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Operating and Safety Guidelines for Use of Burn Barrels to Dispose of Shipboard-Generated (MARPOL V) Wastes

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OPERATING AND SAFETY GUIDELINES FOR USE OF BURN BARRELS TO DISPOSE OF SHIPBOARD GENERATED (MARPOL V) WASTES

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This document was prepared under contract with the National Marine Fisheries Service, National Oceanic and Atmospheric Administration. It is intended to be used as a guide for vessel owners and operators who wish to utilize their own burn barrels. Conceptual designs provided in this document may not be suitable for specific vessels. The services of a qualified engineer should be used to apply the guidance provided in this document to vessel-specific conditions.

TABLE OF CONTENTS

GUIDELINES

PURPOSE OF THESE GUIDELINES

U.S. laws and international treaties now restrict the dumping of shipboard-generated wastes at sea. It has been reported that a variety of vessels are currently utilizing low technology "burn barrels" to dispose of their wastes at sea. These burn barrels are similar to those commonly used to burn household trash during the 1950s. *It must be emphasized that neither NOAA nor SCS is advocating the use of burn barrel technology*. However, under present regulatory authority, such technology is permissible and is being utilized. This document (hereinafter called the Guidelines) presents some cautionary guidelines for vessel owners and operators who are interested in utilizing burn barrels as a means of waste disposal.

These Guidelines are entended to inform vessel owners and operators about:

- the problems associated with indiscriminate disposal of garbage at sea;
- the laws and regulations that control disposal of garbage from vessels;

and to provide guidance on:

- the construction of low tech burn barrels for safe burning of wastes;
- which shipboard wastes can be burned; and
- the safe operation of burn barrels.

These Guidelines neither mandate nor recommend that vessel owners and operators design and operate burn barrels. However, burn barrels are believed to provide a shipboard waste disposal option that can be convenient, safe, and low cost. Thus, if vessel owners and operators choose burn barrels as a method for disposing of shipboard wastes, this document provides guidelines for the design, installation, and safe operation of such equipment.

BACKGROUND

Traditionally, shipboard waste has been dumped over the side or "deep-sixed" without regard as to the impact of the waste on marine life or navigation. However, with the increased amount of vessel traffic as well as the amount of non-degradable waste being discharged, this method of disposal is no longer acceptable. Marine debris is being recognized as a growing problem, threatening marine life, beaches, and vessel safety world wide. The news media has presented vivid examples of marine birds and fish entangled or choked by plastic yokes from beverage six-packs and fishing line, or marine mammals and turtles trapped by synthetic nets or strapping bands. Beaches worldwide are being polluted by garbage washing ashore. Vessels are increasingly disabled due to propellers and engine intakes fouled by derelict ropes, lines, plastic sheeting, and other persistent marine debris.

REGULATORY CONSIDERATIONS

To reduce pollution of the ocean and the hazards of marine debris, the U.S. has signed an international treaty and promulgated several Federal laws. Other laws affect what wastes can be brought ashore. These include:

- Regulations for the Prevention of Pollution by Garbage from Ships (Annex V of the International Convention for the Prevention of Pollution by Ships, 1973): Also known as MARPOL Annex V, this treaty attempts to eliminate the discharge of plastics, including synthetic fishing nets, and control the dumping of other ship-generated garbage into the marine environment. It prohibits dumping of plastics anywhere in the ocean, and sets limitations (approved discharge areas) where other types of garbage may be dumped at sea.

- Public Law 100-220, The Marine Plastic Pollution Research and Control Act of 1987: This law is the implementing U.S. legislation for the requirements of MARPOL Annex V. It came into effect on December 30, 1988, and restricts at-sea discharge of garbage to certain zones and bans all at-sea disposal of plastics. Table 1 indicates how certain types of shipboard waste should be disposed, and in what locations.

- U.S. Dept. of Agriculture, Title 7, Part 330, Federal Plant Pest Regulations: These laws prevent the spread of infectious disease and pests which could harm domestic plants, animals, and crops. They require that food wastes or food-contaminated garbage unloaded from ships arriving from foreign ports (excluding Canada) be contained in approved closed, leak-proof receptacles under the direction of the Animal and Plant Health Inspection Service (APHIS). Such wastes must be disposed of by incineration; by steam sterilization; or by grinding and subsequent discharge into a sewage treatment system.

Because of their persistent nature and the potential damage to marine life, plastics in the marine environment are strictly regulated. Regulations prohibit the dumping of plastics, including synthetic ropes, fishing nets, and plastic garbage bags, anywhere in the ocean. Thus, plastics must be disposed of by:

- burning (incinerating) at sea; or
- if contaminated with food from a foreign port (except Canada), placed in a sealed container and disposed of in port under USDA supervision; or
- if not contaminated with food, disposed of in port with other non-food-contaminated garbage.

At the present time, the U.S. Environmental Protection Agency (USEPA) does not regulate the environmental aspects of burning wastes aboard ships. However, the regulations of individual states and local air pollution control agencies may apply to shipboard combustion sources when operating in coastal waters. Because these regulations vary significantly in range of jurisdiction (i.e., miles offshore) and emissions limits, ship operators are urged to contact the local air pollution control agencies in the states whose coastal waters they frequent.

Table 1. MARPOL Annex V: Garbage Disposal Restrictions

GARBAGE	ALL VESSELS EXCEPT OFFSHORE PLATFORMS AND ASSOCIATED VESSELS		OFFSHORE PLATFORMS AND ASSOCIATED VESSELS[1]
	Outside Special Areas	In Special Areas[2]	
Plastics—includes synthetic ropes, fishing nets, and plastic bags	Disposal prohibited	Disposal prohibited	Disposal prohibited
Floating dunnage, lining and packing materials	Disposal prohibited less than 25 miles from nearest land	Disposal prohibited	Disposal prohibited
Paper, rags, glass, metal, bottles, crockery and similar refuse	Disposal prohibited less than 12 miles from nearest land	Disposal prohibited	Disposal prohibited
Paper, rags, glass, etc., comminuted or ground[3]	Disposal prohibited less than 3 miles from nearest land	Disposal prohibited	Disposal prohibited
Food waste not comminuted or ground	Disposal prohibited less than 12 miles from nearest land	Disposal prohibited less than 12 miles from nearest land	Disposal prohibited
Food waste comminuted or ground[3]	Disposal prohibited less than 3 miles from nearest land	Disposal prohibited less than 12 miles from nearest land	Disposal prohibited less than 12 miles from nearest land
Mixed refuse	Varies by component[4]	Varies by component[4]	Varies by component[4]

Adapted from U.S. Federal Register *Advance Notice of Proposed Rulemaking*, June 24, 1988, p. 23887.

[1]Includes all fixed or floating platforms engaged in exploration or exploitation and associated offshore processing of seabed mineral resources, and all vessels alongside or within 500 m (approximately one-third mile) of such platforms.

[2]The Mediterranean, Baltic, Red, and Black seas and the Persian Gulf.

[3]Must be able to pass through a screen with a mesh size no larger than 25 mm.

[4]When substances having different disposal or discharge requirements are mixed, the more stringent disposal requirement shall apply.

* nautical miles

Adapted from Plastic in the Ocean: What are we doing to clean it up?, Xanthippe Augerot, Washington Sea Grant, Seattle, WA, 1988.

Because U.S. Coast Guard regulations prohibit "open lights" aboard certain classes of vessels (tank; bulk & dangerous), a burn barrel would not be permitted aboard such a vessel. On other classes of vessels (cargo & mis cellaneous; passenger) a fire watch is required; hence, burn barrels and other open lights are not expressly prohibited. On small passenger and uninspected vessels, there are are no bans on open lights nor are fire watches required; hence, burn barrels and other open lights are not expressly prohibited.

If the ash resulting from burn barrel operations does not contain particles larger than one inch, and if it does not contain any unburned plastic, the ash may be discharged from a vessel at least three nautical miles from shore. If the ash particles exceed one inch and do not contain unburned plastic, the ash may be discharged beyond 12 nautical miles from shore. Unburned plastic globules in the ash cannot legally be discharged at sea and must, therefore, be disposed of ashore.

DESIGN GUIDELINES FOR BURN BARRELS FOR SHIPBOARD WASTES

Wastes Suitable for Burning

As an alternative to disposing of foreign food-contaminated plastics in port under USDA supervision, vessel operators may choose to burn these plastics. Paper, cardboard, and rags can be burned along with the plastics to promote smoother combustion. Alternatively, these materials may be discharged in other than "special areas" more than 12 nautical miles from shore (see Table 1 for specific details).

Floating dunnage such as wood, lining, and packing materials must be dumped 25 nautical miles off shore. Paper, rags, and food that are comminuted or ground to one inch (25 mm) or smaller may be dumped beyond three miles. Since glass, ceramics, and metals are incombustible, they may be dumped at sea beyond 12 nautical miles or disposed of properly onshore.

Since plastics are a primary concern from an environmental (ocean pollution) standpoint, and food-contaminated refuse is important from plant and animal disease and human health standpoint, these wastes are logical candidates for disposal by burning at sea.

Wastes not Suitable for Burning

Certain types of waste are extremely dangerous and must not be burned in a burn barrel. These include aerosol cans and sealed containers such as paint cans or jars containing liquids, since there is a high risk of explosion and injury from flying debris. Flammable and combustible liquids such as gasoline, kerosene, paint thinner, and other petroleum products pose a severe fire and explosion hazard as well, and must not be burned. These types of garbage must be stored and disposed of ashore.

Because a burn barrel is not a sophisticated, high technology piece of equipment, complete combustion is unlikely. Noxious fumes and gases are not cleaned up before they enter the atmosphere, presenting a potential danger to the crew and the environment. By taking the precautions outlined

in this document, potential health and safety risks to the crew can be minimized. Because of the relatively small amounts of waste being burned and the large amount of dilution of the burn barrel fumes, the impact on the environment from burn barrel operation is expected to be minor.

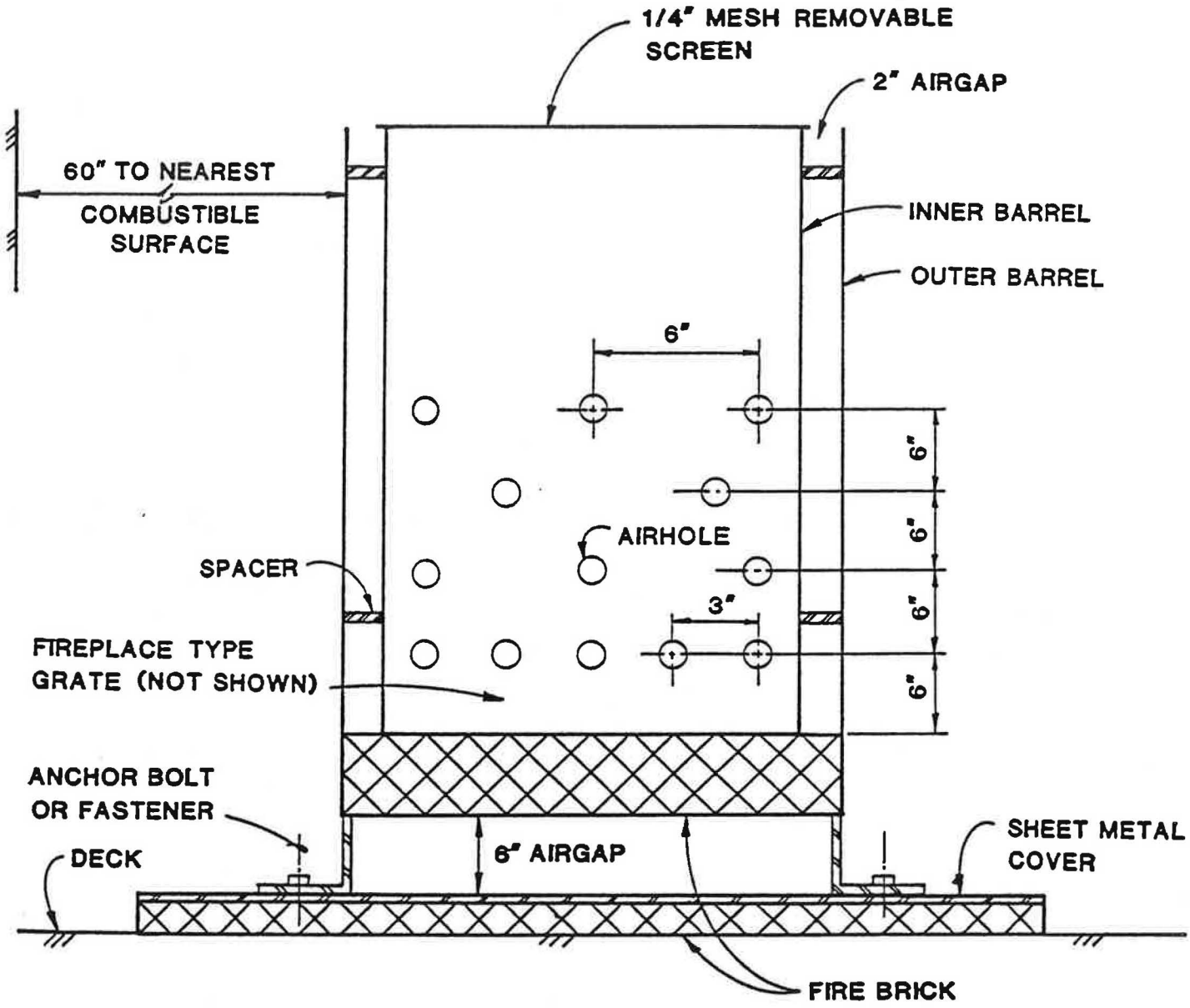
Design Considerations: Configuration, Materials, and Size

For fire safety reasons, burn barrels should be constructed of steel and be of sufficient thickness to prevent premature burn-through and warpage. One possible configuration is a vertical barrel, similar in shape to the familiar 55-gallon drum. To minimize the chances of burns from contact with hot surfaces, a "barrel within a barrel" configuration is preferable (see Figure 1). Metal spacers should be used to maintain at least at least a one inch air gap between the inner and outer barrels. This air gap should help keep the outer barrel cooler and afford some additional protection against burns.

An open-top, 55-gallon drum may be used as a prefabricated inner barrel. It is recommended that drums conform to U.S. Department of Transportation specifications (49 CFR 178.115-118). A drum meeting DOT specification 17C is preferred. Such a drum is made of 16 gauge steel and is less likely to burn through than one of 18 gauge steel that meets specifications 17H or 17E. Drums without rolled (reinforced) top and bottom rims should be avoided, as they are not as strong and may dent or collapse more easily. An 85-gallon steel "overpack" drum, used in the hazardous waste industry as a secondary containment for waste-filled drums, can be used as a prefabricated outer barrel. The overpack drum's 26-inch inner diameter allows about a 1.5-inch air gap all around the inner drum, which has about a 22.5-inch inner diameter. The 85-gallon overpack is about 3.4 inches taller than the 55-gallon drum; however, when insulating materials such as fire brick or refractory cement are placed underneath the inner barrel, the top rims of both drums will be at approximately the same height. The overpack drum should also meet spec 17C. In 1989, a new 17C 55-gallon drum cost about $40, while a new 17C 85-gallon overpack cost about $120.

If a 55-gallon drum is used, it should be thoroughly cleaned to remove any chemical residues which could produce noxious or toxic fumes when a fire is burned inside. For the same reason, any painting or coating on the drum should be removed by grinding or sandblasting prior to burning. To minimize corrosion, heat-resistant paint can be applied to the exterior of the drums, if desired.

Inlet holes for combustion air should be provided on the sides of the inner barrel, near the bottom rim and extending about halfway up the sides. This will allow a cleaner-burning fire by allowing air to reach the burning material more directly than through the top of the barrel. As the air passes downward in the space between the barrels, it is preheated. The lower holes will direct air to the burning wastes, while the upper holes direct air to the resulting combustion gases. These three factors all contribute to better combustion.



SCHEMATIC OF BURN BARREL

NOT TO SCALE

Figure 1

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

The burn barrel should be large enough to burn the expected volume of wastes in a reasonable time. The diameter of the barrel should be large enough so that a full garbage sack cannot block the barrel, preventing smoke and gases from escaping. The barrel should be small enough to preventing occupying too much valuable deck space. If the ashes are to be emptied by tipping the barrel, the barrel should be small and light enough to make this convenient and safe. Alternatively, a removable ash pan could be provided in the bottom of the burn barrel, or an ash scoop or shovel can be used.

The burn barrel should be anchored in such a fashion that it will not tip over in rough seas. This serves to prevent both physical injuries from a unit that breaks loose, as well as preventing burning material from being spilled from a barrel that has tipped over. Clamps or clips that bolt to the deck or the railing are possible methods of securing the burn barrel.

The design should include a spark arrester to prevent sparks and embers from being carried out of the burn barrel and injuring crew members or causing fires on deck. The spark arrester should be constructed of heavy wire mesh with openings not larger than 1/4-inch. In addition, a steel or cast iron grate, similar to those used in fireplaces, should be provided to keep waste off the bottom of the barrel and prevent burn-through. Rebar inserted through holes in the sides of the barrel and arranged like wheel spokes could also serve as a grate.

In addition, a sheet metal cap should be fabricated to keep rain out of the burn barrel when not in use. It should not be used to snuff out an out-of-control fire, as this will cause "puffing" of smoke out the air inlet holes. The cap can be similar to a garbage can lid and should have fasteners to keep it in place in rough seas.

Because of its strength and resistance to warping in the presence of heat, steel is the preferred material of construction for burn barrel components. However, corrosion from salt water and spray is likely. Heat resistant paints may help prevent some corrosion. However, it would probably be more cost-effective to discard and replace some parts, such as the spark screen, rather than attempt to prevent corrosion by using more exotic materials or coatings.

Fire danger is probably the most important safety concern related to the use of burn barrels. To minimize fire danger, it is recommended that local building codes governing the installation of non-UL listed solid fuel burning appliances (e.g. "wood stoves") be consulted. These building codes provide useful information on safe clearances from combustible surfaces.

When installed on a steel deck, it is recommended that the bottom of the burn barrel be at least 6 inches above the deck, allowing air to freely circulate beneath the barrel. A deck made of combustible materials such as wood or fiberglass should be protected by at least 2 inches of closely-spaced solid masonry units or other insulating material suitable for outdoor use. The insulation should be covered with a 24-gauge sheet metal cover. and the sheet metal covering the masonry units. The insulation and sheet metal cover should extend at least 18-inches beyond the burn barrel on all sides.

Burn barrels must be located at least 60 inches (five feet) away from all bulkheads and other vertical combustible surfaces. They should not be located beneath overhead combustible surfaces. They should also be located away from those materials such as steel and aluminum that are subject to corrosion by acidic gases which result from burning plastics.

Each vessel and burn barrel will be a unique situation. To assure a safe installation, consultation with a naval architect or marine engineer who is knowledgable about fire protection is strongly advised, prior to installing a burn barrel. In addition, notification of the vessel's insurance agent is highly recommended before installation of a burn barrel.

Where to Locate a Burn Barrel

Burn barrels should be located in an open, well-ventilated space, not in an enclosed compartment where smoke and fumes could lead to asphyxiation. To prevent the crew from inhaling flue gases and smoke, the burn barrel should be located on the after deck of the vessel. Thus, barring adverse wind conditions, the flue gases should be blown away from the crew if the vessel is underway. Furthermore, to prevent exhaust gases from being sucked into crew quarters or the engine compartment, the burn barrel should be located away from vessel air intakes.

On ships such as research vessels that must remain on station for extended periods, keeping the burn barrel downwind of the crew may be difficult. Coordination of burning with deck operations can alleviate some of these problems. To prevent ignition and explosion of gasoline vapors, burn barrels should not be installed on the aft deck of ships, such as research and fishing vessels, which refuel motor launches from aft deck gasoline storage tanks.

Auxiliary Equipment

For a safe installation, appropriate fire fighting equipment is an absolute necessity. A nearby fire hose with an adjustable spray/fog nozzle is a good choice, since it is less likely to freeze and can provide a greater fire-fighting flow than an extinguisher. A fire extinguisher suitable for Type A fires (ordinary combustibles such as wood, paper, rubber, and many plastics) should also be located nearby. If the extinguisher contains water or other liquids, it should be protected from freezing. The choice of extinguisher type and size should be approved by the vessel's insurance carrier prior to installation.

A first aid kit should also be readily available. It should contain materials specifically for the treatment of burns. At least one crew member should be trained in proper first aid techniques for burn victims.

A poker, tongs, and ash shovel or scoop should be provided to assist in loading, turning, moving, and agitating materials to be burned.

INSURANCE CONSIDERATIONS

A poll of insurance carriers that write marine coverage indicated that the risk of fire was their major concern, due to the difficulty of fighting a fire at sea and the difficulty of escaping from the fire. While a few companies said that they would need more information regarding the specific burn barrel installation before underwriting a vessel, most indicated they would rely on the judgment of a marine surveyor as to whether the installation were safe or not. Marine surveyors are independent agents that inspect vessels and cargo. They are experts in the operation of vessels and their associated equipment. Among their duties is to list the type and location of safety equipment such as fire fighting equipment.

None of the insurers or surveyors indicated a first-hand knowledge of any burn barrel installations. It should also be noted that some insurance companies insure only the cargo, while others insure only the vessel itself.

Because the installation of shipboard burn barrels is apparently a new phenomenon, vessel owners or operators would be well advised to consult with their insurance carriers before installing a burn barrel, rather than risk loss of insurance coverage. Furthermore, the insurance company and/or its marine surveyor may have specific recommendations or requirements for the design, location, or operation of the burn barrel, as well as fire-fighting equipment.

WHEN TO BURN

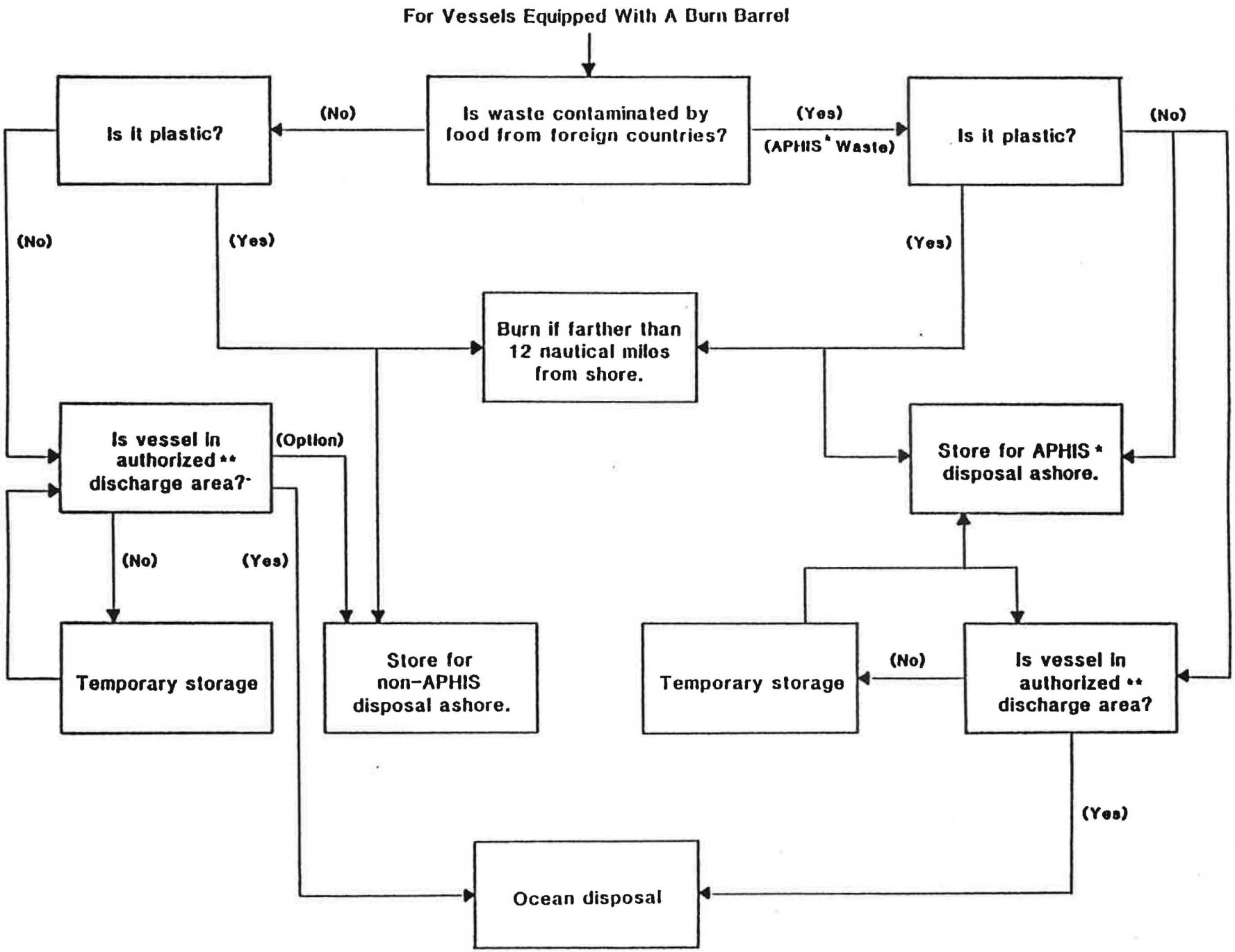
Vessel Location and Waste Types

Choosing the proper time to burn wastes is largely a matter of common sense. Figure 2 shows the various questions about waste types and vessel location that should be asked prior to burning accumulated wastes.

Frequency of burning depends in large part on how much storage capacity the vessel has for wastes, and how much time can be spent burning on any one day. Thus, a vessel with a large storage capacity could burn much less frequently than one with little room for waste storage. Because of the time involved in building a fire properly, it is recommended that a volume at least equal to six large (39 gallon) plastic garbage sacks be available before being burned.

Sea and Weather Conditions, Time of Day

To minimize the chances of the burn barrel tipping over or injuries to the crew during loading and burning operations, burn barrels should be used only when relatively calm sea conditions prevail. The wind and vessel direction must be such that smoke and exhaust gases from the burn barrel are blown towards the stern and away from the crew and vessel. Burning during heavy rainstorms should be avoided, since the rain will tend to wet the waste and cause increased smoking. Another consideration may be vessel operations; for example, a preferable time to burn would be when deck operations are at a minimum.



* APHIS – USDA Animal and Plant Health Inspection Service

** MARPOL Annex V designated at-sea garbage disposal areas

Figure 2
TO BURN OR NOT TO BURN

If wastes are burned at night, the area around the burn barrel must be well-lighted for operator safety and to allow proper observation of the burning process.

HOW TO FIRE A BURN BARREL SAFELY

Building the Fire

Building a fire in a burn barrel is similar to using a fireplace or woodstove. A pile consisting of kindling or small wood scraps and crumpled paper or newspaper should be built on top of the grate. Some vessels have pallets or other wood dunnage; vessels lacking this supply of wood can use corrugated cardboard instead. These materials should be ignited with a match or burning piece of paper, ***not with a flammable liquid such as gasoline***. As the paper and wood begin to burn, cardboard or additional paper and wood can be added.

Plastics have a relatively high heat content (they "burn hot".) Plastics can be added after the fire is well-established (i.e., not smoking heavily). Plastics must be added to the fire slowly. If too much plastic is added at once, the temperature of the fire will drop and the burn barrel will smoke excessively. However, once the plastics begin burning, the fire can grow very rapidly and may accelerate out of control.

Plastics should be fed slowly and in small amounts on a regular basis, rather than infrequently in large batches. It is recommended that plastics be fed roughly five gallons (loosely packed) at a time. By way of reference, a typical household plastic garbage bag holds 33 gallons; a lawn and leaf bag holds 39 gallons.

Systematic feeding of small amounts of plastics will allow them to burn rather than melt into globs that fall to the bottom of the barrel and remain unburned. These plastic globs cannot legally be disposed of at sea and must be separated before the ash is discharged. Hence, patience on the part of the operator is important and can save time in the long run.

Wastes not Requiring Burning

Glass and metal do not burn and they create additional ash requiring disposal. When farther than 12 nautical miles from shore, it is permissible for them to be dumped. Meat and vegetable food scraps do burn, but slowly, and may cause the burn barrel to smoke. Since they can legally be dumped outside the 12-mile limit, the operator may choose not to burn them.

Difficult Wastes

Wet wastes are difficult to burn; these include food scraps, wet rags or paper towels, and discarded fishnets. They should be fed into a well-established fire; this allows the heat to dry them off before subsequent burning can take place. Large or bulky items such chunks of wood or stacks of newspaper do not burn well unless they are broken into smaller pieces or agitated to expose more of their surface to the flames.

Dangerous Wastes

Certain wastes are *extremely dangerous* to burn. These include aerosol cans and flammable or combustible liquids such as gasoline, kerosene, diesel fuel, or other petroleum products. These must not be burned in the burn barrel, as they present a real risk of explosion or uncontrolled fire. They can result in explosions, fires burning out of control, or literally burn outside the barrel. Any closed container containing a liquid (e.g. paint cans) presents an extreme explosion hazard, since the liquid can turn to steam, expand, and explode the container. Aerosol cans may turn into flame throwers when ignited. **DO NOT BURN THESE TYPES OF WASTES.**

Maintaining Good Combustion Conditions

Adequate air must be supplied to the fire at all times. This can be accomplished by making sure the barrel's air inlets are never blocked by waste inside the barrel or by objects outside the barrel. The waste should also be agitated frequently with a steel poker. This breaks up the wastes into smaller pieces that are more easily burned. In addition, it exposes new surfaces to the flames and allows them to ignite. It also provides a pathway for air to enter from above. Wastes in the barrel that are slow to ignite should be turned over with the unburned face down.

Upset Conditions

Upset conditions are conditions which are not ideal, could lead to dangerous situations, or are already dangerous. The following are some examples of upset conditions and recommended responses:

- *A large bag of wet waste is added to the barrel, causing excessive smoke.* Not much can be done once the waste is in the barrel, other than to agitate it frequently with a metal poker to promote drying and igniting of the waste. It should not be removed from the barrel, as this could spread glowing embers or otherwise start a fire on deck.

- *A large amount of plastic is added to the barrel.* Due to the high heat content of the plastics, the fire accelerates and the barrel overheats (glows red). Flames may be shooting out of the top of the barrel. In this case, the fire should be slowed down by quenching with small amounts of water from a nearby fire hose.

- *The burn barrel overturns.* The anchoring system should be designed to prevent this from happening. If, however, the barrel does overturn, the burning waste should be extinguished immediately using standard shipboard firefighting techniques and equipment.

Completing the Burndown of Wastes

The waste pile in the barrel should be agitated frequently with a metal poker. Many pieces of waste will only char on the outside and not burn out completely unless they are turned with a poker. Breaking them up and exposing new surfaces to the flames aids in combustion. After the last waste is loaded, it is especially important to break up and agitate the wastes to bring about as complete a burnout as possible. It is possible

that the barrel will stay warm for several hours after the last waste is loaded.

Ash Diposal

It is desirable to maintain a bed of ash two to three inches thick on the bottom of the barrel, beneath the grate. This layer of ash protects the metal bottom of the burn barrel from heat damage, corrosion, and erosion by the fire and associated chemicals and exhaust gases. Initially, a bed of clean dry sand could be used for this purpose.

Ash should be removed from the barrel before it builds up enough to obstruct the combustion air inlets on the lower sides of the barrel. Ash should be disposed of in accordance with the MARPOL Annex V regulations, specifically with regards to the distance from shore. If the burn barrel does not have a removable ash pan, the use of an ash scoop or shovel will prevent having to lift the barrel and empty it over the side of the vessel.

It is important to note that melted-down globs of plastic are still considered to be plastic; hence, they cannot be legally disposed of at sea. Separation of these plastic globs from the other ash is required before the other ash can be dumped at sea. If this is not convenient, the entire supply of ash should be stored in a non-combustible container (e.g., metal garbage can) and disposed of properly ashore.

HUMAN HEALTH AND SAFETY CONCERNS

As with any other piece of heat-producing equipment, certain safety precautions must be followed to minimize the chance of health or safety problems to the operator or nearby persons.

Burns

The surfaces of the burn barrel are likely to be hot, and phsyical contact with them could result in burns. The suggested "barrel within a barrel" configuration is intended to provide a lower outside surface temperature on the barrel, but caution is still advised. The operator is advised to wear leather gloves and a long-sleeved shirt to provide some additional protection. Avoiding contact with the hot surfaces of the barrel is the best way to avoid being burned. At least two crew members should be trained in first aid and be able to treat burns.

Eye Injuries

Safety glasses or goggles should be worn by burn barrel operators to prevent eye injuries or smoke irritation.

Contact with Wastes

Handling garbage and wastes always poses the risk of cuts, punctures, and infection. Therefore, commonsense precautions must be taken. These include wearing leather gloves and washing all parts of the body that come

into contact with the waste. If dusty wastes are involved, a dust mask should be worn.

Inhalation of Smoke and Fumes

Smoke inhalation can cause respiratory irritation and/or damage. Smoke also irritates the eyes and can cause temporary vision problems which could in turn pose navigational hazards. To minimize the possibility of smoke inhalation, the burn barrel should be located on the after deck and used only when wind conditions will blow the smoke away from the vessel. The burn barrel operator and other crew members should obviously avoid areas where burn barrel smoke is present.

Even when there is little or no visible smoke, fumes from the burn barrel can pose health risks. Carbon monoxide is a clear, odorless gas resulting from incomplete combustion. If excessive amounts are inhaled, it *can cause death*. The operator and crew should stay upwind of the burn barrel as much as possible. The operator should stay away from the burn barrel except when loading or agitating the waste; however, the operator should maintain line-of-sight contact with the barrel.

Plastic items may contain chlorine, which when burned can form hydrogen chloride gas (hydrochloric acid). Hydrochloric acid is corrosive to lung tissue as well as to metals. Garbage that has been soaked in salt water also contains chlorine and presents the same problem. Therefore, with plastic items such as nets, floats, and styrofoam, it may be reasonable to store these items and dispose of them properly ashore. The same precautions for avoiding smoke and carbon monoxide problems are applicable.

Proper location and operation of the burn barrel is the most effective way to prevent health and safety problems.

Tipping and Lifting Hazards

The anchoring system should be properly designed to minimize the chances of the burn barrel tipping over or breaking loose while underway. If an ash scoop or shovel is used to remove ash rather than tipping the barrel over the side, the chance of injury to crew members is less likely.

Fire Hazards

Proper location and operation of the burn barrel is the most effective way to minimize fire danger. Careful loading of wastes, and avoiding the dangerous wastes listed above, are essential to preventing out-of-control fires in the burn barrel.

It is prudent to hold periodic fire drills and to have established procedures and assigned duties for crew members in case of fire. An Action Sheet listing actions such as alerting or waking the crew, making radio contact with the Coast Guard, etc. should be developed and posted.

Ingestion of Food Cooked over Burn Barrels

While it may seem obvious, no one should cook any food over the burn barrel fire. Hazardous or toxic chemicals may be generated by the fire and could contaminate the food.

ENVIRONMENTAL CONSIDERATIONS

Ash Disposal

The ash resulting from proper burn barrel operations should consist only of sand, dirt, metal, and glass (all of which do not burn); small amounts of unburned carbon (similar in appearance to charcoal); and small globules of melted plastic. These melted-down globs of plastic are still considered to be plastic and cannot be legally be disposed of at sea. Separation of these plastic globs from the other ash is required before the other ash can be dumped at sea. If this is not convenient, the entire supply of ash should be stored in a non-combustible container (e.g. metal garbage can) and disposed of properly ashore.

For those barrels used only to burn paper and cardboard, the ash may be discharged directly into the sea.

Air Emissions

At the present time, the U.S. Environmental Protection Agency (USEPA) does not regulate the environmental aspects of burning wastes aboard ships. However, the regulations of individual states and local air pollution control agencies may apply to shipboard combustion sources operating in coastal waters. These regulations vary significantly in terms of range of jurisdiction (i.e., miles offshore), prohibitions, and emissions limits. Therefore, it is recommended that ship operators verify the regulations of the local air pollution control agencies in the states whose coastal waters and ports they frequent.

The combustion of garbage can produce numerous pollutants that vary in quantity, toxicity, and corrosivity. The dangers these present can vary with the type of pollutant, its concentration, and the length of time a person is exposed to it. Since no burn barrels have reportedly been tested for air emissions while burning shipboard waste, no estimate of the types and amounts of pollutants is available. Thus, no risk assessment has yet been conducted to evaluate the potential dangers of exposure to and inhalation of air pollutants by humans in the vicinity of a burn barrel.

CONCLUSIONS

It is believed that burn barrels can be constructed and operated in a safe, convenient, and cost-effective manner. However, use of a burn barrel requires a cautious and conscientious attitude. The MARPOL V guidelines and the Marine Plastic Control Act regulations provide various alternative methods of disposing of shipboard-generated waste.