CHAPTER 13

ENVIRONMENTAL CONTROLS

Many materials and situations aboard ship can damage personnel and the environment. Continued emphasis and direction on combating environmental pollution by federal agencies is contained in presidential executive orders and congressional legislation. All facilities owned by, or leased to, the federal government must be designed, operated, maintained, and monitored to conform to applicable air, water, and noise standards established by federal, state, and local authorities.

The Navy actively participates in a program to protect and enhance the quality of the environment. The Navy adheres to all applicable regulatory standards and initiates actions to conserve natural resources, protect historical and cultural properties, and prevent or control pollution caused by Navy facilities. This chapter contains information dealing with some of the more serious problems that threaten the environment. It also covers the controls that are used to reduce the risks.

HEAT STRESS

On board ship, certain kinds of working spaces may be hot and humid. Some examples of hot and humid spaces are firerooms (boiler rooms), sculleries with automatic dishwashing machines, and galleys.

Heat stress is the basic inability of an individual's body to cope with the effects of a high-temperature and high-humidity environment. When a person works in a hot, humid environment, such as a boiler, heat builds up within his/her body. When the body's capability to cool itself is exceeded, heat stress can occur. The human body tries to cool itself automatically through sweating. Sweating is the mechanism by which the body gets rid of excess heat through evaporation. The sweat evaporates, thereby cooling the body and reducing body temperature. Although the sweating mechanism is a normal body function, the sweating process depletes the body of water and salts and changes the body's chemistry. If liquid volume and salts are not replaced, several heat illnesses or injuries can occur.

HEAT CRAMPS

Heat cramps are simply painful muscle contractions or spasms. They are normally caused by the loss of body fluids through sweating. It is also possible for a person who is overheated to induce muscle cramps by drinking cold liquids too quickly or in large quantities. Heat cramps are often an early warning of heat exhaustion. If you ever experience heat cramps, go to a cooler place, drink plenty of cool (not cold) water, and massage the cramping muscles.

NOTE: Administering salt in any form, even in drinking water, is POOR health care for victims of heat cramps. The loss of body fluids through sweating results in a HIGHER concentration of salts within the body. If the body's heat load builds up, the muscles will absorb increased amounts of salts. This absorption causes the muscles to cramp.

HEAT EXHAUSTION

Heat exhaustion is a more serious threat to health than heat cramps. Heat exhaustion usually occurs when personnel work or exercise in hot environments. The body's sweating mechanism is overloaded and cannot cope with the heat buildup within the body. Since the blood flow is disturbed, the victim may feel dizzy, headachy, and nauseated. The signs and symptoms of heat exhaustion are similar to those of shock and should be treated as such. When a person suffers from heat exhaustion, the skin is gray in color and feels cold and clammy. To help the heat exhaustion victim, remove the victim to a cool area and loosen his/her clothing. You should apply cool wet cloths to the head, groin, and ankles and lightly fan the victim. If the victim is conscious, give him/her cool water to drink. If vomiting occurs, do NOT administer any more fluids. Transport the victim to a medical facility as soon as possible.

HEATSTROKE

Heatstroke is a less common but far more serious threat to health than heat exhaustion. In about 20 percent of heatstroke cases, heatstroke is fatal. In heatstroke, the sweating mechanism breaks down completely; the body is unable to rid itself of excess body heat. The body's temperature may rise as high as 105°F. Prolonged, high body temperatures can cause failure of the brain, kidneys, and liver.

The early symptoms of heatstroke are similar to those of heat exhaustion–headache, nausea, and dizziness. At first, the victim's breathing is deep and rapid; but, as the symptoms progress, breathing becomes shallow, almost absent. The skin appears flushed, dry, and very hot. The pupils are constricted to a pinpoint; the pulse is fast and strong. It is extremely important that you recognize the differences between heat exhaustion and heatstroke. HEATSTROKE IS A TRUE LIFE-AND-DEATH EMERGENCY.

The most important first-aid treatment for a heatstroke victim is to lower the victim's body heat. Move the victim to a cool place. Douse the victim with cold water. Remove as much of the victim's clothing as possible to allow free flow of air over the body to promote cooling. If the victim is conscious, give him/her cool water to drink. Transport the victim to a medical facility as quickly as possible.

So far, we have discussed heat-related problems and the first-aid treatment for heat stress. However, you will be much better off if you learn what you can do to prevent heat stress.

PREVENTION

In spaces where heat stress is likely to occur, it is difficult to lower temperatures. Therefore, preventing heat stress-related conditions is the goal. Monitoring conditions that bring about heat stress and controlling the crew's exposure to high-heat and high-humidity conditions reduces the chances of heat stress.

Some of the factors that cause heat stress are as follows:

- Unnecessary heat and humidity sources
- Steam leaks
- Damaged insulation

Report these types of conditions so they can be corrected. Vents and exhaust blowers should be adjusted to maintain proper air circulation.

On board ship, spaces are ventilated by ductwork connected to supply (intake) and exhaust blowers. These blowers (or fans) are driven by two-speed electric motors. Exhaust fans have a greater air-moving capacity than supply fans. Unless personnel are otherwise directed, supply and exhaust ventilation fans are set to the SAME speed. It is important that you understand the need to MAINTAIN FLOW. If you do not MAINTAIN FLOW, the following could happen to you. A watch stander in a hot space sets the supply blower to high speed and then stands under the outlet.

Usually, you can tell whether the speed of the vent blowers for a space is set correctly by how hard it is for you to open or shut the doors to the space. For example, if a door opens outward and it is hard to close, then the space has a POSITIVE pressure. This means that the supply vent is probably set on high speed, and the exhaust vent is set on low speed.

Another common problem with shipboard ventilation systems is improper care of system filters. Filters are installed at the intake of the supply blowers to prevent dust and dirt from entering the ship. Cleaning these falters is considered to be routine maintenance. If, however, filter cleaning is neglected or is poorly done, the temperature of shipboard working and living spaces increases because there is a reduced flow of coding air. Spaces considered to be heat-stress areas should contain a heat-stress monitor to measure the heat-stress conditions.

On an individual level, wear clothing so there is some air circulation between the clothing and your body. Whenever you perform heavy physical labor, eat lightly and take a rest period before resuming heavy exertion.

The Navy has established strict space environmental monitoring requirements for heat-stress conditions. These *heat-stress surveys,* together with strict exposure limit standard tables, control the amount of time a person may remain in certain high-temperature and high-humidity conditions before being REQUIRED to go to a cool place and rest. For more information about heat injury, you should refer to *Shipboard Heat Stress Control and Personnel Protection,* OPNAVINST 5100.20 (series), and *Navy Occupational Safety and Health (NAVOSH) program Manual for Forces Afloat,* OPNAVINST 5100.19 (series).

Heat illnesses and injuries are primarily caused by the loss of body fluids and salts. Preventing these illnesses and injuries centers on replacing body fluids and salts, monitoring the environment, and controlling exposure. For example, in a hot environment, fluids must be replaced ounce for ounce. Therefore, when you are sweating heavily, increase your water intake proportionately. Meals provide salts to replace those lost through sweating. Therefore, if you work in a high-heat and high-humidity environment, you should eat well-balanced meals at regular intervals, salted to taste. You should get at least 6 hours of sleep every 24 hours. Wear clean clothing made from at least 35 percent cotton. **Do NOT wear starched clothing. Do NOT**

drink commercially prepared electrolyte supplements in place of water. Do NOT take salt tablets unless specified by medical personnel. Do NOT drink alcoholic beverages, because alcohol depletes the level of fluids in the body.

Remember, the effects of heat stress are cumulative (add up). Once you have heat cramps, heat exhaustion, or heatstroke, you are twice as likely to experience a heat stress-related incident; your body has an increased sensitivity to heat. Your awareness of the factors that contribute to heat stress and their prevention, as well as your strict adherence to established exposure limits, will help prevent your becoming a victim of heat stress.

POLLUTION

Before understanding how pollution affects you personally, you must take a realistic look at pollution. Pollutants, whether airborne or waterborne, adversely affect the food chain and often are directly harmful to humans. As Navy personnel, our primary concern is to control the pollutants aboard ship to minimize the pollution risk to ourselves and the environment.

OIL AND CHEMICAL POLLUTION

Fuel oil and chemical cleaning solvents are often used aboard Navy ships, and the possibility exists for a spill. These pollutants collect in the ship's bilges. From the ship's bilges, the pollutants are pumped into a waste oil collecting can.

Oily wastes behave just as their definition suggests: an oily waste is any solid or liquid substance that, alone or in a solution, can produce a surface film or *sheen* when it is discharged in clean water. Most oily wastes are derived (come) from petroleum or have characteristics of petroleum products. Waste oil is an oily waste that cannot be reused by the ship, and it contains only small amounts of water. Any mixture that causes a sludge or emulsion to be deposited beneath the surface oil and chemical pollution of the water is considered to be an oily waste.

Oily wastes frequently present a shipboard pollution problem. (Refer to the *Naval Ships' Technical Manual (NSTM),* chapter 593.) Oily wastes derived from lubricating oils are caused by tank cleaning operations, leakage and drainage from equipment and systems, stripping from contaminated oil-settling tanks, and ballast water from fuel tanks of noncompensated fuel systems during the ship's defueling, refueling, or internal transfer operations.

You may think that if a small amount of oil is pumped overboard, it cannot really cause much damage. Or can it? Remember, oil is less dense than water. It floats on the surface of the water and is carried by the action of winds and tides. Oily wastes can contain appreciable amounts of volatile petroleum or fuel products. When these wastes are confined in spaces, such as tanks and bilge compartments, they become a source of floating flammables or vapors that are potentially hazardous to personnel and equipment. If these vapors collect in a confined area, such as a pocket underneath a pier, they could explode if exposed to an open flame, such as from a welding operation or from a spark from a grinding wheel. Remember, YOU might be the person who is operating the torch, welder, or grinding wheel.

Besides being harmful to the environment and to people, oil and chemical discharge is also against the law. The Oil Pollution Act of 1961 prohibits the discharge of oil and oily waste products into the sea within 50 miles (150 miles in some cases) of land. A more recent law, the Federal Water Pollution Control Act of 1970, prohibits the discharge of oil by any person or agency from any vessel or facility into the navigable waters of the United States inside the 12-mile limit. All oil spills or sheens within the 50-mile prohibited zone of the United States must be reported immediately.

Oil Spill Prevention

Shipboard oil pollution is controlled by the efficient use of the oily waste control system that is incorporated into your ship. Oil pollution control systems reduce oily waste generation, store waste oil and oily wastes, monitor oil and oily wastes, and transfer waste oil and oily wastes to shore facilities. Effective use of your ship's oil pollution control system depends on operators' knowledge of the ship's pollution abatement system. To use your ship's oil pollution control system effectively, operating personnel are trained and plans are made so that oil and oily waste are handled properly. Other requirements for your ship include ensuring that equipment functions properly and that bilges are kept dry and free of oil. The minimum use of detergents is recommended when bilges and equipment are cleaned. Also, always give proper attention to preventive maintenance requirements.

The best prevention method any vessel can use against oil or chemical pollution is not to discharge pollutants into the sea. However, spills do occur during refueling operations. For example, to keep a ship "on an even keel," fuel oil maybe transferred from one tank to

another. Fuel storage tanks are connected by pipes and valves, some of which discharge overboard. All it takes is ONE human error, ONE valve to be open or shut through a vent pipe, and your ship has ONE spill in progress. The simplest solution is to have the people who operate the system do so in a conscientious manner. The people who operate and maintain the pollution control equipment should always be professionally trained and fully qualified.

Oil Spill Removal

If an accident occurs and oil is spilled, your ship should take prompt action to contain the oil and clean it up. A quick reaction by your ship's trained crew results in containment and often collection of the entire spill without the assistance of shore-based personnel.

Every ship should have an Oil Spill Containment and Cleanup Kit (O. S. C. C. K). Instructions for its use can be found in *U.S. Navy Oil Spill Containment and Cleanup Kit, Mark 1,* NAVSEA 0994-LP-013-6010. This manual describes applicable safety precautions for the use of the kit.

The kit consists of various sizes of porous mats, boat hooks, grappling hooks, plastic bags, and an instruction book for their use. If there is a spill, these absorbent mats are used by ship's personnel to soak up the spilled oil. First, soak the porous mats in diesel fuel and wring them out, which causes the mats to soak up the oil instead of water. After they are prepared, throw the mats on the oil spill to soak it up. Then, retrieve the porous mats using the boat hooks and grappling hooks. Next, wring the oil out of the mats into suitable containers. Then, throw the mats back onto the oil spill to soak up more oil. After the oil spill is removed, store the porous mats in plastic bags for disposal at a shore-based facility.

Additionally, containment trawlers can be rigged around a ship in port anytime the ship is engaged in fueling activities. Trawlers are floating fences made up of linked, buoyant *pillows* that confine any spilled oil to the vicinity of the hull.

NOISE POLLUTION AND CONTROL

Another type of pollution, which is often not thought of as pollution, is noise. Prolonged exposure to loud noises is not only psychologically taxing but also a cause of hearing loss. Continued exposure to noise levels of 85 decibels (dB) or greater and impact or impulse noise of 140 dB can cause severe hearing loss. You need to be aware of this problem because spaces in the engineering department can easily have average

Figure 13-1.-Circumaural (Mickey Mouse) type of ear protection.

noise levels within the danger range. The Navy has implemented an occupational noise and hearing conservation program. The goal of this program is to eliminate all noise hazards to personnel.

Wherever possible, noise is being reduced by design and insulation. When there are no other practical means available, personal protective hearing devices MUST be worn. Furthermore, anyone who works in spaces where noise levels exceed 104 dB must wear a combination of insert-type ear plugs and circumaural-type *ear muffs* (fig. 13-1).

In addition, each person assigned to duties in designated hazardous noise areas are included in the hearing conservation program and receive the required hearing tests within 90 days of that assignment. This procedure serves to determine if a significant hearing loss has occurred. Hazardous noise areas are identified and labeled by either the ship's medical personnel or an industrial hygienist. Audiometric hearing tests are required annually to monitor ship's personnel who are exposed to noise hazards. (Refer to *Navy Occupational Safety and Health (NAVOSH) Program Manual,* OPNAVINST 5100.23 [series].

ASBESTOS POLLUTION AND CONTROL

The inhalation of asbestos fibers can, after a period of years, cause a crippling respiratory condition called *asbestosis.* Exposure to asbestos can also cause several forms of cancer. All personnel who work around asbestos, and who smoke, should be aware that their chance of contracting lung cancer is increased ninetyfold.

The most prevalent use of asbestos materials aboard ship is in the fabrication and repair of pipe and boiler insulation. The greatest hazard is present when asbestos particles (dust) are in the air.

In the interest of personnel safety, the Navy has implemented an asbestos control program. The objective is to eventually replace the asbestos insulating materials with nontoxic materials. In the meantime, the asbestos control program identifies asbestos hazards and implements stringent safety requirements to be followed by personnel working with materials that contain asbestos. Ship personnel are not authorized to remove or repair insulation containing asbestos, except in an operational emergency certified by the commanding officer. Repair and removal work should be referred to the local intermediate maintenance activity (IMA) or contractor.

As you know, the greatest danger from asbestos exists when particles of asbestos are in the air, such as during rip-out of old insulation. Rip-out is normally performed by shipyard personnel; however, you may have to enter a space where there are asbestos particles. If you are ripping out old insulation or staying in the space where rip-out is in progress, you MUST wear protective clothing, use a pressure-demand supplied-air respirator (fig. 13-2), and be formally trained on asbestos-handling procedures. After completing your tasks, you MUST proceed to the designated decontamination center to remove the coveralls and respirator and to take a shower. These precautions should remove any asbestos particles and prevent the spread of asbestos dust to other sections of the ship.

You should wet down contaminated disposable coveralls. Wet down is a procedure that reduces the possibility of dust being blown off of the coveralls. Then, dispose of the contaminated coveralls in heavy-duty plastic bags. Clearly mark the plastic bags with caution labels to warn personnel of the asbestos hazard.

Insulation materials other than asbestos pose health hazards. For additional information on safe working practices involving these materials, consult the *NSTM*, chapter 635. REMEMBER, where safety is concerned, take nothing for granted. Your actions can have a positive or negative effect on you and your shipmates.

Figure 13-2.-Disposable protective coveralls and type C respirator.

REFRIGERANTS AND SAFETY PRECAUTIONS

The refrigerants commonly used are fluids, and they are affected by heat, temperature, and pressure in a manner similar to water. Many different fluids are used as refrigerants; their selection is based on low boiling points and other desirable characteristics. The following refrigerants are the most commonly used on U.S. Navy ships:

R-11, trichlorofluoromethane. R-11 is a colorless liquid or gas. At room temperature, R-11 has a slight ethereal odor (smells like ether or dry-cleaning fluid, tetrachloroethylene).

R-12, dichlorodifluoromethane. R-12 is a colorless and odorless gas at room temperature. In high concentration, it has a slight ethereal odor.

NOTE: Dichlorodifluoromethane (formerly F-12), is now called R-12.

R-22, monochlorodifluoromethane. R-22 is a colorless and odorless gas, which, at room temperature in high concentration, has a slight ethereal odor.

R-114, dichlorotetrafluoroethane. R-114 is a colorless and odorless gas, which, at room temperature in high concentration, has a slight ethereal odor.

R-113, trichlorotrifluoroethane. R-113 is a heavy colorless liquid, which, at room temperature, has a slight ethereal odor. R-113 is only used as a solvent, degreaser, and flushing agent. It is not used as a shipboard refrigerant.

These refrigerants, liquid and vapor, are nonflammable and nonexplosive. Air mixtures of these refrigerants are not capable of producing a flame. The products of decomposition have a pungent odor and are very irritating in minute quantities. They give ample warning before dangerous concentrations are reached.

R-12, R-22, and R-114 are shipped under pressure in steel cylinders. R-11 and R-113 are normally shipped in drums, although some R-11 is shipped in cylinders for submarine use. The refrigerant cylinders are easily identified by their orange-colored bodies. In addition, the following markings are made on the cylinder to minimize the possibility of misidentification of the gas:

- The name of the gas is stenciled longitudinally on two diametrically opposite sides of the cylinder.
- A decal bearing the name of the gas may be attached to the shoulder of the cylinder 90 degrees from the stenciling.

WARNING

Do not smoke, braze, or weld when refrigerant vapors are present. Vapors decompose to phosgene, acid vapors, and other products when exposed to an open flame or a hot surface.

The following safety precautions and warnings apply to all of the refrigerants listed in the previous paragraphs.

- Exposure to large concentrations of fluorocarbon refrigerants can be fatal. Vapors displace air (oxygen) in a space and result in asphyxia. In high concentrations, these vapors have an anesthetic effect, causing stumbling, shortness of breath, irregular or missing pulse, tremors, convulsions, and death. Fluorocarbon refrigerants and solvents should, therefore, be treated as toxic gases.
- Initial adverse anesthetic effects of R-113 can be experienced at much lower levels than those of other refrigerants, even though all refrigerants listed here have a threshold limit value (TLV) of 1,000 parts of refrigerant per million parts of air (ppm).
- Personnel overcome by inhalation of fluorocarbon vapors may develop cardiac problems. Remove exposed personnel to fresh air immediately. If breathing has stopped, apply artificial respiration. **Do not permit affected personnel to exert themselves or to exercise.**

TLVs refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed for an 8-hour day, 40 hours per week without adverse effects. In addition to the precautions previously stated, there are other safety measures that should be followed. A few of these methods and precautions are as follows:

- Because refrigerants R-12 and R-22 boil at such low temperatures, they may freeze if they are splashed into the eyes or onto the skin. Always wear chemical safety goggles or a full face shield when you work with any refrigerant. Wear along-sleeved shirt and protective gloves.
- Vapors of fluorocarbon refrigerants are four to five times heavier than air and tend to collect in low places. Perform refrigerant detection within 2 feet of the deck and in possible air pockets.
- Refrigeration machinery spaces should be well ventilated, especially when personnel are servicing machinery. Use portable blowers if necessary to keep the refrigerant vapor levels below the TLV of 1,000 ppm.
- Always have two people present when work is being done on refrigeration systems. Use a halide monitor with an alarm so you can be sure refrigerant vapor concentrations in a space do not exceed safe limits.

SEWAGE SYSTEM

In a continuing effort to control pollution of inland and coastal waters, the Navy is installing sewage treatment systems on board naval ships. These marine sanitation systems are composed of three subsystems:

- Flushing water system (provides flushing water)
- Collection system (collects waste)
- Treatment disposal system (treats and disposes of waste)

Sewage discharged by naval ships into rivers, harbors, and coastal waters and the environmental effects of sewage pollution are of great concern to the Navy. In fact, the Navy is required to control sewage

discharge under regulations issued by the Secretary of Defense.

In the past, shipboard sewage has been discharged overboard as a matter of routine design and operation. Studies have shown that concentrations of sewage in inland waters, ports, harbors, and coastal waters of the United States is detrimental to the environment. The Navy has installed marine sanitation devices (MSDs) on ships. The MSDs allow ships to comply with the sewage discharge standards without compromising mission capability.

In 1972, the Chief of Naval Operations (CNO) made the policy decision to install the sewage collection, holding, and transfer (CHT) system aboard naval ships. The CHT system is designed to hold all shipboard sewage that is generated over a 12-hour period. On large ships, this goal can usually be achieved. For smaller ships, the maximum capacity would limit holding time to 3 hours or less, an insufficient time for the ship to transit the 3-mile restricted zone.

The Jered sewage treatment plant and the LHA sewage treatment plant are other types of MSD systems. The Jered sewage treatment plant is designed for a zero liquid discharge. It is capable of using the vacuum-burn principle. Sewage is first collected by a vacuum and then disposed of by incineration. Sewage can be discharged overboard when the ship is at sea or pumped to shore via a connection facility. The LHA sewage treatment plant is a biological sewage treatment process in which sewage and activated sludge can be mixed and aerated. The activated sludge is separated from the treated sewage by sedimentation and discharged or returned to the process as needed.

There are distinct hazards to personnel associated with all sewage systems. These hazards include explosive gases, toxic vapors, and biological contaminants. When operating a CHT system, for example, personnel must be extremely careful so spills do not occur. **ALL SPILLS CAN BE EXTREMELY HAZARDOUS TO PERSONNEL.**

In addition to the removal of CHT contaminants, CHT spills are sanitized with disinfectants so that residual bacteria are eliminated. Medical department personnel must be notified of any CHT *black water* spills. Medical department personnel must also supervise cleanup and sanitation operations in spill areas.

For further information on sanitation systems, refer to *Hull Maintenance Technician 3 & 2*, volume I, NAVEDTRA 10571 (series), chapter 15, and *NSTM*, chapter 593.

SUMMARY

This chapter introduced you to environmental hazards and control. Remember, pollution takes many shapes and forms. Pollution attacks the environment and directly or indirectly affects each of us. Consequently, we must protect the environment by preventing pollution.

On board ship, certain forms of pollution are sometimes difficult to control, such as heat and noise. In these cases, the first line of defense is PROTECTION. In all other cases, we must be concerned with PREVENTION. Keep in mind that prevention of pollution, in any form, is everybody's business. Pollute your environment, and your environment will pollute you.