Designation: F 873 – 84 (Reapproved 2003)

Standard Guide for Incinerating Oil Spill Wastes at Temporary Field Locations[1]

This standard is issued under the fixed designation F 873; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide addresses incineration as a means of waste disposal and specifically discusses incinerating oil spill wastes at temporary field locations.

1.2 The purpose of this guide is to provide the user with general information on incineration as a means of disposal, not to define a rigid set of standards. It is intended as a reference to plan or execute disposal by incineration.

1.3 This guide outlines procedures and describes some equipment that can be applied to a land-based field incineration process. Included in the guide is a description of typical oil spill wastes that can be incinerated; an outline of procedures to select, prepare, operate, and restore a temporary site; and a summary of general site safety considerations.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary information is given in Section.7

2. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

2.1.1 *field*—a location designed during an oil spill cleanup for incinerating oil spill waste material.

2.1.2 *incineration*—controlled burning of waste products or other combustible material.

2.1.3 *incinerator*—a device constructed for the purpose of containing a material for thermal oxidization.

2.1.4 *landfarming*—a controlled method of spreading a known amount of oil in a nominally uniform layer thickness onto a designated land area for the purpose of biological decomposition. This decomposition process is accelerated by mixing the oil layer with the top few inches of soil, aerating the soil by occasional plowing and adding fertilizers that include nitrogen and potassium to increase the oil decomposition rate.

2.1.5 *landfill*—a land disposal technique that uses excavated pits to contain the oil spill waste material. The waste is placed in the excavation, covered over, and left to degrade.

2.1.6 *oil spill*—An uncontrolled discharge of petroleum materials into the environment.

2.1.7 *on-scene coordinator*—the person in charge of oil spill countermeasures.

2.1.8 *open burning*—the process of burning a material without the aid of an incinerator.

2.1.9 *portable incinerator*—a device capable of being transported by some practical means to a field location for the purpose of burning combustible waste products.

2.1.10 *recycling*—any disposal method that uses oil spill waste material in some manner other than returning it to a marketed product. Examples are road oiling and direct use as fuel supplement.

2.1.11 *relative viscosity*—the measured viscosity of an emulsion (in any convenient unit) divided by the measured viscosity of the oil.

2.1.12 *reprocessing*—reclaimed spilled oil by some type of treatment technique that returns the oil into a product that can be sold.

3. Significance and Use

3.1 A series of five basic operations are generally required to control an oil spill. These operations are: containment, recovery, transfer, storage, and disposal. A deficiency in any one of these operations can cause the entire cleanup activity to slow down or even stop. For example, recovery operations must be terminated when temporary storage fills to capacity and skimmers are no longer able to offload picked-up oil. In order to minimize any adverse effect that the disposal process might have on the other four operations, proper planning and management of the waste disposal operation is essential.

3.2 One way to avoid a slowdown due to the disposal process is to select a disposal site near the cleanup activity. A convenient site reduces the time necessary to transport the picked-up material from storage to disposal, thus increasing the efficiency of the overall operation.

3.3 Unfortunately all oil spill cleanup locations may not be convenient to established oil waste disposal areas. In remote areas travel time to refineries, landfarms, or approved landfills may be hours or even days away from the spill. Therefore, it may be advantageous to establish a temporary field disposal site near the cleanup operation.

[1] This guide is under the jurisdiction of ASTM Committee F20 on Hazardous Substances and Oil Spill Response and is the direct responsibility of Subcommittee F20.15 on In-Situ Burning.

Current edition approved Feb. 28, 1984. Published May 1984.

3.4 An effective disposal method to use at temporary field locations is incineration. Incinerating oily waste does not require a large land surface area as does landfarming. Also, with an incineration process there is no need for long term subsurface monitoring as with the landfill method of disposal.

3.5 The incineration process can serve two functions. First, it can permanently destroy the oily waste to prevent recontamination by the oil, and second, it can reduce the volume of recovered materials that must be transported to other disposal facilities.

3.6 This guide may be applied where deemed suitable by the user. Because of the emergency nature of most spill cleanup situations, it is recognized that these guidelines cannot always be applied in every detail. Accepted industry practice is to do a safe and environmentally acceptable job with the available resources.

3.7 This guide is intended to be used by persons generally familiar with the practical aspects of oil spill cleanup operations. It is intended as a guide for the on-scene coordinator or personnel managing the spill waste disposal phase.

4. Classification of Oil Spill Waste Materials

4.1 The ability of an incinerator to burn oil and oily debris successfully depends on the nature of the recovered material. Of particular importance is the quantity of water associated with the recovered oil and debris, the size distribution of the debris, and the percentage of combustible, organic material in the mixture. This section describes the types of materials that can be incinerated in the field.

4.2 Recovered materials that can be incinerated are divided into several general categories based on their physical state, size, combustibility, transfer requirements, and components. Table 1 summarizes types of oil spill waste into the following categories.

4.2.1 *Liquids*—Oil recovered from a spill usually has water associated with it. The percentage of water collected with the oil varies widely. The water can be present with the oil either as free water or mixed into the oil to form a water-in-oil emulsion. It is often necessary to decant the free water from the oil prior to incineration. In order to decrease the water content in the emulsion, chemicals or heat can be added to break the emulsion into free water and oil. After separation of the free water, the remaining liquids will be uncontaminated oil and emulsions. Both are pumpable by conventional means, contain little or no debris, and have relatively high heating values. According to Table 1, liquids are designated as uncontaminated oil and emulsion.

TABLE 1 Types of Oil Spill Waste

Waste Material	Physical State		
Categories	Liquid	Semi-solid	Solid
Oils			
Uncontaminated (Crudes, refined products)	X	X	
Emulsions (Crudes, some refined products)	X	X	
Weathered (Tarballs, burned oil residue)		X	X
Oily Debris			
Small combustible (Sticks, cups, sorbent pads)		X	X
Large combustible (Logs, seaweed mats, pilings)			X
Small noncombustible (Sand, rocks, metal, soil)		X	X

4.2.1.1 *Uncontaminated Oil*—Liquid, uncontaminated oil is pumpable by conventional means and contains little or no debris. The major component is crude oil or a refined product such as fuel oil, diesel oil, or lubricating oil. These materials normally have high heating values and burn efficiently. Although relatively uncontaminated, this category of liquid may contain small amounts (for example, up to about 5 %) of other non-hydrocarbon.

4.2.1.2 *Emulsions*—Liquid emulsions are pumpable by conventional means and contain little or no debris. The major components are oil, either crude or certain refined products, and water. Generally, the more water in a water-in-oil emulsion, the higher the viscosity. For example, the relative viscosity of a water-in-oil emulsion with 50 % water is 10, whereas the viscosity with 80 % water is 10 000. Viscosity can affect the type of transfer system, incinerator system and pretreatment required to lower the heating value.

4.2.2 *Semi-solids*—Semi-solid waste material may result from oil weathering, debris mixing into oil, or low temperature. Most oil spill cleanup operations must dispose of semi-solid materials. The major components of semi-solids can be either oil or debris. For example, uncontaminated No. 6 fuel oil can become a semi-solid at low temperatures depending on its pour point. Oil-saturated pine needles or straw can also be considered semi-solid type materials. Semi-solids without treatment can generally be transferred by some types of positive displacement pumps, conveyor systems, vacuum systems, or screw augers. They can also be pre-treated prior to incinerating. For example, debris can be separated from the oil or the oil can be heated to make it a liquid in order to be pumped by conventional means. According to Table 1, semi-solids are designated by five categories as follows: uncontaminated oil, emulsions, weathered oil, small combustible debris, and small noncombustible debris.

4.2.2.1 *Uncontaminated Oil*—Semi-solid uncontaminated oil can occur naturally or can be formed as a result of low temperatures. Some crude oils exist in nature as semi-solid materials due to paraffinic constituents and must be heated in order to be easily transferred. In the Arctic, temperatures are low enough to cause some crude oils to become semi-solids.

4.2.2.2 *Emulsions*—Semi-solid emulsions can solidify at low temperatures when the water phase begins to freeze. The greater the water phase the more solid the material becomes.

4.2.2.3 *Weathered Oil*—Semi-solid weathered oils are highly viscous materials composed mainly of oil with components C_{10} and greater. Weathered oil is formed in many ways including exposure to sunlight, heat and long-term mixing in water. Exposure to these conditions causes a reduction in the light ends of the oil and a resultant increase in the viscosity. Tarballs are an example of highly-weathered oil.

4.2.2.4 *Small Combustible Debris*—Semi-solid small combustible debris refers to a mixture of oil, either liquid or semi-solid, and debris. The debris in the mixture is not bulky and any one piece can easily be picked up in one hand. Examples of such debris are oil-coated sorbent pads, leaves and wood cuttings.

4.2.2.5 *Small Noncombustible Debris*—Semi-solid noncombustible debris refers to those oily debris mixtures that contain components that will not burn at the same temperatures as the oil. Oils containing soils and metal may be included in this category.

4.2.3 *Solids*—Solid waste material recovered at oil spills exhibits no fluid characteristics. The major component of the material is the solid matter and not the oil. Solids range in size from oil-coated sand grains to logs. Solids are normally transferred with material handling equipment and cannot be pumped by conventional means. Large oil-coated materials that cannot be handled by one person are in this category and usually require power equipment, such as cranes or conveyor systems to move them. Sometimes it is easier to incinerate large solids by first reducing their size by cutting, shredding or grinding. Solid materials in this guide are designated in Table 1 by the following categories: weathered oil, small combustible debris, large combustible debris, and small non-combustible debris.

4.2.3.1 *Weathered Oil*—Solid weathered oils are found mainly on shorelines and are formed as a result of long-time exposure to sunlight, water and, often, mixing with debris. Normally weathered solid materials are not harmful to the environment but are a nuisance on recreational beaches.

4.2.3.2 *Small Combustible Debris*—Solid small, combustible debris is material that can be picked up and moved by one person. Oil-coated sticks, paper cups, and lightly-oiled sorbent pads are examples.

4.2.3.3 *Large Combustible Debris*—Solid large, combustible debris is material too large to be moved by one person. Normally these materials must be handled by cranes, trucks, bulldozers, etc. These materials are normally reduced in size by cutting, shredding or grinding if they are to be incinerated. Size reduction not only makes it easier to handle the material, but also improves the combustibility of the material.

4.2.3.4 *Small Non-Combustible Debris*—Solid small, noncombustible debris includes oil-coated soils and metals which do not exhibit fluid characteristics. These are normally handled by front-end loaders, shovels, trucks, etc. depending on the amount of material. Incinerating these wastes usually results in residues that must eventually be disposed of following the incineration process.

5. Incineration Equipment

5.1 A variety of incinerators are used to incinerate oil and oily debris in the field. The incinerator used depends on several factors, including the location of the oil spill and incinerator site, the material to be disposed of, size of the oil cleanup operation, and government regulations. Any incinerator system is acceptable to use as long as it is designed to burn oil waste material, is safe to operate in the field, meets the requirements of officials, and is approved (if necessary) to use.

5.2 Some incinerator systems require auxiliary equipment to operate. This equipment includes feed systems for loading the waste, water for cooling the flame, and fuel to ignite the waste or heat the incinerator chamber. Other systems are self-contained and do not require auxiliary equipment.

5.3 *Categories of Incinerators*—Incinerator systems used to burn oil spill waste products can be placed into one of the following categories: factory assembled, user assembled, or user fabricated.

5.3.1 *Factory Assembled*—Factory assembled incinerators are complete commercially available devices. They require no assembly or fabrication by user in order to implement their use in the field.

5.3.2 *User Assembled*—User assembled incinerators are made from commercially available component parts; for example, a fan, a motor, and a refractory lined chamber. They require assembly of the components by the user, but parts do not need to be fabricated.

5.3.3 *User Fabricated*—User fabricated incinerators are those not commercially available that require design and fabrication. These units are generally one of a kind systems.

5.3.4 These guidelines will only describe factory assembled and user assembled systems. User fabricated systems are useful in the field, but are too numerous to include in these guidelines.

5.4 *Requirements of a Field Incinerator*—In order for an incinerator to be a practical tool for field incineration, it must satisfy the following general requirements.

5.4.1 *Burns Oily Materials*—The incinerator must be a proven system, capable of burning oil liquids or semi-solids, or both.

5.4.2 *Transportable*—The incinerator shall be transportable to the oil cleanup location by air, land, or water vehicles.

5.4.3 *Safe*—The incinerator shall be a device proven safe to use, and when operated correctly will not endanger persons, equipment, or the environment.

5.4.4 *Auxiliary Equipment*—The incinerator system shall include all the equipment necessary to incinerate the waste materials, or the auxiliary equipment shall be standard equipment readily available from suppliers. Examples of auxiliary equipment include pumps, supplemental fuel, safety shields, loading systems, portable tankage (bladders or truck tankers), and electrical generator systems.

5.4.5 *Field Repairable*—The incinerator shall be designed so that minor repairs can be made at the temporary incineration site.

5.5 *Types of Field Incinerators*—There are three types of incinerator systems that are most commonly used for on-site incineration. They are commercially available either as complete units or can be assembled from component parts. The three types of systems are the rotary kiln, the air curtain incinerator, and the open flame oil burner.

5.5.1 *Rotary Kiln*—The rotary kiln is an incinerator that uses a rotating inclined cylinder as a combustion chamber to process and contain the waste material. It is designed to tumble the material being fed into it to provide agitation for complete combustion. Residence time in the incinerator is controlled by the combusion chamber angle, speed of rotation, and length. Most of these units are designed to burn fairly smoke-free and

some are supplemented with air and fuel to further improve combustion and reduce emissions. The rotary kiln is used mainly to burn oily debris including sand and gravel, but can be used to incinerate liquids. Small portable units typically burn oil off of sand at rates of 1 ton of waste per hour. Fig. 1 is a schematic of a rotary kiln.

5.5.2 *Air-Curtain Incinerator*—The air-curtain incinerator is a device that uses a high volume air blower, an air plenum, an air distribution nozzle, and an open-top combustion chamber. Fig. 2 illustrates an air-curtain incinerator burning oily waste. In this case, a hole dug into the ground is the open-top combustion chamber. In areas where the soil is not consolidated or is frozen, prefabricated, above-ground chambers can be used.

5.5.2.1 Air is forced through the plenum and out the air nozzle located at the top edge of an open-top chamber that contains the waste material. The air blown into the pit or chamber provides excess oxygen and recirculates unburned particulates back into the combustion zone.

5.5.2.2 These devices are available in a variety of sizes. Burning rates for air curtain incinerators vary according to the size of the chamber and material being burned. Actual field measurements indicate that a 10-ft long chamber can burn oily debris at rates up to several tons per hour.

5.5.3 *Open Flame Oil Burners*—Open flame oil burners are devices commonly used to incinerate smokelessly oil produced from well test operations on offshore platforms. They have also been used onshore for well testing, and for disposal of waste oil products. These systems routinely burn oil-in-water emulsions. Some are designed to burn viscous emulsions at rates exceeding 15 000 gal/h. These types of burners generally cannot tolerate debris. However, each system is different and the manufacturer of the burner can be consulted on the debris size limit.

5.5.3.1 The size, weight, and components of each open-flame burner system vary, but they are all designed to be portable so they can be easily transported, even into remote locations. A typical system is shown in Fig. 3. It consists of a pedestal and boom to support the burner and flow lines, a set of fuel and air nozzles to atomize the fuel (waste oil), and a water ring with nozzles for cooling the area around the flame and suppressing the smoke. High pressure triplex pumps are normally used to feed the burner. In cases when the waste fuel is very viscous, preheating may be necessary in order to obtain proper atomization and combustion of the oil.

5.5.4 Table 2 summarizes the materials that each type of incinerator can burn.

6. Field Incineration Process

6.1 In general, a field incineration process consists of four major steps: planning the operation, preparing the site, operating the site, and restoring the site. The complexity of each step will be influenced by many factors, including the spill size, the type of cleanup operation, equipment available, terrain, weather, and regulations governing the area. The following paragraphs discuss these steps and describe some of the typical tasks which need to be performed during the incineration process. Fig. 4 summarizes the sequence of steps and tasks to be performed.

6.2 *Planning the Operation*:

6.2.1 The first step of the incineration process is to plan the operation. Enough information must be collected so that the equipment and locations can be selected and approvals can be granted from regulating authorities.

6.2.2 Types of information that need to be documented include the following:

6.2.2.1 Spill size,

6.2.2.2 Type of oil,

6.2.2.3 Expected materials dispose,

6.2.2.4 Estimate of the recovery rate,

6.2.2.5 Location of the recovery area,

6.2.2.6 General equipment requirements,

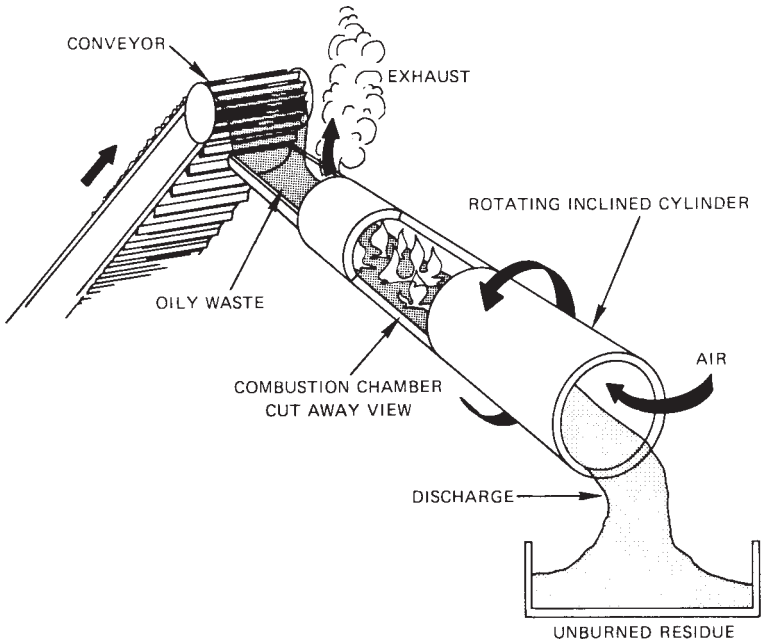

FIG. 1 Rotary Kiln

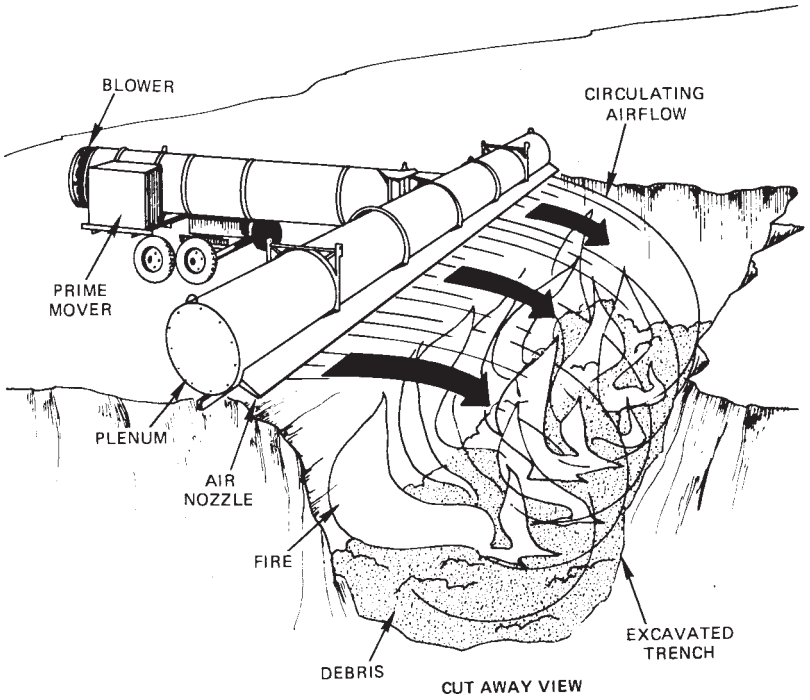

FIG. 2 Air Curtain Incinerator

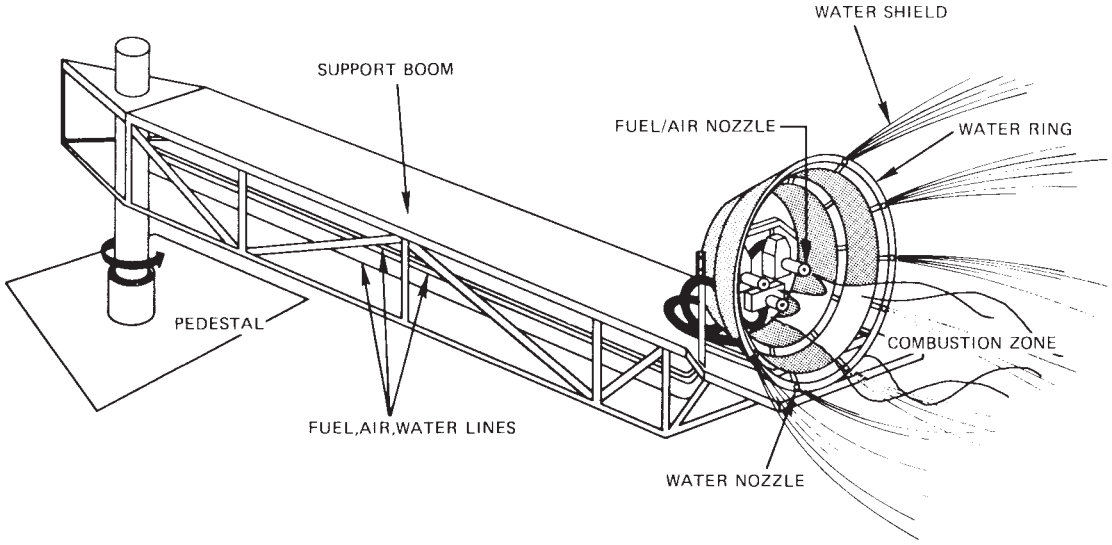

FIG. 3 Open Flame Oil Burner

6.2.2.7 Availability of equipment,

6.2.2.8 Closest landfill, for ash disposal (if applicable), and

6.2.2.9 Proximity to habitation for animals, especially endangered species.

6.2.3 Based on the initial information and by using Table 2, the type of incinerator to use can be selected. It is important to estimate the disposal rate for waste so that the proper number of incinerators can be located and moved to the site.

6.2.4 The proper selection of a temporary incineration site is an important step in the disposal phase of a cleanup. A site located nearest the cleanup activity will enhance the effectiveness and efficiency of the effort and reduce time, cost, and the possibility of secondary impact on the environment.

6.2.5 Improper selection of a site can endanger the populace, environment, equipment, cleanup personnel, and the entire cleanup effort. Damages from improper site selection can be far worse than the oil spill itself.

6.2.6 As much information as can be gathered quickly on the site is important. Some examples of important information to collect are as follows:

6.2.6.1 Present land use,

6.2.6.2 Future land use,

6.2.6.3 Proximity to populace,

6.2.6.4 Soil conditions,

6.2.6.5 Depth of underground water supplies,

TABLE 2 Types of Oil Spill Waste and Incinerators to Use

Waste Material	Physical State		
Categories	Liquid	Semi-solid	Solid
Oils			
Uncontaminated (Crudes, refined products)	2, 3	1, 2	
Emulsions (Crudes, some refined products)	1, 2, 3	1, 2	
Weathered (Tarballs, burned oil residue)		1, 2	1, 2
Oily Debris			
Small combustible (Sticks, cups, sorbent pads)		1, 2	1, 2
Large combustible (Logs, seaweed mats, pilings)			1, 2
Small non-combustible (Sand, rocks, metal, soil)		1, 2	1
Field Incinerator Types			
1. Rotary kiln			
2. Air curtain incinerator			
3. Open flame oil burner			

6.2.6.6 Proximity to underground utilities, including electrical, petroleum, communication lines, and

6.2.6.7 Surface water drainage.

6.2.7 Preferred General Characteristics for an Incineration Site are as follows:

6.2.7.1 Free of features which create a hazard, either from fire or emissions, to the populace, environment, cleanup operations, or cleanup personnel.

6.2.7.2 Located as close to the cleanup activity as possible.

6.2.7.3 Safe access by ground, air, or water transportation.

6.2.7.4 Possible restoration of the land following its use as an incineration site.

6.2.7.5 Area large enough to locate incineration equipment, temporary storage facilities, and access roads.

6.2.7.6 Required permits must be obtainable from either or all federal, state, and local government authorities.

6.2.7.7 Proper surface drainage conditions and proximity to surface water exists to eliminate the possibility of secondary impact.

6.2.8 If required, the plans for the incineration process must be discussed with regulatory authorities. Federal, state, and local permits may need to be obtained prior to conducting the operation.

6.3 *Preparing the Site*:

6.3.1 There are three primary tasks to perform when preparing the incineration site. First, an area layout must be planned. Second, if needed, the site will be excavated. Third, the required equipment will need to be set up on the location.

6.3.2 A temporary incineration site should be sized according to the type of incinerator, number of incinerator units, and the amount of debris and liquid expected to be incinerated. The area layout must make the location convenient and easy to use with safe access to the storage and incinerator areas.

6.3.3 Enough land should be available to stockpile the waste, to provide road access into and out of the site, and to locate the auxiliary equipment.

6.3.4 Roads, if necessary, need to be constructed. They shall be able to support the weight of trucks delivering the waste and vehicles used around the site.

6.3.5 Excavation of the site may include building gravel pads for the incinerator, digging large storage pits, or removing vegetation immediately surrounding the incinerator.

6.3.6 Components of a disposal site should include some of the following items:

6.3.6.1 *Major Equipment*:

((1) Incinerator,

((2) Lined storage facilities, and

((3) Portable tanks for liquids.

6.3.6.2 *Auxiliary Equipment*:

((1) Pumps,

((2) Hoses, pipes, valves, fittings,

((3) Fire fighting equipment,

((4) Shredder or grinders, and

((5) Generator and lights.

6.3.6.3 *Material Handling Equipment*:

((1) Front-end loader,

((2) Conveyor, and

((3) Bulldozer.

6.3.7 An example of a small incineration site is shown in Fig. 5. In this case the storage and disposal area is at the spill recovery location. When the cleanup activity in the immediate vicinity is completed, the disposal operation can be easily moved to another cleanup area.

6.3.8 For some spills, a large disposal area, central to many, scattered recovery locations can be more practical. An example of a large, centralized disposal operation is shown in an aerial view in Fig. 6. In this case, more equipment and storage are available for the disposal operation. Two incinerators, one for liquids and one for solids, are shown. Storage pits have been excavated for storage of the waste material.

6.4 *Operating the Site*:

6.4.1 A number of functions are normally performed during the incineration process. These include managing the overall operation, pretreating the waste for incineration, transferring the waste, incinerating, and disposing of the noncombustible residue.

6.4.2 Managing the operation will involve a variety of activities. Some of these activities are: monitoring the incoming waste to account for the volume, type of material, and its disposition, supervising the labor, controlling traffic, and enforcing safety and security measures.

6.4.3 Pretreating the waste may be necessary prior to incineration. In some cases it may be necessary to separate materials, mix materials, reduce viscosity or reduce the size of solids. The amount of pretreating required will depend on the types of equipment at the incineration site. Extensive pretreating should be avoided if possible. In order to enhance the efficiency of the operation, simple treating is preferred. Some examples of pretreating are as follows:

6.4.3.1 Separate oil from water (separator).

6.4.3.2 Separate debris from oil (filter or strainer).

6.4.3.3 Mix nonviscous oil with viscous emulsion (dilution).

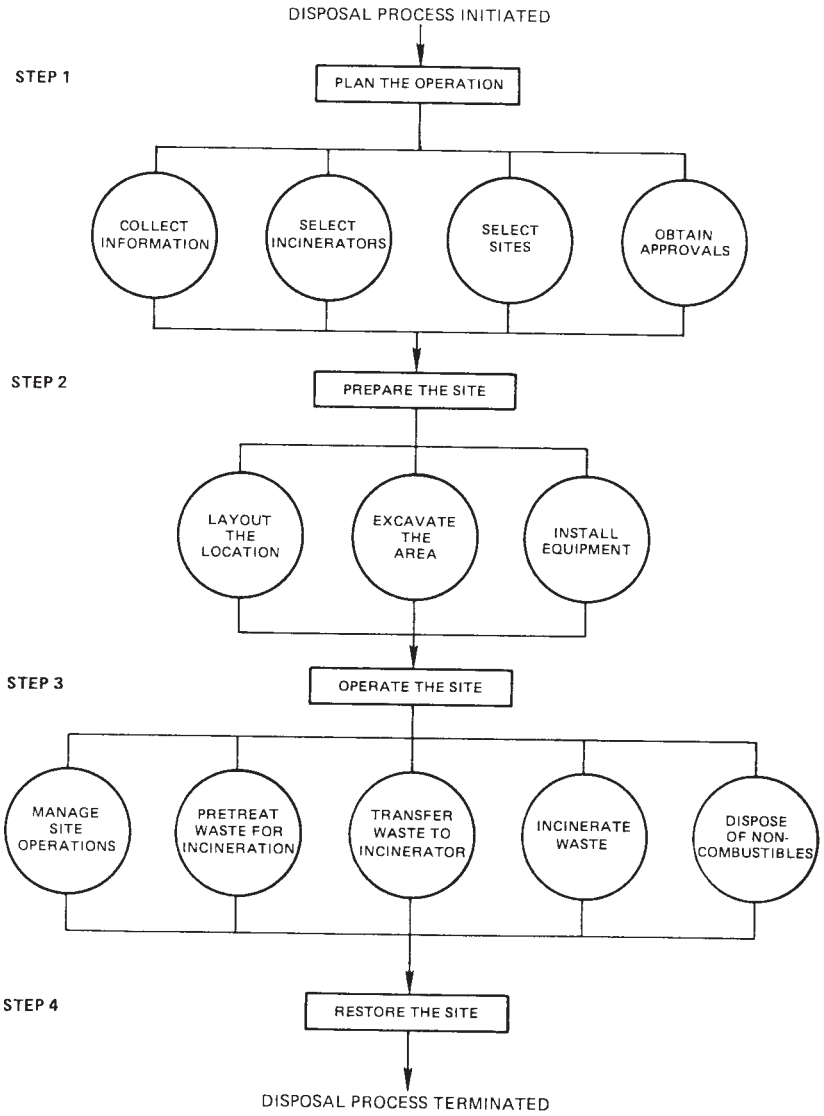

FIG. 4 Summary of Steps to Incinerate Recovered Oil Spill Waste

6.4.3.4 Add chemicals to emulsions to reduce viscosity (breaking emulsions).

6.4.3.5 Shred debris into small pieces (shredding).

6.4.4 Throughout the disposal process, materials will need to be transferred. Typical transfer operations will include: delivery from vehicles to storage, from storage to preheating equipment, and from storage to the incinerator. These operations will require the use of pumps, both centrifugal and positive displacement, conveyors for debris, and heavy lift equipment for bulky items.

6.4.5 The method of charging spill debris or oils into an incinerator depends on the debris characteristics, type of incinerator, and rate of processing. The selected method should be compatible with the equipment used, and should be spill free and safe.

6.4.6 All charging methods should be under direct control of the operator(s). Equipment should be equipped with flow rate control and immediate shutoff capabilities.

6.4.7 The charging system should be properly designed and monitored to avoid incinerator clogging and “flame-back” into the charging and storage components.

6.4.8 Conveyors should be designed and properly inclined to avoid spillage off the sides or “rolling-back” of the conveyed materials.

6.4.9 An adequate zone of safety should be maintained around open pit systems during charging. Any spilled oils in the vicinity of an incinerator should be cleaned up to avoid fire hazards.

6.4.10 The rate of pumping wastes into fluid incinerators should not exceed the capacity. Liquids should be pumped to the incinerator from temporary storage.

6.4.11 Ash from spill debris incineration may or may not contain leachable contaminants. All ash should be properly disposed so as to prevent contamination of surface and ground water and agricultural soils.

6.4.12 On-site burial of non-combustible residue may be possible at the disposal site. On-site burial should be conducted

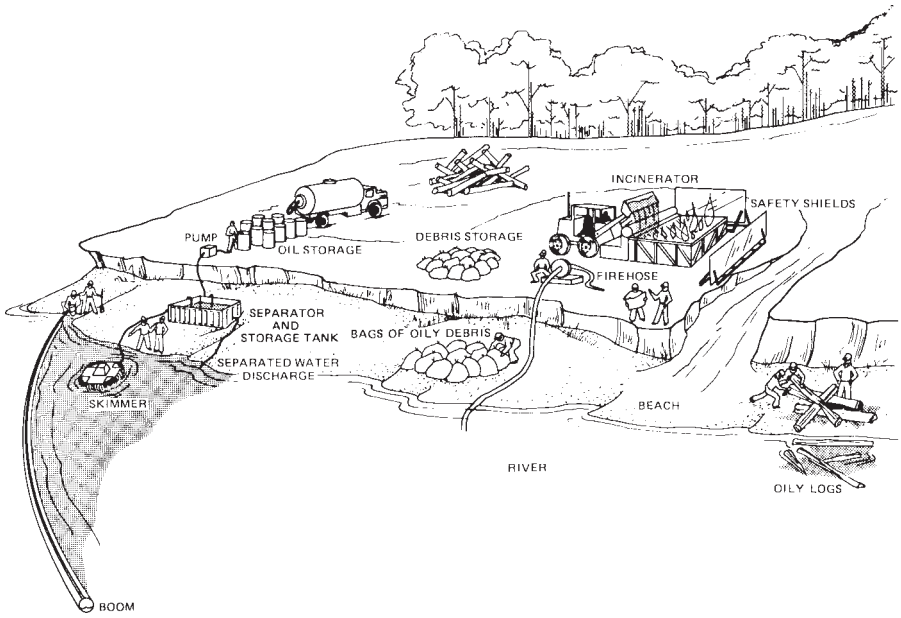

FIG. 5 Small Incineration Site

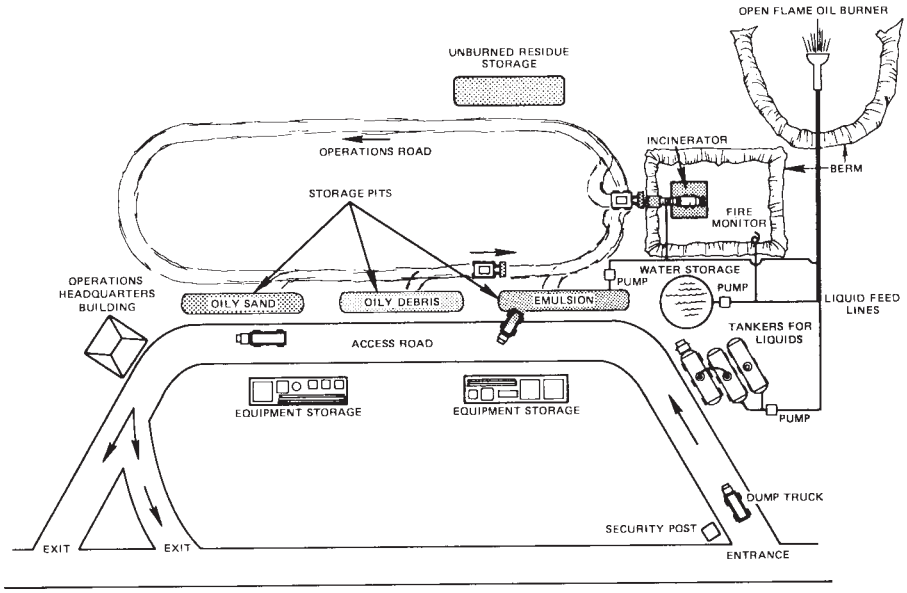

FIG. 6 Large Incineration Site

away from areas subject to flooding and away from any area where subsequent leaching would pollute surface waters or ground water supplies.

6.4.13 Reduction of infiltration of water into the buried mass will reduce the production of leachate. Several feet of impermeable soil or clay materials should be placed over the buried ash and graded so as to prevent ponding.

6.4.14 Ash from properly incinerated oil spill debris will consist primarily of carbonized residues and unburned inert material. Following the incineration process these wastes should be properly disposed of in a landfill.

6.4.15 Under no circumstances should smoldering or still burning ash be placed in municipal waste landfills or transport containers.

6.4.16 Inert solids such as sand and soils may be redeposited at the spill site if the incineration process has sufficiently removed all leachable oils and no hazardous residues are present. Ash incorporation in native sands or soils should be conducted so as to minimize topographical and visual impacts.

6.5 *Restoring the Site*—Once the incineration process is finished, the area will need to be restored.

6.5.1 Gravel pads, pits, etc. need to be removed or filled in.

6.5.2 Vegetation may need to be replanted in order to reduce soil erosion.

7. Personnel Safety

7.1 Due to the heat and flame generated by most field-usable incinerators, and the potential flammability of oil-soaked

debris, personnel safety must be of primary importance at a field incineration site. In many situations, heavy equipment will be used in conjunction with site preparation, operation, and restoration, thus requiring additional safety considerations. Because of the potential for injury in these situations, it is recommended that a "safety officer" be designated who will establish a safety program at the site and who will monitor continually the site for safety-related problems. This person can also be in charge of security in the area.

7.2 *Fire Control Systems*—In addition to the local fire department, a fire control system may need to be installed at the site. Fire hoses can be used if municipal or surface water is available. If surface water is used, water pumps must also be installed. Water must be applied properly to extinguish oil fires. It is extremely useful for cooling purposes and for extinguishing oil fires ignited by any hot ashes which have escaped the confines of the combustion chamber. Three or four 1½ /in. fire hoses equipped with all-purpose nozzles and appropriate pumping systems or water supplies should be available for each incineration unit in operation. In addition, handheld water extinguishers should be available to control any small flareups.

7.2.1 If water or pumping capability is unavailable, fire extinguishers with carbon dioxide, water, or dry chemical should be used. Consideration should be given to establishing a foam fire-fighting system since foam is particularly effective for oil-based fires. This system may consist of foam-type extinguishers, foam eductor-type systems, or both. Sufficient foam should be available to extinguish the fire in the combustion chamber of the incinerator being used.

7.3 *Personnel Protective Equipment*—Any operations personnel who expect to approach within 100 ft of the incinerator while it is in use should wear fire-resistant clothing, footwear, and gloves. It is also recommended that hardhats be worn by all personnel during assembly, operation, and disassembly of the incinerator. Eye protection is also recommended to protect against hot flying ash. Near the incinerator there should be self-contained breathing apparatus available for rescue of injured personnel.

7.4 *Protection of the General Populace*, An area around the incinerator should be established which is marked off-limits to those not actively involved in the disposal operation.

7.5 *Noise Protection*—Persons working near the incinerator should be issued industrial-type ear plugs for protection from the noise associated with the incinerator.

7.6 *General Safety Procedures*—Safety procedures should be clearly understood by all persons in the disposal operation. Everyone should adhere to the enforcement of the safety procedures. It is recommended that operators be informed of the materials being incinerated during any working period to understand the possible hazard of each different type of material. Conducting scheduled safety meetings is an excellent means of preventing accidents at the disposal site.