amount of mercury and cadmium, particulate sampling of the stack gases must be made.

   Note that both a destruction efficiency of 99.99 percent and a combustion efficiency of 99.95 ± 0.05 percent must be demonstrated under a Research Permit.

SPECIAL PERMIT: TECHNICAL ASPECTS

GENERAL

A Special Permit authorizes incineration aboard a specific vessel for a specified, but relatively large, volume of waste over a given period of time for a number of runs at an approved burn site. Its duration is limited to a maximum of three years. The basis for evaluating a Special Permit application is the operational and environmental data obtained during a trial burn carried out under a Research Permit, or data supplied by burns under other Special or Research Permits. Among other things, these data must show that no adverse environmental effects occur while burning the specific wastes under known operating conditions. One function of the Special Permitting procedure is to apply the specific data of the trial burn to the conditions specified for the Special Permit application.

While each trial burn is confined to a relatively limited volume of waste during a restricted and specific time period (such as one to several days), the Special Permit covers a large volume to be burned during several voyages extending over several months or years. In addition, the composition of this large waste quantity may vary somewhat from that used in the trial burn, and the applicant must identify the expected variation in analysis.

An analysis of the environmental impact on the marine environment for the relatively prolonged burn cycles normally expected under a Special Permit may have to be done. Mathematical models of the incinerator plume with its contaminants and the burn site environment may serve as effective tools in the evaluation process. The result of this analysis may limit waste quantity, the duration and dates of burning as well as the permissible variation in waste composition.

The sequence of steps comprising the Special Permit protocol is illustrated in Fig. 4.

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FIG. 4 COMPLETENESS & TECHNICAL EVALUATION OF SPECIAL PERMIT
PROCESS MONITORING

As under the Research Permit, continuous monitoring for combustion efficiency during a burn under a Special Permit is essential to determine compliance with the performance standards and to assure safety. Note that while both the destruction and combustion efficiencies must be calculated under a Research Permit, only the specified combustion efficiency of 99.95 percent ± 0.05 percent need be demonstrated throughout the burning of wastes under a Special Permit. It is assumed that the destruction efficiency obtained in the trial burn will be met in subsequent burns as long as all other measurable combustion conditions are achieved (temperatures, excess air, CO and O₂ levels, feed rate, etc.).

ENVIRONMENTAL EFFECTS

To issue an ocean incineration permit, the U.S. Ocean Dumping Act requires EPA to determine that the marine environment, among other things, will not be unreasonably degraded or endangered. Making this determination involves assessing the effects of stack emissions on air and water resources at the proposed burn site. Potential environmental effects are considered by EPA in two separate contexts:

(a) designation of sites
(b) permitting of specific wastes.

EPA policy calls for the preparation of a formal environmental impact statement (EIS) under the federal National Environmental Policy Act (NEPA) when specific sites are designated for ocean incineration. Studies are now under way to find a site in the Pacific Ocean, and a study was recently completed for the North Atlantic.

When a permit applicant proposes incineration of a given volume of waste at a designated site, the environmental effects of stack emissions must be considered by EPA before the issuance of a permit. This involves an analysis of the waste characteristics, the proposed incineration system, and the anticipated effects of stack emissions on the marine environment. To a large extent, this analysis can build upon the existing environmental studies used to designate the particular site, but it is likely that some additional waste-specific studies may need to be done. Some potential environmental concerns relate to heavy metals and other inorganic materials. It may be necessary to perform a worst-case analysis, assuming the incineration system operates for a period of time considerably below its performance level or assuming the occurrence of a catastrophic event.

NEEDS ASSESSMENT

The U.S. Ocean Dumping Act requires EPA to evaluate the need for ocean incineration of the proposed wastes as part of the permitting process. EPA regulations list several factors to be addressed:

- degree of treatment of proposed wastes
- the extent to which the raw material and manufacturing processes causing the subject wastes are essential to the applicant's goods or services
- the relative environmental risks, impacts and costs (comparing ocean dumping to other feasible alternatives)
- irreversible consequences of alternatives to ocean incineration.

The tradeoff of environmental risks, impacts and cost represent the most important aspect of this needs assessment. Ocean incineration alternatives that must be considered include landfill, well injection, land-based incineration, open ground spreading, recycling/reuse, storage, and additional biological or physical treatment of intermediate or final waste streams. Balancing the relative environmental impacts and costs of such alternatives is a subjective exercise, but one that must be carefully and comprehensively done. A fairly recent case in the federal district court overturned a permitting decision by EPA regarding the disposal of sludge by the City of New York because (in part) the relative environmental impacts and costs of land based vs ocean disposal were not adequately assessed.

EPA regulations provide some guidance for preparing a needs assessment. Based upon a thorough evaluation of the factors listed above, a need is demonstrated when:

(a) there are no practical improvements available in process technology or in overall waste management that would reduce environmental impacts related to the subject wastes; and
(b) there are no practical ocean incineration alternatives with less environmental impact.

In this context, "practical" means available at reasonable incremental costs and energy expenditure. The regulations seem to contemplate the situation where a more costly alternative for waste disposal may have to be implemented if the relative environmental risks and impacts justify such additional cost.

CONTINGENCY PLAN

GENERAL

In the course of loading, transporting and incinerating hazardous wastes at sea, various emergency situations may occur requiring immediate response actions by the master and crew of a vessel. Such emergencies encompass various situations in which there is a threat to the vessel, it crew cargo, or the environment. The following emergency situations could arise, possibly leading to a cargo discharge:

- fire or explosion
• mechanical (loss of power or steering)
• collision
• running aground
• accidental flooding
• breakup due to weather
• accidental spillage or leakage while loading, burning or transferring cargo.

REGULATORY BACKGROUND

Consistent with RCRA regulations for land-based hazardous waste incineration, EPA requires, as part of the ocean incineration permit application, a Contingency Plan outlining effective actions to minimize damages from emergency situations. Furthermore, the International Conference on Training and Certification of Seafarers — 1978 stresses the importance of developing a contingency plan for vessels carrying liquid chemical substances in bulk.

The U.S. government and international organizations have adopted regulations dealing with the loading and transporting of hazardous substances in ocean-going vessels. In general, the U.S. regulations are in effect for all vessels operating in the navigable waters and adjoining shorelines of the U.S., and the contiguous zone. In the high seas beyond the contiguous zone, all activities are regulated by the Outer Continental Shelf Lands Act and the Deep Water Port Act of 1974. The U.S. also regulates any activities which may affect natural resources under the exclusive management authority of the U.S., including resources under the Fishery Conservation and Management Act of 1976. Pollution of the high seas outside U.S. jurisdiction is governed by international regulations established by the MARPOL Convention of 1973 and the MARPOL Protocol of 1978, of which the U.S. is a signatory.

The merchant marine industry has developed guidelines for the master and crew of a vessel to mitigate or prevent emergency situations. In the past, emergency response actions were intended to save life and property. Today, equal consideration is expected from the industry toward protecting the environment from the damaging effects of a discharge. The primary manual summarizing the merchant marine emergency response practices is “Peril at Sea and Salvage.” The manual is a guide for vessel masters outlining procedures and actions to be taken during an emergency. While this guide was primarily developed for oil tankers, most of the procedures are appropriate for bulk liquid chemical-carrying vessels.

Most of the U.S. regulations described fall under the jurisdiction of the U.S. Coast Guard (USCG) which, by agreement between the EPA and USCG, takes the lead in evaluating proposed Contingency Plans.

MISCELLANEOUS CONSIDERATIONS

LOADING OF WASTES

Details must be contained in the permit application regarding the proposed method of loading the vessel at dockside. The land-based facilities necessary to support an ocean incineration vessel (receiving, storage, and handling facilities) are regulated by EPA under RCRA, by the affected state under its statutes and regulations, and by the municipal government under applicable local ordinances. Loading from barges and other vessels outside the harbor limits is discouraged due to the risk of spillages.

DISPOSAL OF RESIDUES

Tank washings, pump room bilges, etc. contaminated with wastes should be incinerated at sea. Remaining residues, ash or residual wastes must be returned to shore for proper disposal, not dumped at sea. There must be no means of waste disposal on the high seas other than by incineration, unless an emergency condition exists that threatens human life or the vessel.

CONTROL OF BURN DATA, LOCATION AND SCHEDULE

Research and Special Permits limit the date and location of burns to avoid hazards to other vessels. Regular radio warnings should be broadcast during the period of incineration. USCG and port authorities must be notified of the intended date of sailing, schedule and vessel movements.

VESSEL SURVEY

Before a permit is issued for a new ship, a physical survey must be made of the incinerator ship by EPA and USCG to ensure that regulations and permit requirements have been met. Specifically, the survey shall include the following:

(a) approve the siting, type, and use of temperature measuring devices;
(b) approve the gas sampling system, including probe locations, analytical devices and the manner of recording;
(c) ensure that approved devices have been installed to automatically shut off the waste feed to the incinerator if the temperature drops below approved minimum temperatures;
(d) ensure that the only means of waste or other matter disposal is the incinerator during normal operations;
(e) approve the devices by which waste feed and fuel rates of are controlled and recorded;
(f) ascertain that communication equipment is available to broadcast regular radio warnings during the period of incineration.

ON BOARD OBSERVERS

A condition may be included in the permit that allows observers aboard the vessel during the voyage covered under the Research or Special Permit. The permittee may be required to give adequate notice to EPA, as well as the other cognizant authorities, of the sailing day so that suitable arrangements can be made.

ENVIRONMENTAL MONITORING PLAN

The purpose of environmental monitoring is to identify what effect, if any, the incineration of such wastes actually imposes on the marine environment. This will enable a comparison of predicted and actual environmental impacts. Such monitoring may also include a study of the plume dispersion, the possibility of transport to coastal areas, the potential impact on the water surface, and the effect on marine flora and fauna.

CONCLUSIONS

While international regulations and practices are in place to protect the environment during incineration of hazardous wastes on the high seas, there appears to be a recognized need for U.S. regulations dealing specifically with this subject. Evaluation of the vessel construction for safety by the U.S. Coast Guard together with EPA's review of the incinerator design and operational parameters provide important environmental safeguards. Regulations and accepted procedures exist for response actions in case of accidents in port and perils at sea, such as spills, collisions, etc.

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BIBLIOGRAPHY

I. UNITED STATES LAWS AND ACTS

Federal Water Pollution Control Acts.
Outer Continental Shelf Lands Act.
Intervention on the High Seas Act.
Intervention on the High Seas Amendment Act.

II. UNITED STATES CODES AND REGULATIONS

CFR 33 Navigation and Navigable Waters.
Part 6 Protection and Security of Vessels, Harbors, and Waterfront Facilities.
Part 126 Handling of Explosives or Other Dangerous Cargoes within or Contiguous to Waterfront Facilities.
Part 153 Control of Pollution by Oil and Hazardous Substances, Discharge Removal.
Part 156 Oil Pollution Prevention Regulations for Oil Transfer Operations Involving Vessels.

Part 117 Determination of Reportable Quantities for Hazardous Substances.
Part 220 General (Navigable Waters).
Part 300 National Oil and Hazardous Substances Pollution Contingency Plan.

CFR 46 Shipping.
Part 542 Financial Responsibility for Water Pollution.

CFR 49 Transportation (Hazardous Materials).
Part 171 General Information, Regulations, and Definitions.
Part 176 Carriage by Vessel.

III. INTERNATIONAL CODES AND REGULATIONS

Safety of Life at Sea (Solas) and 1978 Protocol.
International Convention on Standards of Training, Certification
and Watchkeeping of Seafarers, IMO 1978.
International Maritime Dangerous Goods Code, IMO.

IV. INDUSTRY PRACTICES
Perils at Sea and Salvage, International Chamber of Shipping,
1982.